Matter Formation and Matter Interactions in Elementary Body Theory

Phenomenology – Derivations – Formalism

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Abstract

This document unfolds the phenomenological and mathematical foundations of Elementary Body Theory (EBT). Instead of abstract probability waves, virtual exchange particles, or iteratively adjusted perturbation theories, EBT understands elementary particles as real, mass-radius-coupled geometric entities. At the center of the consideration stands the exact, parameter-free derivation of fundamental quantities – from the Rydberg energy of the hydrogen atom, through Sommerfeld's fine-structure constant, to discrete energy levels and splittings such as fine and hyperfine structure as well as the Lamb shift. The calculation of the neutron mass based on proton and electron elementary bodies, the derivation of the (anomalous) magnetic moments for proton, electron, and neutron, and much more. The channel ladder of matter formation presented here demonstrates how not only atomic spectroscopy but also the masses of neutron, pions, and muon emerge from the geometric superposition of elementary bodies and their energetic analogies. In doing so, EBT questions the ontological basis of established concepts of quantum mechanics, quantum electrodynamics, and quantum chromodynamics. Phenomena such as the anomalous magnetic moments or the supposed quark substructure of nucleons find a consistent, purely analytical, and intuitive explanation in the energetic embodiment of measurement fields and the radially symmetric superposition. The present work thus documents the design of a causal, geometrically founded phenomenology that dispenses with free parameters, renormalization, and theory-laden extractions, and instead understands measurable reality as a direct consequence of spatial-energetic transformations.

Elementary Body Theory Overview

In EBT, the matter wave is the mediator between rest, motion and interaction. It is one of the keys to fundamental understanding. Therefore, in addition to the present explanations, there exist the pdf-document on the matter wave and the pdf-document on gravitation. These three sources of information comprehensively represent the EBT.

Preliminary Note

The thought model described below is based, in a catchy-psychological way, on the assumption that significantly simpler, consistent descriptions of matter and, resulting from this, simpler formalizations exist than those announced in the standard models. The following remark by Karl Popper (1902–1994) addresses the psychological problem of the "modern scientist" within highly complex mathematical model conceptions:

> *"Our investigation shows that even obvious connections can be overlooked if we are constantly hammered with the claim that searching for such connections is 'meaningless'."*

Karl Popper (1902–1994), The Logic of Scientific Discovery. 9th ed. Mohr, Tübingen 1989, p. 196.
Ed. E. Botcher: The Unity of the Social Sciences. Vol. 4;
The Logic of Scientific Discovery. (1935); 2nd Ed. London, New York: Basic Books 1959.

The EBT Mass-Space Coupling is experientially comprehensible

Before phenomenological derivation, formalization and concrete calculation are undertaken here, the EBT accomplishes something extraordinary. Something that one would not expect, in particular, from a thought model of theoretical physics: direct experimental evidence that anyone can observe without further measuring apparatuses and, in the truest sense of the word, experience. Standard-model physics requires a gigantic theoretical apparatus – Hilbert spaces, Feynman diagrams, renormalization, lattice QCD, Monte Carlo simulations – in order to explain retrospectively to the observer what is. There, energy is an abstract bookkeeping quantity, a scalar in a Lagrangian density whose existence is made "visible" only to the expert community through highly complex calculation scenarios and sometimes extremely time-intensive, strongly theory-laden, iterative-algorithmic computer simulations. The human stands outside the phenomenon and looks at it through the filter of the theory.

Back to the roots

The mass-space energy of the Elementary Body Theory (EBT) is fundamentally omnipresent and therefore fundamentally confirmed: The pressure wave of an explosion, caused by the enormous increase in volume, is a sensuously perceptible expansion of space energy – mass has been transformed into space. Even though here the "loss of mass" of the macroscopic embodiments is extremely small. The light of the sun is not an "electromagnetic wave in vacuum" and also not a "photon stream from quantum field excitations" (whatever the one and the other are supposed to be in real physical terms), but visible space energy that is released in the fusion of hydrogen into helium – mass-bound energy was transformed into radius-bound space energy and radiates isotropically into the cosmos.

The heat of a nuclear reactor is not "thermal energy from binding energy differences," but the perceptible consequence that more massive atomic nuclei transform into lighter constituents and in doing so transform mass(energy) into space(energy) – space energy that is released to the environment as perceived heat.

The decisive philosophical and ontologically justified sentence is therefore: In the EBT, energy is not an abstract quantity that one merely calculates. **Energy is experienceable space.** The EBT requires here no detector, no particle accelerator, no theory-laden reconstruction chain in order to "measure" this transformation. It requires only the senses of a human being who, for example, watches an explosion, feels the sun ... That is the return of physics to what it originally was: a science of the sensuously experienceable – not a mathematics of the postulated. Considered argumentatively and logically, the Elementary Body Theory is not merely a physical thought model, but the compelling ontological correction of a science frozen in mathematical metaphysics.

Historical Retrospective – The Irony of Probabilistic Fate

The continuous "analysis and synthesis system" in the form of the Fourier series or Fourier transform is ubiquitous in "modern" physics today.

Quantum mechanics (QM) and the quantum electrodynamics (QED), quantum chromodynamics (QCD), and the resulting Standard Model of (elementary) particle physics (SM) developed from it have one thing in common at their mathematical core. They are all primarily "based" on the sine function. As an aside, it should be noted here that the cosine function can be understood as a sine function phase-shifted by $\pi/2$.

Mathematical Backgrounds, Original Sense and Purpose, Deliberate Renunciation of Visualization

According to the Weierstrass theorem, "arbitrary" curves can be approximated, at least piecewise, by "sine-cosine function combinations." When the function transitions into a new (sub)section, in the limiting process the individual sections become ever shorter and finally "shrink" to points. The function is approximated point by point. In this limiting case, the original picture of the differentiable manifold is again reached, in which the eigenbasis of the motion space now consists of the building blocks of sine and

cosine functions. Without going into further mathematical questions, it follows that any mathematical function $f(t)$ can be expanded as follows:

$$f(t) = \frac{a_0}{2} + \sum_{k=1}^{\infty} \Big(a_k \cos(kt) + b_k \sin(kt) \Big) \tag{1}$$

Spaces with this structure are called Hilbert spaces. In the 20th century, this approach was first introduced into atomic spectroscopy and then generally into quantum field theories.

Just as a sound can be represented by the fundamental tone x and the overtones $2x, 3x, 4x \ldots$, in quantum field theory the state of a particle (e.g., an electron) is decomposed into a ground state x and higher states. At the beginning, therefore, stands the qualitative decomposition into elementary components; then, for each elementary component, follows the decomposition into the "overtone series" (Fourier series). Overall, probabilities can now be defined or (interpreted as) measured, with which the electron is in one of the possible states. If one looks more closely, the integer quantization here follows banally from the mathematical representation. The formalism now enables the supposed "convenience" of not having to engage with the phenomenology of quantization in terms of real object content in order to obtain results. That was, in retrospect, the **"ontological end"** of quantum mechanics, already laid in its cradle. Real-physical unvisualizability and postulated probability spaces obscured the view of simple, causal connections.

The Birth of EBT from the Spirit of Parsimony

If one considers this mathematical scenario from a **"parsimonious point of view"** (Ockham's razor), the sine function remains as the base approach. Thought through consistently minimalistically, it is therefore obvious not to take the Fourier transform as the method of Fourier analysis as the simplest possible mapping for formalization, but rather minimalistically the "pure" sine function itself.

Mathematically speaking, that was the birth of Elementary Body Theory (EBT). From it follow necessarily and without further dogmatic assumptions the development equations of the elementary body:

$$r(t) = r_0 \sin\left(\frac{c \cdot t}{r_0}\right) \quad \text{and} \quad m(t) = m_0 \sin\left(\frac{c \cdot t}{r_0}\right) \tag{2}$$

EBT thus replaces the abstract Hilbert space and the statistical probability wave with real, phenomenologically graspable geometry.

Contents

1 An Overdue Rendezvous with Causal Rationality

1.1 What Is It About?

A sustainable paradigm shift.

1.1.1 What is meant here by paradigm shift?

The replacement of the standard thought models of theoretical physics:

SM: Standard Model of elementary particle physics

ΛCDM: cosmological standard model

1.1.2 What takes their place?

A significantly more intuitive, more effective, interdisciplinarily communicable, mathematically simpler thought model, Elementary Body Theory, EBT for short, which describes the micro- and macrocosm in a unifying and cross-scale predictive manner.

Elementary Body Theory is particularly concerned with answers to the question of how mass and space are fundamentally linked to each other and, in their interplay, lead to understandable matter formations that can be calculated formal-analytically – both microscopically and correspondingly macroscopically.

For an intuitive understanding and, resulting from this, for the phenomenologically founded Elementary Body Theory-based equations, demonstrably neither a variable time, nor mathematical space-time constructs, nor any form of substructuring is necessary.

1.2 Which Arguments Speak for This Paradigm Shift?

1.2.1 The Parsimony Principle

Occam's razor, lex parsimoniae, principle of parsimony.

The strictly analytically motivated use of the principle of parsimony in the present explanations:

Thought models can only be evaluated on consistency, internal axiomatic freedom from contradiction, with regard to the capability of making statements concerning concrete predictions of actually measured quantities, and minimalism.

In order to be able to describe experimentally testable relationships formal-analytically within the framework of thought models, the thought model is to be preferred that makes the most exact predictions possible with the fewest physical variables and mathematically simplest equations.

Furthermore, the most suitable thought model is the one that, in addition to the mathematics used, is phenomenologically graspable and consistent, can describe both the micro- and the macrocosm across scales, and captures a formal and phenomenologically justifiable connection between light, more precisely photons, and matter.

1.3 Applied Sociology Instead of Scientific Argumentation

Whoever studies the history of elementary particle physics somewhat neutrally will hardly be able to believe that these are natural scientific considerations and efforts in the sense of a purposeful simplification and unification.

Whenever experimental physics refuted the theory or theories, the theory was extended by means of new elementary particles, renewed substructuring, and, if necessary, new quantum numbers that handled the missing properties, the missing energy, or the missing symmetry.

This has little to do with science and is more reminiscent of contemporary politics. Instead of tackling the problems with a new radical theory approach, small and large cosmetic corrections are continuously carried out. Instead of simplifying and unifying, there is merciless extension and specialization. A hodgepodge of particles and particle properties emerges.

Put succinctly: For every case of an undesired deviation, for every particle, theory-preserving special regulations are added as needed.

The mathematical formalism is the smallest problem in this fantasy process. If necessary, divergent terms are regularized and renormalized or simply declared unphysical, simply omitted. That this destroys the axiomatic basic structure seems to be clear to only a few, or is obviously irrelevant to the majority of theorists in a result-oriented manner.

Content-analytically, the fact follows from this that the great standard models of physics, namely the Standard Model of elementary particle physics and the Standard Model of cosmology, the ΛCDM model, as well as supposedly competing models such as string theories and the desired SM extension SUSY, supersymmetry, do not withstand any rational logical criticism upon closer inspection.

Only the sociologically tested argument that tens of thousands of mathematically excellently trained scientists, over now several generations, would not occupy themselves with models if these were meaningless due to immense internal contradictions, is brought into the field as the final stroke.

Since these standard models are the scientifically and popular-scientifically propagated non plus ultra of theoretical thought-model physics, we need not be surprised that we have been sitting deep in an epistemological black hole for decades.

How egocentric, arrogant, decadent, meaningless, and inconsequentially contradictory the protagonists of the standards deal with apologists, fans, critics, and themselves in their works, they have impressively proven with the following pathology of knowledge:

> In 2013 there was a Nobel Prize for the Higgs mechanism, which demands massless neutrinos.
> In 2015 there was a Nobel Prize for the alleged detection of neutrino oscillations, which require neutrino masses.

1.3.1 For Understanding

Within the framework of the Standard Model, neutrinos belong to the leptons and are defined as exactly massless fermions. In order to generate fermion masses by coupling the fermions to the Higgs field, the following conditions must be fulfilled:

- The masses of the right- and left-handed fermions must be equal.
- The neutrino must remain massless.

The original Standard Model of elementary particle physics is a gauge field theory. It is based on the gauge group:

$$SU(3)_C \times SU(2)_L \times U(1)_Y$$

The entire structure – particle content, interactions, mass generation – follows from the demand for gauge invariance of this group. Every change of the group or its representations is a change of the model itself.

Why the universality of the matter wave refutes the existence of postulated neutrino masses (see Chapter 30 and following) and why neutrino masses cannot extend the SM but logically and formally destroy it, see in detail Appendix I.

The formal consequence is: The original SM is falsified by the postulate of neutrino oscillations and the resulting neutrino masses. The so-called "extension" is not an extension, but would be a new model.

Even though this is a scientific consideration of matter, humor and interdisciplinary references as well as polemics should not be neglected. Authenticity and egocentricity of the theory father shall and will not remain a secret.

In view of the documented, Nobel Prize-honored schizophrenia, it would, among other things, not be a bad idea to have the makers and decision-makers examined psychologically, psychiatrically, and neurologically.

1.4 Art and Science in Harmony – Formalized Expressionism

It is striking and remarkable that the emergence and expansion of quantum mechanics as well as the introduction of Special and later General Relativity at the beginning of the 20th century coincides with Expressionism.

Observation thesis: Quantum mechanics and relativity theory were and are formalized Expressionism.

Expressionism lost its figurative form and then became abstract Expressionism, see works by Jackson Pollock, Willem de Kooning, and Mark Rothko, 1940s to 1950s. Just as quantum mechanics became the even more abstract quantum electrodynamics, among other things with virtual theory entities.

Neo-Expressionism of the 1960s, see exemplarily works by Georg Baselitz, corresponds to the attempt of quantum chromodynamics to give an outward face, although the Standard Model underlying QCD possesses no sense-experienceable intuition whatsoever.

1.5 Art, Belief, and Science

An anecdote first: Years ago, I showed self-employed construction workers, who among other things carried out restorations of listed properties, picture motifs by the abstract Expressionist Mark Rothko, without, however, foregrounding an art reference. I asked what they thought these motifs were, what it was probably about. See exemplarily: No. 13, White, Red on Yellow.

Their spontaneous answer was that these were probably color samples created to determine the correct color coating for the building according to monument protection specifications.

This example makes clear that everything that has to do with non-figurative, abstract, modern painting lies in a broad spectrum from banal meaninglessness with more or less perceptible unique features to postulated great creative art.

It has been repeatedly reported that viewers of Mark Rothko's paintings wept with emotion. In my case of erotic depictions, they rarely weep when viewing them; they sometimes come.

The selective, subsequent capitalization of Mark Rothko's very minimalist colored canvases is a great masterpiece of capitalist decadence, almost an act of magic. The immaterial is stylized into something extremely valuable.

Example: Rothko's painting No. 10 was auctioned in May 2015 for 81.9 million dollars.

As an analytical science chronicler, the question occasionally arises as to why the non-intuitive quantum mechanics and the even more non-intuitive relativity theory were and are so successful in dissemination and application, especially popular-scientifically.

The answer is relatively easy to understand: Within the framework of these thought-model concepts, large free spaces open up for all possible metaphysical fantasies, interpretations, and couplings to known religious belief patterns. Everyone may and can stage themselves as an epigone, apologist, and science believer with the reference that, according to scientific decree, it is something that one cannot understand anyway.

The church is not questioned and finds an intersection with science. The postulated divine may and should exist within the framework of theoretical physics. This symbiosis is perfected by the implementation of strongly theory-laden cosmic observations, which are interpreted entirely in the spirit of the church by the standard model constructors.

1.6 Creators of Belief

Put succinctly, modern art, introduced at the beginning of the 20th century by Marcel Duchamp in 1915 as ready-made, today has the same radiance as quantum mechanics and relativity theory.

However, these are only postulated arbitrarinesses that were announced as something great without having any real practical significance. In all these cases, no justifications of existence or explanations are expected or demanded that enable an understandable coupling to a real-object-oriented reality.

The joy of the creators of belief, their proclaimers and dealers, and the mass of irrationality was aphoristically expressed by Theodor Fontane as follows, without, however, being able to know how his early observation would escalate in the following period:

> "We are already deep in decadence; the sensational counts and only to one does the crowd stream even more enthusiastically: to bare nonsense."
>
> – Theodor Fontane (1819–1898)

1.7 Standard Models of Physics – Memories of Epicycle Theory Are Awakened

1.7.1 Geocentric Worldview

The Earth stands at the center of the cosmos, the celestial bodies move on circular orbits. However, for example, the orbit of Mars could not be a simple circular orbit around the Earth, because the orbit showed inexplicable loops, i.e., in places a backward motion.

In order to maintain the dogma of the natural circular orbit, it was ad hoc claimed that the Mars orbit was indeed a circle, but the Earth was not the center of its orbit. The center of the circular orbit of Mars, its epicycle, itself moves on a circle around the Earth, the so-called deferent.

Since the velocity of Mars is not uniform, it was again ad hoc claimed that the Earth is not exactly at the center of the deferent; the Earth is thus eccentrically arranged.

But the introduction of epicycles and eccentricities was still not sufficient for the exact orbit description. Ptolemy introduced the equant as a further parameter. Only from the equant viewed do all orbits present themselves as uniform.

The Ptolemaic model provides an exact description of the phenomena if the parameters epicycle, eccentricity, and equant are suitably varied. A causal physical explanation for the model construction was not given.

1.8 The Phlogiston Drama – Welcome to Baroque 2.0

With today's established standard model physics, we are experiencing a renewed, but this time significantly more complex, phlogiston drama. Welcome to Baroque 2.0, so to speak.

As a reminder: Georg Ernst Stahl, together with Johann Joachim Becher, was a main founder of the phlogiston theory. The phlogiston theory could make oxidation and reduction processes sufficiently understandable. The phlogiston theory stimulated the collection and investigation of finely distributed phlogiston. The theory enabled a systematization of substance groups.

Antoine Laurent de Lavoisier then replaced phlogiston with the caloric substance, which was likewise invisible, possessed no weight, and was located between the molecules.

Later, Lavoisier investigated the weight changes of various substances during oxidation and reduction and discovered that the newly found element oxygen plays the decisive role, and refuted the phlogiston theory.

In vain, the defenders of the phlogiston theory, such as Henry Cavendish, Joseph Priestley, and Carl Wilhelm Scheele, tried to preserve it by creating modified phlogiston models.

1.8.1 Self-Experiment

Replace phlogiston with modern theory objects such as quarks, gluons, dark matter, dark energy, neutrinos, and others.

> It is not the mathematics, which generally cannot distinguish between dust and vacuum cleaner, that is wrong, but the mathematically formulated, arbitrarily postulated thought constructs are, which upon closer inspection already lack the simplest logic and ultimately generate no gain in knowledge.

2 Epistemological Basic Principle: The Signature of the Matter Wave

2.1 The Illusion of the Resting Experiment

The exact derivations of Elementary Body Theory (EBT) – be it the Rydberg energy of the H atom, the binding energy of the H_2 molecule, or the masses of elementary particles – are based on the invariant rest quantities m_0 and r_0. This is the ontological core of the elementary body in the state $v = 0$.

Every real experiment, however, measures entities that are **not** in an absolute state of rest. In the laboratory, the interacting bodies always possess a center-of-mass velocity $v > 0$, caused by thermal conditions, the preparation process, or the measurement apparatus itself. The comparison of Elementary Body Theory and experiment is therefore always a comparison between the resting ideal state of the theory and the moving real state of the experiment.

2.2 The Isotropic Embodiment of Kinetic Energy

According to the *Freyling intervention* and the mass-radius coupling, kinetic energy is not an abstract bookkeeping quantity, but **embodies itself as real space**. In EBT, the de Broglie matter wave is not a probability amplitude, but the exact radius that the kinetic energy of a moving elementary body occupies isotropically in space:

$$\lambda_{\mathrm{deB}} = \lambda_C \cdot \sqrt{\left(\frac{c}{v}\right)^2 - 1} \tag{3}$$

Although the motion itself is anisotropic (directed), its spatial embodiment occurs radially symmetrically. A moving elementary body therefore always spans an effective total radius that is composed of its rest radius and the radius of its embodied kinetic energy:

$$r_{\mathrm{effective}} = r_0 \oplus \lambda_{\mathrm{deB}} \tag{4}$$

2.3 The Energy Superposition as the Cause of Measurement Deviations

When elementary bodies interact in the experiment (proton, electron, or like the four bodies in H_2 binding or the collisions in particle physics), not only their pure rest radii r_0 superimpose in the common origin. Their **effective radii**, which are spanned by the embodied kinetic energy, superimpose.

This additional spatial extension changes the contact geometry of the spherical caps and the density of the space-energy shell. The much-discussed deviations in the per mille to percent range (such as the $+0.09\,\%$ for the H_2 molecule or the deviations in the masses of pions and muons) are therefore **not errors of the theory and not phenomenological adjustment parameters**.

Rather, they are the measurable, energetic signature of the matter wave. The deviation is the amount of the **kinetic energy superposition** that is unavoidably measured along with the experiment because the entities embody their kinetic energy as real space that extends into the superposition geometry.

2.4 Conclusion for the Theory-Experiment Comparison

1. **The EBT rest formula** (based on m_0, r_0) is the exact, ideal limit for $v = 0$.
2. **The experimental deviation** is not a deficiency of the theory, but the empirical proof of the de Broglie matter wave as a real spatial entity.
3. **The matter wave** is the universal bridge between the resting ontological state and the moving epistemic measurement state.

The EBT rest formulas do not have to be "rescued" by arbitrary factors. The deviations are the physical proof that kinetic energy spans a real space that modifies the measurement. These can be small deviations or percentage deviations, since in accelerator experiments very high velocities are associated with the objects under investigation. Thus, the embodied energy is a significant, within the framework of EBT phenomenology, geometric equation parameter.

Under this phenomenological aspect and the universality of the matter wave, all subsequently named deviations are to be understood.

In the appendix, the fundamental significance of the matter wave is explicitly discussed, also in the macroscopic picture.

2.5 Mass-Inherent Elementary Body Radius

A fundamental quantity is the mass-inherent elementary body radius r_0, which follows effortlessly from the Compton wavelength

$$\lambda_C = \frac{\pi}{2} \cdot r_0 \tag{5}$$

This is observed in all scattering processes. The misinterpretations of prevailing physics, especially elementary particle physics, regarding the measured radii are all theory-induced.

A significantly false assumption results from the inertial-system-burdened, one-dimensional consideration of moving "test bodies" and their inadmissible extrapolation to spatially structured, real-physical objects. For one-dimensionally moving test bodies: According to Lorentz transformation, the transverse components are easily comprehensible unchanged; only in the direction of motion does a length contraction exist.

In a radially symmetric spherical-surface contraction, however, all spatial directions are equal. Here the result is a linear combination, i.e., the spatial change leads to an isotropic radius reduction.

Through the addition of external electric-magnetic energy, for example in accelerators, it follows: The radius reduction depends on the total energy of the elementary body and can be uniquely determined by means of the dynamized relativistic factor as a function of velocity:

$$r(v(t)) = r_0 \cdot \gamma_{\mathrm{dyn}} \tag{6}$$

Every center-of-mass velocity change is ultimately based on acceleration. The idea of self-radiation due to a center-of-mass acceleration is generally misleading, because electrons, protons, and generally ions are accelerated by electric, magnetic, or corresponding alternating fields. For the individual charge, the accelerator system represents an infinitely large energy reservoir.

This means that through the energy supply, the inner ratio of space energy to mass energy is changed radially symmetrically (see the following detailed explanations on this); furthermore, a center-of-mass motion occurs, and part of the supplied energy is radiated again in the form of radiation. The energy supposedly radiated by the charge did not belong to the unaccelerated charge, but to the accelerator system with an infinitely large energy reservoir.

The charge, so to speak, as a "mediator" divides the supplied external energy into motion energy and radiation energy and "suffers" an internal restructuring compared to the unaccelerated particle – casually formulated, it is radially symmetrically compressed and center-of-mass moved. Due to the practically infinitely large energy reservoir of the accelerator system, no energy balance can be established. Thus, the phenomenology of the process is anything but clarified. The missing phenomenology of radiation, however, has no influence on the resulting findings in the sense of the misunderstanding about the size ratios.

The acceleration and velocity, for example of a proton or electron, lead to a change in total energy, but the inner energy remains constant. The ratio of mass-dependent and radius-dependent energy changes. With increasing total energy – variable translational energy and constant inner energy – the elementary body becomes ever "smaller and proportionally heavier". This means that the interaction cross sections decrease with $(r(v))^2$.

From this results the misinterpretation that the radius calculated from the interaction cross sections of highly relativistic particles corresponds to the rest radius. If interaction in the detector leads to deceleration, the radius increases with proportional mass reduction; mass-dependent energy is transformed into radius-dependent space energy.

"Calorically", however, only the translational energy is measured. This is understandable from the perspective of the phenomenology of elementary bodies, since the object enlargement means inner space energy that cannot be made available to the outside. This process is not realizable in the thinking of prevailing physics.

Since in particle decays radius-smaller objects, i.e., Compton-wavelength-smaller objects, transform into radius-larger objects, energy seems to have been lost. Here, fatally, the neutrino postulate comes into play, which is refuted on an EBT basis. Whereby the neutrino mass postulate is already refuted model-independently by the universality of the matter wave (more on this later in detail).

3 Elementary Body – Photon

Elementary Body Theory offers a self-consistent, minimalist, and intuitive description of the photon and its interaction with matter. Starting from the fundamental mass-radius constant equation $m_0 r_0 = 2h/(\pi c)$, the transition from the photon, pure motion energy, to the massive elementary body is described by simple sine functions.

The zero point does not represent "nothing", but the maximum state of motion – the timeless speed of light. Information and material state are connected by the mass-radius coupling.

3.1 Historical Context

The term "photon" was first proposed in 1926 by the American physical chemist Gilbert Lewis in his work "The Conservation of Photons" – 21 years after Einstein's work on the photoelectric effect. Lewis speculated whether light consists of a new kind of atom that can neither be created nor destroyed, i.e., obeys a conservation law.

This historical note is significant because it shows that the photon concept was connected from the beginning with the question of the nature of light and its relation to matter – a question that Elementary Body Theory answers in a remarkably simple way.

For an intuitive understanding and, resulting from this, for the phenomenologically founded Elementary Body Theory-based equations, demonstrably neither a variable time, nor mathematical space-time constructs, nor any form of substructuring is necessary.

The fundamental, phenomenologically founded Elementary Body-based thought-model demand consists in the fact that the most minimalist possible equations depict both the massless photon and massive matter. The creation equations

$$r(t) = r_0 \cdot \sin\left(\frac{c \cdot t}{r_0}\right)$$

and

$$m(t) = m_0 \cdot \sin\left(\frac{c \cdot t}{r_0}\right)$$

accomplish exactly this. The timeless speed of light – as a state of pure motion – is not in contradiction with matter-energy embodiment.

3.2 Philosophical Preliminary Consideration on Minimalism

The most origin-symmetric spatial arrangement is the non-rotating infinitesimal spherical surface. Only on an idealized infinitesimal, non-rotating spherical shell are all point elements or surface elements equal.

The philosophical condition for an elementary structure, in the sense of a strict meaning, is the absence of a substructure. Even a principal axis of inertia creates an asymmetry, with the extremes that the poles do not rotate at all and at the equator maximum rotational velocity prevails. Thus, structural elements, such as points and surfaces, of a rotating body are not equal.

Thus, a rotating body, even if it is an infinitesimal hollow sphere rotating about a principal axis of inertia with constant angular velocity, possesses a substructure that manifests itself through structural elements moving at different velocities. Rotation can therefore, from a logical perspective, not be a fundamental property of an elementary structure.

»**phenomenologically founded**«

In the present explanations, the term »phenomenologically founded« is used repeatedly. What does that mean?

In contrast to the prevailing standard models of elementary particle physics (SM) and the cosmological standard model (ΛCDM model), the alternative thought model of Elementary Body Theory is mathematically simple and intuitive. The model equations are geometrically founded and "sense-experienceable". What this means in detail is the subject of all following considerations and resulting calculations within the framework of EBT.

3.3 Elementary Body Evolution Equations

The time-dependent elementary body evolution equations are derived from the observed invariance of the vacuum speed of light. The fundamental difference from Special Relativity or the Lorentz transformation is the interaction-necessary radially symmetric-dynamic character of these equations.

Within the framework of the present approximation-free, phenomenologically founded elementary bodies, the term rest mass m_0 is used; however, this is to be distinguished from the concept of rest mass in Special Relativity. The rest mass corresponds to the fully formed elementary body with $m(t) = m_0$ and $r(t) = r_0$. The inner structural dynamics and all possible elementary body interactions are inertial-system-freed-dynamic.

The evolution equations are:

$$r(t) = r_0 \sin\left(\frac{ct}{r_0}\right) \tag{7}$$

$$m(t) = m_0 \sin\left(\frac{ct}{r_0}\right) \tag{8}$$

$$v(t) = \frac{dr}{dt} = c\cos\left(\frac{ct}{r_0}\right) \tag{9}$$

The boundary conditions are:

$$r(0) = 0, \quad m(0) = 0, \quad v(0) = c$$

$$r(t_0) = r_0, \quad m(t_0) = m_0, \quad v(t_0) = 0$$

The evolution time is:

$$t_0 = \frac{\pi}{2} \cdot \frac{r_0}{c} \tag{10}$$

3.4 What Is Mass?

The rest mass (invariant mass) of Special Relativity (SR) is inherently connected with inertial systems. For the definition of terms: A quantity that does not change under Lorentz transformations is called a Lorentz invariant. In Special Relativity, mass (m_{SR}) is defined such that it is a Lorentz-invariant quantity. **In Elementary Body Theory, the rest mass m_0 is a measure of the oscillation frequency of the elementary body**. The radius-smaller elementary bodies possess a larger mass, since this is equivalent to the possible motion of the oscillating surface. **Mass is therefore, in the picture of the elementary body, equivalent to inner motion and is traced back to the radius via reciprocal proportionality:**

$$m_0 = \frac{2h}{\pi c\, r_0} = \frac{F_{\mathrm{EB}}}{r_0} \tag{11}$$

3.5 The Elementary Body Spherical Surface

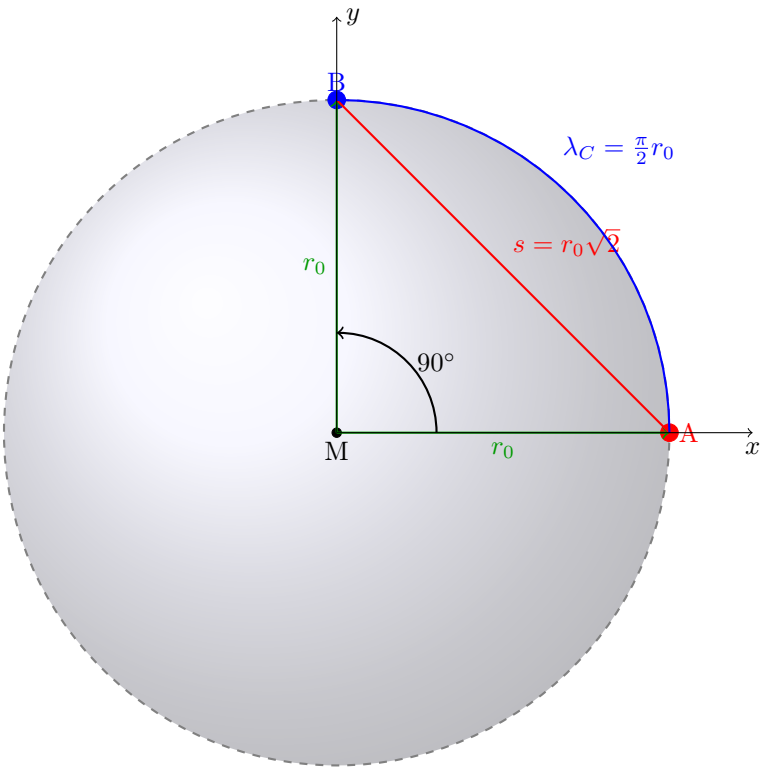


Figure 1: The elementary body spherical surface with radius r_0. The orthodrome $\lambda_C = \frac{\pi}{2} r_0$ corresponds to the Compton wavelength and corresponds to the complete elementary body evolution.

The figure shows the elementary body spherical surface with radius r_0. Point A lies on the x-axis, point B on the y-axis. The Euclidean distance between A and B is the red chord:

$$s = r_0\sqrt{2}$$

The orthodrome, the blue quarter arc, is:

$$\lambda_C = \frac{\pi}{2} r_0$$

This orthodrome corresponds to the Compton wavelength of the elementary body and marks the complete evolution from the photon to the massive elementary body.

3.6 In the Beginning Was the Unique "Invariant C" – Thought-Model History

The communication or interpretation problem from the perspective of standard physicists began or begins – as so often – with a formalism freed from real physics. The observable invariance of the vacuum speed of light is by no means "directly" connected with Special Relativity (SR), as is suggested. The historically much-cited Michelson-Morley experiment is conceived one-dimensionally and says nothing at all about massive particles in the sense of prevailing physics and also does not treat transverse components. The mathematical invariance of the transverse components is merely a formal consequence of the rectilinearly uniformly moving observers with respect to force-free particles in a mathematical thought model. In other words, the entire construct of the Lorentz transformation(s) is bound to inertial systems. Phenomenologically, SR says nothing about the invariance of the speed of light.

Before misunderstandings arise, it is not claimed that the mathematics of relativity theory is wrong. But the mathematical construct possesses – apart from the underlying observable invariance of the vacuum speed of light – no real-physical basis. Observations exist, but no phenomenology exists for the mathematics of SR. The inertial-system-burdened "relativity of observers" is a "delicate matter", since

in nature measurable system changes occur only when energy is exchanged. Energy exchange, however, fundamentally means that accelerations occur. With acceleration, the inertial system "takes its leave" and consequently also the Lorentz transformation in its original form. The mathematics of SR is not wrong, but already "by definition" not dynamic.

In simple words: Already in 1986, during my basic physics studies, the question arose to me (Dirk Freyling) as to which mathematical primal equation depicts the "relativistic" factor of the dynamized Lorentz transformation. Fact is: Detached from concrete thought-model approaches, real-object interactions are always dynamic. Since SR is "inertial-system-burdened", it was mandatory for a dynamic evolution process to replace $v = \text{const.}$ with $v = dr/dt$.

Finding the function

$$r(t) = r_0 \cdot \sin\left(\frac{c \cdot t}{r_0}\right) \tag{12}$$

was therefore simple. The later devised elementary body reconstruction (**Freyling intervention**) represents one of the thought experiments of how one can geometrically imagine "something". But primarily and in the final consequence, the "simple" replacement of the "unnaturally" always constant velocity by a variable velocity was the key to a completely new understanding.

4 The Freyling Intervention: Geometric Derivation of Elementary Body Dynamics

Starting from isotropic light propagation in the center of a becoming spherical surface and the Pythagorean theorem, the relation $r(t) = ct\sqrt{1 - v^2/c^2}$ is derived. The sinusoidal evolution $r(t) = r_0 \sin(ct/r_0)$ results from the requirement that the initial conditions $r(0) = 0$, $v(0) = c$ and the final conditions $r(t_0) = r_0$, $v(t_0) = 0$ must be fulfilled. The step-by-step derivation shows every transformation. It is interesting to mention that the geometry and plausibility get by without "relativistic ideas". In the following, it is shown how a so-called elementary body arises from a simple geometric consideration and the relativity principle in the form of the dynamic-relativistic factor γ_{dyn} is a consequence of radial symmetry.

4.1 Step 1: Emergence of a Spherical Surface through Isotropic Light Propagation

We consider the emergence of a spherical surface as isotropic light propagation from the center with maximum radius r_0. Due to spherical symmetry, the consideration reduces to a circle with radius $r_0 = c \cdot t$ (c: speed of light, t: time).

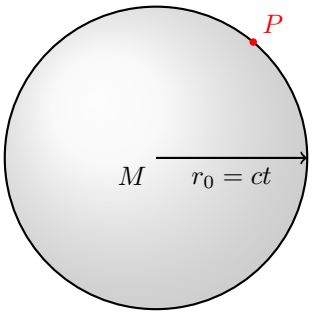


Figure 2: Isotropic light propagation from the center M creates a spherical surface. At time t the surface has radius $r_0 = ct$. Point P is an arbitrary point on the surface.

At time $t = 0$ the radius is zero – this corresponds to the photon. At time t the surface has radius r_0.

4.2 Step 2: Variable Velocity and the Freyling Intervention

The spherical surface expands with a variable radial velocity $v = dr/dt$.

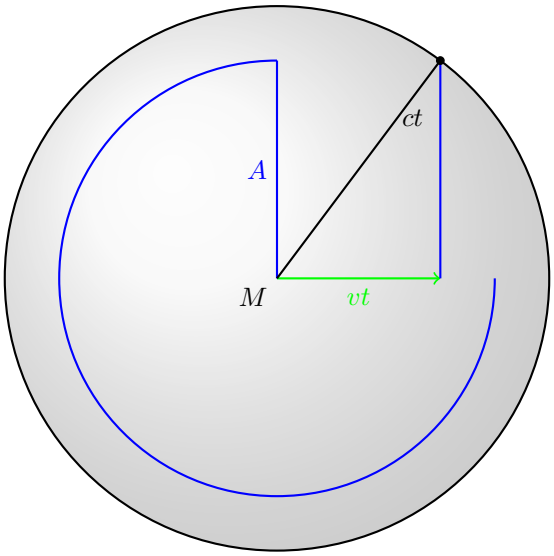


Figure 3: **Freyling intervention**: The horizontal segment vt (green), the blue verticals (the second labeled with A), A corresponds geometrically to a reduced radius as a function of the velocity v.

For the mathematical calculation, it is illustratively necessary to consider the velocity v as a snapshot constant and perpendicular to c with defined spatial direction, but in the context of a phenomenological consideration this is not the case. The spherical surface obviously develops dynamically and radially symmetrically with $v = dr/dt$ isotropically. In other words: Looking at the above graphic, A stands perpendicular to $v \cdot t$ for mathematical calculation, but A can be rotated arbitrarily in the circle, or thinking further in space, due to radial symmetry, without the magnitude of A changing. This is the **Freyling intervention**.

A corresponds geometrically to a reduced radius as a function of the velocity v, which reaches its maximum at $r = r_0$. We now seek a solution that describes $A(v) := r(v)$ as a function of time. If we assume v as variable, then: $v = dr/dt$.

4.3 Step 3: Pythagorean Theorem – First Equation

From the drawing follows the Pythagorean theorem:

$$(ct)^2 = A^2 + (vt)^2.$$

Since A in this construction is exactly the current radius $r(t)$, we write:

$$(ct)^2 = r(t)^2 + (vt)^2.$$

Solving for $r(t)$:

$$\begin{aligned} A^2 + (v \cdot t)^2 &= (c \cdot t)^2 \\ A^2 &= (c \cdot t)^2 - (v \cdot t)^2 \\ A^2 &= t^2(c^2 - v^2) \\ A^2 &= c^2 t^2 \left(1 - \left(\frac{v}{c}\right)^2\right) \end{aligned}$$

Thus for A, the radius $r(t)$ results:

$$\boxed{r(t) = ct\sqrt{1 - \left(\frac{v}{c}\right)^2}}$$

4.4 Step 4: The Sinusoidal Solution

The boundary conditions are:

$$r(0) = 0, \quad v(0) = c, \quad r(t_0) = r_0, \quad v(t_0) = 0.$$

The simplest approach that satisfies these conditions and at the same time identically fulfills the above Pythagorean relation is the sine function:

$$\boxed{r(t) = r_0 \sin\left(\frac{ct}{r_0}\right)} \qquad \boxed{v(t) = \frac{dr}{dt} = c\cos\left(\frac{ct}{r_0}\right)}.$$

The maximum extension r_0 is reached when $\sin(ct/r_0) = 1$, i.e., at

$$t_0 = \frac{\pi}{2} \cdot \frac{r_0}{c}.$$

4.5 Step 5: Evolution Time, Orthodrome, and the Mass-Radius Constant

The evolution time t_0 is the time span from the photon to the fully formed elementary body. The arc length traversed on the spherical surface during this time, the orthodrome, is

$$\lambda = ct_0 = \frac{\pi}{2} r_0.$$

In quantum physics, the Compton wavelength of a particle of mass m_0 is given by $\lambda_C = \frac{h}{m_0 c}$. EBT identifies λ with λ_C:

$$\frac{\pi}{2} r_0 = \frac{h}{m_0 c}.$$

From this follows the fundamental **mass-radius constant equation**:

$$\boxed{m_0 r_0 = \frac{2h}{\pi c}} \qquad \text{[F1]}.$$

This equation is the heart of Elementary Body Theory. It links mass and radius of every elementary body without free parameters.

4.6 On the Compton Wavelength – Quarter Period, Not Full Period

Energy-equivalently, the energy of the mass-radius-coupled real object is alternatively defined by the Compton wavelength $\lambda_C = \frac{\pi}{2} r_0$. Thus the Compton wavelength results object-naturally.

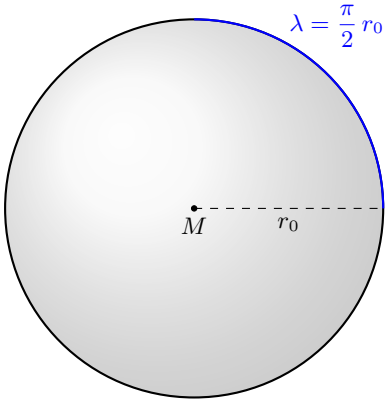
In prevailing physics, the Compton wavelength is introduced as $\lambda_C = \frac{h}{m_0 c}$, but without geometric justification and implicitly as the result of a **full period** 2π. EBT, by contrast, shows: The embodiment process from the photon to the massive elementary body corresponds to a **quarter period** $\frac{\pi}{2}$ of the underlying oscillation. Therefore the correct relation is:

$$\lambda_C = \frac{\pi}{2}\, r_0.$$

From this immediately follows the **mass-inherent radius**:

$$r_0 = \frac{2}{\pi}\, \lambda_C = \frac{2}{\pi} \cdot \frac{h}{m_0 c}.$$

The question of how value-certain the rest radii $r_0(m_0)$ inherent to the rest masses associated with the Compton wavelengths are is easy to answer: **Compton wavelengths are also measured quantities.** [CODATA-λ_C(proton), CODATA-λ_C(electron)]



$\lambda_C = \frac{\pi}{2}\, r_0$

From this immediately follows the **mass-inherent radius**:

$$r_0 = \frac{2}{\pi}\, \lambda_C = \frac{2}{\pi} \cdot \frac{h}{m_0 c}$$

Figure 4: The orthodrome as quarter arc of the spherical surface: $\lambda_C = \frac{\pi}{2} r_0$

This elementary-body-theoretical foundation is confirmed by measurement results within the framework of differential scattering cross sections of elastic and inelastic scattering – and at the same time stands in glaring contradiction to the statements of elementary particle physics.

4.7 Experimental Confirmation by Scattering Cross Sections

The following compilation shows that the **classical radius**

$$r_{\mathrm{cl}} = \frac{e^2}{4\pi\varepsilon_0 m_0 c^2}$$

derived from the mass-radius coupling appears in all established scattering formulas – a strong indication of the physical reality of the mass-inherent radius r_0. In EBT this is expressed as

$$r_{\mathrm{cl}} = \frac{\alpha}{4}\, r_0,$$

where α is the fine-structure constant. The factor $\alpha/4$ is the ratio of electrical energy to total energy.

The seven experimentally confirmed scattering formulas include:

- Thomson scattering
- Møller scattering
- Bethe-Bloch-Sternheimer equation
- Photoelectric effect
- Pair production
- Compton scattering (Klein-Nishina)
- Kramers-Heisenberg formula

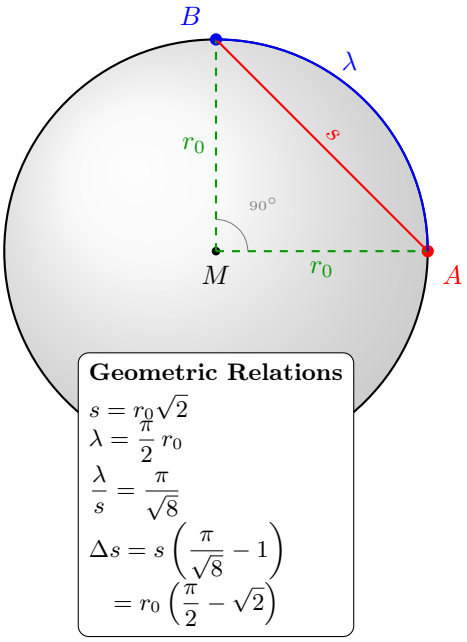
In all these equations the classical radius r_{cl} or $\frac{\alpha}{4} r_0$ appears. The experimental agreement is a direct proof of the validity of the mass-radius coupling.

4.8 General Embodiment of the Euclidean Distance

The fact that we live to a very good approximation – in comparison, contrary to modern theoretical abstractions of elementary particle physics and in correspondence to the mass-radius-coupled microcosm – on a spherical surface does not lead to a three-dimensional spatial curvature or even to a space-time continuum.

The fact that elementary structures initially consist of oscillating spherical surfaces likewise does not lead to a four-dimensional concept with exchange possibilities of space and time. On the contrary, it leads to a constructive descriptive impoverishment. The isotropy leads to a 2-dimensional plausibility that formally impoverishes to time and radius. The self-evident fact that the path on a spherical surface does not correspond to the Euclidean distance between points A and B requires no abstraction.

4.8.1 Embodied Euclidean Distance



The Embodiment of the Euclidean Distance
On a spherical surface, the shortest connection λ (orthodrome)
is longer than the Euclidean distance s in three-dimensional space.

Figure 5: Euclidean distance s (red chord) and orthodrome λ (blue arc) on a spherical surface. Both points A and B have the distance r_0 from the center M and enclose a 90° angle.

For every Euclidean distance s of points A and B, there are radially symmetric bodies with radius r_0 that uniquely determine the distance of points A and B on the spherical surface in a spherically symmetric manner.

From the perspective of an observer at the body center, the shortest distance connecting points A and B on the spherical surface is: $\lambda = \frac{\pi}{2} r_0$ or $\lambda = s\,\frac{\pi}{\sqrt{8}}$. Due to the embodiment, the interaction is radially symmetric. This means that a physical space is built up.

A communication and interpretation problem consists in the fact that it is tacitly assumed that in the microcosm there is the classical possibility of a Euclidean distance and that this Euclidean thought approach finds an abstract differential-geometric fulfillment in the framework of General Relativity through a curved three-dimensional space with extended time function. But for example, neither the quantum mechanical spin, based on a postulated probability wave or alternatively postulated point mass of the electron, nor the postulated curvature of space contain physical plausibility, let alone reality.

5 Electron Radius - What Is a Physical Equation?

A physical equation consists of governing quantities such as charge, mass, and radius, possibly natural constants, coefficients, and calculation rules. The purpose of a physical equation is to make a qualitative and quantitative statement depending on the occurring equation components.

Now to claim that the classical electron radius $r_{e,\text{classical}}$ or the electron radius r_e inherent to the electron mass does indeed appear in all equations for scattering on electrons – exception particle accelerators – but has no governing significance, but is nothing more than a calculation quantity, is unreal and interdisciplinarily grotesque.

The classical electron radius is not an abstract calculation quantity, but the – due to the ratio of electrical energy to the rest energy of the electron – scaled interaction radius r, which appears without exception in all scattering experiments on electrons, including in particle accelerators.

For the electron, as for all elementary bodies, the fundamental mass-radius relation holds:

$$m_e \cdot r_e = \frac{2h}{\pi c} = F_{\text{EB}} \tag{13}$$

From this follows the electron-mass-inherent radius:

$$r_e = \frac{2h}{\pi c \cdot m_e} = \frac{2}{\pi} \cdot \lambda_{C,e} \tag{14}$$

With the CODATA values, the result is:

$$r_e \approx 1.54 \cdot 10^{-12}\,\text{m} \tag{15}$$

In EBT, the classical electron radius is the interaction radius scaled by the ratio of electrical energy to total energy:

$$r_{e,\text{cl}} = \frac{\alpha}{4} \cdot r_e \tag{16}$$

Numerically:

$$r_{e,\text{cl}} = \frac{\alpha}{4} \cdot r_e \approx 2.82 \cdot 10^{-15}\,\text{m} \tag{17}$$

This classical radius appears in all scattering formulas on electrons – from Thomson scattering through the Klein-Nishina formula to the Bethe-Bloch equation. It is not an abstract calculation quantity, but the scaled real interaction radius of the electron.

It is not the typical energy-dependent electron radii smaller than 10^{-19} m in connection with particle accelerators that are measured incorrectly, but the conclusions resulting from elementary particle physics regarding resting electrons.

Elementary Body Theory consistently describes both the behavior at conventional scattering energies of the electron's scattering partners and at high energies in the particle accelerator. Here there are the greatest emotional outbursts and a methodological refusal of plausibility by standard model physicists and their adherents.

The classical electron radius leads to the electron-mass-inherent electron radius r_e, which appears as a scaled interaction radius r in scattering experiments. Here the fundamental mass-radius coupling becomes clear, which finds its formal expression in the mass-radius constant equation:

$$m_0 r_0 = \frac{2h}{\pi c} = F_{\text{EB}} \tag{18}$$

Protons

In mass-radius-coupled reality, the proton scattering centers with cross sections smaller than the cross section of the proton – which are theory-induced interpreted as quark-gluon substructure – are the radially symmetric radius-reduced protons themselves. The same applies to high-energy electrons.

Only here does the established thought schema lead to the fact that one does not want to give electrons a substructure by postulate. As a result, electrons then suffer the phenomenologically meaningless point-impoverishment of mass and electric charge according to the Standard Model of particle physics.

The resulting divergences are point-impoverishment-inherent. Resulting infinities of mass, charge, and energy density are then made to disappear by means of elaborate, mathematically-axiomatically

questionable new constructions – keywords renormalization and regularization – with specially constructed, compensating negative infinities.

Particle Accelerators

In the truest sense of the word, a particle accelerator is the energetically dimensionally largest non-inertial system made by human hands. There, the Lorentz transformation of SR does not apply. The relativity principle also does not apply to a particle accelerator.

The continuously accelerated particles – regardless of type – and their accelerated reference systems for formal description are clearly distinguishable from the accelerator system. The supplied energy, which manifests itself through the increased total energy of the particles, cannot be described with the Lorentz transformation, since relativity would unmistakably be bound to inertial systems.

Whoever – with or without an academic degree – believes that, in the absence of a known formalism, the Lorentz transformation can conveniently be applied to a particle accelerator and leads to a one-dimensional length contraction as well as a simultaneous relative mass increase of the accelerated particles, is subject to a naive decadence. Or how else should one express it when an axiomatic reality is arbitrarily blanked out?

The radially symmetric, dynamic extension of the Lorentz transformation within the framework of Elementary Body Theory, however, is not bound to inertial systems. The invariance of the vacuum speed of light is and remains a basic prerequisite for Elementary Body Theory. There are no contradictions to observation.

5.0.1 ***Note***

Although particle accelerators are not inertial systems, the theoretical consequence and axiomatics of the inertial-system-bound Special Relativity is suppressed due to wishful thinking of standard model physicists and quantum field theorists, and reduced to a relative mass increase and length contraction only in the direction of motion of an accelerator system.

This dogmatically decreed, in the sense of SR non-applicable relativistic one-dimensionality leads to fatal misinterpretations of the measurement results, which ultimately lead to the supposed substructure of protons and to the statement that electrons possess a radius smaller than 10^{-18} m and can theoretically be assumed as point-like.

The electrons brought to collision are accelerated many-particle systems. The amount of energy provided up to the collision is a multiple of the absorbed energy of the electrons. The suggestion that the individual electron absorbs a predetermined amount of energy from the accelerator is more wish than reality.

Since the radiated power – bremsstrahlung, in ring accelerators synchrotron radiation – for accelerated electrons at the same acceleration is on the order of

$$\frac{P_e}{P_p} = \left(\frac{m_p}{m_e}\right)^4 \approx 10^{13} \tag{19}$$

larger than for accelerated protons, the interplay of energy supply and energy removal is evident. Since the structure or inner dynamics of the electron is unknown to prevailing physics, the question of theoretical embedding is superfluous.

Without going into the problem of the missing phenomenology of standard physics in more detail and quantitatively, the following can be stated generally: The electron radius in high-energy collisions in particle accelerators depends on the energy or velocity. With increasing velocity, the momentum mass of the electron grows. According to the mass-radius constant equation, this results in a decrease of the electron radius.

The supposedly substructured, quark-based proton and the supposedly structureless electron are, upon closer inspection, comprehensible misinterpretations of particle accelerator experiments.

Protons and electrons in collider beams fundamentally change their mass-radius ratios according to the mass-radius constant equation. Thus, interpretations and theories on substructure, scattering, form and structure factors, quarks, gluons, W and Z bosons, confinement, asymptotic freedom, CKM matrix, and other particle accelerator phenomena are theory-laden energetic arbitrarinesses and possibilities, overall SM artifacts that have little to do with the actual resting particle.

6 Myth "Theory Creates"

Practically oriented Egyptians, Romans, and Greeks created complex structures long before the introduction of integral and differential calculus, long before theoretical models on the load-bearing capacity and bending possibilities of beams and columns, fragments of which can partly still be viewed today. It was not the theory of the semiconductor that created the semiconductor; the semiconductor as an electrotechnical tinkering and fiddling object left room for theoretical considerations. Functioning technology as innovation of applied physics requires and required experiment-friendly "makers"; (mis-)successes (trial error) showed the way.

Physics and Philosophy - Theses and Reality

"Physics answers how-questions, philosophy answers why-questions." Well, philosophers express opinions; rarely if ever, especially in the area of theoretical physics thought models, are these answers that go beyond arbitrary, subjective evaluations. In the framework of applied physics, there are practical answers that, in the result, make storage media, communication, and real transport possible, for example. In modern theoretical physics, there have been no answers for more than 100 years that are phenomenologically founded, if one demands intuitive real physics.

In order to understand at a higher level why the **S**tandard **M**odel of (elementary) particle physics (SM) and the cosmological standard model (Λ**C**[old]**D**[ark]**M**[atter] model) could establish themselves without great resistance, despite the extreme internal contradictions, 25 free parameters SM and at least 6 free parameters in the Standard Model of cosmology, postulated faster-than-light expansion of the universe,... exclusively postulated, indirect existence proofs and theory-laden measurements,... it should be noted that these model considerations had and have no significance whatsoever for real physics research, i.e., materials and applications research. This applies both to "diagnostics" (material investigations) and to the construction of (material) applications (more on this "on the side" later).

Facts are: Theoretical models always lag(ged) behind (measurable) reality. The myth that highly complex, mathematical theories could and can describe reality and generate new things lives on. However, that the predictive capabilities of theoretical models, upon closer inspection, are results of repeatedly (newly) carried out post-corrections does not reveal itself to most interested parties. Real-object interpretations are born within the framework of the standard models from mathematically formalized (sometimes esoteric) [BR]) concepts. Theoretical was adapted over decades again and again to ever more precise measurement results. Be it through additional calculations, new quantum numbers, new interaction postulates, and new substructure theses, as well as extremely time-intensive, iteratively-algorithmically post-corrected results by means of cluster computing systems or "supercomputers".

A secured "higher mathematical reality" exists exclusively within the framework of axiomatically founded language (mathematics). To what extent a correct mathematical structure ("higher mathematical reality") is physically applicable cannot be decided by means of mathematics (see indisputably exemplary epicycle theory and Banach-Tarski paradox). Mathematics ultimately captures sets and cannot distinguish between vacuum cleaner and dust.

»**Nature can only add or subtract**«

7 Equal Electric Charge Strength as an Indication of the Common Total Energy Scale

A particularly simple phenomenological indication of the energetic relationship between electron and proton lies in an elementary experimental fact: **Electron and proton possess, despite their very different masses, exactly the same electric elementary charge in magnitude** e,

$$\boxed{|q_e| = |q_p| = e.}$$

In the picture of EBT, this equality is precisely the expected result. Electron and proton represent different divisions of the same total energy into mass and spatial embodiment. The basis for this is the mass-radius constant equation

$$\boxed{m\,r = F_{\mathrm{EB}},}$$

from which immediately follows:

$$\boxed{m_e r_e = m_p r_p = F_{\mathrm{EB}}.}$$

A larger mass is thus necessarily connected with a correspondingly smaller mass-inherent radius, a smaller mass with a correspondingly larger radius. Electron and proton consequently differ considerably in their **distribution between mass and space**, but not in the underlying mass-radius-coupled total quantity.

Against this background, the equal magnitude of the electric elementary charge acquires a special phenomenological significance. Although

$$m_p \gg m_e$$

holds, the electric coupling strength of both elementary bodies remains equal. It therefore does not simply follow the respective mass, but points in the EBT picture to the **common total energy scale** that stands behind the different mass-radius embodiments. The experimentally established equality of the charge magnitudes can therefore be understood as a simple indirect indication of that energetic equivalence which the mass-radius constant equation expresses geometrically.

Electron and proton thus appear as **two different mass-spatial embodiment states of the same elementary total energy scale**: The proton represents the more strongly mass-bound and correspondingly spatially smaller state, the electron the mass-poorer and correspondingly spatially more developed state.

To be separated from this is initially the question of the charge direction conventionally designated as "positive" and "negative". That electron and proton experimentally show opposite electric behavior is beyond question. **Which geometric or energetic property within EBT underlies this difference, however, remains a research task.** The terms "positive" and "negative" therefore initially designate the observed behavior, but within EBT do not yet provide an explanation of its cause.

The formation of the hydrogen atom also thereby receives a further-reaching interpretation. The statement that proton and electron "attract each other due to their opposite charges" initially describes the observed behavior. In the EBT picture, the bound state is understood more fundamentally as an **energetic-spatial balance of two complementary mass-radius embodiments**. Proton and electron form a common state because their different mass and radius components enter into relation with each other and enable a state of balance.

The fundamental statement can therefore be summarized as

$$\boxed{\text{different mass-radius embodiments} \longrightarrow \text{common energetic-spatial state of balance.}}$$

In this picture, the equal magnitude of the electric elementary charge is the immediately visible phenomenological indication that behind the different masses and radii of electron and proton stands **the same elementary total energy scale**.

8 Proton Radius – Exact Determination

8.1 The Fundamental Mass-Radius Coupling

The exact theoretical determination of the proton radius takes place within the framework of Elementary Body Theory (EBT) via the mass-radius constant equation [$F1$]. This equation states that the product of mass and radius of an elementary body is a fundamental invariant that depends exclusively on natural constants:

$$m_0 \cdot r_0 = \frac{2h}{\pi c} = F_{\mathrm{EB}} \qquad [F1] \tag{20}$$

With knowledge of the proton mass m_p, the proton-mass-inherent proton radius results:

$$r_p = \frac{2h}{\pi c \cdot m_p} \tag{21}$$

The derivation of this relation follows a stringent geometric-energetic logic: If one considers Planck's constant of action h as the smallest scalar action, then this action has the dimension energy times time. If one inserts the mass-dependent rest energy $E_0 = m_0 c^2$ for the energy, a specific time results for every rest mass:

$$t(m_0) = \frac{h}{m_0 c^2} = \frac{\lambda_0}{c} \tag{22}$$

This time can also be expressed by the Compton wavelength $\lambda_0 = h/(m_0 c)$ of the rest mass. The evolution equation of the elementary body

$$r(t) = r_0 \sin\left(\frac{c}{r_0} \cdot t\right) \tag{23}$$

provides the state of maximum extension at $ct/r_0 = \pi/2$, from which

$$t_0 = \frac{\pi}{2} \cdot \frac{r_0}{c} \tag{24}$$

results. Equating both time expressions leads directly to $[F1]$.

8.2 Numerical Value and Experimental Confirmation

The elementary-body-theoretical prediction for the proton radius is:

$$r_p(\mathrm{EBT}) = 8.412356415 \cdot 10^{-16}\ \mathrm{m} \tag{25}$$

This value lies within the stated accuracy range of the experimental value from muonic hydrogen with $8.4087(\pm 0.0039) \cdot 10^{-16}$ m – the experimental maximum lies at $8.4126 \cdot 10^{-16}$ m. The current CODATA value for the charge radius of the proton of $8.751(61) \cdot 10^{-16}$ m, by contrast, deviates by more than 4 % from the EBT prediction.

The experimental confirmation of the EBT prediction was provided by several independent measurements:

Muonic Hydrogen (2010/2013) The Lamb shift measurements on muonic hydrogen by Randolf Pohl and colleagues yielded a proton radius of

$$r_p(\mu) = 8.4087(39) \cdot 10^{-16}\ \mathrm{m} \tag{26}$$

– an agreement with the EBT prediction within the measurement uncertainty.

Regular Hydrogen (2017) Scientists at the Max Planck Institute of Quantum Optics in Garching confirmed the unexpectedly small proton radius with high-precision laser spectroscopy. The measurement of the 2S-4P transition in hydrogen achieved a relative measurement uncertainty of $4 \cdot 10^{-12}$. The values derived from this for the Rydberg constant and the proton radius agreed very well with the measurements on muonic hydrogen:

$$R_\infty = 10973731.568076(96)\ \mathrm{m}^{-1}$$
$$r_p = 8.335(95) \cdot 10^{-16}\ \mathrm{m}$$

Electron-Proton Scattering (PRad Experiment, 2019) The Proton Charge Radius (PRad) experiment at Jefferson Lab measured elastic electron-proton scattering at extremely low momentum transfers ($Q^2 = 2 \cdot 10^{-4}$ to 0.06 $(\mathrm{GeV}/c)^2$) with sub-percent precision. The result

$$r_p = 0.831 \pm 0.007_{\mathrm{stat}} \pm 0.012_{\mathrm{syst}} \text{ fm} \tag{27}$$

agrees excellently with the theoretically calculated EBT value.

8.3 Historical Measurements and the Constancy of the EBT Value

Already in 1958, Robert Hofstadter and colleagues determined a proton radius of

$$r_p = 0.80 \pm 0.04 \text{ fm} \tag{28}$$

in electron-proton scattering experiments – a value that is compatible with the EBT prediction. Later evaluations, such as the "dispersion fit" of 1996/1997 with 0.832(12) fm, also confirmed the tendency toward smaller values.

The EBT calculation of the proton radius is parameter-free. The accuracy of the theoretical prediction depends only on the accuracy of the proton mass value and the natural constants h and c. In contrast, the experimental determinations by scattering experiments are strongly theory-laden – they depend on the form factors and model assumptions used.

Remark 8.1. ***On the fundamentality of the proton:*** *The physicist Hans-Peter Dürr already pointed out in 1986 that the idea of a particle substructure fails upon reaching a characteristic limit. This limit results from the ratio between Planck's constant of action and the speed of light ($mR \ll h/c \approx 10^{-37}$ g cm). According to Dürr, this is the case for the first time with a proton ($R \approx 10^{-13}$ cm, $m = 1.7 \cdot 10^{-24}$ g), from which $mR \approx 10^{-37}$ g cm results. Dürr takes this striking coincidence as an occasion to criticize the quark model. It seems much more convincing to him that the quark structure as well as a subquark structure only has the function of an effective description in the sense of the quasiparticle language of many-body physics.*

8.4 The Proton Radius Puzzle and Its Resolution

The discrepancy between the proton radii from electronic hydrogen (~ 0.877 fm) and muonic hydrogen (0.84087 fm) – the so-called *proton radius puzzle* – is not a mystery in EBT. The theoretical, parameter-free value

$$r_p = \frac{F_{\mathrm{EB}}}{m_p} = \frac{2h}{\pi c m_p} = 0.84124 \text{ fm} \tag{29}$$

lies exactly in the range of the most precise muonic measurements.

The deviation of the CODATA values results from the theory-ladenness of the extraction methods and the neglect of the interaction with the measurement field.

8.5 Methodological Consequences

EBT shows that the proton radius is an inherent property of the mass-radius coupling – and not the result of a complex quark-gluon substructure. The agreement of the parameter-free EBT prediction with the most precise experimental results (deviation in the range of the measurement uncertainty) is a strong indication of the consistency of the elementary-body-theoretical approach. The proton radius is thus no longer a freely determinable quantity, but a result derivable from natural constants.

8.6 Summary of the Proton Radius Determination

EBT provides a parameter-free calculation of the proton radius based exclusively on natural constants:

The agreement of the EBT prediction with the most precise experimental results (muonic hydrogen, regular hydrogen, PRad experiment) lies within the measurement uncertainties. The significant deviation of the CODATA value is an indication of the theory-ladenness of the extraction method used there.

Method	Value	Deviation from EBT value	Reference
EBT (theoretical)	$8.412356415 \cdot 10^{-16}$ m	–	–
Muonic hydrogen	$8.4087(39) \cdot 10^{-16}$ m	+0.04 %	Pohl et al. (2010/2013)
Regular hydrogen	$8.335(95) \cdot 10^{-16}$ m	−0.92 %	MPQ Garching (2017)
PRad (e-p scattering)	$8.31(7)(12) \cdot 10^{-16}$ m	−1.22 %	JLab (2019)
CODATA 2014	$8.751(61) \cdot 10^{-16}$ m	+4.03 %	CODATA 2014
Hofstadter (1958)	$8.0(4) \cdot 10^{-16}$ m	−4.90 %	Hofstadter et al. (1958)

Table 1: Comparison of the EBT prediction with experimental determinations of the proton radius.

9 Charge Concept, Polarity of Embodiment, Interaction, and Nuclear Situation in Elementary Body Theory

In Elementary Body Theory (EBT), the concept of electric charge has a stringent geometric-energetic ontology. The electron and proton are structurally identical elementary bodies. Both obey the same fundamental invariant

$$m_e r_e = m_p r_p = F_{EB} = \frac{2h}{\pi c}. \tag{30}$$

Their total energy is thus determined by the product of mass and radius and is identically scaled. The different mass distribution – the electron light and spatially extended, the proton heavy and spatially compact – is merely a different partitioning of the same total energy scale into mass-bound and radius-bound contributions. The equal-magnitude electric elementary charge of both bodies is, in this picture, not an unexplained fact but the immediate phenomenological indication of the common energetic foundation.

The elementary body charge q_0 is that maximum charge whose electrostatic self-energy corresponds exactly to the entire rest energy of the elementary body:

$$\frac{q_0^2}{4\pi\varepsilon_0 r_0} = m_0 c^2. \tag{31}$$

From the mass-radius invariant it follows that

$$q_0 = \sqrt{8\varepsilon_0 h c}. \tag{32}$$

The ratio of the empirical elementary charge e to the maximum charge q_0 defines the energetic scaling of the electric interaction:

$$\frac{e^2}{q_0^2} = \frac{\alpha}{4}. \tag{33}$$

Thus $\alpha/4$ is the measure of the "electric coupling efficiency": only the fraction $\alpha/4 \approx 1/548$ of the mass-radius-coupled total energy of an elementary body appears as electric self-energy or interaction energy. The far greater part of the energy remains embodied in the geometry (radius and accompanying space-energy shell). The Sommerfeld fine-structure constant α is, in EBT, not a free parameter but a theorem derived from the ratio of electric energy to total energy (see the detailed derivation of α in the corresponding section).

9.1 Polarity of Energetic Embodiment and the Meaning of Attraction and Repulsion

In EBT, interaction is not a force between point charges but an inelastic radius superposition in the common geometric origin. The resulting total state must again be a valid elementary-body state, i.e., it must lie on the unit circle of the transformation and satisfy the invariant $m \cdot r = F_{EB}$. The system strives toward the energetically and geometrically most favorable equilibrium state. The decisive factor is the relative "polarity" of the energetic embodiment of the elementary bodies involved.

For opposite energetic embodiment (proton and electron), the superposition leads to a more compact, stable common state. The collective space-energy shell can form optimally, the phases match, and the

energy difference appears as binding energy. For the hydrogen atom, the ground-state energy follows parameter-free from

$$\Delta E = \left(\frac{m_e}{1 + m_e/m_p} \right) \cdot \left(1 - \sqrt{1 - \alpha^2}\right) \cdot c^2. \tag{34}$$

With the known values, this equation yields $\Delta E = 13.5984682\,\text{eV}$ and thus agreement with the experimental Rydberg energy at the level of $2 \cdot 10^{-6}$. "Attraction" is therefore the geometric necessity that two complementary mass-radius embodiments of the same total energy scale strive toward a common equilibrium state. (This structure corresponds to the e–e channel of the dyadic ladder and the associated matter equation.)

For identical energetic embodiment (electron–electron or proton–proton), the elementary bodies involved have the same polarity of the space-energy shell. Their radius superposition in the common origin does not lead to a stable, energetically more favorable compact state. Instead, a configuration arises in which the collective space-energy shell becomes geometrically unfavorable – the phases interfere destructively or the invariant enforces an increase of the effective radius or a separation. The system therefore strives toward the state in which the two like elementary bodies do not permanently remain in the close common origin. Macroscopically and atomically, this appears as repulsion.

In summary, the following holds in EBT:

- Opposite embodiment → favorable equilibrium state → "attraction",
- Identical embodiment → unfavorable superposition → tendency toward separation → "repulsion".

It is the same geometric-energetic logic, only with reversed sign of the energetic matching. The necessity of postulating a separate repulsive force between point charges is eliminated. The tendency toward separation of like elementary bodies follows directly from the geometry of radius superposition and the requirement that every combined state must again be a valid elementary-body state.

9.2 Relation to the Postulated Quantum-Mechanical Orbitals

In quantum mechanics, like charges are repelled via the Coulomb potential, and the orbitals arise from solving the Schrödinger or Dirac equation under this potential together with the Pauli principle. In EBT, the necessity of such a separate repulsive force is eliminated. Two electrons "repel each other" because their like mass-radius embodiment does not permit a stable, energetically lowered common state – in contrast to the proton-electron pair, which finds precisely such a state.

9.3 The Nuclear Situation

The same reason that supports attraction in the hydrogen atom also explains why protons in the nucleus do not classically repel each other via Coulomb interaction: a common geometric-energetic equilibrium state is sought. The interaction is inelastic radius superposition in the common origin, and the dominant scale is the strong elementary body charge q_0, not the electric elementary charge e.

In the Standard Model, the stability of nuclei is explained by the competition of two forces. The attraction between nucleons is described as a residual interaction of the strong force via pion exchange and formalized by the Yukawa potential

$$V_{\text{Y}}(r) = -g^2 \frac{e^{-m_\pi c r/\hbar}}{r} \tag{35}$$

with a range of about 1.4 fm. The electromagnetic repulsion of two protons is

$$V_{\text{Coul}}(r) = +\frac{\hbar c\,\alpha}{r} \approx +\frac{1.44\,\text{MeV·fm}}{r/\text{fm}}. \tag{36}$$

At typical nucleon separations of 1 fm, the nuclear force is 30–50 times stronger than the Coulomb repulsion; at even smaller separations it becomes repulsive (hard core). The balance is summarized semi-empirically in the Bethe–Weizsäcker mass formula:

$$E_B = a_V A - a_S A^{2/3} - a_C \frac{Z(Z-1)}{A^{1/3}} - a_A \frac{(A-2Z)^2}{A} + \delta(A,Z). \tag{37}$$

The individual terms represent:

- **Volume term** $a_V A$: saturating strong binding in the interior of the nucleus (each nucleon interacts only with a limited number of neighbors);
- **Surface term** $-a_S A^{2/3}$: correction for nucleons at the surface, which have fewer neighbors;
- **Coulomb term** $-a_C Z(Z-1)/A^{1/3}$: electrostatic repulsion of the protons;
- **Asymmetry term** $-a_A(A-2Z)^2/A$: energetic disadvantage for unequal proton and neutron fractions (Pauli principle / Fermi gas);
- **Pairing term** $\delta(A,Z)$: additional binding energy for even proton and neutron numbers (spin pairing).

The volume term (strong force) outweighs the Coulomb term for all stable nuclei; only at very large Z does the Coulomb term become dominant and limit the existence of stable nuclei.

In EBT, these mechanisms do not exist as independent forces. The pions themselves arise from q_0–q_0 or related channels of the mass-radius geometry (see the dyadic ladder and the explicit matter equations). There is no separate meson exchange as an independent force. The short-range, saturating binding is the direct consequence of the geometric superposition of multiple elementary bodies (protons and neutrons as configurations) on the q_0 scale. Range and saturation follow from the finite capacity of the space-energy shell and the requirement that the combined state must again lie on the unit circle – not from an exponentially decaying potential.

The electric interaction in EBT remains always $1e$-based and follows from the common total energy scale $mr = F_{EB}$. However, it is the weaker, secondary manifestation. The dominant interaction in the nuclear region runs via the strong elementary body charge q_0 (with $e^2/q_0^2 = \alpha/4$). The "repulsion" is therefore overlaid by the geometric tendency toward the equilibrium state on the stronger scale. There is no necessity to postulate a separate residual force that overcomes the Coulomb repulsion.

The order-of-magnitude comparison at $\sim 1\,\mathrm{fm}$ corresponds in EBT to the transition between different channels of the dyadic ladder: the q_0 channel provides the strong, saturating binding; the electric component remains present but is energetically subordinate. The "hard core" (repulsion at very small separations) is the geometric consequence that the space-energy shell and radius addition no longer permit further compression without violating the invariant and the unit circle.

The terms of the Bethe–Weizsäcker formula appear in EBT not as independent phenomenological contributions but as different geometric aspects of the same mass-radius superposition of multiple elementary bodies:

- Volume term $\approx$ saturating q_0 superposition in the interior,
- Coulomb term $\approx$ remaining electric e component,
- Surface and asymmetry terms $\approx$ boundary and phase effects of the collective space-energy shell.

The finiteness of the periodic table (Coulomb term becomes dominant at large Z) appears as the point at which the electric component exceeds the geometric stability of the many-body superposition.

9.4 Ontological Comparison and Result

In the Standard Model, electric charge stands without stringent ontological justification. The proton is treated as a composite object with quark substructure, the electron as a pointlike elementary particle. Nevertheless, both carry exactly the same charge magnitude $\pm e$. The quarks themselves carry fractional charges ($\pm\frac{1}{3}e$, $\pm\frac{2}{3}e$), which have never been observed in isolation. Confinement is postulated as an insurmountable property of the strong interaction and remains experimentally inaccessible; it functions in effect as an article of faith that explains the non-observability of fractional charges. The equality of the charge magnitudes of proton and electron thus appears as an empirical fact without deeper geometric or energetic necessity.

In EBT, electron and proton are structurally identical carriers of the same total energy F_{EB}. From this it follows immediately: the electric interaction is always based on the same elementary charge e (or the elementary body charge q_0). There is no need for fractional charges and no confinement postulate. The

equality of charge is the natural consequence of the common total energy scale behind the two mass-radius embodiments (cf. the derivation of α and the matter equations of the dyadic ladder).

Empirically, EBT confirms the observation that nuclei are stable and that binding saturates and is short-range. It reproduces the relevant mass differences (neutron, pions) parameter-free and with high precision from the same geometric logic. What is falsified is the ontological necessity of a separate Yukawa/meson exchange mechanism, fractional quark charges plus confinement, and an independent "residual strong force" that must overcome the Coulomb repulsion.

The Standard Model picture can be embedded as an effective description of the energetic orders of magnitude but loses its ontological postulates. EBT replaces them with a single, consistent mass-radius and space-energy geometry: the radius superposition of structurally identical elementary bodies, the search for the equilibrium state, and the partitioning of the total energy F_{EB} into mass-bound and space-bound contributions.

9.5 Open Research Project on the Mass Ratio of Proton and Electron

A still open but conceptually clearly outlined research approach within EBT concerns the concrete mass ratio m_p/m_e (or the inverse radius ratio r_e/r_p).

From the fundamental invariant it follows necessarily that

$$\frac{m_p}{m_e} = \frac{r_e}{r_p}. \tag{38}$$

Electron and proton thus represent merely different partitions of the same total energy scale F_{EB} into mass-bound and radius-bound contributions. The question of why this ratio takes precisely the empirical value ≈ 1836 is therefore equivalent to the question of by what geometric principle the total energy is partitioned into the two complementary embodiment states (strongly mass-bound/compact versus mass-poor/extended).

Since the energetic fractions $\alpha/4$ (electric contribution) and $1-\alpha/4$ (non-electric, geometric-space-energy contribution) already appear in the electric interaction, it is natural to connect the mass ratio with combinations of these fractions, such as

$$\frac{\alpha}{4}, \qquad 1-\frac{\alpha}{4}, \qquad \frac{1-\alpha/4}{\alpha} \tag{39}$$

and further geometrically motivated expressions formed from them. A purely geometric derivation would mean that the empirical mass ratio is no longer an independent natural constant but follows from the same spherical geometry, isotropic radial development, and unit-circle logic that already support the velocity addition theorem, the Rydberg energy, and the derivation of α itself.

Thus the "twofoldness" of proton and electron – complementary mass-radius embodiments of the same total energy scale – would receive a quantitative geometric foundation, and a further free parameter of the theory would be reduced to a derived quantity. The elaboration of this connection constitutes a clearly defined open research project of Elementary Body Theory.

10 Ground State Energy of the Hydrogen Atom

The question of the ground state energy of the hydrogen atom is one of the oldest and most precise questions in physics. It stands at the intersection of classical mechanics, quantum mechanics, quantum electrodynamics, and Elementary Body Theory. The way in which different theories answer this question reveals their respective epistemological foundations.

Established physics requires an enormous theoretical apparatus to calculate the ground state energy of the hydrogen atom: the exact solution of the Dirac equation, the expansion in the fine-structure constant, quantum electrodynamics (QED) with renormalization, recoil effects, proton structure, and hadronic contributions. At the end stands a numerical result that was "calculated beautifully" over years by means of cluster computers until the experimental result was exactly achieved.

Elementary Body Theory (EBT) confronts this effort with a single, geometrically founded equation:

$$\Delta E_{ee} = \left(\frac{m_e}{1+\frac{m_e}{m_p}}\right) \cdot \left(1-\sqrt{1-\alpha^2}\right) \cdot c^2 \tag{40}$$

With the CODATA values $m_e = 9.10938356\text{e-}31$ kg, $m_p = 1.672621898\text{e-}27$ kg, $c = 2.99792458\text{e+}08$ m/s and $\alpha = 0.0072973525664$, this equation yields:

$$\Delta E_{ee} = 2.17871478 \cdot 10^{-18} \text{ J} = 13.5984682 \text{ eV}. \tag{41}$$

Comparison with the experimentally determined Rydberg energy $E_{\text{Ry}}(\text{exp}) = 13.59844$ eV:

$$\frac{\Delta E_{ee}}{E_{\text{Ry}}(\text{exp})} \approx 1.00000207. \tag{42}$$

That is an agreement to $2 \cdot 10^{-6}$ – without free parameters, without renormalization, without loop integrals, without Monte Carlo simulations.

11 e-e Interaction in General

The designation **e-e interaction** means that two elementary charge carriers enter into interaction.

11.1 Formal Result for the Ground State Energy of Two e-Charge Carriers with Masses m_A and m_B

$$\Delta E_{e,e} = \left(\frac{m_A}{1 + \frac{m_A}{m_B}} \right) \cdot \left(1 - \sqrt{1 - \alpha^2} \right) \cdot c^2 \qquad [E_{ee}] \tag{43}$$

$$\Delta m_{e,e} = \left(\frac{m_A}{1 + \frac{m_A}{m_B}} \right) \cdot \left(1 - \sqrt{1 - \alpha^2} \right) \qquad [m_{ee}] \tag{44}$$

On the basis of Elementary Body Theory, all charge interactions are to be traced back to mass-radius couplings. As will be shown, electric charges occur within Elementary Body Theory only implicitly via functions of Sommerfeld's fine-structure constant α. From the "known" e-e proton-electron interaction, the hydrogen atom arises.

11.2 Rydberg Energy – the Ground State Energy of the H Atom According to Equation $[E_{ee}]$

The following values were used for the calculation:

- $m_A = \mathbf{m_e} = \mathbf{9.10938356}\text{e-}\mathbf{31}$ kg: electron mass,
- $m_B = \mathbf{m_p} = \mathbf{1.672621898}\text{e-}\mathbf{27}$ kg: proton mass,
- $c = \mathbf{2.99792458}\text{e+}\mathbf{08}$ m/s,
- $\alpha = \mathbf{0.0072973525664} \Rightarrow (1 - \sqrt{1 - \alpha^2}) = 2.6626031711955\text{e-}5$,
- $1/(1 + m_e/m_p) = 0.99945567942486$.

Step 1: Reduced mass

$$\mu = \frac{m_e}{1 + \frac{m_e}{m_p}} = \frac{9.10938356 \cdot 10^{-31}}{1 + 0.000544617} = 9.10842 \cdot 10^{-31} \text{ kg}. \tag{45}$$

Step 2: Relativistic factor

$$1 - \sqrt{1 - \alpha^2} = 1 - \sqrt{1 - 5.324 \cdot 10^{-5}} = 2.662603 \cdot 10^{-5}. \tag{46}$$

Step 3: Energy

$$\Delta E_{ee} = \mu \cdot \left(1 - \sqrt{1-\alpha^2}\right) \cdot c^2 \tag{47}$$

$$= (9.10842 \cdot 10^{-31}) \cdot (2.662603 \cdot 10^{-5}) \cdot (8.98755 \cdot 10^{16})$$

$$= 2.17871478 \cdot 10^{-18} \text{ J} = \mathbf{13.5984682} \text{ eV}. \tag{48}$$

Step 4: Mass difference

$$\Delta m = 2.4241471 \cdot 10^{-35} \text{ kg}. \tag{49}$$

Step 5: Frequency

From $E = h \cdot \nu$ with $h = 6.62607015 \cdot 10^{-34}$ Js follows:

$$\nu \approx 3.288095 \cdot 10^{15} \text{ Hz}. \tag{50}$$

Comparison with experimentally determined Rydberg energy $E_{\text{Ry}}(\text{exp}) = 13.59844$ eV (NIST):

$$\frac{\Delta E_{ee}}{E_{\text{Ry}}(\text{exp})} \approx \mathbf{1.00000207}. \tag{51}$$

The calculations based on the above mass-radius-coupling phenomenology-based equations also lead to exact results for **muonic hydrogen** and for **positronium**, which are experimentally confirmed.

12 Muonic Hydrogen Atom

In muonic hydrogen, the electron is replaced by a muon. Due to the muon mass being ~ 207 times larger compared to the electron, a significantly larger mass term results according to equation $[HE]$.

$$\Delta E = \left(\frac{m_\mu}{1 + \frac{m_\mu}{m_p}}\right) \cdot \left(1 - \sqrt{1-\alpha^2}\right) \cdot c^2 \qquad [HE] \tag{52}$$

With the values:

- $m_\mu = 1.883531475 \cdot 10^{-28}$ kg
- $r_\mu = 7.470377173 \cdot 10^{-15}$ m
- $t_0 = 3.914188202 \cdot 10^{-23}$ s
- $r(t) = r_0 \cdot \sin(c/r_0 \cdot t)$

the result is:

$$\Delta E = \mathbf{2528.52693213} \text{ eV}, \qquad E_{\mu,\text{exp}} \approx 2530 \text{ eV}. \tag{53}$$

13 Positronium

An electron-positron pair can not only decay freely, but also form a state that strongly resembles that of hydrogen. The energy states of the bound e^+e^- system can be calculated equivalently to the hydrogen atom.

$$\Delta E = \left(\frac{m_e}{1 + \frac{m_e}{m_e^+}}\right) \cdot \left(1 - \sqrt{1-\alpha^2}\right) \cdot c^2 \qquad [HE] \tag{54}$$

With the values:

- $m_e = 9.10938291 \cdot 10^{-31}$ kg $= m_e^+$
- $r_e = 1.54463707 \cdot 10^{-12}$ m $= r_e^+$
- $t_0 = 8.0932997891464 \cdot 10^{-21}$ s

the result is:

$$\Delta E = \mathbf{6.80293683457} \text{ eV}, \qquad E_{\text{exp}} \approx 6.8 \text{ eV}. \tag{55}$$

13.1 Why There Are No "Exact" Experimental Comparison Values

Remark 13.1. *An attentive reader will notice that the experimental comparison values for the ground state energies of muonic hydrogen ($E_{\mu,\text{exp}} \approx 2530\ eV$) and positronium ($E_{\text{exp}} \approx 6.8\ eV$) are given only as rough approximations compared to the Rydberg energy of regular hydrogen. This is not a deficiency of EBT, but exposes a fundamental methodological limit of established physics:*

1. Measurement of differences instead of absolute energies: *Experimentally, in atomic physics only* transition frequencies *(energy differences between levels, e.g., $2S \to 2P$ or $1S \to 2S$) can always be measured by means of laser or X-ray spectroscopy. The* absolute *ground state energy ($1S$) cannot be measured directly with high precision. In muonic hydrogen, the hardware-side resolution of X-ray detectors ($\sim$ eV range) limits a direct measurement. In positronium, the extremely short lifetime (and the associated annihilation) forces a natural energetic line width of the state via Heisenberg's uncertainty principle.*

2. The theory-laden QED extract: *In order to conclude from the measured transition frequency to the absolute ground state energy in standard physics, the apparatus of quantum electrodynamics (QED)* must *necessarily be applied. Vacuum polarization, self-energies, Lamb shift, and (in positronium) virtual annihilation diagrams must be added. Every "exact" value for the absolute ground state energy that is given in the literature to many decimal places is consequently* ***not a measured value****, but a theory-laden QED extract (a circular argument).*

The specification $E_{\mu,\text{exp}} \approx 2530\ eV$ and $E_{\text{exp}} \approx 6.8\ eV$ therefore represents the only honest, theory- and model-free experimental baseline consensus. That Elementary Body Theory calculates the absolute ground state energies directly*, parameter-free, and without the detour via QED corrections or transition differences from the mass-radius coupling is one of its greatest phenomenological strengths.*

14 Matter Formation Possibilities

The proton-electron interaction does not "end" with the "low-energy" matter formation presented here. The "key" to understanding the further matter formations are the phenomenologically founded charge possibilities. On the one hand, the energetically rest-mass-equivalent (**strong**) elementary body **charge** q_0 and the **electric elementary charge** e. Explanations for this can be found further below $\downarrow$.

These calculations lead, among other things, to the exact neutron mass calculation and to the calculation of pion masses.

15 Sommerfeld's Fine-Structure Constant α: Derivation

15.1 Elementary Body Charge and Fine-Structure Constant

Consequently, the **fine-structure constant** α is **determined energetically on the basis of Elementary Body Theory**. It results from the comparison of total energy (elementary body charge q_0 as (function of) radius-mass equivalent) and electric energy by means of the electric elementary charge e. It should be noted here that quantitatively **not** α but $\alpha/4$ **is the "measure of things"**.

The question of the origin and meaning of Sommerfeld's fine-structure constant leads to the electric elementary charge. α is thus a "derived" quantity that "originates" from the electric elementary charge e.

15.2 Concept of Electric Charge

Electric charge is a secondary concept of prevailing physics that suggests a "phenomenological entity" decoupled from the mass (and radius) of the charge carrier. On the basis of Elementary Body Theory, however, all charge interactions are intuitively traceable to mass-radius couplings. Electric charges in the elementary body thought model occur as a (formal) result of the mass-radius coupling conveniently only implicitly via functions of Sommerfeld's fine-structure constant α. Of further fundamental significance in the direct phenomenological context is the **elementary body charge** q_0, which results quantitatively from the comparison of electric energy to total energy.

Remark 15.1. *In the **cgs system** (centimeter, gram, second), electric charge is "directly defined as the square root" of the product of $m_0 r_0 c^2$:*

$$q_{cgs} = \frac{q_{SI}}{\sqrt{4\pi\varepsilon_0}} \Rightarrow q_{cgs} = \sqrt{\frac{F_{EB}}{m_0 r_0}} \cdot c^2 \tag{56}$$

15.3 Derivation of α

α results from the comparison of total energy and electric energy by means of the electric elementary charge e. The strong charge q_0 (**double Planck charge**) represents the fundamental charge associated with the total energy of the elementary body.

$$m_0 r_0 \cdot c^2 = E(r) \cdot r = \frac{q_0^2}{4\pi\varepsilon_0} \tag{57}$$

$$F_{\mathrm{EB}} = m_0 r_0 = \frac{2h}{\pi c} \qquad [F1] \tag{58}$$

15.3.1 Elementary Body Charge

$$q_0 = \pm\sqrt{8\varepsilon_0 hc} = \pm\sqrt{f_7 \cdot F_{\mathrm{EB}}} = \pm 2 \cdot \sqrt{2\varepsilon_0 hc} \tag{59}$$

$$1 \cdot 10^7 \ [\mathrm{A^2 s^2 kg^{-1} m^{-1}}] = 4\pi\varepsilon_0 c^2 = f_7 \tag{60}$$

15.3.2 Fine-Structure Constant

$$\Rightarrow \frac{e^2}{8\varepsilon_0 hc} = \frac{\alpha}{4} = \frac{e^2}{q_0^2} = \frac{\text{electric energy}}{\text{total energy}} \qquad [E_{a4}] \tag{61}$$

$$\alpha \approx 0.0072973525664, \qquad 1/\alpha \approx 137.0359991381545 \tag{62}$$

It should be noted here that quantitatively **not** α but $\alpha/4$ **is the energetic "measure of things"**.

15.4 The Phenomenological Status of α: Axiom vs. Theorem

The fine-structure constant α occupies a fundamentally different position in the two competing theory edifices. This difference is not only a question of mathematical formulation, but concerns the ontological status of the quantity itself.

15.4.1 α in the Standard Model: An Axiom

In the Standard Model of elementary particle physics, α is an **axiom**. It is the "magic number" – as Richard Feynman called it – a free parameter that must be measured experimentally and inserted into the theory. The theory offers no explanation of why α has the value $1/137.035999\ldots$, or what it means phenomenologically. α appears as an abstract coupling strength, as a dimensionless prefactor that quantifies the strength of the electromagnetic interaction – but without this quantification having any deeper geometric or energetic meaning.

The question "Why does α have this value?" remains unanswered in the SM. It is a parameter that comes from observation, not from theory.

15.4.2 α in EBT: A Theorem

In Elementary Body Theory, by contrast, α is a **theorem**. It is derived from deeper-lying geometric and energetic principles – not as a free parameter, but as a consequence of the mass-radius coupling and the ratio of electric to total energy of an elementary body.

The derivation follows a stringent, geometric-energetic logic:

1. **Mass-radius coupling:** An elementary body possesses a fundamental invariant:

$$m_0 r_0 = \frac{2h}{\pi c} = F_{\mathrm{EB}} \tag{63}$$

   This relation is not a postulate, but a geometric necessity: The body is a radially symmetric spherical surface whose mass-radius product is fixed by the fundamental constants h and c.

2. **The elementary body charge q_0:** If one interprets the entire rest energy of the body ($m_0 c^2$) as electrostatic self-energy

$$\frac{q_0^2}{4\pi\varepsilon_0 r_0} = m_0 c^2 \tag{64}$$

   then a fundamental maximum charge calculable purely from natural constants (h, c, ε_0) results:

$$q_0 = \sqrt{8\varepsilon_0 h c} \tag{65}$$

   This is a true prediction of the geometry of the elementary body: The charge q_0 is that charge whose total self-energy corresponds to the rest energy of the body.

3. **The energy ratio:** The electron empirically possesses the charge e. EBT now does not define α as an abstract parameter, but derives it as the ratio of electric energy to total energy:

$$\frac{\alpha}{4} = \frac{E_{\mathrm{electric}}(e)}{E_{\mathrm{total}}(q_0)} = \frac{e^2}{q_0^2} \tag{66}$$

   The result:

$$\alpha = 4 \cdot \frac{e^2}{q_0^2} \tag{67}$$

   The fine-structure constant is thus nothing other than four times the ratio of the electric energy (carried by the charge e) to the total energy (carried by the maximum charge q_0).

15.4.3 Why This Is a True Derivation: Ontological Reduction

The decisive point is the **ontological reduction**. α is degraded from a primary, inexplicable law of nature to a secondary, derived quantity – in the positive, epistemological sense.

EBT answers the question "What is α actually?" as follows: α is the dimensionless fraction of the total energy of an elementary body that is available for electromagnetic interactions. That $\alpha \approx 1/137$ phenomenologically simply means: The electric charge e is dimensioned such that it binds only about $1/548$ (i.e., $\alpha/4$) of the mass-radius-coupled total energy of the electron as electric self-energy. By far the largest part of the energy is not of an electric nature – it is "embodied" in the geometry of the elementary body itself.

α is thus the measure of the **"electric coupling efficiency"** of the elementary body. It indicates which fraction of the total energy can appear as electric interaction at all. That this fraction is so small is not a "magical" property of nature, but a direct consequence of the fact that the charge e is much smaller than the maximum charge q_0 corresponding to the total energy.

15.4.4 The Epistemological Significance

This derivation has far-reaching epistemological consequences. While in the Standard Model α remains a free parameter that imposes the theory from outside, in EBT α is derived from the same geometric structure that also determines the Rydberg energy, the proton radius, and the masses of elementary

particles. EBT reduces the number of free parameters – α is no longer a parameter, but a calculable result.

The question "Why $\alpha \approx 1/137$?" is answered in EBT with: "Because the charge of the electron e is so small in relation to the maximum charge q_0, and because the geometry of the elementary body fixes this ratio via the mass-radius coupling." The number 137 is no longer magical, but the result of a simple, geometrically founded calculation.

α is not a free parameter, but a derived quantity.

The **extended charge principle** leads beyond the Elementary Body Theory-based **hydrogen atom**-forming **proton-electron interaction**. From the generalized, intuitively phenomenological process, primarily the **neutron** and **pions** follow as energetically possible (time-unstable) "particles". Without concretizing this here, the charged pions decay into muon and anti-muon, and these then into electron and positron. Overall, "diverse elementary particles" can be formed in "formal analogy" within the framework of the extended charge concept. Remarkable is the fact that the formalism provides simple, approximation-free solutions that are in good agreement with the (energy and mass) values of the formed "particles".

16 α, Planck's Constant of Action, and $1/n^2$ Dependence of Energy

With the postulate that the indivisible Planck constant of action represents the smallest scalar action, larger quantized actions can be defined as a function of the natural number n $(1, 2, 3, \dots)$.

Remark 16.1. *The phenomenological meaning of Planck's constant of action is not really clarified. The fact is that the indivisibility of the quantum of action has never been justified for over a hundred years to this day. Max Planck did not justify it because he considered the quantum of action to be an elementary* ***mathematical*** *quantity whose "necessity" followed from the theory. Einstein did not consider a justification necessary because he believed in Planck's "deduction". He shifted the meaning of the quantum of action by interpreting the mathematical quantity as a* ***physical*** *quantity.*

Sommerfeld's fine-structure constant depends on $1/h$. With the above postulate, larger n-dependent actions can be defined, which result in discontinuous (discrete) portions of the fine-structure constant $\alpha \to \alpha(n) \to \alpha_n = \alpha/n$. This means for equation $[mr\alpha^2]$ that the quadratic velocity term $(v/c)^2 = \alpha^2$ with $1/n^2$ leads to an equivalent term of $(r/r_0)n^2$, so that for all n the ratio of electric energy to total energy is always $\alpha/4$. If the energy is $1/r$ dependent, then a $(1/n^2)$-"splitting" follows.

If one now defines n-dependent energy states $E \to E(n) \to E_n$ and asks for the energy difference ΔE between two energy levels, the energy difference can be defined as an additional term Δ_n to the ground state energy E_0.

$$h_n \to n \cdot h \qquad h(n) \to h_n \quad \text{discrete multiples of Planck's constant of action} \tag{68}$$

$$n = 1, 2, 3, \dots \tag{69}$$

$$\alpha_n = \frac{e^2}{2\varepsilon_0 hc} \cdot \frac{1}{n} = \alpha \cdot \frac{1}{n} \tag{70}$$

$$\left(\frac{r}{r_0}\right) \cdot \left(\frac{v}{c}\right)^2 = \frac{\alpha}{4} \implies \left(\frac{r}{r_0}\right) \cdot n^2 \cdot \left(\frac{v}{c}\right)^2 \cdot \frac{1}{n^2} = \frac{\alpha}{4} \qquad [r_{vn}] \tag{71}$$

$$r(n) = r \cdot n^2 \quad \text{with } E = E(1/r) \text{ follows } E(n) = E_n = \frac{E_0}{n^2} \qquad [E_{On}] \tag{72}$$

$$\Delta E_{n,n+1} = E_0 \cdot \Delta_n = E_0 \cdot \left(\frac{1}{n^2} - \frac{1}{(n+1)^2}\right) \quad n = 1, 2, 3, \dots \qquad [E_{n2}] \tag{73}$$

The present considerations and the resulting energy term scheme arose stringently from the connection of radius-dependent and primarily mass-dependent energy within the framework of the electric elementary charge e, whereby the mass dependence of the charge carrier was transformed into the velocity dependence in the picture of the oscillating elementary body, and from the postulate that larger actions are the n-fold of the indivisible Planck constant of action.

Remark 16.2. *The series* $\sum(1/n)$ *diverges, the series* $\sum(1/n^2)$ *converges* $(= \pi^2/6)$*,* $n = 1, 2, 3, \dots$
$\pi^2/6 \approx 1.64493406685$.

16.1 Balmer, Bohr, Schrödinger, and the Principle of Parsimony

From the perspective of EBT, the QM derivation of the $1/n^2$-energy levels is a historical, methodologically completely overloaded detour – comparable to the epicycles of Ptolemaic astronomy.

QM requires abstract probability waves, complex differential operators, and a metaphysical interpretation in order to ultimately arrive at the Balmer formula.

EBT, by contrast, derives the same $1/n^2$-dependence *directly*, *geometrically*, and *compellingly* from two simple, phenomenological premises (see Section 7):

1. Planck's constant of action is the *smallest scalar action*; larger actions are discrete multiples:
$$h_n = n \cdot h \tag{74}$$
2. From this follows a discrete portioning of the fine-structure constant:
$$\alpha_n = \frac{\alpha}{n} \tag{75}$$
3. Because of the mass-radius coupling and the condition
$$\left(\frac{r}{r_0}\right) \cdot \left(\frac{v}{c}\right)^2 = \frac{\alpha}{4} \tag{76}$$
this necessarily leads to a radius scaling:
$$r(n) = r \cdot n^2 \tag{77}$$

Since the energy is inversely proportional to the radius ($E \propto 1/r$), it follows immediately and without any mathematical magic:

$$E_n = \frac{E_0}{n^2} \tag{78}$$

The QM derivation is thus "history" – a relic from a time in which the geometric-energetic nature of quantization was not yet understood and had to be replaced by abstract mathematics.

Remark 16.3. *The principle of parsimony (Occam's razor) demands that, of two competing explanations, one chooses the one that gets by with the fewest assumptions. EBT requires two phenomenological premises for the $1/n^2$-levels; QM requires an entire apparatus of probability waves, operators, and interpretation postulates. The choice is therefore unambiguous.*

17 Little-Known Documented Truths

What is hardly realized, since it is not communicated popular-scientifically, is the fact that almost all quantum mechanics constructors distanced themselves from it in retrospect.

Schrödinger Equation

$$H(t)|\psi(t)\rangle = i\hbar\frac{\partial}{\partial t}|\psi(t)\rangle \tag{79}$$

17.1 Three QM Heroes "in Retrospect"

17.1.1 Erwin Schrödinger (1887–1961)

The QM co-founder Erwin Schrödinger remarked in retrospect:

> "I am not opposing a few specific statements of today's quantum physics (1950s); I am opposing, so to speak, the entire quantum physics, I am opposing its fundamental views, which were coined 25 years ago when Max Born presented his probability interpretation, which was accepted by almost everyone. ... Had I known that we would not get rid of this damned quantum jump, I would never have gotten involved in this business!"

Source: "Dr Faustus of Modern Physics"

17.1.2 John von Neumann (1903–1957)

The mathematician John von Neumann (born Neumann János) published his opus magnum on the *Mathematical Foundations of Quantum Mechanics* in 1932. The date of publication of this book was considered by Carl-Friedrich von Weizsäcker to be the beginning of the "seizure of power" of mathematics in theoretical physics. But even before this date, doubts about his theory befell von Neumann.

In 1935, he proved that any theory of quantum mechanics developed on the basis of Hilbert space as a reference basis is physically unacceptable. He avoided any clear public comment on this throughout his life, although he demonstrated together with F. J. Murray in a series of mathematically highly innovative publications on algebra (von Neumann algebras) how a correct version of quantum mechanics should be designed.

In the truly extensive stock of publications on quantum theory, one finds hardly any substantial note on von Neumann's dilemma. Only 44 years after his death in 1957 can the professional public learn from several private statements why von Neumann never revoked or withdrew his famous book of 1932. The motive was simple: No professional colleague would have taken his "falsification" seriously, since Hilbert space had long belonged to the basic stock of quantum theory worldwide. But also grave thermodynamic objections played a role, with which no one of the great quantum heroes in their textbooks dealt except von Neumann. Source: *Non-mechanistic presentation of the physical disciplines as mathematical system theory*, Vilmos Balogh

17.1.3 Albert Einstein (1879–1955)

Interestingly, it was Albert Einstein who identified quantum mechanics "already early" – with comprehensible argumentative justification – as unusable:

> "The ψ-function is to be understood as a description not of a single system, but of a system community. Roughly stated, this result reads: Within the framework of the statistical interpretation, there is no complete description of the single system. Cautiously, one can say: The attempt to understand the quantum-theoretical description of individual systems leads to unnatural theoretical interpretations that immediately become unnecessary if one accepts the view that the description refers to the system totality and not to the single system. The whole egg dance to avoid the "physically real" then becomes superfluous. There is, however, a simple physiological reason why this obvious interpretation is avoided. For if statistical quantum theory does not claim to completely describe the single system (and its temporal course), then it appears unavoidable to search elsewhere for a complete description of the single system, whereby it would be clear from the outset that the elements of such a description would not be contained within the conceptual scheme of statistical quantum theory. One would thereby admit that this scheme cannot in principle serve as the basis of theoretical physics. Statistical theory would – in the case of the success of such efforts – occupy a position within future physics somewhat analogous to that of statistical mechanics within classical mechanics."
>
> A. Einstein, *Out of my later years*, Phil. Lib. New York 1950, page 498

Einstein's unbeatable arguments were and are to this day "simply" ignored. Einstein's critical statements, especially on quantum mechanics, ultimately led to his isolation. He was indeed later a "media star", but scientifically without further significance.

17.2 Is Quantum Mechanics Unintelligible?

A widespread and gladly expressed protective claim states that quantum mechanics (QM) is indeed unintelligible, somehow "strange", but scientifically considered very predictively precise.

This has (had) the advantage for the "QM preservers" that almost no one feels (felt) called upon to critically engage with the assumptions and statement postulates of QM.

First of all: Quantum mechanics is not "strange" from a mathematical perspective. In the broad spectrum of mathematics, there are significantly more difficult, more complex, and above all significantly more abstract subject areas. See for example *differential topology* and *abstract algebra*.

17.3 Mathematical Backgrounds, Original Sense and Purpose, Willful Renunciation of Intuition

According to Weierstrass's theorem, "arbitrary" curves can be approximated at least sectionwise by "sine-cosine function combinations". When the function changes into a new (partial) section, in the limit transition the individual sections become ever shorter and finally "shrink" to points. The function is approximated pointwise. In this limit case, the original picture of the differentiable manifold is reached again, in which the eigenbasis of the motion space is now the building blocks of the sine and cosine functions.

Without going into further mathematical questions, it follows that every mathematical function $f(t)$ can be developed by the following equation (Fourier series):

$$f(t) = \frac{a_0}{2} + \sum_{k=1}^{\infty} \left(a_k \cos(kt) + b_k \sin(kt)\right) \tag{80}$$

with the coefficients:

$$a_k = c_k + c_{-k} \quad k \geq 0 \tag{81}$$

$$b_k = i\,(c_k - c_{-k}) \quad k \geq 1 \tag{82}$$

and the integral representations:

$$a_k = \frac{1}{\pi} \int_{-\pi}^{\pi} f(t) \cdot \cos(kt)\, dt \quad k \geq 0 \tag{83}$$

$$b_k = \frac{1}{\pi} \int_{-\pi}^{\pi} f(t) \cdot \sin(kt)\, dt \quad k \geq 1 \tag{84}$$

Spaces with this structure are called **Hilbert spaces**. In the 20th century, this approach was first introduced into atomic spectroscopy and then generally into quantum field theories.

Just as a sound can be represented in the fundamental tone x and the overtones $2x$, $3x$, $4x$, ..., in quantum field theory the state of a particle (e.g., an electron) is decomposed into a ground state x and higher states. At the beginning stands the qualitative decomposition into basic elements, then follows for each basic element the decomposition into the "overtone series" (Fourier series). Overall, probabilities can now be defined or (interpreted) measured with which the electron is in one of the possible states.

If one looks more closely, the integer quantization follows banally from the mathematical representation. The formalism now enables the supposed "convenience" of not having to engage real-object-contentwise with the phenomenology of quantization in order to obtain results.

17.4 Copenhagen Interpretation of 1927

In the course of the Copenhagen interpretation of quantum mechanics, the loss of reality is methodical and intentional. According to the Copenhagen interpretation of 1927, the probability character of quantum-theoretical predictions is not an expression of the incompleteness of the theory, but of the principally indeterministic (unpredictable) character of quantum-physical natural processes.

Furthermore, the objects of the formalism "replace" reality without themselves possessing a reality. The Copenhagen interpretation is characterized by the convenience it provides to its "believers".

The wave-particle dualism permitted (permits) a "switch" to the "wave" with an e-function with complex exponent, which according to Fourier's theorem in turn permits *everything* piecewise monotone, thus also every experimental result, to be formally mathematically represented.

The statistical interpretation refrains from the effort of exploring the physical process; intuition and phenomenology are blanked out.

18 What Is and What May Be? – Quantum Mechanical Misunderstandings

Even after more than 100 years of quantum mechanical description of the hydrogen atom, the phenomenological aspects are unclarified. There is an abundance of direction-giving misinterpretations that surprise

from an epistemological perspective, since the qualitative-analytical understanding of the omissions is available with great transparency.

In the first place is the unfounded quantization. The finding that only discrete, discontinuous "energy quantities" occur is not a merit of quantum mechanics, but an observation, just like the from the perspective of prevailing physics unfounded invariance of the (vacuum) speed of light.

The energy splittings are generally not self-induced. Only when energy is introduced from outside in the form of electric or magnetic fields does the splitting occur. Phenomenologically, physical fields are unfounded. From the perspective of an atom or molecule, they represent infinite energy reservoirs that interact with the "test objects" (exemplarily the H atom) of the fields. On the basis of Elementary Body Theory, energy is always present "embodied". Fields are quasi-continuous superpositions of mass-radius-coupled entities. This means that in the case of interaction, many-body systems are inevitably present.

Considered additionally with the "quantum mechanical words" of *Werner Heisenberg*:

> "*For every measurement of a quantum-theoretical quantity, an intervention into the system to be measured is necessary, which under circumstances disturbs the system considerably. The measurement of the radiation energy in a mathematically sharply delimited part of a cavity would only be possible by an "infinite" intervention and is therefore a useless mathematical fiction. A practically feasible experiment, however, can only provide the energy in a region with blurred boundaries.*" [Statement by *Werner Heisenberg* 1931]

The mathematics used within quantum mechanics (QM) and consequently within quantum field theories (QFTs), partly newly defined (keywords: perturbation theory, regularization, renormalization), is phenomenologically unfounded. It is indeed formally(-axiomatically) significantly more complex and more difficult to understand than the mere insight that energy levels are "quantized" as a function of the principal quantum number n with $1/(n^2-(n+1)^2)$, but does not get beyond the status of a calculation rule. Moreover, within the framework of perturbation theory there are **no formal-analytical solutions**. So when quantum electrodynamics (QED)-based reports of an excellent agreement between theory and experiment are made, these are gigantic solution systems whose iterative results were adapted to the experimental results. **Some do not say it, others do not see through it.**

Interesting is the fact that Arnold Sommerfeld's extension of the Bohr atomic model correctly describes the fine structure of the hydrogen atom without the spin postulate. Sommerfeld introduced relativistic, Keplerian elliptical orbits for the electron circling radially symmetrically in the Bohr model, referred to spherical coordinates, and quantized these independently of each other.

Why he did not consistently, thinking celestial-mechanically, also give the electron a phenomenological spin in the sense of a real-physical moment of inertia is questionable. From today's Elementary Body Theory-based intuition, it would have been evident that Bohr, Sommerfeld, and colleagues should generally have asked themselves how a charge-dependent electric centripetal force phenomenologically interacts with a mechanical, mass-dependent centrifugal force, since this was not possible and is not possible within the framework of the prevailing description models. Only when one recognizes and accepts the mass-radius coupling and the connection between charge and mass-radius constancy does it become understandable that the mathematical equating of electric and mechanical force possesses a phenomenologically founded basis.

19 General Derivation of Ground State Energies

19.1 Step 1: The Simple Addition of Radii

The **simple addition** of the radii of electron and proton leads via $[F1]$ to a reduced total mass $m(r_p+r_e)$. It should be noted here that no energy has been lost, but is now equivalently contained in the enlarged radius (space energy). The total energy of mass-dependent energy and radius-dependent space energy remains constant.

$$m_A r_A = m_B r_B = m(r_A+r_B)\cdot(r_A+r_B) = \frac{F_{\mathrm{EB}}}{E_K} = \frac{2h}{\pi c} \qquad [F1] \tag{85}$$

$$A(m_A, r_A) + B(m_B, r_B) = AB(m(r_A + r_B), (r_A + r_B)) \tag{86}$$

The electric elementary charge e leads as a governing parameter to an inherent electric energy that is smaller by the factor $\alpha/4$ than the massive rest energy. From this follows, as a function of velocity, a radius enlargement ($r = r_0/(4\alpha)$):

$$\left(\frac{r}{r_0}\right) \cdot \left(\frac{v}{c}\right)^2 = \frac{\alpha}{4} \qquad [mr\alpha^2] \tag{87}$$

$$\frac{1}{4\alpha} \cdot \alpha^2 = \frac{\alpha}{4} \qquad [mr\alpha^4\alpha^2] \tag{88}$$

$$r = \frac{r_0}{4\alpha} \qquad [r_\alpha], \qquad \frac{v}{c} = \alpha \qquad [v_\alpha] \tag{89}$$

The velocity $v = \alpha c$ is thus uniquely determined by the electric elementary charge e. The further calculation follows **non-relativistically** and **freed from the virial theorem** ($2E_{\text{kin}} = E_{\text{pot}}$); if one will, the mass-radius coupled "**relativistics**" springs from the **radial symmetry on the unit circle**, so to speak!

19.2 Step 2: Evolution State and Binding Energy E_{Ry}

From the spherical-surface velocity $v = \alpha c$, the evolution state and thus the binding energy E_{Ry} can be calculated, which is based on the mass difference of the inelastic interaction of proton and electron $[MAB]$ with common center of mass and the reduced mass according to momentum-mass inversion dynamics.

20 Elementary Body Interaction

Superposition of two elementary bodies A and B with common geometric origin:

$$A(m_A, r_A) + B(m_B, r_B) = AB(m(r_A + r_B), (r_A + r_B)) \tag{90}$$

$$m_A r_A = m_B r_B = m(r_A + r_B) \cdot (r_A + r_B) = F_{\text{EB}} = \frac{2h}{\pi c} \qquad [F1] \tag{91}$$

$$\Rightarrow r_A + r_B = \frac{F_{\text{EB}}}{m_A} + \frac{F_{\text{EB}}}{m_B} = F_{\text{EB}} \left(\frac{1}{m_A} + \frac{1}{m_B}\right) \tag{92}$$

$$\Rightarrow m(r_A + r_B) = \frac{F_{\text{EB}}}{(r_A + r_B)} = \frac{m_A}{1 + \frac{m_A}{m_B}} = \frac{m_B}{1 + \frac{m_B}{m_A}} \qquad [MAB] \tag{93}$$

$$\Rightarrow (r_A + r_B) \cdot \left(\frac{m_B}{1 + \frac{m_B}{m_A}}\right) = (r_A + r_B) \cdot \left(\frac{m_A}{1 + \frac{m_A}{m_B}}\right) = F_{\text{EB}} = \frac{2h}{\pi c} \tag{94}$$

Here one sees clearly that the supposed center-of-mass correction of the "**celestial-mechanical thought model of the past**" of "established" physics between proton and electron has nothing to do with the center of mass of two charges at distance r, since electron and proton, then as now, as equally strong charges cannot experience a center-of-mass shift, neither phenomenologically nor computationally.

$$\mathcal{E}(r, q_e) = \frac{1}{r} \cdot \frac{q_e^2}{4\pi\varepsilon_0} \tag{95}$$

It is astonishing how this state of affairs has been ignored mass-psychologically over generations and continues to be ignored. Overall, in the worldview of prevailing physics, a mass cannot interact with a charge.

Equating an electric centripetal force with a (merely) mass-dependent centrifugal force is phenomenologically unfounded within the framework of local physics and is reminiscent of epicycle theory. The

expression for the resulting mass $m(r_A + r_B)$ in equation $[MAB]$ is mathematically indeed identical to the celestial-mechanical center-of-mass correction of two macroscopic masses that interact computationally as point masses elastically, but the phenomenology of equation $[MAB]$ is a completely different one.

The time-dependent evolution follows:

$$r(t) = r_0 \cdot \sin\left(\frac{c}{r_0} \cdot t\right) \tag{96}$$

$$\lambda_0 = \frac{\pi}{2} \cdot r_0 \tag{97}$$

$$r(t_0) = r_0 \implies t_0 = \frac{\pi}{2} \cdot \frac{r_0}{c} = \frac{\lambda_0}{c} \tag{98}$$

$$v(t) = \dot{r}(t) = c \cdot \cos\left(\frac{c}{r_0} \cdot t\right) \tag{99}$$

$$\left(\frac{c}{r_0} \cdot t\right) = \arccos\left(\frac{v(t)}{c}\right) \tag{100}$$

$$r(t) = r_0 \cdot \sin\left(\arccos\left(\frac{v(t)}{c}\right)\right) = r_0 \cdot \sqrt{1 - \left(\frac{v(t)}{c}\right)^2} \tag{101}$$

$$v = \alpha \cdot c \implies r(t) = r_0 \cdot \sqrt{1 - \alpha^2} \tag{102}$$

$$\Delta E = \left(\frac{m_A}{1 + \frac{m_A}{m_B}}\right) \cdot \left(1 - \sqrt{1 - \alpha^2}\right) \cdot c^2 \qquad [HE] \tag{103}$$

21 Phenomenology of the Matter-Forming Proton-Electron Interaction

Proton and electron satisfy the mass-radius constant equation $[F1]$: $m_e r_e = r_p m_p = F_{EB} = 2h/\pi c$.

21.1 Hydrogen Atom

The binding energy ΔE of the proton-electron interaction calculated by means of equation $[HE]$ is compared with the experimental Rydberg energy $E_{\mathrm{Ry,exp}}$. A further comparison of the mass-radius quotients r_e/m_e and r_p/m_p yields, to a good approximation, the mass difference of the matter-forming electron-proton interaction if one varies the proton mass so that the radius-mass quotients are equal $(r_e/m_e = r_p/\Delta m_p)$. This mass difference is, by means of momentum-mass inversion, equal to the mass $m_e(t)$ that the electron possesses when it reaches the proton radius r_p.

21.2 Matter-Forming Proton-Electron Interaction – Mass-Radius Coupled

$$r(t) = r_0 \cdot \sqrt{1 - \left(\frac{v(t)}{c}\right)^2} \tag{104}$$

$$v = \alpha \cdot c \implies r(t) = r_0 \cdot \sqrt{1 - \alpha^2} \tag{105}$$

$$\Delta E = \left(\frac{m_A}{1 + \frac{m_A}{m_B}}\right) \cdot \left(1 - \sqrt{1 - \alpha^2}\right) \cdot c^2 \qquad [HE] \tag{106}$$

With the values:

- $m_e = 9.10938291 \cdot 10^{-31}$ kg, $r_e = 1.54463707 \cdot 10^{-12}$ m, $t_0 = 8.0932997891464 \cdot 10^{-21}$ s, $r_e(t) = r_e \cdot \sin(c/r_e \cdot t)$
- $m_p = 1.672621777 \cdot 10^{-27}$ kg, $r_p = 8.412356415 \cdot 10^{-16}$ m, $t_0 = 4.4077488287274 \cdot 10^{-24}$ s, $r_p(t) = r_p \cdot \sin(c/r_p \cdot t)$

the result is:

$$\Delta E = \mathbf{13.5984682}\ \text{eV}, \qquad \frac{\Delta E}{E_{\text{Ry,exp}}} = 1.000002074. \tag{107}$$

Rydberg energy = 13.5984682 eV

21.3 Dirac Ground State, Reduced Mass and the Significance of Identical Equation Structures

In calculating the ground-state energy of the hydrogen atom, a remarkable relationship emerges between the relativistic Dirac solution and Elementary Body Theory. What is remarkable here is not merely a numerical similarity. For the ground state, **exactly the same algebraic factor**

$$\boxed{1 - \sqrt{1 - \alpha^2}}$$

appears that EBT derives from its geometric development function.

Together with a second already known fact – the mathematical identity of the EBT mass term with the so-called reduced mass – this provides a particularly clear example that the agreement of mathematical components of equations does not yet permit any conclusion as to whether their physical origin and phenomenology are also identical.

21.3.1 The Dirac Solution for the Hydrogen Ground State

P. A. M. Dirac published *The Quantum Theory of the Electron* in 1928. The starting point was the relativistic description of the electron. Of particular relevance to the ontological classification is the fact that Dirac explicitly assumes an atom with "point-charge electrons."

The energy eigenvalues for the electron in the Coulomb field can be written in the form

$$E_{n,\kappa} = mc^2 \left[1 + \frac{\alpha^2}{\left(n - |\kappa| + \sqrt{\kappa^2 - \alpha^2} \right)^2} \right]^{-1/2}.$$

For the hydrogen ground state

$$1S_{1/2}$$

we have

$$n = 1, \qquad j = \frac{1}{2}, \qquad \kappa = -1, \qquad |\kappa| = 1.$$

Thus, the first term in the denominator vanishes:

$$n - |\kappa| = 1 - 1 = 0.$$

What remains is

$$E_{1S} = mc^2 \left[1 + \frac{\alpha^2}{\left(\sqrt{1 - \alpha^2} \right)^2} \right]^{-1/2}.$$

Since

$$\left(\sqrt{1-\alpha^2}\right)^2 = 1-\alpha^2,$$

it follows that

$$E_{1S} = mc^2\left[1+\frac{\alpha^2}{1-\alpha^2}\right]^{-1/2}.$$

Now,

$$1+\frac{\alpha^2}{1-\alpha^2} = \frac{1-\alpha^2+\alpha^2}{1-\alpha^2} = \frac{1}{1-\alpha^2}.$$

Thus, exactly,

$$E_{1S} = mc^2\left(\frac{1}{1-\alpha^2}\right)^{-1/2}$$

and finally

$$\boxed{E_{1S} = mc^2\sqrt{1-\alpha^2}.}$$

The difference relative to the rest energy

$$E_0 = mc^2$$

is therefore

$$\Delta E_{\mathrm{D}} = E_0 - E_{1S},$$

hence

$$\boxed{\Delta E_{\mathrm{D}} = mc^2\left(1-\sqrt{1-\alpha^2}\right).}$$

Importantly, the factor

$$\boxed{1-\sqrt{1-\alpha^2}}$$

arises here **not through a series expansion or approximation**. For the ground state, it follows exactly from the Dirac energy formula.

21.3.2 Exactly the Same Factor in EBT

$$\boxed{\Delta E_{e,p} = \frac{m_e}{1+m_e/m_p}\left(1-\sqrt{1-\alpha^2}\right)c^2.}$$

Using the values employed in the document gives

$$\Delta E_{e,p} = 13.5984682\,\mathrm{eV}.$$

Thus, as a purely algebraic finding,

$$\boxed{\left(1-\sqrt{1-\alpha^2}\right)_{\mathrm{Dirac}} = \left(1-\sqrt{1-\alpha^2}\right)_{\mathrm{EBT}}.}$$

The equality is exact.

But it is precisely here that the physically interesting part begins: **The mathematical identity says nothing yet about the origin of this term.**

21.3.3 Where Does the Same Term Come From Within EBT?

The EBT-starting-point is the development function

$$r(t) = r_0 \sin\left(\frac{c}{r_0}t\right).$$

Its time derivative gives

$$v(t) = \dot{r}(t) = c\cos\left(\frac{c}{r_0}t\right).$$

Thus,

$$\frac{v(t)}{c} = \cos\left(\frac{c}{r_0}t\right),$$

and therefore

$$\frac{c}{r_0}t = \arccos\left(\frac{v(t)}{c}\right).$$

Substitution into the radius function gives

$$r(t) = r_0 \sin\left[\arccos\left(\frac{v(t)}{c}\right)\right].$$

Using

$$\sin(\arccos x) = \sqrt{1-x^2},$$

it follows that

$$r(t) = r_0\sqrt{1-\left(\frac{v(t)}{c}\right)^2}.$$

For the EBT development state

$$v = \alpha c,$$

this gives

$$\boxed{r(t) = r_0\sqrt{1-\alpha^2}.}$$

Thus, within EBT,

$$\boxed{\sqrt{1-\alpha^2} = \frac{r(t)}{r_0}}$$

is not a relativistic correction adopted from Dirac theory, but rather a component of its own development geometry.

This is precisely why the mathematical equality with the Dirac term is epistemologically interesting.

21.3.4 The Same Phenomenon Occurs a Second Time: the Reduced Mass

The EBT mass term for the proton and electron is

$$\frac{m_e}{1+m_e/m_p}.$$

Algebraically,

$$\frac{m_e}{1+m_e/m_p}=\frac{m_e m_p}{m_e+m_p}.$$

Thus, exactly,

$$\boxed{\frac{m_e}{1+m_e/m_p}=\mu=\frac{m_e m_p}{m_e+m_p}.}$$

Mathematically, this is the familiar reduced mass.

The EBT phenomenology of this term, however, is found elsewhere in the document. From the mass-radius constancy

$$m_A r_A = m_B r_B = F_{\mathrm{EK}},$$

it follows that

$$r_A=\frac{F_{\mathrm{EK}}}{m_A}, \qquad r_B=\frac{F_{\mathrm{EK}}}{m_B}.$$

If the radii are added,

$$r_{AB}=r_A+r_B,$$

then

$$r_{AB}=F_{\mathrm{EK}}\left(\frac{1}{m_A}+\frac{1}{m_B}\right).$$

The mass corresponding to this resulting radius according to the same mass-radius relation is

$$m_{AB}=\frac{F_{\mathrm{EK}}}{r_{AB}}.$$

Thus,

$$m_{AB}=\frac{1}{\frac{1}{m_A}+\frac{1}{m_B}}$$

and therefore

$$\boxed{m_{AB}=\frac{m_A m_B}{m_A+m_B}.}$$

Mathematically, this is again the reduced mass.

The EBT explicitly points out that this mathematical identity is precisely **not an identity of phenomenology**.

We therefore now have not just one, but two parallel cases:

$$\boxed{\frac{m_A m_B}{m_A+m_B}}$$

and

$$\boxed{1-\sqrt{1-\alpha^2}.}$$

Both mathematical structures also exist outside EBT. However, on the basis of its own premises, EBT assigns each of them a concrete geometric origin.

21.3.5 The Historical Point: Were the Dirac Solution and Nuclear Motion Unknown?

No. And this is precisely what makes the matter more interesting.

The historical literature clearly shows that the question of finite nuclear mass in connection with Dirac theory was known.

As early as 1937, Irving S. Lowen published a paper with the unequivocal title *The Effect of Nuclear Motion in the Dirac Equation*. Lowen investigated corrections to the Dirac equation resulting from the motion of a heavy nucleus of mass M, using the relativistic Breit two-body interaction. The calculation was carried out to order

$$\frac{m}{M}.$$

It is therefore historically excluded that the subsequent development was simply due to the finite proton mass having gone unnoticed in connection with the Dirac equation.

This becomes even clearer in 1948.

Gregory Breit and G. E. Brown published *Effect of Nuclear Motion on the Fine Structure of Hydrogen*. They explicitly state that they take the energy of the Dirac electron in the central field as their reference point. Their result explicitly contains the original Bohr reduced-mass correction and, in addition, a further term depending on the principal quantum number.

This means that

$$\boxed{\text{Dirac solution} + \text{reduced mass}}$$

were by no means mutually unknown mathematical components.

Their connection was explicitly investigated.

21.3.6 Why, Then, Did One Not Stop at the Simple Combination?

Here, historical fact must be distinguished from theoretical interpretation.

Historically, it can be established that the relativistic two-body treatment was regarded as a problem that was not completely solved by the simple substitution

$$m_e \longrightarrow \mu$$

in the Dirac equation.

For this reason, additional recoil calculations were developed.

In 1937, Lowen calculated corresponding nuclear-motion corrections.

In 1948, Breit and Brown again started from the Dirac electron and obtained an additional contribution alongside the reduced-mass correction.

In 1951, these works were revisited, for example, by Takehiko Ishidzu using a relativistic 16-component wave equation. The paper explicitly refers to Breit and Brown as well as to earlier two-body treatments.

The historical development therefore was not

$$\text{Dirac term unknown} \longrightarrow \text{later complicated calculations.}$$

The later authors were therefore very well aware of the Dirac solution.

21.3.7 The Remarkable Complete Equation Structure

If one initially considers only the two mathematical structures, something extraordinarily simple emerges.

From the Dirac solution:

$$\Delta E_{\mathrm{D}} = mc^2 \left(1 - \sqrt{1-\alpha^2}\right).$$

From the two-body mass:

$$m \longrightarrow \mu = \frac{m_e m_p}{m_e + m_p}.$$

Combining the two gives

$$\Delta E = \mu c^2 \left(1 - \sqrt{1-\alpha^2}\right),$$

that is,

$$\boxed{\Delta E = \frac{m_e m_p}{m_e + m_p} \left(1 - \sqrt{1-\alpha^2}\right) c^2.}$$

And this is algebraically exactly the EBT equation [Eee] for the proton and electron:

$$\boxed{\Delta E_{\mathrm{EBT}} = \Delta E_{\mathrm{Dirac},\, m \to \mu}.}$$

This is the truly remarkable finding.

Not only does the square-root term coincide.

Not only does the mass term coincide.

Rather, the direct combination of both known mathematical components gives exactly

$$\boxed{\frac{m_e m_p}{m_e + m_p} \left(1 - \sqrt{1-\alpha^2}\right) c^2.}$$

21.3.8 Identical Equation Structure Does Not Mean Identical Phenomenology

It is precisely this equality that does not prove identical phenomenology.

The central epistemological relationship is

$$\boxed{\text{Identical equation structure} \not\Rightarrow \text{identical physical phenomenology.}}$$

Mathematically, one can write

$$\underbrace{\frac{m_e m_p}{m_e + m_p}}_{\text{reduced mass}} \cdot \underbrace{\left(1 - \sqrt{1-\alpha^2}\right)}_{\text{Dirac ground state}} c^2.$$

The equation itself, however, does not say **why** these two factors occur.

Within EBT, by contrast, the phenomenological chain is

$$mr = F_{\mathrm{EK}}$$

which, through the addition of radii, leads to

$$\boxed{m_{ep} = \frac{m_e m_p}{m_e + m_p},}$$

while the development function

$$r(t) = r_0 \sin\left(\frac{c}{r_0}t\right)$$

via

$$v = \alpha c$$

leads to

$$\boxed{\frac{r(t)}{r_0} = \sqrt{1-\alpha^2}.}$$

Taken together, the two give

$$\boxed{\Delta E_{e,p} = \underbrace{\frac{m_e m_p}{m_e + m_p}}_{\substack{\text{EBT: resulting mass} \\ \text{from radius addition}}} \underbrace{\left(1 - \sqrt{1-\alpha^2}\right)}_{\substack{\text{EBT: geometric} \\ \text{development state}}} c^2.}$$

This is the decisive difference between recognizing a formula and deriving it within a physical conceptual model.

21.3.9 The Historically More Precise Question

The historical question is therefore not:

> Why did nobody know the Dirac solution with reduced mass?

For this would not be historically accurate.

The more precise question is:

> **Why was the already known combination of the reduced mass term and the exact Dirac ground-state factor not considered as a potentially independent physical overall structure of the proton-electron system, but merely as a starting point for further formally required correction calculations?**

Breit and Brown demonstrate particularly clearly in 1948 that both mathematical structures lay directly side by side: They took the energy of the Dirac electron in the central field as their reference and explicitly obtained the Bohr reduced-mass correction as well as a further term.

The mathematical components were therefore present.

What was lacking, at any rate, was not knowledge of them.

21.3.10 Significance for EBT

The comparison thus acquires a different significance from the mere observation that EBT contains a factor already known from Dirac theory.

In fact, there are two mathematical correspondences:

$$\boxed{m_{\text{EBT}} = \frac{m_e m_p}{m_e + m_p} = \mu}$$

and

$$\boxed{f_{\text{EBT}} = 1 - \sqrt{1-\alpha^2} = f_{\text{Dirac},1S}.}$$

Their combination gives

$$\boxed{\Delta E_{\mathrm{EBT}} = \mu \left(1 - \sqrt{1-\alpha^2}\right) c^2.}$$

EBT does not obtain this structure, however, by first adopting the reduced mass and then the Dirac solution. Within the EBT conceptual model, both components are traced back to the mass-radius coupling and the development geometry.

This is precisely why the comparison illustrates particularly clearly the relationship already established for the reduced mass:

same mass term + same square-root term

does not mean

the same physical conceptual model.

Precisely because the algebraic final structures coincide, it becomes particularly clear that an equation does not derive its physical meaning from its mathematical form alone.

Historical Sources P. A. M. Dirac, *The Quantum Theory of the Electron*, Proceedings of the Royal Society of London. Series A, Vol. 117 (1928), pp. 610–624, DOI: 10.1098/rspa.1928.0023.

Irving S. Lowen, *The Effect of Nuclear Motion in the Dirac Equation*, Physical Review, Vol. 51 (1937), p. 190, DOI: 10.1103/PhysRev.51.190.

G. Breit and G. E. Brown, *Effect of Nuclear Motion on the Fine Structure of Hydrogen*, Physical Review, Vol. 74 (1948), p. 1278, DOI: 10.1103/PhysRev.74.1278.

Takehiko Ishidzu, *Effects of Nuclear Motion on the Fine and the Hyperfine Structure of Hydrogen, I*, Progress of Theoretical Physics, Vol. 6 (1951), pp. 48–60.

21.4 The Bohr Radius in QM vs. EBT

The Bohr radius (r_{Bohr}) is, in the picture of two charges, the distance to the common charge center of mass. The distance between the charge centers is $2r_{\mathrm{Bohr}}$. In the thought model of Elementary Body Theory, two elementary bodies superimpose during the inelastic interaction in such a way that they each enlarge to the measure of the Bohr radius. This means: The now resulting, equal-sized elementary bodies are superimposed.

Remark 21.1. *Incidentally, the quantum mechanical consideration leads to a "Bohr radius" of* $3/2a_0$ *(?!?). The "quantum mechanical" expectation value of the Bohr radius* $\langle r \rangle$ *is calculated as follows:*

"Quantum mechanically", in the Bohr atomic radius, the probability of presence for the electron is maximal. On average $\langle r \rangle$*, the electron is at a distance of* $\boldsymbol{1.5}a_0$ *from the nucleus. This finding is not trivial. What do we do with the expectation value* $\langle r \rangle$ *when the Rydberg energy, also used in quantum mechanics, corresponds not to the expectation value* $\langle r \rangle$*, but to the Bohr atomic radius* a_0*?*

22 Theoretical Determination of the Ground State Energy of the Hydrogen Atom According to the Standard Model

22.1 Summary

In the following, the complete theoretical structure for the "high-precision calculation" of the ground state energy of the hydrogen atom within the framework of the Standard Model (SM) is given. Considered are the exact solution of the Dirac equation, the expansion in the fine-structure constant, quantum electrodynamics (QED), renormalization, recoil effects, proton structure, and hadronic contributions. Additionally, the theoretical and numerical effort is classified.

BUT...

Predictive Capability of Quantum Mechanics
The mathematics used within quantum mechanics (QM) and consequently within quantum field theories (QFTs), partly newly defined (keywords: perturbation theory, regularization, renormalization), is phenomenologically unfounded. It is formally(-axiomatically) significantly more complex and more difficult to understand than the mere insight that, for example, energy levels are "quantized" as a function of the principal quantum number n with $1/(n^2 - (n+1)^2)$, but does not get beyond the status of a calculation rule. Moreover, within the framework of perturbation theory there are **no formal-analytical solutions**. So when quantum electrodynamics (QED)-based reports of an excellent agreement between theory and experiment are made, these are gigantic solution systems whose iterative results were repeatedly adapted to the measured values. **Some do not say it, others do not see through it.**

22.2 Total Structure of the Energy

The complete energy can be written schematically as:

$$E = E_{\text{Dirac}} + \Delta E_{\text{1-Loop}} + \Delta E_{\text{2-Loop}} + \Delta E_{\text{Recoil}} + \Delta E_{\text{Proton}} + \Delta E_{\text{Hadronic}} + \dots \tag{108}$$

22.3 Dirac Theory (Exact Relativistic Solution)

The Dirac equation in the Coulomb potential is:

$$\left[c\boldsymbol{\alpha}\cdot\mathbf{p} + \beta mc^2 - \frac{e^2}{4\pi\varepsilon_0 r}\right]\psi = E\psi \tag{109}$$

The exact energy eigenvalues are:

$$E_{n,j} = mc^2\left[1 + \frac{(Z\alpha)^2}{\left(n - j - \frac{1}{2} + \sqrt{(j+\frac{1}{2})^2 - (Z\alpha)^2}\right)^2}\right]^{-1/2} \tag{110}$$

For the ground state ($n=1$, $j=\frac{1}{2}$, $Z=1$):

$$E_{1s} = mc^2\sqrt{1-\alpha^2} - mc^2 \tag{111}$$

Expansion in α:

$$E_{1s} = -\frac{mc^2\alpha^2}{2} - \frac{mc^2\alpha^4}{8} + O(\alpha^6) \tag{112}$$

22.4 Fine Structure and Effective Hamiltonian

The relativistic corrections result from:

$$H = H_0 - \frac{p^4}{8m^3c^2} + \frac{\hbar^2}{8m^2c^2}\nabla^2 V + \frac{1}{2m^2c^2}\frac{1}{r}\frac{dV}{dr}\mathbf{L}\cdot\mathbf{S} \tag{113}$$

22.5 Quantum Electrodynamics (QED)

The QED Lagrangian density is:

$$\mathcal{L} = \bar{\psi}(i\gamma^\mu D_\mu - m)\psi - \frac{1}{4}F_{\mu\nu}F^{\mu\nu} \tag{114}$$

with

$$D_\mu = \partial_\mu + ieA_\mu \tag{115}$$

22.5.1 1-Loop Self-Energy

The leading correction yields the Lamb shift:

$$\Delta E_{\text{Lamb}} \propto \frac{\alpha}{\pi}(Z\alpha)^4 mc^2 \ln\left(\frac{1}{(Z\alpha)^2}\right) \tag{116}$$

22.6 Recoil Corrections

By using the reduced mass:

$$\mu = \frac{mM}{m+M} \tag{117}$$

BUT...

The fact is: **The calculation of ground state energies is neither quantum mechanically nor quantum electrodynamically founded** or not possible, since a significantly governing portion is determined by the ratio of the interacting masses. There is neither on a QM basis nor on a QED basis the possibility to introduce the "**reduced mass** $m_{\text{red}} = m_A/(1 + m_A/m_B)$" quantum-field-phenomenologically. The reduced mass term $m_{\text{red}} = m_A/(1+m_A/m_B)$ affects the energetic conditions. The reduced mass is – whether one wants to admit it or not – historically derived from celestial mechanics within the framework of standard physics. This means, in plain language, that in the sense of atomic interactions, this is neither QM- nor QED-founded.

22.7 Proton Structure and Hadronic Contributions

Further corrections come from:

- Proton form factors
- Higher-order vacuum polarization
- Two-loop QED
- Lattice QCD calculations

22.8 Numerical and Theoretical Effort

- Dirac solution: analytically exact.
- 1-loop QED: symbolic calculation + numerical evaluation.
- 2-loop QED: complex multi-loop integrals.
- Proton structure: partly experimental, partly lattice QCD.
- Complete precision calculation: research level, possibly supercomputer.

22.9 Result for the Ground State Energy

Taking into account all known corrections, the result is:

$$E_{1s} \approx -13.59843449 \text{ eV} \tag{118}$$

Here, obviously, modifying for so long, partly over years, by means of cluster computers, everything was numerically "calculated beautifully" until the experimental result was exactly achieved.

23 The Matter Equations: The Consequent Evolution Ladder

The decisive formal matter-formation "breakthrough" lies in the insight that the product of interaction radius r and channel velocity v follows an exact arithmetic progression. Referred to the maximum value $r_0 \cdot c$, four discrete stages result, which correspond exactly to the values $1\hbar$ to $4\hbar$:

- **e–e channel (Rydberg):** $r \cdot v = \frac{1}{4} r_0 c \quad \Longrightarrow \quad 1\hbar$
- **e–q_0 channel (neutron):** $r \cdot v = \frac{2}{4} r_0 c \quad \Longrightarrow \quad 2\hbar$
- **Muon channel:** $r \cdot v = \frac{3}{4} r_0 c \quad \Longrightarrow \quad 3\hbar$
- **q_0–q_0 channel (pion):** $r \cdot v = \frac{4}{4} r_0 c \quad \Longrightarrow \quad 4\hbar$

By multiplication with the invariant mass m_0 and use of the mass-radius constant $m_0 r_0 c = 2h/\pi$, it is proven that this ladder is not an arbitrary construction, but the geometrically founded sequence of coupling stages.

The decay $\pi \to \mu \to e$ is now understood as the stepwise descent of these action stages, whereby mass-bound energy is transformed into radius-bound space energy.

The ladder is bounded above: Since the radius r can be at most r_0 and the velocity v at most c, the product $r \cdot v$ is bounded above by $r_0 \cdot c$ (stage $4\hbar$). A "5th channel" ($5\hbar$) is geometrically impossible. EBT is thus a self-contained, finite system of discrete states and not an open classification scheme. EBT describes the matter-forming interaction of two elementary bodies by equations that consist of two building blocks:

1. **Bracket (Who interacts?)**: the reduced mass $\frac{m_A}{1+m_A/m_B}$ or the strongly transformed form $\frac{q_0 m_A}{1+_{q_0} m_A/m_B}$,
2. **Channel factor (How much is converted?)**: $(1 - \gamma_{\text{dyn}})$ with the dynamized factor $\gamma_{\text{dyn}} = \sqrt{1-(v/c)^2}$ at the characteristic channel velocity.

23.1 The Three Basic Equations

Channel	Charges	Basic Equation
e–e	e with e	$\Delta E_{e,e} = \frac{m_A}{1+\frac{m_A}{m_B}} \cdot \left(1 - \sqrt{1-\alpha^2}\right) \cdot c^2$
e–q_0	e with q_0	$\Delta E_{e,q_0} = \frac{q_0 m_A}{1+\frac{q_0 m_A}{m_B}} \cdot \left(1 - \sqrt{1-\alpha}\right) \cdot c^2$
q_0–q_0	q_0 with q_0	$\Delta E_{q_0,q_0} = \frac{q_0 m_A}{1+\frac{m_A}{m_B}} \cdot c^2$

Table 2: The three basic equations of matter formation.

The characteristic channel velocities. The three channel factors correspond to the energetic analogies:

- e–e: $r = r_0/(4\alpha)$, $v = \alpha c$, analogy $L = \hbar$,
- e–q_0: $r = r_0/(2\sqrt{\alpha})$, $v = \sqrt{\alpha}\, c$, analogy $L = 2\hbar$,
- q_0–q_0: $r = r_0$, $v = c$, analogy $L = 4\hbar$.

23.2 The Muon Mass in Elementary Body Theory

Explicit Summary – Every Calculation Term and Its Justification, Understandable Without EBT Prior Knowledge

0. The Minimum of Prior Knowledge the Reader Needs The elementary body. In EBT, every particle (electron, proton, ...) is an "elementary body": a mass-radius-coupled spherical surface created from a photon. Its mass-radius product is invariant:

$$m_0 \cdot r_0 = \frac{2h}{\pi c} = F_{\mathrm{EB}} \qquad [F1] \tag{119}$$

The smaller the radius, the larger the mass (and vice versa). "Decays" such as $\pi \to \mu \to e$ are therefore mass-radius transformations: mass-bound energy is converted into radius-bound (space) energy – without neutrino.

The two charges.

- e = electric elementary charge (the "electric channel").
- q_0 = elementary body charge (the "strong channel"). It is the charge whose self-energy corresponds to the total rest energy m_0c^2. Since the electric energy makes up only the fraction $\alpha/4$ of the total energy ($\alpha/4 = e^2/q_0^2$), the equivalent mass belonging to the strong charge is larger by the reciprocal:

$$_{q_0}m = \frac{4}{\alpha} \cdot m \tag{120}$$

This is the origin of the factor $4/\alpha$ in all strong terms.

The three matter equations. If two elementary bodies A and B meet in the common origin, their radii add, and the resulting mass follows from $[F1]$. Formally, this yields exactly the "reduced mass" bracket. Depending on which charges the partners carry, there are three interaction types – and thus three equations:

$$\Delta m_{e,e} = \left(\frac{m_A}{1+\frac{m_A}{m_B}}\right) \cdot \left(1-\sqrt{1-\alpha^2}\right) \qquad [m_{ee}] \tag{121}$$

$$\Delta m_{e,q_0} = \left(\frac{_{q_0}m_A}{1+\frac{_{q_0}m_A}{m_B}}\right) \cdot \left(1-\sqrt{1-\alpha}\right) \qquad [m_{q_0 e}] \tag{122}$$

$$\Delta m_{q_0,q_0} = \left(\frac{_{q_0}m_A}{1+\frac{_{q_0}m_A}{_{q_0}m_B}}\right) = \left(\frac{_{q_0}m_A}{1+\frac{m_A}{m_B}}\right) \qquad [m_{q_0 q_0}] \tag{123}$$

Each of these equations consists of two building blocks: the bracket (Who interacts? With which – possibly strongly transformed – mass and which partner?) and the channel factor (How much of the embodied energy is converted/radiated in this interaction?). Both building blocks are justified individually below.

1. Building Block 1 – The Bracket: Who Interacts, and with Which Mass? The bracket is the geometric superposition, not center-of-mass mechanics. Two bodies with $m_A r_A = m_B r_B = F_{\mathrm{EB}}$ superimpose in the common origin; the radii add to $r_A + r_B$, and from $m \cdot (r_A + r_B) = F_{\mathrm{EB}}$ it follows compellingly

$$m = \frac{m_A}{1+\frac{m_A}{m_B}} \tag{124}$$

Formally identical to the reduced mass – but phenomenologically the superposition in the origin. The bracket thus answers the question: Which portion of the strong (or electric) embodiment of A arises in the presence of partner B?

Why $_{q_0}m_A = \frac{4}{\alpha}m_A$ stands in the strong channel: q_0 is the charge of the total energy. If a body is embodied via the strong channel, its mass must therefore be translated into the strong picture: multiplied by $4/\alpha$ (the ratio total energy/electric energy). In the purely electric channel $[m_{ee}]$, by contrast, the bare mass m_A stands.

Why the factor $4/\alpha$ cancels in the q_0-q_0 channel in the ratio: If both partners stand under strong charge, then $4/\alpha$ cancels in the quotient ${}_{q_0}m_A/{}_{q_0}m_B = m_A/m_B$; what remains is the bracket with the bare mass ratio, but in front still the strongly transformed mass ${}_{q_0}m_A$. Precisely therefore, the pion equation reads $\frac{4}{\alpha} \cdot \frac{m_e}{1+m_e/m_p}$: in front the strong embodiment of the electron, behind the cancellation of the strong charges.

2. Building Block 2 – The Channel Factor: How Much Is Converted? Each channel possesses a characteristic velocity and a characteristic radius (the "energetic analogies" of EBT). With the dynamized factor $\gamma_{\text{dyn}} = \sqrt{1-(v/c)^2}$, the channel factor is always $(1-\gamma_{\text{dyn}})$ – the portion of the embodiment that is radiated or converted as ground state energy in the matter-forming interaction:

Channel	**Charges**	**Radius** r	**Vel.** v	$(r/r_0)(v/c)$	**Factor** $(1-\gamma_{\text{dyn}})$
e–e	e with e	$r_0/(4\alpha)$	αc	1/4	$(1-\sqrt{1-\alpha^2})$
e–q_0	e with q_0	$r_0/(2\sqrt{\alpha})$	$\sqrt{\alpha}\,c$	1/2	$(1-\sqrt{1-\alpha})$
q_0–q_0	q_0 with q_0	r_0	c	1	$(1-\sqrt{1-1})=1$

The justification of the three factors in detail:

- **e–e:** Only the electric fraction $\alpha/4$ of the energy participates; the characteristic velocity is $v = \alpha c$. Inserted into $(1-\sqrt{1-(v/c)^2})$, this yields $(1-\sqrt{1-\alpha^2})$ – the Rydberg factor. With the bracket $(m_e/(1+m_e/m_p))$, $[m_{ee}]$ provides the Rydberg energy to $2.5 \cdot 10^{-6}$ accuracy.
- **e–q_0:** The mixed channel carries the dyadic middle of the ladder, $v = \sqrt{\alpha}\,c$ (geometric mean of αc and c). The factor becomes $(1-\sqrt{1-\alpha})$ – the neutron factor. With the strongly transformed electron mass ${}_{q_0}m_e$ and the proton as partner, $[m_{q_0 e}]$ provides the neutron mass difference to $6.5 \cdot 10^{-6}$ accuracy.
- **q_0–q_0:** The strong channel embodies the full energy; $v = c$, thus $\gamma_{\text{dyn}} = 0$ and the factor = 1. Therefore, the pion equation has no root factor: the entire strong embodiment becomes mass. $[m_{q_0 q_0}]$ with A=e, B=p provides $4.99053598 \cdot 10^{-28}$ kg $= 2\,m_{\pi^\pm}$ (factor 1/2 because of pair creation, see below); with A=B=e the neutral pion $(2/\alpha)m_e$; with A=B=p the Higgs-like state (+2.9 %).

The ladder is thereby calibrated: Same bracket, different channel factor – different particle. The fourth equation for the muon is not an external construction, but the consistent continuation of exactly this ladder.

3. The Fourth Matter Equation: The Muon Pair

$$\Delta m_{\mu,\bar{\mu}} = \left(\frac{{}_{q_0}m_e}{1+\frac{m_e}{m_p}}\right) \cdot \left(1-\frac{1}{4}\right) = 2\,m_\mu(\text{EBT}) \qquad [m_{\mu\mu}] \tag{125}$$

$$m_\mu(\text{EBT}) = \frac{\Delta m_{\mu,\bar{\mu}}}{2} \tag{126}$$

3.1 Why the bracket $\frac{{}_{q_0}m_e}{1+m_e/m_p}$ (the pion bracket term): The muon arises phenomenologically from the charged pion ($\pi^\pm \to \mu^\pm$). The charged pion, however, is the q_0-q_0 embodiment of the electron-proton system, i.e., exactly the bracket term $\frac{{}_{q_0}m_e}{1+m_e/m_p}$. The muon therefore inherits the same reduced strong mass: It is the successor body of the pion embodiment, not a new, independent source. Therefore, the same bracket stands in the muon term as in the pion term – with the proton as partner (proton-reduced), not the equal-mass bracket.

3.2 Why the channel factor $(1-1/4)$: The muon stands in the decay chain $\pi \to \mu \to e$ between the full strong embodiment (pion, factor 1) and the electric ground state (electron). It is the strong embodiment reduced by the electric analogy portion. This portion is exactly the quarter from the e–e row of the ladder:

$$\frac{1}{4} = \left(\frac{r}{r_0}\right)_{\text{e-e}} \cdot \left(\frac{v}{c}\right)_{\text{e-e}} = \frac{1}{4\alpha} \cdot \alpha = \frac{L_{ee}}{L_{q_0 q_0}} \tag{127}$$

(the same quarter that stands in the angular momentum analogy [eL]: $L_{ee} = \frac{1}{4} r_0 m_0 c$ compared to $L_{q_0 q_0} = r_0 m_0 c$ – expressed solely with r, v, α, without $\hbar$). The muon factor is thus

$$1 - \frac{L_{ee}}{L_{q_0 q_0}} = 1 - \frac{1}{4} = \frac{3}{4} \tag{128}$$

And it has exactly the same form as the three known factors: If one sets $\gamma_{\mathrm{dyn},\mu} = 1/4$, then $(1 - 1/4) = (1 - \sqrt{1 - 15/16})$, i.e., the muon channel is a $(1 - \gamma_{\mathrm{dyn}})$-factor with the channel velocity

$$v_\mu = \frac{\sqrt{15}}{4}\, c \approx 0.96825\, c \tag{129}$$

The fourth equation is thus structurally identical to [m_{ee}], [$m_{q_0 e}$], [$m_{q_0 q_0}$]: same bracket, same factor type $(1 - \gamma_{\mathrm{dyn}})$, only the channel velocity is that of the muon step of the ladder.

3.3 Why the factor $1/2$: As with the pions, charge conservation forces a pair: The q_0-q_0 embodiment of the electron-proton system yields two charged pions (charge sum zero); analogously, the muon embodiment yields muon and anti-muon. The pair term is therefore $\Delta m_{\mu,\bar{\mu}} = 2\, m_\mu$, and the mass of the single muon is half – exactly the same $1/2$ as in $m_\pi = \Delta m/2$.

4. The Explicit Numerical Evaluation (Step by Step) Step 1 – strong transformation mass of the electron:

$$_{q_0}m_e = \frac{4}{\alpha} \cdot m_e = 548.1439966 \times 9.10938356 \cdot 10^{-31}\ \mathrm{kg} = 4.99325391 \cdot 10^{-28}\ \mathrm{kg} \tag{130}$$

Step 2 – proton-reduced strong mass (pion pair term):

$$\frac{m_e}{m_p} = 0.000544617 \implies \frac{4.99325391 \cdot 10^{-28}}{1.000544617} = 4.99053598 \cdot 10^{-28}\ \mathrm{kg}\ (= 279.9485175\ \mathrm{MeV}) \tag{131}$$

Step 3 – muon channel factor:

$$\left(1 - \frac{1}{4}\right) = 0.75 \implies \Delta m_{\mu,\bar{\mu}} = 4.99053598 \cdot 10^{-28} \times 0.75 = 3.74290199 \cdot 10^{-28}\ \mathrm{kg}\ (= 209.9613881\ \mathrm{MeV}) \tag{132}$$

Step 4 – pair splitting:

$$m_\mu(\mathrm{EBT}) = \frac{3.74290199 \cdot 10^{-28}}{2} = 1.87145099 \cdot 10^{-28}\ \mathrm{kg} = 104.9806940\ \mathrm{MeV} \tag{133}$$

Step 5 – comparison with the theory-laden measured value:

$$\frac{m_\mu(\mathrm{exp})}{m_\mu(\mathrm{EBT})} = \frac{105.6583745}{104.9806940} = 1.0064553 \quad (\mathrm{EBT}\ -0.64\,\%) \tag{134}$$

Cross-check (equal-mass channel, analogous to π^0):

$$\left(\frac{_{q_0}m_e}{2}\right) \cdot \frac{3}{4} = 1.87247024 \cdot 10^{-28}\ \mathrm{kg} = 105.0378767\ \mathrm{MeV} \implies \text{ratio } 1.0059066\ (-0.59\,\%). \tag{135}$$

5. Status and Classification The fourth matter equation [$m_{\mu\mu}$] provides the muon mass as a prediction at the percent level – the same class as the neutral pion (+3.76 %) and the Higgs-like state (+2.9 %), and closer to the measured value than both. The deviation of −0.64 % is transparently flagged, not calculated beautifully; the "measured values" are themselves theory-ladenly extracted. The search for a derivation at the 10^{-6} level of the parade examples (Rydberg, neutron) remains the open, clearly defined research task.

The dyadic ladder. The four channels form a complete ladder:

$$\underbrace{\left(1 - \sqrt{1 - \alpha^2}\right)}_{e\text{–}e,\ L=\hbar}, \qquad \underbrace{\left(1 - \sqrt{1 - \alpha}\right)}_{e\text{–}q_0,\ L=2\hbar}, \qquad \underbrace{\left(1 - \frac{1}{4}\right)}_{\mu,\ L=3\hbar}, \qquad \underbrace{1}_{q_0\text{–}q_0,\ L=4\hbar}. \tag{136}$$

Equation	Bracket (Who?)	Channel Factor (How much?)	Result
$[m_{ee}]$	$m_e/(1+m_e/m_p)$	$(1-\sqrt{1-\alpha^2})$, e–e	Rydberg energy
$[m_{q_0e}]$	${}_{q_0}m_e/(1+{}_{q_0}m_e/m_p)$	$(1-\sqrt{1-\alpha})$, e–q_0	neutron-Δ
$[m_{q_0q_0}]$	${}_{q_0}m_e/(1+m_e/m_p)$	1, q_0–q_0	$2\,m_{\pi^\pm}$
$[m_{\mu\mu}]$	${}_{q_0}m_e/(1+m_e/m_p)$	$(1-1/4)=(1-\sqrt{1-15/16})$, muon channel	$2\,m_\mu$(EBT)

Table 3: Summary table of the four matter equations.

24 Matter Formations

24.1 Mass of the Neutron – The Neutron Mass Difference from the e-q_0 Interaction

In Elementary Body Theory, the neutron arises from a **matter-forming charge interaction** between a proton and a strongly transformed electron. While the hydrogen atom emerges from the electric e-e interaction, in which the electric elementary charge e is governing, the neutron formation is based on the **strong elementary body charge** q_0.

The strong charge q_0 is that charge whose self-energy corresponds to the total rest energy of the elementary body. Its ratio to the electric elementary charge e is fixed by the fine-structure constant:

$$\frac{e^2}{q_0^2}=\frac{\alpha}{4} \tag{137}$$

From this follows for the strongly transformed mass of the electron:

$${}_{q_0}m_e=\frac{4}{\alpha}\cdot m_e \tag{138}$$

The electron thus does not appear in neutron formation with its electric mass m_e, but with its **strong embodiment mass** ${}_{q_0}m_e$. This is larger than the electric mass by the factor $4/\alpha\approx 548$.

The matter-forming interaction between the strongly transformed electron and the proton follows the same structure as the e-e interaction in the hydrogen atom – however with the channel factor characteristic of the e-q_0 channel:

$$\Delta m_n=\frac{{}_{q_0}m_e}{1+\frac{{}_{q_0}m_e}{m_p}}\cdot\left(1-\sqrt{1-\alpha}\right) \tag{139}$$

Here:

- The **bracket term** $\frac{{}_{q_0}m_e}{1+{}_{q_0}m_e/m_p}$ is the geometric superposition in the common origin – formally identical to the reduced mass, phenomenologically, however, the consequence of the additive radius superposition according to $m_0r_0=F_{\mathrm{EB}}$.
- The **channel factor** $(1-\sqrt{1-\alpha})$ is the characteristic energy conversion of the mixed e-q_0 channel. It stands in the dyadic ladder between the e-e channel $(1-\sqrt{1-\alpha^2})$ and the q_0-q_0 channel (factor 1).

Numerically, the result is:

$$\Delta m_n=1.4056007\cdot 10^{-30}\,\mathrm{kg}=0.78848\,\mathrm{MeV}/c^2 \tag{140}$$

The total mass of the neutron is thus:

$$m_n=m_p+m_e+\Delta m_n=1.67493844\cdot 10^{-27}\,\mathrm{kg} \tag{141}$$

The comparison with the experimental value $m_n(\mathrm{exp})=1.67492747\cdot 10^{-27}\,\mathrm{kg}$ yields:

$$\frac{m_n}{m_n(\mathrm{exp})}=1.00000655 \tag{142}$$

This corresponds to a relative deviation of only $6.5 \cdot 10^{-6}$ – **without free parameters, without lattice QCD, without quark mass tuning**.

Furthermore, the kinetic energy of the electron emitted in neutron decay is in EBT a direct consequence of the mass difference:

$$E_{\text{kin}} = (\gamma - 1)m_e c^2 \approx 0.78\,\text{MeV} \tag{143}$$

This value is in agreement with the literature and follows **without** the assumption of a neutrino. The seemingly "missing" energy in the continuous spectrum of beta decay is in EBT not energy given off to a ghost particle – it is the **radius-bound space energy** of the decay products, which eludes calorimetric measurement.

24.2 "Unloved" State of Affairs: The Maximum Electron Energy of Neutron Decay

The following is the mention of a state of affairs that prevailing physics likes to leave unmentioned in the description of neutron synthesis or in the decay of the neutron.

If one takes as a basis the maximum kinetic energy of about 0.78 MeV of the electron emitted in the decay of the neutron, as given in the literature, the mass difference of the neutron to electron and proton results directly from the relativistic kinetic energy of the electron. The picture is identical in magnitude in EBT – this means the SR calculation corresponds to the EBT calculation with the dynamized factor.

This statement is only to be understood as trivial if one obtains the neutron on an elementary-body basis from a direct proton-electron interaction, as described above. Within the framework of the Standard Model of particle physics, by contrast, a postulated quark transformation and a postulated neutrino emission are present.

The Standard Model provides – compared to Elementary Body Theory – no possibility of calculating anything concrete about neutron decay formal-analytically and approximation-free. The SM averagings over free parameters, variable coupling constants, and postulated theory objects as well as their equally postulated interactions exist without direct existence proof.

EBT, by contrast, obtains the maximum electron energy of neutron decay **directly from the same mass difference** that also provides the neutron mass itself. From the already derived neutron mass difference

$$\Delta m_n = \frac{q_0 m_e}{1 + \frac{q_0 m_e}{m_p}} \cdot \left(1 - \sqrt{1 - \alpha}\right) = 1.4056007 \cdot 10^{-30}\,\text{kg} \tag{144}$$

the maximum kinetic energy of the emitted electron follows immediately from the mass difference between neutron and the decay products proton and electron:

$$\Delta m = m_n - m_p - m_e \tag{145}$$

With the EBT values:

$$m_n = 1.67493844 \cdot 10^{-27}\,\text{kg} \tag{146}$$

$$m_p = 1.672621898 \cdot 10^{-27}\,\text{kg} \tag{147}$$

$$m_e = 9.10938356 \cdot 10^{-31}\,\text{kg} \tag{148}$$

the result is:

$$\Delta m = 1.67493844 \cdot 10^{-27} - 1.672621898 \cdot 10^{-27} - 9.10938356 \cdot 10^{-31} \tag{149}$$

$$\Delta m = 1.40515884 \cdot 10^{-30}\,\text{kg} \tag{150}$$

The **dynamized factor** of EBT is defined as:

$$\gamma_{\text{dyn}} = \sqrt{1 - \left(\frac{v}{c}\right)^2} \tag{151}$$

For neutron decay, the velocity v of the electron is determined by the mass difference Δm. The energy balance is:

$$\Delta m \cdot c^2 = m_e c^2 \left(\frac{1}{\gamma_{\text{dyn}}} - 1\right) \tag{152}$$

Solved for the dynamized factor:

$$\gamma_{\text{dyn}} = \frac{1}{1 + \frac{\Delta m}{m_e}} \tag{153}$$

With the numerical values:

$$\frac{\Delta m}{m_e} = \frac{1.40515884 \cdot 10^{-30}}{9.10938356 \cdot 10^{-31}} = 1.542545 \tag{154}$$

$$\gamma_{\text{dyn}} = \frac{1}{1 + 1.542545} = 0.393304 \tag{155}$$

And thus the maximum kinetic energy:

$$E_{\text{kin}}^{\max} = m_e c^2 \left(\frac{1}{\gamma_{\text{dyn}}} - 1\right) = \Delta m \cdot c^2 \tag{156}$$

$$E_{\text{kin}}^{\max} = 1.40515884 \cdot 10^{-30} \cdot (2.99792458 \cdot 10^8)^2 \tag{157}$$

$$E_{\text{kin}}^{\max} = 1.26290 \cdot 10^{-13}\,\text{J} \tag{158}$$

$$\boxed{E_{\text{kin}}^{\max} = 0.788226\,\text{MeV}} \tag{159}$$

The agreement with the literature is exact in magnitude – and requires neither quarks nor neutrinos nor free parameters. EBT reproduces the maximum electron energy of neutron decay **consistently from the same equation structure** that also provides the neutron mass itself.

24.3 The QCD Calculation of the Neutron Mass – An Elaborate Fitting Procedure

In the Standard Model of particle physics, there is no closed analytical formula for calculating the neutron mass. Instead, the mass of the neutron is determined within the framework of lattice quantum chromodynamics (lattice QCD) by a multi-stage, numerical adjustment procedure.

The process begins with the finding that quark masses are free parameters of the theory. The international FLAG review documents this state of affairs unambiguously:

> "Quark masses cannot be measured directly in experiment because quarks cannot be isolated, as they are confined inside hadrons. On the other hand, quark masses are free parameters of the theory and, as such, cannot be obtained on the basis of purely theoretical considerations."

Since quark masses cannot be derived from the theory, they are inserted into the simulation as **input values**. Lattice QCD then calculates the resulting hadron masses for a variety of these input values. Subsequently, the quark masses are **adjusted** – in technical jargon: **tuned** – until the calculated hadron masses agree with the experimentally measured values:

> "One computes as many experimentally measurable quantities as there are quark masses. [...] They are usually computed for a variety of input values of the quark masses which are then adjusted to reproduce experiment."

For the light quarks, this process is explicitly described as tuning in the FLAG review:

> "Thus, in lattice calculations, light-quark masses are typically obtained by [...] tuning them to reproduce NGB masses."

Here NGB denotes the Nambu-Goldstone bosons – i.e., pions and kaons. This means: The quark masses are **not predicted**, but numerically varied until the known pion and kaon masses are reproduced.

Additionally, the procedure requires a **scale fixing**. A further observable – for instance the pion decay constant or the mass of a baryon from the octet – must be used as an anchor to fix the absolute energy scale of the lattice:

> "Another observable, such as the pion decay constant or the mass of a member of the baryon octet, must be used to fix the overall scale."

Only after this calibration can the neutron mass be extracted from the simulation. The result is therefore **not an independent prediction**, but the consequence of a multi-stage adjustment:

1. **Choice of quark mass inputs** – free, theory-undetermined
2. **Calculation of hadron masses** – numerical, on supercomputers
3. **Tuning of quark masses** – until pions/kaons are reproduced
4. **Scale fixing** – via a further observable
5. **Extraction of the neutron mass** – as the result of the calibrated system

In addition, there are corrections for electromagnetic effects and isospin breaking, which are based on phenomenological models and whose parameters must also be adjusted. Different collaborations – MILC, BMW, RBC/UKQCD, and others – arrive at partly incompatible results despite similar basic methods.

24.3.1 The QCD Deviation Despite the Gigantic Effort

Despite this enormous numerical and methodological effort, lattice QCD achieves an accuracy in the calculation of the neutron mass that lies in the range of about **1 to 2 percent**.

24.4 Lattice QCD as One of the Most Computationally Intensive Scientific Undertakings

Lattice QCD belongs to the **most computationally intensive scientific undertakings** of all.

Indicator	**Value**
Typical lattice QCD simulations	10^6 to 10^8 CPU core hours per ensemble
Several ensembles necessary	Different lattice spacings, quark masses, volumes
Scale fixing + tuning	Several passes per ensemble
Total effort per publication	10^7 to 10^9 CPU core hours

Table 4: Computational effort of lattice QCD

These are **millions to billions** of CPU core hours – depending on the counting method.

24.4.1 Concrete Examples

- The **MILC collaboration** typically reports several hundred million CPU hours per ensemble set.
- The **BMW collaboration** used several hundred million core hours on supercomputers such as JUGENE/JUWELS in Jülich for their precise hadron mass calculations.
- The **FLAG review** explicitly lists the computing resources used for the most precise results – on the order of 10^8 to 10^9 core hours.

This immense effort serves – methodologically considered – not the **prediction** of physical quantities, but the **calibration** of free parameters to already known measured values. EBT requires **none** of these resources for the calculation of the neutron mass – a single analytical equation suffices.

While lattice QCD achieves a deviation in the percent range with hundreds of millions to billions of CPU core hours and a multi-stage fitting procedure, EBT provides a deviation in the millionth range with a single analytical equation. The difference amounts to **three orders of magnitude** – in favor of EBT.

Method	**Calculated mass**	**Experiment**	**Deviation**
Lattice QCD	$\approx 1.67 \cdot 10^{-27}\,\mathrm{kg}$	$1.67492747 \cdot 10^{-27}\,\mathrm{kg}$	$\sim$ 1–2 %
EBT	$1.67493844 \cdot 10^{-27}\,\mathrm{kg}$	$1.67492747 \cdot 10^{-27}\,\mathrm{kg}$	$6.5 \cdot 10^{-6}$

Table 5: Comparison of accuracy: lattice QCD vs. EBT

EBT, by contrast, calculates the neutron mass with **a single equation**:

$$m_n = m_p + m_e + \frac{q_0 m_e}{1 + \frac{q_0 m_e}{m_p}} \cdot \left(1 - \sqrt{1-\alpha}\right) \tag{160}$$

With a relative deviation of $6.5 \cdot 10^{-6}$ – **without tuning, without scale fixing, without supercomputer, without free parameters**.

24.5 Pions

24.5.1 Charged Pions

From the q_0–q_0 interaction between electron and proton, two charged pions arise (charge conservation):

$$\Delta m_{\pi^\pm,\mathrm{pair}} = \frac{q_0 m_e}{1 + \frac{m_e}{m_p}} = 4.990536 \cdot 10^{-28}\ \mathrm{kg}. \tag{161}$$

The mass of the single charged pion:

$$m_{\pi^\pm}(\mathrm{EBT}) = \frac{\Delta m}{2} = 2.49527 \cdot 10^{-28}\ \mathrm{kg} = 139.97\ \mathrm{MeV}/c^2. \tag{162}$$

Comparison: $m_{\pi^\pm}(\mathrm{exp}) = 2.48806 \cdot 10^{-28}$ kg $\Rightarrow$ deviation +0.29 %.

24.5.2 Neutral Pion

From the q_0–q_0 interaction of two electrons ($m_A = m_B = m_e$):

$$m_{\pi^0}(\mathrm{EBT}) = \frac{2}{\alpha} \cdot m_e = 140.05\ \mathrm{MeV}/c^2. \tag{163}$$

Comparison: $m_{\pi^0}(\mathrm{exp}) = 134.98\ \mathrm{MeV}/c^2$ $\Rightarrow$ deviation +3.76 %.

24.6 The Field Environment at the LHC: No Vacuum

The experiments at the Large Hadron Collider (LHC) are usually described as scattering processes in vacuum. From the perspective of Elementary Body Theory, this characterization is inaccurate – it misjudges the energetic reality of the measurement environment.

The main dipole magnets of the LHC generate a magnetic field strength of up to 8.3 T to keep the protons on their circular path. The high-frequency cavity resonators work with electric field strengths of 5 MV/m to accelerate the protons. Both fields are not passive observers, but **energetic interaction partners** of the accelerated elementary bodies.

In EBT, energy is always spatially embodied. A region permeated by electric and magnetic fields of this strength is therefore **not an energy-free space** – it is a space of high energy superposition. The idea of a "vacuum" in which isolated particles collide is an idealization that blanks out the interaction of the elementary bodies with the applied fields.

Phenomenologically, this means: What is measured at the LHC is **never** the interaction of two isolated protons – it is the interaction of two protons **within a massive, field-filled environment** whose energy contributions enter the measurement. The fields are part of the experiment – and thus part of the result.

24.7 Heavy Ions in Plasmatic Dream States – a Pathetic Attempt to Practically Circumvent the Confinement Thesis

The LHC is designed to accelerate protons to energies of 7 TeV and thus enable collisions with a center-of-mass energy of 14 TeV. In the range of accelerated heavy ions, such as lead nuclei, the LHC reaches energies of 2.7 TeV per nucleon; in collisions of lead nuclei with 208 nucleons, collisions at an energy of 1150 TeV thus theoretically take place. The currently second-strongest ion accelerator is the Relativistic Heavy Ion Collider (RHIC) in Brookhaven (USA), which reaches a theoretical maximum energy of about 78 TeV in collisions of gold nuclei at 0.2 TeV per nucleon. The ALICE experiment is designed to evaluate these events, with which the postulated quark-gluon plasma is to be investigated.

So much for the theory and practice of the Standard Model. But the postulated quark-gluon plasma detections are not direct experimental proofs, but strongly theory-laden interpretations of experimental results. This also applies to heavy ion collisions. The actual communication problem begins much earlier. The term "plasma" is wrong with respect to the theory objects quark and gluon.

The quark masses postulated according to the SM do not by far add up to the nucleon masses. Gluons are massless.

- Postulated up quark mass: $2.3 \pm 0.7 \pm 0.5\,\mathrm{MeV}/c^2$
- Postulated down quark mass: $4.8 \pm 0.5 \pm 0.3\,\mathrm{MeV}/c^2$
- $938.2720813(58)\,\mathrm{MeV}/c^2$ proton mass (duu): ~ 0.8–$1.2\,\%$ quark mass fraction
- $939.5654133(58)\,\mathrm{MeV}/c^2$ neutron mass (ddu): ~ 1.1–$1.4\,\%$ quark mass fraction

Thus heavy ions composed of protons and neutrons (such as lead or gold nuclei) cannot be represented by quarks and gluons either. This means that, according to the mass-energy equivalence principle, nucleons and ultimately heavy ions consist almost entirely of phenomenologically indeterminate binding energy.

Even more serious is the fact that the heavy ions are accelerated to nearly the speed of light before they collide. This means that in addition to the binding energy, a considerable amount of external energy is added. How this phenomenologically imaginably divides into translational energy and "mass equivalence" is not told to us by relativity theory.

Richard Feynman's statement "It is important to realize that in physics today, we have no knowledge of what energy is." has not changed to this day. Physics lives from secondary quantities or secondary concepts that all possess no (consistent) phenomenology.

More precisely: If 2.7 TeV per nucleon at the LHC falls to lead ions, then with a mass fraction of the quarks of about 1 %, the percentage mass fraction of the event is just 0.00035 %.

Conclusion: Not according to an opinion, but according to the state of knowledge and the postulates of the SM, in particle collisions mainly phenomenologically indeterminate accelerated energy packets –

i.e., binding energies and mainly external energy – collide with each other. Of elementary particle masses there is practically no "trace".

One can obviously "explain away" contradictions with observation in any theory by incorporating further (unverifiable) postulates into the theory that precisely "explain" this observation.

24.7.1 Brigitte Falkenburg's Analysis: Particle Metaphysics

Brigitte Falkenburg writes in *Particle Metaphysics: A Critical Account of Subatomic Reality* (2007), among other things:

> It must be made transparent step by step what physicists themselves regard as the empirical basis for today's knowledge of particle physics. And it must be transparent what they concretely mean when they speak of subatomic particles and fields. The continued use of these concepts in quantum physics leads to serious semantic problems. Modern particle physics is indeed the hardest case for incommensurability in Kuhn's sense.
>
> Finally, theory dependence is a poor criterion for distinguishing between secure background knowledge and uncertain assumptions or hypotheses.
>
> Subatomic structure does not really exist in itself. It only shows itself in a scattering experiment with a certain energy, i.e., due to an interaction. The higher the energy transfer in the interaction, the smaller the measured structures. In addition, according to the laws of quantum field theory, new structures arise at very high scattering energies. Quantum chromodynamics states that the higher the scattering energy, the more quark-antiquark pairs and gluons arise inside the nucleon. According to the model of scattering in this region, this in turn leads to scaling violations that have actually been observed. This sheds new light on Eddington's old question of whether the experimental method leads to discovery or to production. Does the interaction at a certain scattering energy reveal the measured structures or does it create them?
>
> It is not possible to trace a measured cross section back to its individual cause. No causal story relates a measured form factor or structure function to its cause.
>
> With the beams produced in particle accelerators, one can neither look into the atom, nor see subatomic structures, nor observe point-like structures inside the nucleon. Such talk is metaphorical. The only thing that makes a particle visible is the macroscopic structure of the target.
>
> Niels Bohr's quantum philosophy... Bohr's claim was that classical language is indispensable. This remains valid to this day. At the individual level of clicks in particle detectors and particle tracks on photographs, all measurement results must be expressed in classical terms. The use of the known physical quantities length, time, mass, and momentum-energy on the subatomic level is indeed due to an extrapolation of the language of classical physics into the non-classical realm.

Brigitte Falkenburg clearly shows that the experimental side of the SM also measures no analytically calculated matter within the framework of a real physical experiment. Ununderstood binding energy and kinetic energy collide here.

24.8 EBT Higgs-Like State

The q_0–q_0 interaction of a proton-antiproton pair ($m_A = m_B = m_p$):

$$\Delta m_{p\bar{p}} = \frac{q_0 m_p}{2} = \frac{2}{\alpha} \cdot m_p = 257.154 \text{ GeV}/c^2. \tag{164}$$

The mass of the two resulting states:

$$m_H(\text{EBT}) = \frac{\Delta m}{2} = 128.577 \text{ GeV}/c^2. \tag{165}$$

Comparison with the LHC value $m_H(\text{exp}) \approx 125$ GeV/c^2: deviation +2.86 %. This deviation lies within the real detector error framework (~ 5 % before SM-based post-correction to ± 0.2 GeV).

25 Proton-Antiproton Interaction and the Charge Question of the Higgs Boson

25.1 The Possible Variation from Charge Conservation

The starting point is the proton-antiproton interaction:

$$p^+ + p^- \to \text{interaction products} \tag{166}$$

Charge conservation forces:

$$(+1) + (-1) = 0 \tag{167}$$

From this, **two** possible final states result:

Interaction type	**Charge possibilities**	**Mass of the products**
Elastic	(0)(0) or $(-1)(+1)$	$(\Delta m(p^+, p^-)/2)/m_H \sim 1.02861642$
Inelastic	Exclusively (0)	$m = 4.58418826 \cdot 10^{-25}\,\text{kg}$

Table 6: Possible final states of the proton-antiproton interaction

25.2 The Elastic Variant

In elastic interaction, **two** particles arise. The charge possibilities are:

- **Two neutral particles:** (0)(0)
- **A charged pair:** $(-1)(+1)$

The mass per particle is:

$$\frac{\Delta m(p^+, p^-)}{2} \tag{168}$$

The ratio to the declared Higgs mass is:

$$\frac{\Delta m(p^+, p^-)/2}{m_H} \sim 1.02861642 \tag{169}$$

This means: **The EBT mass lies about** $2.86\,\%$ **above the LHC value.**

25.3 The Inelastic Variant

In inelastic interaction, **one** particle arises with charge (0) and the mass:

$$m = 4.58418826 \cdot 10^{-25}\,\text{kg} \tag{170}$$

This corresponds to:

$$m \approx 257.15\,\text{GeV}/c^2 \tag{171}$$

This is **exactly** the strong embodiment of the proton-antiproton system:

$$\Delta m_{p^+,p^-} = \frac{2}{\alpha} \cdot m_p \tag{172}$$

25.4 Is the "Higgs Boson" Really Neutral?

EBT poses a precise question:

> **Is the charge neutrality of the "Higgs boson" a measurement result – or an SM-theory-desired postulate?**

The answer is:

- **The "Higgs boson" is not directly detected.**
- **It is reconstructed via decay channels.**
- **The decay channels are SM-theoretically postulated.**
- **The charge neutrality is an assumption in the reconstruction process – not an independent measurement result.**

25.5 The Theory-Laden SM Decay Channels

The SM postulates decay channels for the Higgs boson such as:

$$H \to \gamma\gamma \tag{173}$$

$$H \to ZZ^* \to 4\ell \tag{174}$$

$$H \to WW^* \to \ell\nu\ell\nu \tag{175}$$

But:

- The photons are **neutral** – they carry no charge information about the original particle.
- The leptons come from **secondary decays** – their charge sum is zero, but this is **trivial** because they come from neutral intermediate states.
- **Not a single decay channel provides an independent charge measurement of the primary particle.**

25.6 The EBT Consequence

From charge conservation alone follows:

- **Elastic:** Two products – the charge possibilities $(0)(0)$ or $(-1)(+1)$ are both allowed.
- **Inelastic:** One product – charge (0) is forced.

The question of whether the "Higgs boson" is **really** neutral is experimentally **not answered** – because the charge of the primary particle is **not measured**.

25.7 Summary

Aspect	SM position	EBT position
Charge of the Higgs	Neutral (0) – postulated	Elastic: (0)(0) or (−1)(+1) possible
Mass	$125\,\mathrm{GeV}/c^2$ – measured via decay channels	$128.6\,\mathrm{GeV}/c^2$ – calculated from $2m_p/\alpha$
Direct detection	Not present	Not present
Charge measurement	Not present – only theory-laden reconstruction	Not present – but EBT shows the alternatives
Status	Postulate	Calculation with open charge question

Table 7: Comparison: SM vs. EBT on the Higgs charge question

25.8 Conclusion

EBT shows that the charge neutrality of the "Higgs boson" is **not a measurement result**, but an **SM-theory-desired assumption**. Charge conservation also allows charged final states (−1)(+1) in elastic interaction. EBT calculates the mass of the Higgs-like state from the proton-antiproton interaction as $128.6\,\mathrm{GeV}/c^2$ – within the real detector error framework of about 5 %.

The question of whether the "Higgs boson" is really neutral remains **experimentally open** – and is **not answerable** by the SM decay channel interpretations.

26 Fine Structure Splitting from the Transverse Rydberg Interaction

The fine structure splitting of the hydrogen atom is not interpreted in EBT as a relativistic correction in the sense of the Dirac equation, but as a consequence of a transverse, magnetic interaction of the embodied Rydberg quantum.

The starting point is the already derived Rydberg energy of level n:

$$E_n = \frac{E_0}{n^2},$$

where E_0 denotes the Rydberg ground energy.

The characteristic velocity of the respective level follows from the EBT relation

$$\left(\frac{r_n}{r_0}\right)\left(\frac{v_n}{c}\right)^2 = \frac{\alpha}{4}.$$

Since the interaction radius grows with the principal quantum number according to

$$r_n = n^2 r_1$$

and for the ground state the previously derived relation

$$\frac{r_1}{r_0} = \frac{1}{4\alpha}$$

holds, it follows

$$n^2 \frac{1}{4\alpha}\left(\frac{v_n}{c}\right)^2 = \frac{\alpha}{4}.$$

Thus

$$\left(\frac{v_n}{c}\right)^2 = \frac{\alpha^2}{n^2}$$

and therefore

$$\boxed{v_n = \frac{\alpha c}{n}}.$$

The transverse interaction is described in EBT by the same mass-radius correction that already leads to the Rydberg fine structure scale for the ground state. For a state with characteristic velocity v_n, the corresponding correction term is

$$\delta E_n = E_n \left[1 - \sqrt{1 - \left(\frac{v_n}{c}\right)^2}\right].$$

With

$$E_n = \frac{E_0}{n^2}$$

and

$$\left(\frac{v_n}{c}\right)^2 = \frac{\alpha^2}{n^2}$$

it follows immediately

$$\boxed{\delta E_n = \frac{E_0}{n^2}\left[1 - \sqrt{1 - \frac{\alpha^2}{n^2}}\right]}.$$

This quantity describes the magnitude of the transverse energy shift of a single fine structure branch. For small values of α, one can expand:

$$\sqrt{1-x} = 1 - \frac{x}{2} - \frac{x^2}{8} - \dots$$

with

$$x = \frac{\alpha^2}{n^2}.$$

Thus

$$1 - \sqrt{1 - \frac{\alpha^2}{n^2}} = \frac{\alpha^2}{2n^2} + \mathcal{O}(\alpha^4),$$

and consequently

$$\boxed{\delta E_n \simeq \frac{E_0 \alpha^2}{2n^4}}.$$

For the ground state $n = 1$, this yields the characteristic transverse Rydberg correction scale

$$\delta E_1 = E_0 \left(1 - \sqrt{1 - \alpha^2}\right) \simeq \frac{E_0 \alpha^2}{2}.$$

Numerically, it follows

$$\boxed{\delta E_1 = 3.6207 \times 10^{-4}\,\mathrm{eV}}.$$

This value is to be understood as the magnitude of the transverse energy shift and not as the distance between two already split fine structure levels.

Geometric Branch Structure of the Fine Structure

An observable splitting is an energy distance between two different states. Within EBT, it is therefore assumed that the transverse Rydberg interaction allows two geometrically opposite coupling states. These possess the same magnitude of the transverse correction, but opposite orientation relative to the interaction geometry:

$$E_{n,+} = E_n + \delta E_n,$$

$$E_{n,-} = E_n - \delta E_n.$$

The fine structure splitting is then the distance of these two states:

$$\Delta E_{\mathrm{FS}}(n) = E_{n,+} - E_{n,-}.$$

From this follows

$$\boxed{\Delta E_{\mathrm{FS}}(n) = 2\delta E_n}.$$

With the previously derived exact EBT correction, therefore

$$\boxed{\Delta E_{\mathrm{FS}}(n) = \frac{2E_0}{n^2}\left[1 - \sqrt{1 - \frac{\alpha^2}{n^2}}\right]}.$$

In leading order in α, it follows

$$\Delta E_{\mathrm{FS}}(n) \simeq 2 \cdot \frac{E_0 \alpha^2}{2n^4},$$

thus

$$\boxed{\Delta E_{\mathrm{FS}}(n) \simeq \frac{E_0 \alpha^2}{n^4}}.$$

The characteristic scaling of the fine structure is therefore

$$\boxed{\Delta E_{\mathrm{FS}}(n) \propto \frac{1}{n^4}}.$$

This n^{-4}-dependence arises within EBT as the product of two independent scalings:

$$E_n \propto \frac{1}{n^2}$$

and

$$\left(\frac{v_n}{c}\right)^2 \propto \frac{1}{n^2}.$$

Numerical Calculation for $n = 2$

For level $n = 2$, for a single transverse branch first

$$\delta E_2 = \frac{E_0}{4}\left[1 - \sqrt{1 - \frac{\alpha^2}{4}}\right].$$

In leading order

$$\delta E_2 \simeq \frac{E_0 \alpha^2}{32}.$$

With the ground state correction scale

$$\delta E_1 \simeq \frac{E_0 \alpha^2}{2} = 3.6207 \times 10^{-4}\,\mathrm{eV}$$

it follows

$$\delta E_2 = \frac{\delta E_1}{16} = 2.2629 \times 10^{-5}\,\mathrm{eV}.$$

The observable fine structure splitting, however, is the distance of the two opposite transverse states:

$$\Delta E_{\mathrm{FS}}(2) = 2\delta E_2.$$

Thus

$$\boxed{\Delta E_{\mathrm{FS}}(2) = 4.5259 \times 10^{-5}\,\mathrm{eV}}.$$

Equivalently, one can write:

$$\Delta E_{\mathrm{FS}}(2) = \frac{E_0 \alpha^2}{16}.$$

Referred to the transverse ground state correction scale, therefore

$$\frac{\Delta E_{\mathrm{FS}}(2)}{\delta E_1} = \frac{E_0\alpha^2/16}{E_0\alpha^2/2} = \boxed{\frac{1}{8}}.$$

The factor 1/8 thus does not arise from a subsequent normalization, but from two different quantities:

$$\delta E_1 = \frac{E_0 \alpha^2}{2}$$

is the magnitude of the transverse correction of a single ground state branch, while

$$\Delta E_{\mathrm{FS}}(2) = \frac{E_0 \alpha^2}{16}$$

describes the distance of two oppositely shifted transverse states in level $n = 2$.
The comparison with the experimental value

$$\Delta E_{\mathrm{FS}}(2)_{\mathrm{exp}} \approx 4.536 \times 10^{-5}\,\mathrm{eV}$$

yields

$$\frac{\Delta E_{\mathrm{FS}}(2)_{\mathrm{EBT}}}{\Delta E_{\mathrm{FS}}(2)_{\mathrm{exp}}} = 0.9977,$$

thus a relative deviation of

$$\boxed{-0.23\,\%}.$$

The fine structure splitting thus appears in EBT as an immediate consequence of

$$E_n \propto n^{-2}, \qquad v_n \propto n^{-1},$$

the transverse mass-radius correction

$$1 - \sqrt{1 - \left(\frac{v_n}{c}\right)^2}$$

and the geometric branch structure of two opposite transverse coupling states.

The only additional structural prerequisite of this derivation is the assumption that the transverse interaction geometry allows two energetically symmetric orientations

$$+\delta E_n \qquad \text{and} \qquad -\delta E_n$$

This branch structure must be justified from the EBT sphere or channel geometry; the factor 2 is not numerically adjusted, but is the distance between these two states.

26.1 Geometric Derivation of the Transverse Branch Structure

The fine structure splitting presupposes that the transverse interaction not only produces a positive correction magnitude, but possesses two energetically distinguishable states of equal magnitude geometry.

This branch structure follows in EBT from the radial symmetry of the spherical surface dynamics. For an elementary body with radius vector $\mathbf{r}_n$ and transverse motion $\mathbf{v}_{\perp,n}$, the orientation of the transverse interaction can be described by

$$\mathbf{L}_n = \mathbf{r}_n \times \mathbf{v}_{\perp,n}.$$

The magnitude of this quantity is

$$|\mathbf{L}_n| = r_n v_{\perp,n}$$

for perpendicular transverse motion. Due to radial symmetry, however, two opposite orientations of equal magnitude geometry exist:

$$\mathbf{L}_n^{(+)} = +\mathbf{L}_n, \qquad \mathbf{L}_n^{(-)} = -\mathbf{L}_n.$$

The reversal of the transverse orientation therefore does not change the magnitude of the interaction,

$$|\mathbf{L}_n^{(+)}| = |\mathbf{L}_n^{(-)}|,$$

but its orientation relative to the interaction geometry.

To describe these two geometric possibilities, the orientation variable

$$\sigma = \pm 1$$

is introduced.

The magnitude of the transverse energy shift is still determined solely by the previously derived EBT mass-radius correction:

$$\delta E_n = \frac{E_0}{n^2}\left[1 - \sqrt{1 - \frac{\alpha^2}{n^2}}\right].$$

The orientation variable does not change this magnitude, but fixes merely the relative orientation of the transverse coupling:

$$\boxed{\delta E_{n,\sigma} = \sigma\, \delta E_n}, \qquad \sigma = \pm 1.$$

Thus two energetic branches arise:

$$E_{n,+} = E_n + \delta E_n,$$

$$E_{n,-} = E_n - \delta E_n.$$

The emergence of the sign is to be distinguished from the emergence of the correction magnitude. The factor

$$\left(\frac{v_n}{c}\right)^2$$

determines exclusively the size of the transverse energy change and is necessarily positive. The sign, by contrast, results from the spatial orientation of the transverse interaction.

This can also be understood geometrically as a coupling of two transverse orientation vectors. Let $\hat{\mathbf{t}}_n$ be the orientation of the transverse motion and $\hat{\mathbf{k}}$ the distinguished orientation direction of the interaction geometry. Then the orientation-dependent coupling has the form

$$\delta E_{n,\mathrm{orient}} = \delta E_n \left(\hat{\mathbf{t}}_n \cdot \hat{\mathbf{k}}\right).$$

For the two extreme, energetically distinguishable orientations

$$\hat{\mathbf{t}}_n \cdot \hat{\mathbf{k}} = \cos(0) = +1$$

or

$$\hat{\mathbf{t}}_n \cdot \hat{\mathbf{k}} = \cos(\pi) = -1.$$

Thus it follows immediately

$$\delta E_{n,+} = +\delta E_n, \qquad \delta E_{n,-} = -\delta E_n.$$

The branch structure is thus not an additional numerical normalization, but the consequence of two opposite orientations of the same transverse interaction.

The observable fine structure splitting is the energy distance of these two states:

$$\Delta E_{\mathrm{FS}}(n) = E_{n,+} - E_{n,-}.$$

Inserting yields

$$\Delta E_{\mathrm{FS}}(n) = (E_n + \delta E_n) - (E_n - \delta E_n),$$

and thus

$$\boxed{\Delta E_{\mathrm{FS}}(n) = 2\delta E_n}.$$

The factor 2 is thus not numerically adjusted. It arises exclusively as the distance of the two geometrically opposite orientation states:

$$\boxed{2 = (+1) - (-1)}.$$

With the EBT correction

$$\delta E_n = \frac{E_0}{n^2}\left[1 - \sqrt{1 - \frac{\alpha^2}{n^2}}\right]$$

the complete fine structure splitting therefore follows:

$$\boxed{\Delta E_{\mathrm{FS}}(n) = \frac{2E_0}{n^2}\left[1 - \sqrt{1 - \frac{\alpha^2}{n^2}}\right]}.$$

For small α,

$$1 - \sqrt{1 - \frac{\alpha^2}{n^2}} \simeq \frac{\alpha^2}{2n^2},$$

so that

$$\boxed{\Delta E_{\mathrm{FS}}(n) \simeq \frac{E_0\alpha^2}{n^4}}.$$

The fine structure splitting thus results in EBT from three separate geometric components:

$$E_n \propto \frac{1}{n^2}$$

for the electric level energy,

$$v_n^2 \propto \frac{1}{n^2}$$

for the magnitude of the transverse correction, and

$$\sigma = \pm 1$$

for the two opposite orientations of the transverse coupling geometry.

The factor 2 is therefore not a fit parameter and no subsequent normalization, but the geometric distance between the two orientation branches $+\delta E_n$ and $-\delta E_n$.

27 Hyperfine Structure of the Hydrogen Ground State in EBT

27.1 Introduction

The hyperfine structure of the hydrogen ground state is understood within Elementary Body Theory as the magnetic analogue to electric superposition. Proton and electron are not treated as point-like objects, but as real, mass-radius-coupled elementary bodies. The hyperfine structure arises from their magnetic embodiment in geometric superposition in the common origin.

The energy splitting thus results from already existing EBT quantities: the transverse ground scale of the bound system, the full energetic saturation in the near range, the universal contact normalization, the previously independently derived magnetic embodiment factors of electron and proton, and the superposition mass following from the radius addition.

27.2 Phenomenological Principle: Magnetic Analogue to Electric Superposition

In EBT, electron and proton each possess a mass-inherent radius. When both bodies couple magnetically in the hydrogen ground state in the common origin, their real spatial embodiments superimpose.

The hyperfine structure is therefore not an additional abstract spin-spin interaction, but the energetic consequence of this magnetic contact geometry. The governing factors of the HFS formula must therefore stem directly from the EBT geometry and the already derived magnetic embodiments of the two elementary bodies.

27.3 The Energetic Basis: Magnetic Ground Scale

27.3.1 Transverse Ground Energy

The HFS is based on the transverse magnetic interaction of the already bound hydrogen system. The associated energy scale is:

$$\boxed{E_0 = E_{\mathrm{Ry}}\, f^2.}$$

Here E_{Ry} is the Rydberg energy determined within EBT from the electric binding and f^2 the geometric evolution factor:

$$\boxed{f^2 = 1 - \sqrt{1-\alpha^2}.}$$

Numerically:

$$\boxed{E_0 \approx 3.6207 \times 10^{-4}\,\mathrm{eV}.}$$

This quantity describes the energy of the transverse interaction of the embodied Rydberg quantum and is thus the magnetic ground scale on which the hyperfine structure builds.

27.3.2 Transfer to the Proton Scale

The magnetic interaction of the bound electron-proton system must additionally be transferred to the proton scale. This happens through the mass ratio:

$$\boxed{\frac{m_e}{m_p}.}$$

Thus the magnetic base scale of the HFS is initially:

$$\boxed{E_{\mathrm{Base}} = E_0 \frac{m_e}{m_p} = E_{\mathrm{Ry}} f^2 \frac{m_e}{m_p}.}$$

27.4 The Factor 4: Full Energetic Saturation

27.4.1 Electric Fraction

Within EBT, for the electric elementary charge in relation to the complete elementary body charge:

$$\boxed{\frac{e^2}{q_0^2} = \frac{\alpha}{4}.}$$

The electric channel thus carries only the fraction 1/4 of the complete mass-radius-coupled energetic embodiment.

27.4.2 Transition to the Magnetic Near Range

The hyperfine structure is a magnetic contact interaction in the common origin. In the immediate near range, the interaction is no longer reduced to the electric fraction 1/4, but couples with full energetic saturation:

$$\frac{4}{4} = 1.$$

Relative to the electric fraction, therefore:

$$\frac{4/4}{1/4} = 4.$$

Thus the near-range factor follows:

$$\boxed{G_{\mathrm{Saturation}} = 4.}$$

The factor 4 is thus the measure for the restoration of the full energetic effect strength in the magnetic contact region compared to the reduced electric far effect.

27.5 The Geometric Contact Factor 8/3

The HFS interaction takes place in the common origin. Therefore, the same universal EBT contact normalization applies as in other radial near-range interactions.

27.5.1 EBT Normalization of the Sphere Geometry

The complete Euclidean angle integration over the sphere is:

$$4\pi.$$

The Freyling intervention leads within EBT to the geometric effect ratio:

$$\frac{2}{\pi}.$$

The transfer of Euclidean sphere geometry into the EBT effect unit yields:

$$4\pi \cdot \frac{2}{\pi} = 8.$$

Thus:

$$\boxed{G_{\text{Sphere}} = 8.}$$

27.5.2 Isotropic Radial Projection

The interaction at the common origin is a radial or longitudinal probe. For an isotropic three-dimensional geometry, the mean quadratic portion of one spatial direction is:

$$\left\langle \cos^2 \theta \right\rangle = \frac{1}{3}.$$

Thus:

$$\boxed{G_{\text{radial}} = \frac{1}{3}.}$$

27.5.3 Contact Normalization

Both geometric factors are combined:

$$G_{\text{Contact}} = G_{\text{Sphere}} G_{\text{radial}}.$$

Thus:

$$\boxed{G_{\text{Contact}} = 8 \cdot \frac{1}{3} = \frac{8}{3}.}$$

27.6 The EBT-g-Factors

The hyperfine structure uses the magnetic embodiment factors of the electron and the proton. These are not introduced only for the HFS, but are already derived within EBT from the magnetic field embodiment formalism.

27.6.1 Electron-g-Factor

For the electron, the EBT fine adjustment is:

$$\boxed{f_e^{(\mathrm{EBT})} = \frac{\alpha}{2\pi}\,\frac{1+\frac{\alpha}{8}+\left(\frac{\alpha}{8}\right)^2+\left(\frac{\alpha}{8}\right)^3}{1+\frac{\alpha}{3}}.}$$

The factor $\alpha/(2\pi)$ describes the magnetic field embodiment. The series in $\alpha/8$ describes the fractal back-reaction of the embodied field on the elementary body. The factor $\alpha/8$ is connected with the quadratic surface scaling of the magnetic coupling to the spherical surface. The denominator $1+\alpha/3$ describes the spatial coupling; the factor $1/3$ corresponds to the isotropic averaging over three spatial directions.

The electron g-factor follows from this as:

$$\boxed{g_e^{(\mathrm{EBT})} = 2\left(1+f_e^{(\mathrm{EBT})}\right).}$$

Numerically:

$$\boxed{g_e^{(\mathrm{EBT})} = 2.00231930436182.}$$

27.6.2 Proton-g-Factor

The proton g-factor is transferred within EBT from the same magnetic field embodiment to the proton scale:

$$\boxed{g_p^{(\mathrm{EBT})} = 2\left[\left(\frac{\alpha}{2\pi f_e^{(\mathrm{EBT})}}-1\right)\frac{m_p}{m_e}\left(1+f_e^{(\mathrm{EBT})}\right)\frac{1+\alpha/3}{1+(\alpha/8)^2}\right].}$$

The ratio m_p/m_e transfers the magnetic embodiment to the proton scale. The factor $1+f_e^{(\mathrm{EBT})}$ uses the already corrected electron embodiment as reference. The quotient

$$\frac{1+\alpha/3}{1+(\alpha/8)^2}$$

contains the spatial and surface-related correction.

Numerically:

$$\boxed{g_p^{(\mathrm{EBT})} = 5.585694698.}$$

27.6.3 Use in the HFS

The normalized magnetic embodiment portions enter the HFS equation:

$$\boxed{\frac{g_e^{(\mathrm{EBT})}}{2}\cdot\frac{g_p^{(\mathrm{EBT})}}{2}.}$$

These quantities are preliminary results of the EBT derivation of the magnetic moments and are not newly adjusted in the hyperfine structure.

27.7 The Geometric Superposition Mass

The last scaling factor of the HFS follows immediately from the addition of the mass-inherent radii of electron and proton in the common origin.

27.7.1 Radius Addition

For both elementary bodies, the EBT invariant holds:

$$m_e r_e = F_{\mathrm{EB}}, \qquad m_p r_p = F_{\mathrm{EB}}.$$

Thus:

$$r_e = \frac{F_{\mathrm{EB}}}{m_e}, \qquad r_p = \frac{F_{\mathrm{EB}}}{m_p}.$$

In the common origin, the two radii add:

$$\boxed{r_{\mathrm{total}} = r_e + r_p.}$$

27.7.2 Resulting Superposition Mass

For the common interaction radius, again:

$$m_{\mathrm{total}} = \frac{F_{\mathrm{EB}}}{r_{\mathrm{total}}}.$$

Inserting the two radii yields:

$$m_{\mathrm{total}} = \frac{F_{\mathrm{EB}}}{\frac{F_{\mathrm{EB}}}{m_e} + \frac{F_{\mathrm{EB}}}{m_p}}.$$

After canceling F_{EB}:

$$m_{\mathrm{total}} = \frac{1}{1/m_e + 1/m_p}.$$

Multiplying numerator and denominator by m_e, one obtains:

$$\boxed{m_{\mathrm{total}} = \frac{m_e}{1 + m_e/m_p}.}$$

Thus for the dimensionless geometric superposition scale:

$$\boxed{\frac{m_{\mathrm{total}}}{m_e} = \frac{1}{1 + m_e/m_p}.}$$

This factor is in EBT not a subsequent recoil correction, but the direct consequence of the radius addition of two mass-radius-coupled elementary bodies in the common origin.

27.8 The Complete EBT-HFS Formula

All previously independently justified factors are now combined:

$$\boxed{\Delta E_{\mathrm{HFS}} = \left(E_{\mathrm{Ry}} f^2 \frac{m_e}{m_p}\right) \cdot 4 \cdot \frac{8}{3} \cdot \frac{g_e^{(\mathrm{EBT})}}{2} \cdot \frac{g_p^{(\mathrm{EBT})}}{2} \cdot \frac{1}{1 + m_e/m_p}.}$$

With $E_0 = E_{\mathrm{Ry}} f^2$, the same equation can also be written as:

$$\boxed{\Delta E_{\mathrm{HFS}} = E_0 \frac{m_e}{m_p} \cdot 4 \cdot \frac{8}{3} \cdot \frac{g_e^{(\mathrm{EBT})}}{2} \cdot \frac{g_p^{(\mathrm{EBT})}}{2} \cdot \frac{1}{1 + m_e/m_p}.}$$

27.9 Numerical Evaluation

With the magnetic ground scale

$$E_0 \approx 3.6207 \times 10^{-4}\,\mathrm{eV},$$

the EBT-g-factors

$$g_e^{(\mathrm{EBT})} = 2.00231930436182$$

and

$$g_p^{(\mathrm{EBT})} = 5.585694698,$$

as well as the remaining geometric factors:

$$\boxed{\Delta E_{\mathrm{HFS}}^{(\mathrm{EBT})} \approx 5.878 \times 10^{-6}\,\mathrm{eV}.}$$

The comparison value of the 21-cm line is:

$$\boxed{\Delta E_{\mathrm{HFS}}^{(\mathrm{exp})} = 5.87433 \times 10^{-6}\,\mathrm{eV}.}$$

The deviation is thus approximately:

$$\boxed{0.06\,\%.}$$

27.10 Summary of the Equation Terms

Term	**EBT-internal meaning**
$E_{\mathrm{Ry}} f^2 = E_0$	Transverse magnetic ground scale of the already bound Rydberg system.
m_e/m_p	Transfer of the magnetic base scale to the proton scale.
4	Restoration of the full energetic saturation in the magnetic near range compared to the electric fraction 1/4.
8/3	Universal EBT contact normalization from $4\pi \cdot 2/\pi = 8$ and radial projection 1/3.
$g_e^{(\mathrm{EBT})}/2$	Magnetic embodiment of the electron from the previously derived fractal field coupling.
$g_p^{(\mathrm{EBT})}/2$	Magnetic embodiment of the proton from the previously derived transfer to the proton scale.
$1/(1 + m_e/m_p)$	Geometric superposition scale from the addition of the mass-inherent radii $r_e + r_p$.

Result. The hyperfine structure of the hydrogen ground state is described in EBT as magnetic contact superposition of two really extended, mass-radius-coupled elementary bodies. All factors of the HFS equation are constructed from already existing EBT quantities and the geometry of the common origin.

28 Lamb Shift (2s–2p) in EBT

The geometric near-range correction from electric and magnetic self-embodiment

28.1 Introduction

The Lamb shift is not understood within Elementary Body Theory as a consequence of vacuum fluctuations of virtual particles. Rather, it is described as a measurable energetic difference between two geometrically different embodiment situations of the bound electron. Decisive is thereby the physical near-range contact of the $2s$-state with the proton compared to the transverse distance of the $2p$-state.

In EBT, electron and proton are not point-like objects, but real radially extended elementary bodies. The Lamb shift therefore arises not from a correction of an abstract point-particle potential, but from the changed electric and magnetic self-embodiment of the electron as soon as its real spatial structure reaches the immediate contact region of the proton.

Methodological starting point: The derivation is constructed from already existing EBT quantities. The magnetic ground scale, the contact normalization 8/3, the electric coupling α^2, the elementary body constant F_{EB}, the elementary body charge q_0, and the evolution time t_0 are not back-determined from the measured Lamb shift.

28.2 The Phenomenological Principle: Contact versus Distance

The decisive difference between the $2s$- and the $2p$-state lies in their geometry at the origin. The $2s$-state possesses a non-zero embodiment density at the origin. Its real spatial extension therefore reaches the immediate contact region of the proton and physically probes the changed interaction geometry there.

The $2p$-state, by contrast, is geometrically separated from the origin by its transverse structure. It does not possess the same immediate contact geometry. The Lamb shift is thus within EBT the energetic difference between these two real spatial situations:

$$\boxed{\Delta E_{\mathrm{Lamb}} = E_{2s}^{(\mathrm{Contact})} - E_{2p}^{(\mathrm{Distance})}.}$$

The contact of the $2s$-state changes two energetic components: the magnetic embodiment and the electric self-embodiment. The complete Lamb shift results from the cooperation of both contributions.

28.3 The Magnetic Ground Scale

28.3.1 The Electric Ground Scale E_0

The near-range calculation begins with an energy scale already present within EBT. It is not introduced specifically for the Lamb shift, but describes the transverse interaction energy of the embodied Rydberg quantum:

$$\boxed{E_0 = E_{\mathrm{Ry}}\, f^2.}$$

The geometric evolution factor is:

$$\boxed{f^2 = 1 - \sqrt{1-\alpha^2}.}$$

Its basis is the characteristic electric coupling velocity

$$v = \alpha c.$$

Thus E_0 is an EBT ground scale already fixed before the Lamb shift calculation. It forms the energetic starting basis both for the magnetic near-range correction and for the electric self-embodiment.

28.3.2 The Factor $\alpha/(2\pi)$

The factor

$$\frac{\alpha}{2\pi}$$

is not interpreted in EBT as a loop correction of virtual particles. It describes the effect ratio of the electric elementary charge to the complete elementary body embodiment and thus marks the magnetic-transverse conversion of the electric coupling.

It is consequently an effect factor already present in EBT and not a number subsequently determined from the Lamb shift.

28.3.3 The Factor 4: Full Energetic Saturation

In the electric far region, the interaction appears as a reduced portion of the complete elementary body embodiment. In the immediate contact region of the proton, this geometric reduction is canceled. The interaction couples there with full energetic saturation:

$$\frac{4}{4} = 1.$$

The corresponding transition from the reduced electric fraction to the complete near-range effectiveness provides the factor:

$$\boxed{\frac{1}{1/4} = 4.}$$

28.3.4 The Geometric Contact Factor 8/3

The contact normalization arises from two mutually independent geometric steps.

First, the complete Euclidean sphere geometry

$$4\pi$$

is transferred into the EBT effect geometry with the EBT ratio resulting from the Freyling intervention

$$\frac{2}{\pi}$$

as:

$$4\pi \cdot \frac{2}{\pi} = 8.$$

Thus for the normalized sphere geometry:

$$\boxed{G_{\text{Sphere}} = 8.}$$

The contact at the origin is additionally a radial or longitudinal probe of an isotropic three-dimensional geometry. For the quadratic radial projection:

$$\langle \cos^2 \theta \rangle = \frac{1}{3}.$$

Thus one obtains:

$$\boxed{G_{\text{Contact}} = 8 \cdot \frac{1}{3} = \frac{8}{3}.}$$

28.3.5 Magnetic Base Value

The four already justified quantities are now combined:

$$\boxed{\Delta E^{(0)}_{\text{mag}} = E_{\text{Ry}} \cdot f^2 \cdot \frac{\alpha}{2\pi} \cdot 4 \cdot \frac{8}{3}.}$$

With $E_0 = E_{\text{Ry}} f^2$, this can be written more compactly as:

$$\boxed{\Delta E^{(0)}_{\text{mag}} = E_0 \cdot \frac{\alpha}{2\pi} \cdot 4 \cdot \frac{8}{3}.}$$

Numerically:

$$\boxed{\Delta E^{(0)}_{\text{mag}} \approx 4.485 \times 10^{-6}\ \text{eV}.}$$

28.4 The Magnetic Near-Range Correction

The magnetic ground scale alone does not yet describe the complete contact geometry. In the near range, two real elementary bodies superimpose. Therefore, the interaction is not one-sided. The magnetic flux of the electron acts on the proton, while the proton reacts magnetically to this action.

28.4.1 Action: Flux through the Proton Region

For the magnetic flux density of the proton in the contact region, the following is used:

$$B_p = \frac{\mu_0}{4\pi}\frac{f_p \alpha}{r_p^2}.$$

The corresponding proton contact area leads to the magnetic flux:

$$\boxed{\Phi_p = \frac{\mu_0}{2} f_p \alpha \frac{r_e}{r_p}.}$$

28.4.2 Reaction: Induced Counter-Flux

The electron flux generates a magnetic counter-reaction in the proton. The electron portion is:

$$\Phi_e = \frac{\mu_0}{2}\alpha.$$

Including the protonic magnetic factor f_p:

$$\boxed{\Phi_{\text{ind}} = f_p \Phi_e = \frac{\mu_0}{2} f_p \alpha.}$$

28.4.3 Total Flux from Action and Reaction

The physically effective contact interaction is the sum of both contributions:

$$\Phi_{\text{total}} = \Phi_p + \Phi_{\text{ind}}.$$

Thus:

$$\boxed{\Phi_{\text{total}} = \frac{\mu_0}{2} f_p \alpha \left(\frac{r_e}{r_p} + 1\right).}$$

This sum already contains action and reaction completely. An additional doubling would double-count the same contact interaction.

28.5 The EBT Energy-Flux Translation Rule

To convert the total magnetic flux into an energy, EBT uses its own energy-flux translation rule. It consists exclusively of already existing EBT quantities.

28.5.1 Elementary Body Constant

$$\boxed{F_{\mathrm{EB}} = m_0 r_0 = \frac{2h}{\pi c} = \frac{4\hbar}{c}.}$$

F_{EB} forms the fundamental mass-radius action scale of the theory.

28.5.2 Elementary Body Charge

$$\boxed{q_0 = \sqrt{8\varepsilon_0 h c}.}$$

q_0 normalizes the magnetic interaction to the complete energetic charge embodiment of the elementary body.

28.5.3 Evolution Time

The spatial embodiment is in EBT a dynamic process. The characteristic evolution time is:

$$\boxed{t_0 = \frac{\pi}{2}\frac{r_0}{c}.}$$

Through $1/t_0$, the geometric effect is related to a temporal energy evolution.

28.5.4 Conversion Factor

The complete translation rule is:

$$\boxed{K_{\Phi E} = \frac{2}{\mu_0} \cdot \frac{F_{\mathrm{EB}}}{q_0 t_0}.}$$

Written out:

$$\boxed{K_{\Phi E} = \frac{2}{\mu_0} \cdot \frac{2h}{\pi c} \cdot \frac{1}{q_0} \cdot \frac{1}{t_0}.}$$

28.5.5 Origin of the Factor $2/\mu_0$

The factor $2/\mu_0$ is the inverse normalization of the quantity $\mu_0/2$ already occurring in the contact flux geometry. Inserting the total flux into the energy relation,

$$E_{\mathrm{EBT}} = K_{\Phi E}\Phi_{\mathrm{total}},$$

yields:

$$E_{\mathrm{EBT}} = \left[\frac{2}{\mu_0}\frac{F_{\mathrm{EB}}}{q_0 t_0}\right]\left[\frac{\mu_0}{2} f_p \alpha \left(\frac{r_e}{r_p} + 1\right)\right].$$

The magnetic normalization cancels exactly:

$$\boxed{\frac{2}{\mu_0} \cdot \frac{\mu_0}{2} = 1.}$$

Thus remains:

$$\boxed{E_{\mathrm{EBT}} = \frac{F_{\mathrm{EB}}}{q_0 t_0} f_p \alpha \left(\frac{r_e}{r_p} + 1\right).}$$

28.5.6 Dimensional Consistency

For the participating quantities:

$$\left[\frac{1}{\mu_0}\right] = \mathrm{A}^2\mathrm{s}^2\mathrm{kg}^{-1}\mathrm{m}^{-1},$$

$$[F_{\mathrm{EB}}] = \mathrm{kg\,m}, \qquad [q_0] = \mathrm{A\,s}, \qquad [t_0] = \mathrm{s}.$$

Therefore:

$$[K_{\Phi E}] = \mathrm{A}.$$

The magnetic flux has the unit:

$$[\Phi] = \mathrm{Wb} = \frac{\mathrm{J}}{\mathrm{A}}.$$

Thus:

$$\boxed{[K_{\Phi E}\Phi] = \mathrm{A} \cdot \frac{\mathrm{J}}{\mathrm{A}} = \mathrm{J}.}$$

The energy-flux translation is thus dimensionally consistent and uses no additional empirical conversion constant.

28.5.7 Magnetic Correction Factor

From the action-reaction geometry, for the relevant near-range contribution in leading form:

$$\boxed{\delta_{\mathrm{Near}}^{(\mathrm{mag})} = 1 - f_p\alpha.}$$

The corrected magnetic Lamb shift contribution is therefore:

$$\boxed{\Delta E_{\mathrm{mag}} = \Delta E_{\mathrm{mag}}^{(0)}(1 - f_p\alpha).}$$

Completely inserted:

$$\boxed{\Delta E_{\mathrm{mag}} = E_0 \frac{\alpha}{2\pi} \cdot 4 \cdot \frac{8}{3}(1 - f_p\alpha).}$$

28.6 The Electric Self-Embodiment in the Near Range

In addition to the magnetic contact interaction, the immediate proton contact changes the electric self-embodiment of the $2s$-electron. The proton is a really extended elementary body. Its spatial-energetic embodiment therefore changes the geometry in which the electric self-embodiment of the electron can form at the origin.

The $2s$-state is immediately affected by this change because its embodiment density at the origin is non-zero. The $2p$-state does not possess this immediate contact geometry. The electric contribution to the Lamb shift therefore describes the reduction of the electric self-embodiment of the $2s$-state in the common near range.

28.6.1 Energetic Ground Scale

Also for this contribution, no new energy quantity is required. The starting point is the same already independently determined transverse ground scale:

$$\boxed{E_0 = E_{\mathrm{Ry}} f^2.}$$

28.6.2 Geometric Contact Factor

Since again an immediate radial contact of two elementary bodies is present, the same EBT contact normalization applies:

$$\boxed{G_{\text{Contact}} = \left(4\pi \frac{2}{\pi}\right) \left\langle \cos^2 \theta \right\rangle = 8 \cdot \frac{1}{3} = \frac{8}{3}.}$$

28.6.3 Double Electric Coupling

The electric near-range change affects two electrically coupled elementary bodies. The electron enters the contact region with its electric coupling α; at the same time, the protonic change of the electric contact geometry is also determined by the same electric coupling strength.

Therefore, for the bilateral electric coupling:

$$\boxed{\alpha \cdot \alpha = \alpha^2.}$$

The factor α^2 is thus not a quantity subsequently introduced to close a numerical difference, but the product of the two electric couplings in the common contact region.

28.6.4 Sign

The immediate proton contact reduces the undisturbed electric self-embodiment of the $2s$-state. The corresponding energy contribution is therefore negative:

$$\boxed{\Delta E_{\text{elec}} < 0.}$$

28.6.5 Electric Near-Range Term

The three independently determined components are now combined:

$$\boxed{\Delta E_{\text{elec}} = -E_0 \cdot \frac{8}{3} \cdot \alpha^2.}$$

Thus the structure of the term is completely visible:

$$\boxed{\Delta E_{\text{elec}} = -\underbrace{E_0}_{\text{Ground scale}} \underbrace{\frac{8}{3}}_{\text{Contact geometry}} \underbrace{\alpha^2}_{\text{bilateral electric coupling}}.}$$

Numerically:

$$\boxed{\Delta E_{\text{elec}} \approx -0.0514 \times 10^{-6} \text{ eV}.}$$

28.7 The Complete EBT-Lamb-Shift Formula

The Lamb shift is thus composed of two real near-range contributions:

- the magnetic self-embodiment including the action-reaction correction,
- the electric self-embodiment in the immediate contact region.

The complete EBT formula is:

$$\boxed{\Delta E_{\text{Lamb}}^{(\text{EBT})} = \Delta E_{\text{mag}}^{(0)}(1 - f_p\alpha) - E_0\frac{8}{3}\alpha^2.}$$

With

$$\Delta E_{\text{mag}}^{(0)} = E_0\frac{\alpha}{2\pi}\cdot 4\cdot\frac{8}{3}$$

it follows:

$$\boxed{\Delta E_{\text{Lamb}}^{(\text{EBT})} = E_0\frac{\alpha}{2\pi}\cdot 4\cdot\frac{8}{3}(1 - f_p\alpha) - E_0\frac{8}{3}\alpha^2.}$$

And with

$$E_0 = E_{\text{Ry}}\left(1 - \sqrt{1-\alpha^2}\right)$$

the completely written-out EBT form results:

$$\boxed{\Delta E_{\text{Lamb}}^{(\text{EBT})} = E_{\text{Ry}}\left(1 - \sqrt{1-\alpha^2}\right)\left[\frac{\alpha}{2\pi}\cdot 4\cdot\frac{8}{3}(1 - f_p\alpha) - \frac{8}{3}\alpha^2\right].}$$

28.8 Numerical Evaluation

28.8.1 Magnetic Base Value

$$\Delta E_{\text{mag}}^{(0)} \approx 4.485\times 10^{-6}\ \text{eV}.$$

28.8.2 Magnetic Near-Range Correction

With

$$1 - f_p\alpha \approx 0.9869$$

it follows:

$$\Delta E_{\text{mag}} = 4.485\times 10^{-6}\ \text{eV}\cdot 0.9869 \approx 4.4263\times 10^{-6}\ \text{eV}.$$

28.8.3 Electric Self-Embodiment

$$\Delta E_{\text{elec}} \approx -0.0514\times 10^{-6}\ \text{eV}.$$

28.8.4 Total Result

$$\Delta E_{\text{Lamb}}^{(\text{EBT})} = 4.4263\times 10^{-6} - 0.0514\times 10^{-6}\ \text{eV}.$$

Thus:

$$\boxed{\Delta E_{\text{Lamb}}^{(\text{EBT})} = 4.3749\times 10^{-6}\ \text{eV}.}$$

This corresponds to the used comparison value:

$$\boxed{\nu_{\text{Lamb}} = 1057.844\ \text{MHz}.}$$

28.9 Methodological Classification

The complete derivation can be decomposed into three mutually separate levels. First, an already existing EBT ground scale is used. Second, the near-range factors are justified geometrically and energetically. Third, the numerical comparison takes place only afterwards.

Building block	**EBT-internal meaning**
$E_0 = E_{\mathrm{Ry}} f^2$	Already existing transverse electric ground scale.
$\alpha/(2\pi)$	Effect ratio of the electric to the complete elementary body embodiment.
4	Transition to full energetic saturation in the immediate near range.
8/3	EBT-normalized sphere geometry $4\pi \cdot 2/\pi = 8$ and radial projection 1/3.
$1 - f_p\alpha$	Magnetic near-range correction from action and reaction.
$K_{\Phi E}$	Dimensionally consistent energy-flux translation rule from $F_{\mathrm{EB}}, q_0, t_0$ and $2/\mu_0$.
α^2	Bilateral electric coupling in the common contact region.
Negative sign of the electric term	Reduction of the electric self-embodiment of the $2s$-state in immediate proton contact.

Working conclusion: The Lamb shift appears in EBT as a geometric-energetic near-range correction of really extended elementary bodies. The $2s$-state enters into immediate contact with the proton geometry; thereby its magnetic and electric self-embodiment change. The complete formula is constructed from already existing EBT quantities and only afterwards compared with the observed value.

29 The Arithmetic Series of Action Analogies

The key to the channel ladder lies not in the masses themselves, but in the product of interaction radius r and channel velocity v. This product is interpreted in EBT as an energetic analogy to angular momentum $L = r \cdot m \cdot v$, without a real rotation taking place. If one considers the four channels, for the product $r \cdot v$ – relative to the maximum value $r_0 \cdot c$ – an exact arithmetic progression results:

1. **e–e channel (Rydberg):**

$$r = \frac{r_0}{4\alpha}, \quad v = \alpha c \quad \Longrightarrow \quad r \cdot v = \frac{1}{4} r_0 c \tag{176}$$

2. **e–q_0 channel (neutron):**

$$r = \frac{r_0}{2\sqrt{\alpha}}, \quad v = \sqrt{\alpha} c \quad \Longrightarrow \quad r \cdot v = \frac{2}{4} r_0 c \tag{177}$$

3. **Muon channel:** Implicitly via the factor $(1 - 1/4)$:

$$r \cdot v = \frac{3}{4} r_0 c \tag{178}$$

4. **q_0–q_0 channel (pion):**

$$r = r_0, \quad v = c \quad \Longrightarrow \quad r \cdot v = \frac{4}{4} r_0 c \tag{179}$$

Multiplying this with the invariant mass m_0 and using the mass-radius constant equation $m_0 r_0 c = (2h/\pi c) \cdot c = 2h/\pi$, one obtains exactly the step ladder of the action analogies:

$$\frac{1}{4} \cdot \frac{2h}{\pi} = \frac{h}{2\pi} = 1\hbar \tag{16.5.1}$$

$$\frac{2}{4} \cdot \frac{2h}{\pi} = 2\hbar \tag{16.5.2}$$

$$\frac{3}{4} \cdot \frac{2h}{\pi} = 3\hbar \tag{16.5.3}$$

$$\frac{4}{4} \cdot \frac{2h}{\pi} = 4\hbar \tag{16.5.4}$$

The channel ladder is thus not an arbitrary compilation of particle masses, but a strictly geometrically founded sequence of discrete action stages.

29.0.1 Why the Muon Factor $(1 - 1/4)$ *Is Not an "Adjustment"*

The factor $(1 - 1/4)$ is the compelling logical consequence of the 3rd stage ($3\hbar$) in this geometric ladder. The muon is not inserted here as a "foreign body" to fill a gap, but it is the phenomenologically necessary "missing link" between the pion ($4\hbar$, full strong embodiment) and the electric ground state ($1\hbar$).

The decay $\pi \to \mu \to e$ is in this reading nothing other than the stepwise traversal of these discrete action stages from $4\hbar$ via $3\hbar$ down to $1\hbar$, whereby mass-bound energy is transformed into radius-bound space energy. The muon is thus not a random particle that is subsequently fitted into a scheme, but the natural consequence of the fact that nature allows only discrete stages of energetic coupling in the superposition of elementary bodies.

29.0.2 Why There Are No Further Channels – the Natural Limit

The answer is provided by the geometry of the elementary body itself:

- The radius r can be at most r_0 (the fully formed elementary body in the rest state).
- The velocity v can be at most c (the limit of the speed of light).

The maximum of the product $r \cdot v$ is thus $r_0 \cdot c$. This corresponds exactly to stage $4\hbar$ – the q_0–q_0 channel. The ladder is naturally bounded above. A "5th channel" ($5\hbar$) is geometrically impossible, since it would require either $r > r_0$ or $v > c$, which contradicts the fundamental postulates of EBT.

The ladder is thus not an open classification system into which arbitrarily many particles can be sorted, but a self-contained, finite system of discrete states. Nature allows in the superposition of elementary bodies only discrete stages of energetic coupling: $1\hbar, 2\hbar, 3\hbar, 4\hbar$.

The fact that the masses of Rydberg energy, neutron, muon, and pion fall exactly onto these four stages is, from this perspective, no coincidence and no subsequent calibration, but the proof that EBT has identified the correct "eigenstates" of matter formation.

The deviations in the per mille to percent range (especially for muon and pion) are due to the fact that the experimental "measured values" themselves are theory-laden extracts (QCD, SR back-calculations) and not raw, model-free observations. EBT, by contrast, provides pure predictions from the geometry of the action stages.

30 The Hydrogen Molecule

The formation of the H_2 molecule from two hydrogen atoms is described in established physics by molecular orbitals, exchange interaction, spin pairing, and the Pauli principle – an apparatus of abstract probability waves and postulates that possesses no phenomenological connection to primary quantities.

Elementary Body Theory (EBT) replaces this apparatus by a single question: **Can four elementary bodies (p_1, e_1, p_2, e_2) find a geometric superposition in the common origin that allows a larger collective radius – and thus, according to $m_0 r_0 = F_{\mathbf{EB}}$, a smaller total mass – than the sum of two isolated H atoms?**

The answer is: Yes. And the binding energy follows directly from the mass difference.

Remark 30.1. *The H_2 molecule is* ***not a fifth channel*** *in the EBT action ladder. The four primary channels (e–e, e–q_0, μ, q_0–q_0) are bounded above by $r \leq r_0$ and $v \leq c$. The H_2 binding is a* ***secondary superposition*** *of two already bound e–e systems – a molecular superposition above the primary ladder structure. Concepts such as an "equilibrium distance" between the protons are relics of standard physics (Born-Oppenheimer approximation) and have no place in the pure EBT calculation, which is based on the superposition in the common geometric origin.*

30.1 Starting Point: The Isolated H Atom

The H atom is the e-e interaction between proton and electron in the common origin. Its binding energy is the Rydberg energy, exactly calculated from the EBT mass formula:

$$E_{\mathrm{Ry}} = \left(\frac{m_e}{1 + \dfrac{m_e}{m_p}} \right) \cdot \left(1 - \sqrt{1 - \alpha^2} \right) \cdot c^2 = 13.5984682 \text{ eV} \tag{180}$$

30.2 The Four-Body Superposition in the Common Origin

Two H atoms consist of four elementary bodies: p_1, e_1, p_2, e_2. Each satisfies the mass-radius constant equation:

$$m_p r_p = m_e r_e = \frac{2h}{\pi c} = F_{\mathrm{EB}} \tag{181}$$

When two H atoms approach, the radius fields of the four bodies superimpose in the common geometric origin. The EBT question is: Does there exist a geometric configuration in which the four bodies form a **common collective radius** that is larger than that of the two isolated H atoms?

$$r_{\mathrm{H_2}} > r_{\mathrm{H}} \tag{182}$$

If yes, then it follows compellingly from the mass-radius coupling:

$$m_{\mathrm{H_2}} < 2 \cdot m_{\mathrm{H}} \tag{183}$$

The mass difference is the binding energy:

$$\Delta E_{\mathrm{bond}} = (2m_{\mathrm{H}} - m_{\mathrm{H_2}})\, c^2 \tag{184}$$

30.3 The Common Geometric Formalism

In order to prove the factors of the H_2 binding not as phenomenological adjustments, but as compelling consequences of the sphere geometry, we introduce a common geometric formalism.

30.4 Decomposition into Transverse and Longitudinal Components

The H_2 molecule possesses a distinguished symmetry axis – the connection axis of the interacting systems. We define this as the unit vector $\mathbf{e}_z$.

For an elementary body with radius vector $\mathbf{r} = r\,\hat{\mathbf{r}}$, the square of the radius decomposes into a longitudinal (parallel) and a transverse (perpendicular) component:

$$r^2 = r_{\parallel}^2 + r_{\perp}^2 = r^2 \cos^2\theta + r^2 \sin^2\theta \tag{185}$$

where θ is the polar angle with respect to the symmetry axis $\mathbf{e}_z$.

30.5 The Exact Angle Integrals

For an isotropic ground distribution of the elementary body surface, the geometric mean values over the spherical surface S^2 are calculated exactly:

The transverse portion:

$$\langle \sin^2\theta \rangle = \frac{1}{4\pi} \int_0^{2\pi} d\varphi \int_0^{\pi} \sin^2\theta \sin\theta \, d\theta = \frac{1}{2} \int_0^{\pi} \sin^3\theta \, d\theta = \frac{1}{2} \cdot \frac{4}{3} = \frac{2}{3} \tag{186}$$

The longitudinal portion:

$$\langle \cos^2\theta \rangle = \frac{1}{4\pi} \int_0^{2\pi} d\varphi \int_0^{\pi} \cos^2\theta \sin\theta \, d\theta = \frac{1}{2} \int_0^{\pi} \cos^2\theta \sin\theta \, d\theta = \frac{1}{2} \cdot \frac{2}{3} = \frac{1}{3} \tag{187}$$

The sum of both portions necessarily yields unity:

$$\langle \sin^2\theta \rangle + \langle \cos^2\theta \rangle = \frac{2}{3} + \frac{1}{3} = 1 \tag{188}$$

Thus the numbers 2/3 and 1/3 are not numerological coincidences and not fit parameters, but **exact isotropic projection factors** of the quadratic radius components onto a distinguished axis.

30.6 The 4-Body Integral and the Angle Weighting

30.6.1 The EBT-Conformal Surface Density

The elementary body is a spherical surface, not a spherical volume. The space-energy density of the four-body system is therefore a sum of surface densities:

$$\rho_4(\mathbf{r}) = \sum_{a \in \{p_1, e_1, p_2, e_2\}} \frac{U_a}{4\pi r_a^2} \, \delta(|\mathbf{r} - \mathbf{R}_a| - r_a) \tag{189}$$

with the normalization:

$$\int_{\mathbb{R}^3} \rho_4(\mathbf{r}) \, d^3r = U_{p_1} + U_{e_1} + U_{p_2} + U_{e_2} \tag{190}$$

30.6.2 The Transverse Projection as Binding Driver

With the binding axis $\mathbf{e}$ and the surface normal $\hat{\mathbf{n}}$, we define the binding-relevant transverse projection:

$$P_\perp(\mathbf{r}) = 1 - (\hat{\mathbf{n}} \cdot \mathbf{e})^2 = \sin^2\theta \tag{191}$$

The binding-relevant surface density is:

$$\rho_{i,\perp}(\mathbf{r}) = \rho_i(\mathbf{r}) \cdot \sin^2\theta \tag{192}$$

30.6.3 The Four-Body Integral

The binding energy as superposition integral of the four surfaces:

$$\Delta E_{\mathrm{H}_2} = -\sum_{i<j} \frac{U_i}{4\pi} \int_{S_i} K_{ij}(\mathbf{r}) \, \sin^2\theta_i \, d\Omega_i \tag{193}$$

For isotropic superposition (K_{ij} angle-independent):

$$\Delta E_{\mathrm{H}_2} = -\frac{2}{3} \sum_{i<j} U_i K_{ij} \tag{194}$$

30.6.4 The Separation into Transverse and Longitudinal Components

The angle integration alone provides an **additive** structure:

$$I_\perp + I_\parallel = \frac{2}{3} + \alpha \cdot \frac{1}{3} = \frac{2}{3} \left(1 + \frac{\alpha}{2}\right) \tag{195}$$

This additive structure is **mathematically correct**, but it says nothing yet about **how** the longitudinal component reduces the binding energy.

30.6.5 The Phenomenological Normalization Prescription

The EBT formula for the H_2 binding contains the term:

$$\frac{1}{1 + f \cdot \alpha/3} \tag{196}$$

Here:

- **Variant A** ($f = 1$): $1/(1 + \alpha/3)$ – H_2-calibrated, magnetic embodiment of the load.
- **Variant B** ($f = 1/4$): $1/(1 + \alpha/12)$ – formally consistent with $\alpha/4$ as the measure of the electric coupling.

This term is **not** derivable from the angle integration. It is a **phenomenological normalization prescription** that states:

- The longitudinal extension acts as a **multiplicative reduction** of the binding energy.
- The reduction is proportional to the longitudinal mean value $\langle \cos^2 \theta \rangle = 1/3$.
- The coupling strength of this reduction is either α (magnetic embodiment, Variant A) or $\alpha/4$ (electric coupling, Variant B).

Remark 30.2. *The question of the correct coupling strength of the longitudinal load is currently **not decidable**. Both variants are compatible with the EBT phenomenology. The numerical agreement favors $f = 1$ (+0.09 % vs. +0.27 %), but this is an indication, not a proof. The decision requires an independent derivation from the EBT field equation or an independent experimental test.*

30.6.6 The Geometric Contact Analysis for Isotopes

The transfer of the four-body formula to isotopes (D_2, HD) requires a **geometric overlap factor** $\eta(r_{\text{nucleus}})$:

$$\Delta E_{\text{bond}} = \eta(r_{\text{nucleus}}) \cdot \frac{m_{AB}}{2} \cdot \left(1 - \sqrt{1 - \alpha^2 \cdot \frac{2}{3}}\right) \cdot \frac{1}{1 + f \cdot \alpha/3} \cdot c^2 \tag{197}$$

For H_2, $\eta(r_p) = 1$ (by definition, because H_2 is the calibration point).

For D_2, $\eta(r_d)$ must be calculated from the **explicit integration of the spherical cap geometry**. The experimental data show:

$$\frac{\Delta E_{D_2}^{(\text{exp})}}{\Delta E_{H_2}^{(\text{exp})}} = \frac{4.556}{4.520} = 1.00796 \tag{198}$$

The pure mass effect (without geometric correction) yields:

$$\frac{m_{d,\text{red}}}{m_{p,\text{red}}} = 1.000272 \tag{199}$$

The **geometric correction** must therefore amount to:

$$\eta(r_d) = \frac{1.00796}{1.000272} = 1.00769 \tag{200}$$

This means: The contact region in D_2 is **by** 0.77 % **more efficient** than in H_2, although the nuclear radius is halved.

Remark 30.3. *The isotope test is **not suitable** for deciding between the variants $f = 1$ and $f = 1/4$, because the geometric effect (0.77 %) covers the difference between the variants (0.18 %). Both variants make the same error because they ignore the geometry of the contact region.*

Quantity	Value / Status	Origin
$\langle \sin^2\theta \rangle$	2/3	Mathematically exact (sphere geometry)
$\langle \cos^2\theta \rangle$	1/3	Mathematically exact (sphere geometry)
Transverse binding driver	$\alpha^2 \cdot 2/3$	EBT-conformally derived
Longitudinal spatiality term	$1/(1 + f \cdot \alpha/3)$	Phenomenologically motivated
Variant A ($f = 1$)	$1/(1 + \alpha/3)$	Numerically successful (+0.09 %)
Variant B ($f = 1/4$)	$1/(1 + \alpha/12)$	Formally consistent with $\alpha/4$ (+0.27 %)
Geometric overlap factor $\eta(r)$	**Open**	Requires explicit integration
Isotope test (D_2, HD)	**Not decidable**	Geometric effect dominates
Decision $f = 1$ vs. $f = 1/4$	**Open**	Requires derivation from field equation

Table 8: Status of the open hypotheses in the H_2 formalism.

30.6.7 Status of the Open Hypotheses

30.7 Explicit EBT Calculation of the H_2 Binding Energy

30.8 The Channel Velocity from the Transverse Portion

The H_2 binding is a **double electric coupling**: Each H atom couples to the other with strength α. The coupling is thus α^2.

The geometric factor comes from the transverse portion of the sphere geometry (Eq. 186). The ratio of the transverse extension to the total extension is $\langle r_\perp^2 \rangle / \langle r^2 \rangle = 2/3$.

Thus for the square of the channel velocity:

$$\left(\frac{v_{H_2}}{c}\right)^2 = \alpha^2 \cdot \langle \sin^2\theta \rangle = \alpha^2 \cdot \frac{2}{3} \tag{201}$$

30.9 Explicit Numerical Calculation

Step 1 – Channel factor:

$$1 - \sqrt{1 - \alpha^2 \cdot \frac{2}{3}} = 1 - \sqrt{1 - 3.55009 \times 10^{-5}} = 1.77505 \times 10^{-5} \tag{202}$$

Step 2 – Bracket (Who interacts?): The reduced mass of the two-H-atom system:

$$\frac{m_H}{2} = 4.55421 \times 10^{-31}\ \text{kg} \tag{203}$$

Step 3 – Binding energy without spatiality correction:

$$\Delta E_{H_2}^{(0)} = \frac{m_H}{2} \cdot \left(1 - \sqrt{1 - \alpha^2 \cdot \frac{2}{3}}\right) \cdot c^2 = 4.535\ \text{eV} \tag{204}$$

Step 4 – The spatiality correction from the longitudinal portion: The isotropic mean value of the spatial weight function results directly from Eq. 187:

$$\langle W_{3D} \rangle = 1 + \alpha \langle \cos^2\theta \rangle = 1 + \frac{\alpha}{3} = 1.0024324 \tag{205}$$

Step 5 – Complete binding energy (Variant A, $f = 1$):

$$\Delta E_{\text{bond}}(\text{EBT}) = \frac{\Delta E^{(0)}_{\text{H}_2}}{1 + \alpha/3} = \frac{4.535}{1.0024324} = 4.524 \text{ eV} \tag{206}$$

Step 6 – Comparison with the experimental value:

$$\frac{\Delta E_{\text{bond}}(\text{EBT})}{\Delta E_{\text{bond}}(\text{exp})} = \frac{4.524}{4.52} = 1.0009 \tag{207}$$

The deviation is $+0.09\,\%$ – the same class as the other strong embodiments of EBT.

30.10 The Complete EBT Formula for the H_2 Binding

$$\boxed{\Delta E_{\text{bond}}(\text{H}_2) = \underbrace{\frac{m_{\text{H}}}{2}}_{\text{Bracket}} \cdot \underbrace{\left(1 - \sqrt{1 - \alpha^2 \cdot \frac{2}{3}}\right)}_{\text{transverse } \langle \sin^2\theta \rangle} \cdot \underbrace{\frac{1}{1 + f \cdot \alpha/3}}_{\text{longitudinal } \langle \cos^2\theta \rangle} \cdot c^2} \tag{208}$$

with:

- **Variant A** ($f = 1$): $\Delta E_{\text{bond}} = 4.524$ eV ($+0.09\,\%$)
- **Variant B** ($f = 1/4$): $\Delta E_{\text{bond}} = 4.532$ eV ($+0.27\,\%$)

30.11 The Geometric Saturation: Why H_2 and Not H_3?

The question of why a third H atom does not attach is answered by EBT purely geometrically via the superposition in the common origin:

- The 4-body configuration (p_1, e_1, p_2, e_2) represents in the common origin a local maximum of collective radius expansion. The common space-energy shell reaches its geometrically optimal extension.
- A 6-body system $(3p, 3e)$ that superimposes in the same origin can no longer form a larger collective radius. The geometric interference of the additional spherical surfaces forces a local compression of the space-energy shell.
- According to $m_0 r_0 = F_{\text{EB}}$, a radius compression necessarily leads to a **mass increase**. The system would have to absorb energy to reach this state.
- Phenomenologically, this forced geometric compression in the origin manifests itself as what macroscopic physics falsely interprets as a "repulsive force" over a distance.

EBT needs no Pauli principle, no spin, and no exchange interaction to explain the saturation of the chemical bond. The saturation follows compellingly from the geometry of the spherical-surface superposition in the origin and the mass-radius coupling.

30.12 Status and Open Calculation Tasks

30.13 Epistemological Evaluation

Established physics needs for the H_2 molecule: molecular orbitals, exchange interaction, spin pairing, Pauli principle, Born-Oppenheimer approximation, Hartree-Fock method, configuration interaction – an apparatus of abstract probability waves and postulates.

EBT confronts this with a single question: Can four mass-radius bodies in the common origin find a geometric superposition that allows a larger collective radius? The answer is yes, and the binding energy follows from the mass difference according to the mass-radius coupling.

Through the introduction of a common geometric functional (Eq. 193), the two previously phenomenologically justified factors (2/3 and 1/3) are traced back to the same exact angle decomposition of the sphere geometry. This shifts the theory from the numerical justification of known factors to a consistent geometric formalism. Concepts such as a spatial equilibrium distance between the nuclei are recognized as relics of standard physics and consistently replaced by the pure superposition geometry in the origin.

Aspect	Status	Next step
H atom binding energy E_{Ry}	Exactly calculated ($2.5 \cdot 10^{-6}$)	–
Angle integrals $\langle \sin^2\theta \rangle$, $\langle \cos^2\theta \rangle$	Exactly closed (sphere geometry)	–
H_2 channel velocity	Geometrically derived ($\alpha\sqrt{2/3}\,c$)	–
H_2 binding energy	Explicitly calculated (+0.09 %)	–
Spatiality term $1/(1 + f \cdot \alpha/3)$	Phenomenologically motivated	Derivation from EBT field equation
Decision $f = 1$ vs. $f = 1/4$	**Open**	Independent test / field equation
Geometric overlap factor $\eta(r)$	**Open**	Explicit integration of the cap geometry
Saturation (H_2 instead of H_3)	Geometrically founded (origin compression)	Formal 6-body geometry

Table 9: Status of the H_2 calculation in EBT: achieved and open steps.

30.14 Methodological Conclusion

The H_2 formula is **formally closed**, but **epistemologically an open hypothesis remains**:

1. **The angle integrals are mathematically exact.** $\langle \sin^2\theta \rangle = 2/3$ and $\langle \cos^2\theta \rangle = 1/3$ are compelling consequences of the sphere geometry.
2. **The transverse binding driver is EBT-conformally derived.** The channel velocity $(v/c)^2 = \alpha^2 \cdot 2/3$ follows from the transverse projection.
3. **The longitudinal spatiality term is phenomenologically motivated.** The form $1/(1 + f \cdot \alpha/3)$ is a normalization prescription that states that the longitudinal load acts as a multiplicative reduction. The coupling strength f is currently not derivable from first principles.
4. **The decision between $f = 1$ and $f = 1/4$ is open.** Both variants are compatible with the EBT phenomenology. The numerical agreement favors $f = 1$ (+0.09 % vs. +0.27 %), but this is an indication, not a proof.
5. **The transfer to isotopes requires a geometric overlap factor $\eta(r)$.** This is not yet calculated. The isotope test is therefore currently not suitable for deciding between $f = 1$ and $f = 1/4$.

30.15 Pragmatic Decision

Since the isotope test is not decidable and the difference between $f = 1$ and $f = 1/4$ for H_2 is only 0.18 %, **Variant A** ($f = 1$, $1/(1 + \alpha/3)$) is chosen as the numerically more successful variant. This choice is **pragmatic** – it is not a derivation from first principles, but it is the best available agreement with the experiment.

The open question $f = 1$ vs. $f = 1/4$ is documented as a **defined, solvable task**. It requires an independent derivation of the longitudinal correction term from the EBT field equation or an independent experimental test.

30.16 Summary

The EBT explanation of the H_2 binding is based on three principles:

1. **Mass-radius coupling:** $m_0 r_0 = F_{\mathrm{EB}}$
2. **Geometric superposition:** Four elementary bodies form in the common origin a space-energy shell.
3. **Geometric decomposition:** The transverse extension ($\langle \sin^2\theta \rangle = 2/3$) drives the binding, the longitudinal load ($\langle \cos^2\theta \rangle = 1/3$) reduces it.

The H_2 binding is not a primary channel interaction, but a **secondary molecular superposition** of two bound e–e systems.

31 Magnetic Moments as Fractal Embodiment

31.1 The Experimental Starting Data

Electron:

$$\begin{aligned}
\mu_{\mathrm{Be}}^{(\mathrm{th})} &= 9.27400999205404 \cdot 10^{-24}\ \mathrm{J/T} \quad \text{(semiclassical value)} \\
\mu_{\mathrm{Be}}^{(\mathrm{exp})} &= 9.284764620 \cdot 10^{-24}\ \mathrm{J/T} \quad \text{(experimental value)} \\
f_e &= 0.00115965218091 \quad \text{(anomalous portion)} \\
g_e &= 2.00231930436182 \quad \text{[CODATA2014]}
\end{aligned}$$

Proton:

$$\begin{aligned}
\mu_{\mathrm{Bp}}^{(\mathrm{th})} &= 5.0507836982111 \cdot 10^{-27}\ \mathrm{J/T} \quad \text{(semiclassical value)} \\
\mu_{\mathrm{Bp}}^{(\mathrm{exp})} &= 1.4106067873 \cdot 10^{-26}\ \mathrm{J/T} \quad \text{(experimental value)} \\
f_p &= 1.7928473512 \quad \text{(anomalous portion)} \\
g_p &= 5.585694702 \quad \text{[CODATA2014]}
\end{aligned}$$

Neutron:

$$\begin{aligned}
\mu_{\mathrm{Bn}}^{(\mathrm{exp})} &= 9.6623650 \cdot 10^{-27}\ \mathrm{J/T} \\
\mu_{\mathrm{Bn}}^{(\mathrm{th})} &= 0 \quad \text{(since uncharged)}
\end{aligned}$$

Ratios:

$$\frac{m_p}{m_e} = 1836.15267376007 = \frac{\mu_{\mathrm{Be}}^{(\mathrm{th})}}{\mu_{\mathrm{Bp}}^{(\mathrm{th})}}$$

$$\frac{\mu_{\mathrm{Be}}^{(\mathrm{exp})}}{\mu_{\mathrm{Bp}}^{(\mathrm{exp})}} = 658.21068660613$$

$$\frac{\Delta\mu_{\mathrm{Be}}}{\Delta\mu_{\mathrm{Bp}}} = 1.18766299383179$$

$$\frac{f_p}{f_e} = 1546.021626754602$$

31.2 The Central Observation

Remarkable is the fact that the experimental results, if one considers them without theory-laden expectations in the direction of leptonic structurelessness or quark-based substructure, exhibit an easily ascertainable commonality. The additional, supposedly anomalous magnetic moment contributions to the semiclassically expected ones are always $\sim 1 \cdot 10^{-26}$ Joule/Tesla for proton, neutron, and electron.

The differences of the experimentally measured magnetic moments to the semiclassical expectations:

$$\Delta\mu_{\mathrm{Be}} = \mu_{\mathrm{Be}}^{(\mathrm{exp})} - \mu_{\mathrm{Be}}^{(\mathrm{th})} = 1.075462794596 \cdot 10^{-26}\ \mathrm{J/T}, \tag{209}$$

$$\Delta\mu_{\mathrm{Bp}} = \mu_{\mathrm{Bp}}^{(\mathrm{exp})} - \mu_{\mathrm{Bp}}^{(\mathrm{th})} = 9.055284174789 \cdot 10^{-27}\ \mathrm{J/T}, \tag{210}$$

$$\Delta\mu_{\mathrm{Bn}} = \mu_{\mathrm{Bn}}^{(\mathrm{exp})} - 0 = 9.6623650 \cdot 10^{-27}\ \mathrm{J/T}. \tag{211}$$

These three values are of the same order of magnitude – although the total moments differ greatly!

$$\frac{\Delta\mu_{\mathrm{Be}}}{\Delta\mu_{\mathrm{Bp}}} \approx 1.18766, \qquad \frac{\Delta\mu_{\mathrm{Be}}}{\Delta\mu_{\mathrm{Bn}}} \approx 1.11296 \tag{212}$$

Remark 31.1. *In other words: If one embodies the magnetic field in an energetic analogy, the experimentally measured magnetic moments of proton, electron, and neutron result from the respective energetic superposition with the magnetic field. The magnetic field itself as an "energy supplier" provides a particle-specific contribution on the order of* 10^{-26} *J/T to the measured magnetic moment.*

31.3 The Measurement Setup as Energetic Interaction Partner

The modern misunderstanding of interpreting a quantum mechanical experiment begins with the idealization, or reduction, that the experimental setup – which additively provides energy in the form of electric or magnetic fields – is not perceived as an energetic interaction partner. Values of supposedly intrinsic object quantities, such as the fine structure of spectral lines or here magnetic moments, however, arise only through the "application" of external fields. This logically comprehensible, unavoidable observation effect is categorically suppressed by the protagonists of standard model physics. It is pretended as if the additional energy only brings to light the inner energetic conditions that already exist even without observation, i.e., without external energy supply. This assumption is not only debatable, this assumption is fatal and wrong.

In the Penning trap or double Penning trap, the three-dimensional electric field is also not negligible. It also interacts with the charge carrier under investigation. Due to the Penning trap-specific field energies, the magnetic field dominates, but in sum, the electric field also provides a measurement-inherent contribution to the supposedly intrinsic magnetic moments of the trapped electrons or protons. The measurement results can be mapped and calculated via a mass-radius-coupled embodiment of the magnetic field. Here the term $(\alpha/2\pi)$ – which, in connection to history, is called the Schwinger term – stands for the primarily governing energetic embodiment of the magnetic field as a function of the electric elementary charge. If one embodies the magnetic field in an energetic analogy, the metrologically recorded magnetic moment of the proton and the electron result from the respective energetic superposition with the magnetic field. The magnetic field itself as an energy giver interacts with electron and proton and provides a particle-specific contribution on the order of $1 \cdot 10^{-26}$ Joule/Tesla to the measured magnetic moment. The entire mathematical QFT magic about supposedly anomalous, intrinsic magnetic moments and their corrections is thus theory-induced, or more simply formulated – in the truest sense of the word – irrelevant. Furthermore, it follows: The experimentally determined magnetic moment of the proton is now plausible without substructure.

31.4 The Magnetic Moment Is Not an Intrinsic Free-Space Property

Two mutually independent indications support the EBT reading here. First, the already cited coincidence, which the physicist Hans-Peter Dürr pointed out in his essay "Newer Developments in High-Energy Physics – the End of Reductionism? (1986)". He points out that the idea of a particle substructure fails upon reaching a characteristic limit. This limit results from the ratio between Planck's constant of action and the speed of light ($mR \ll h/c \approx 10^{-37}$ g cm). According to Dürr, this is the case for the first time with a proton ($R \approx 10^{-13}$ cm, $m = 1.7 \cdot 10^{-24}$ g), from which $mR \approx 10^{-37}$ g cm results. Dürr takes this striking coincidence as an occasion to criticize the quark model. The proton is thus fundamental; its magnetic moment is a whole-body property of the elementary body, not a sum of postulated quark and gluon contributions.

Second, Michaele Suisse and Peter Cameron, in their work "Quantum Interpretation of the Proton Anomalous Magnetic Moment" (February 2017), come to a remarkably congruent conclusion in a fundamentally different, Clifford-algebraic approach: "The role of the anomalous moment in the geometric Clifford algebra of topological mass generation of the proton suggests that the anomaly is not an intrinsic property of the proton in free space, but rather a topological effect of the application of the electromagnetic bias field required to define the eigenstates determined by the measurement of the magnetic moment." This is exactly the EBT position: The magnetic field is not an abstract vector field, but a quasi-continuous medium of mass-radius-coupled entities; the measured moment is the energetic superposition of the elementary body with this medium.

31.5 The Neutron as a Touchstone: The Two-Stage Embodiment

Is there, besides the obviously plausible argument that one cannot simply ignore the energy contribution of the magnetic field, further evidence for an additive contribution to the magnetic moment of the test

bodies? Yes, there is. It is the magnetic moment of the electrically uncharged neutron, which does not exist within the framework of the semiclassical consideration and is attributed to this in the framework of the postulated neutron quark substructure. Only: Is the magnetic moment of the neutron really proof of a substructure? Or is this assumption only a theory-laden measurement value interpretation of the Standard Model?

A look at the bare numbers confirms the thesis that the magnetic moment of the electrically neutral neutron results exclusively from the magnetic field contribution that the neutron induces in the applied magnetic field. The neutron possesses – as it holds for an uncharged object semiclassically and on an elementary-body basis – no intrinsic moment:

$$\Delta\mu_{\mathrm{Bn}} = \mu_{\mathrm{Bn}}(\mathrm{exp}) - \mu_{\mathrm{Bn}}(\mathrm{th}) = 9.6623650 \cdot 10^{-27}\ \mathrm{J/T} - 0 = 9.6623650 \cdot 10^{-27}\ \mathrm{J/T}. \tag{213}$$

Consistent assumption: The measured value $\mu_{\mathrm{Bn}}(\mathrm{exp}) = \Delta\mu_{\mathrm{Bn}} \approx 9.66237 \cdot 10^{-27}$ J/T is nothing other than the measurement-inherent contribution of the magnetic field that the neutron, which according to Elementary Body-based matter-forming charge interaction has arisen from electron and proton, induces in the magnetic field.

Proof, First Stage – Equation $[\mu n]$

If the assumption is correct, then the magnetic moment of the neutron ($\mu_{\mathrm{Bn}}(\mathrm{exp}) = \Delta\mu_{\mathrm{Bn}}$) must be calculable from the measurement-inherent magnetic field contributions of electron and proton ($\Delta\mu_{\mathrm{Be}}$ and $\Delta\mu_{\mathrm{Bp}}$). A simple possibility to connect the three quantities $\Delta\mu_{\mathrm{Bn}}$, $\Delta\mu_{\mathrm{Be}}$, and $\Delta\mu_{\mathrm{Bp}}$ without explicit knowledge of the magnetic field embodiment is to equate $(\Delta\mu_{\mathrm{Bn}})^2$ with $\Delta\mu_{\mathrm{Be}} \cdot \Delta\mu_{\mathrm{Bp}}$. Here it must be considered that the neutron is composed of the q_0-electron and e-proton charge interaction. This can be expressed by the factor $1 + (e/q_0) = 1 + (\sqrt{\alpha}/2)$. The resulting – consistently phenomenologically founded – result is:

$$(\Delta\mu'_{\mathrm{Bn}})^2 = \frac{\Delta\mu_{\mathrm{Be}} \cdot \Delta\mu_{\mathrm{Bp}}}{1 + \frac{\sqrt{\alpha}}{2}} \implies \Delta\mu'_{\mathrm{Bn}} = 9.66421304 \cdot 10^{-27}\ \mathrm{J/T}. \qquad [\mu n] \tag{214}$$

The comparison with $\mu_{\mathrm{Bn}}(\mathrm{exp}) = 9.6623650 \cdot 10^{-27}$ J/T yields the ratio $\mu_{\mathrm{Bn}}(\mathrm{exp})/\Delta\mu'_{\mathrm{Bn}} \approx 0.999808775$ – already a remarkable agreement that follows solely from the two field contributions and the charge ratio.

Phenomenological Fine Adjustment, Second Stage – Equation $[\mu n2]$

Equation $[\mu n]$ can be refined in a phenomenologically justified way by including an explicit mass dependence of the neutron in the calculation, which expresses the effective charge-dependent mass reduction – inherently coupled to this a charge-dependent proportional charge-radius enlargement – in relation to the total neutron mass. Similarly to the hydrogen atom, the object radius enlarges as a function of the charge, only that in the case of the neutron the proton as elementary body charge carrier e interacts with the electron as elementary body charge carrier q_0.

The charge radius of this matter-forming e-q_0 interaction is $r(e - q_0) = r_0/(2\sqrt{\alpha})$ with $r_0 := r_e + r_p$ (for comparison: $r(e - e) = r_0/(4\alpha)$). From this follows the effective charge mass $m(r(e - q_0)) = [m_e \cdot 2\sqrt{\alpha}/(1 + m_e/m_p)] \cdot 2$. The factor 2 accounts for the fact that neutron formation takes place without loss of binding energy (the H atom, by contrast, radiates half of the total energy as $(\alpha/4)$-scaled binding energy). The mass coefficient

$$k_n = \frac{m(r(e - q_0))}{m_n} = \frac{m_e \cdot 4\sqrt{\alpha}}{m_n \cdot \left(1 + \frac{m_e}{m_p}\right)} \qquad [mmn] \tag{215}$$

results in $\approx 1.8574 \cdot 10^{-4}$. Thus the refined equation is:

$$\Delta\mu''_{\mathrm{Bn}} = \frac{\Delta\mu'_{\mathrm{Bn}}}{1 + k_n} = \frac{\sqrt{\frac{\Delta\mu_{\mathrm{Be}} \cdot \Delta\mu_{\mathrm{Bp}}}{1 + \frac{\sqrt{\alpha}}{2}}}}{1 + k_n} = 9.662418366 \cdot 10^{-27}\ \mathrm{J/T}. \qquad [\mu n2] \tag{216}$$

The comparison with $\mu_{\mathrm{Bn}}(\mathrm{exp}) = 9.6623650 \cdot 10^{-27}$ J/T yields $\mu_{\mathrm{Bn}}(\mathrm{exp}) \approx 0.999994477 \cdot \Delta\mu''_{\mathrm{Bn}}$ – the deviation lies within the standard uncertainty of $\pm 0.0000023 \cdot 10^{-27}$ J/T.

Remark 31.2. *Equation* [$\mu n2$] *is a minimalist, completely phenomenologically founded formula and embodies by far the most precise equation for calculating the magnetic moment of the neutron. Neither QCD nor alternatives come even close to the presented analytically valuable natural philosophy. The derivation is feasible model-consistently even without knowledge of the experimental value and has clear predictive power.*

The consistently phenomenologically founded, formalized prediction for the magnetic moment of the neutron, based on charge-interacting magnetic field contributions of electron and proton, identifies the neutron as electron-proton-based. However, the magnetic moment of the neutron is a pure magnetic field embodiment, meaning: The magnetic-field-free neutron possesses – compared to proton and electron – no intrinsic magnetic moment, but consists exclusively of the measurement-inherent contribution. This analysis dismantles the assumption of an asymmetrically quark-, sea-quark-, and gluon-substructured substructure.

31.6 The Magnetic Moment of the Proton

The hypothesis of measurement-inherent magnetic field contributions demonstrated on the electron and neutron proves itself fully also in the calculation of the magnetic moment of the proton. The experimental finding is unambiguous: The difference value between the measured and the semiclassically expected magnetic moment of the proton is

$$\Delta\mu_{\mathrm{Bp}} = \mu_{\mathrm{Bp}}^{(\mathrm{exp})} - \mu_{\mathrm{Bp}}^{(\mathrm{th})} = 9.055284174789 \cdot 10^{-27}\ \mathrm{J/T} \tag{217}$$

and thus lies in the same order of magnitude of about 10^{-26} J/T as the corresponding difference values for electron and neutron. This is a further, strong indication of a common, external origin of these contributions.

In EBT, the necessity of a hypothetical quark-gluon substructure completely disappears. Instead, a direct, quantitative relationship between the experimentally determined magnetic moments of electron and proton is established, which reveals the measurement-inherent character of these quantities. The relation found by numerical analysis is:

$$\mu_{\mathrm{Bp}}^{(\mathrm{exp})} = \left(\frac{\alpha}{2\pi \cdot f_e} - 1\right) \cdot \mu_{\mathrm{Be}}^{(\mathrm{exp})} \cdot k_p \qquad [\mu p] \tag{218}$$

with the phenomenologically founded coupling term

$$k_p = \frac{1 + \frac{\alpha}{3}}{1 + \left(\frac{\alpha}{8}\right)^2}. \tag{219}$$

Here $f_e = 0.00115965218091$ is the experimentally determined anomalous portion of the electron and α the fine-structure constant. The term $(1 + \alpha/3)$ is the only analytical expression that "comes newly into play" within the framework of the magnetic field embodiment and possesses a clear phenomenological interpretation: It accounts for the fact that the proton, as an electrically positively charged and, compared to the electron, mass-richer elementary body, couples to the embodied magnetic field with a different coupling strength.

The Phenomenological Structure of the Proton g-Factor and the "Muon Trap" The EBT calculation of the magnetic moment of the proton leads to a coupling term k_p that presents itself as the ratio of two correction terms:

$$k_p = \frac{1 + \alpha/3}{1 + (\alpha/8)^2} \tag{220}$$

The phenomenological interpretation of this term is not arbitrary, but follows from the geometric and energetic nature of the magnetic field embodiment.

The numerator $1+\alpha/3$: The term $1+\alpha/3$ accounts for the specific coupling strength of the proton to the embodied magnetic field. The proton is a mass-richer, positively charged body – its interaction with the magnetic field differs quantitatively from that of the electron.

An immediate interpretation possibility arises from the direction dependence of the magnetic moment: The factor 1/3 corresponds to one of three spatial directions. That spatial orientations actually play a role is suggested by the signs of the g-factors: The electron possesses a negative, the proton a positive magnetic moment.

A further-reaching numerical analysis of the terms $(f_e \cdot m_p)$ and $(f_p \cdot m_e)$ leads to a remarkable connection. The relation

$$\frac{\alpha}{3} \sim \frac{1}{2} \cdot \frac{m_e}{m_\mu} \quad \Rightarrow \quad 2 \cdot \frac{\alpha}{3} = 0.00486490171093 \tag{221}$$

and

$$\frac{m_e}{m_\mu} \approx 0.00483633170212 \tag{222}$$

shows that $2\alpha/3$ and m_e/m_μ lie in the same order of magnitude. The difference is:

$$2 \cdot \frac{\alpha}{3} - \frac{m_e}{m_\mu} = 2.8570009 \cdot 10^{-5} \tag{223}$$

This is a numerical pattern that presents itself to a superficial consideration as an indication of a muon connection. In fact, however, this is the entry into a "muon trap": Whoever forcibly couples simple numerical results to Standard Model interpretations will be tempted to see a muon loop of QED here. EBT knows no such loops – it operates exclusively with α-terms that map energetic corrections of the electric elementary charge e via e^2 into α.

As a reminder:

$$\alpha = \frac{e^2}{2\varepsilon_0 hc}, \qquad \frac{e^2}{q_0^2} = \frac{E_{\text{electric}}}{E_{\text{total}}} = \frac{\alpha}{4} \tag{224}$$

The QED fermion loops with muon contribution to the calculation of the "anomalous" magnetic moment of the electron create a seeming necessity, although in a more stringent phenomenology only α-terms exist. The muon contribution is, from the EBT perspective, nothing more than an artifact of a theory-laden extraction.

The denominator $1+(\alpha/8)^2$: The denominator $1+(\alpha/8)^2$ reflects the fractal structure of the magnetic field embodiment. The term $(\alpha/8)^2$ is a second-order term in the series of energetic fine adjustment. Its "correction performance" reduces to $(\alpha/8)^2$ – this means that radius ratios ($r_{\text{Bohr}}/r_{\text{Ry}} = m_{\text{Ry}}/m_{\text{Bohr}} = \alpha/8$) enter the calculation quadratically.

Here the "Bohr radius" does not refer to the hydrogen atom, but to the elementary-charge-based energetic radius enlargement of the solitary charge carrier. The Bohr radius used here is inherently connected with the elementary charge e. That this term enters quadratically is geometrically plausible: The magnetic moment is causally connected with the "spanned" (r^2-dependent) spherical surfaces of the elementary bodies.

Systematics of the α-Terms in EBT In general: In Elementary Body Theory, α with the factors 1/2, 1/4, 1/8, $2/\pi$, or the reciprocals, is a phenomenologically founded component of geometric-energetic considerations that always lead to concrete calculation possibilities (ground state energies, proton radius, temperature of the 3K background radiation, ...). The embodiment of the secondary concept magnetic field implies the expression $\alpha/3$ and – as already shown – the expression $\alpha/2\pi$ ("Schwinger term"):

$$\frac{\alpha}{2\pi} = \frac{2}{\pi} \cdot \frac{\alpha}{4} \tag{225}$$

The "mass-radius-embodied", phenomenologically founded derivation of $\alpha/2\pi$ is substantively significantly more plausible and mathematically significantly simpler than the QED procedure. EBT needs no

virtual fermion loops, no renormalization, no divergent integrals – it calculates with the geometry of the elementary bodies and the resulting energetic analogies.

Summary The coupling term k_p is not a free parameter, but a phenomenologically and geometrically founded quantity:

- The **numerator** $1 + \alpha/3$ represents the direction-dependent coupling of the proton to the embodied magnetic field.
- The **denominator** $1 + (\alpha/8)^2$ represents the fractal structure of the magnetic field embodiment with quadratic radius dependence.

The numerical proximity of $2\alpha/3$ to m_e/m_μ (difference $2.857 \cdot 10^{-5}$) is not an indication of a muon loop, but a numerical pattern that plays no further role in the EBT phenomenology. The entire calculation of the proton g-factor gets by without experimental muon inputs and is completely parameter-free.

For the g-factor of the proton, it follows:

$$g_p = \left[\left(\frac{\alpha}{2\pi \cdot f_e} - 1 \right) \cdot \frac{m_p}{m_e} \cdot (1 + f_e) \cdot \frac{1 + \frac{\alpha}{3}}{1 + \left(\frac{\alpha}{8}\right)^2} \right] \cdot 2. \qquad [g_p] \tag{226}$$

With the CODATA2014 values $f_e = 0.00115965218091$, $m_p/m_e = 1836.15267376006$ and $\alpha = 0.0072973525664$,

EBT calculates:

$$g_p = 5.585694698054034. \tag{227}$$

The experimental value is $g_p = 5.585694702$ [CODATA2014] with a standard uncertainty of ± 0.000000017. The deviation thus lies within the experimental error limits.

This phenomenologically consistent calculation of the proton g-factor solely from the fundamental constants as well as from the experimental value or from the following EBT calculation of the electron g-factor proves the viability of the concept of measurement-inherent magnetic field embodiment. It simultaneously demonstrates that the complex and ultimately arbitrary quark substructure of the Standard Model is phenomenologically unfounded and explanatorily superfluous.

31.7 The g-Factor of the Electron

The fine structure of the term $(\alpha/2\pi)$ leads to a fractal correction.

Step 1: Base term

$$f'_e = \frac{\alpha}{2\pi} \cdot \frac{1 + \left(\frac{\alpha}{8}\right)^2}{1 + \frac{\alpha}{3}} \approx 0.001158592479512731 \tag{228}$$

Step 2: Fine adjustment

$$f''_e = \frac{\alpha}{2\pi} \cdot \frac{1 + \frac{\alpha}{8} + \left(\frac{\alpha}{8}\right)^2 + \left(\frac{\alpha}{8}\right)^3}{1 + \frac{\alpha}{3}} \tag{229}$$

Step 3: Hyperfine adjustment

$$f'''_e = \frac{\alpha}{2\pi} \cdot \frac{1 + \left(\frac{\alpha}{8}\right)^2}{1 + \frac{\alpha}{3}} \cdot \left(1 + \left(\frac{\alpha}{4}\right)^2\right) \cdot \left(1 + \left(\frac{\alpha}{3}\right)^3\right) \cdot \left(1 + \left(\frac{\alpha}{2\pi}\right)^3\right) \tag{230}$$

$$f'''_e = 0.00115965218091 = f_e \tag{231}$$

From this follows the g-factor:

$$g'''_e = 2\,(1 + f'''_e) = 2.00231930436129188 \tag{232}$$

Comparison with the experimental value $g_e = 2.00231930436182 \pm 0.00000000000026$ [CODATA2014]: deviation $< 10^{-12}$ – within the standard deviation!

31.8 Precision and Limits of the EBT Calculation

For orientation, one may compare the mass-space coupling-based equations with 13,000 (in words: thirteen thousand!!!) Feynman diagrams and resulting millions (!!!) of numerical calculations, of which analytical results exist only up to and including the 3rd order. That means the (only) analytical QED calculation has a relative standard deviation of 4.37e-8 instead of the stated 2.6e-13 (CODATA 2014) to the experimental measured value. The "rest" is "circular-reasoning belief work" in the form of years-long Monte Carlo integrations on computer clusters, which are designed so modified-selectively that the measured value is reproduced.

The most precise equation of EBT for the magnetic moment of the electron (equation of hyperfine adjustment) is a parody of measurement-result-oriented QED "perturbation calculation" (including postulated hadronic contributions) for determining the g-factor. Relevant and phenomenologically justifiable is the equation of fine adjustment, Equation (229). Meaning: The natural-philosophy-oriented standards within Elementary Body Theory allow only the fine adjustment – expressed by Equation (229) – to appear as consistent and "argumentatively tenable". Thus the elementary-body-based magnetic field embodiment provides an additive contribution to the magnetic moment of the electron $\Delta\mu''_{\mathrm{Be}}$, or an f''_e-value that depends only on α-terms, in very good agreement with the experimental value.

The sequence $1 + \left(\frac{\alpha}{8}\right) + \left(\frac{\alpha}{8}\right)^2 + \left(\frac{\alpha}{8}\right)^3$ embodies a series that one could think of further fractally; mathematically, however, the conceivable supplementary terms $\left(\frac{\alpha}{8}\right)^4$, $\left(\frac{\alpha}{8}\right)^5$ etc. lie outside the measurable. For already the additive term $\left(\frac{\alpha}{8}\right)^4$ in the numerator enlarges f''_e only by 0.000000000000101 to 0.00115964931173901 instead of 0.001159649311738 – thus already clearly outside the stated measurement limit.

The division term $\left(1 + \frac{\alpha}{3}\right)$ is phenomenologically interpretable. Not to forget that the base term

$$\frac{1 + \left(\frac{\alpha}{8}\right)^2}{1 + \frac{\alpha}{3}} \tag{233}$$

leads effortlessly to the (exactly calculated compared to the experimental value) anomalous magnetic moment of the proton.

The present results within the framework of a phenomenologically founded mass-radius-coupled magnetic field embodiment followed stringently from the numerical conspicuousness of the experimental measurement results and the resulting assumption of measurement-inherent magnetic field contributions. The central "Schwinger term" $= \alpha/(2\pi)$ derives from the embodiment of the magnetic field under consideration of the energetic conditions of the electric energy and the electric elementary charge e compared to the total energy, expressed by the elementary body charge q_0. The ratio $e/q_0 = \sqrt{\alpha}/2$ is also consistently governing for the calculation of the magnetic moment of the neutron from the proton and electron magnetic field contributions $\Delta\mu_{\mathrm{Be}}$ and $\Delta\mu_{\mathrm{Bp}}$, see Equations $[\mu n]$ and $[\mu n2]$.

Chance is excluded in these connections phenomenologically (due to the thought-model consistency), logically, and methodically. With the result: Leptonic and quark-based fantasies crumble at the numerical reality. Further consequences: The neutron is electron-proton-based and, like the proton, without (quarks & Co.) substructure.

31.9 The Geometric Logic of the Correction Terms: Surface Scaling and Spatiality

The EBT formula for the "fine adjustment" of the anomalous magnetic moment contains two correction terms that at first glance could seem like arbitrary numerical adjustments. Upon closer inspection, however, they turn out to be compelling consequences of the geometric nature of the elementary body.

31.9.1 The Term $1 + (\alpha/8)^2$: Geometry Instead of Numerology

In EBT, the magnetic moment is not an intrinsic point-particle property, but the result of the energetic superposition of the elementary body with the external magnetic field. Magnetic effects couple to surfaces (or cross sections), not to lengths. Surfaces scale with r^2.

The ratio of the Bohr radius (as energetic interaction radius) to the Rydberg radius is in EBT exactly $\alpha/8$

$$\frac{r_{\text{Bohr}}}{r_{\text{Ry}}} = \frac{m_{\text{Ry}}}{m_{\text{Bohr}}} = \frac{\alpha}{8} \tag{234}$$

If now the fractal embodiment of the magnetic field (the back-reaction of the field on the body) scales geometrically over the surface/area of the elementary body, then this fundamental length factor $\alpha/8$ must enter *quadratically*.

The term $(1 + (\alpha/8)^2)$ is thus not an arbitrary fit parameter, but the direct mathematical translation of the fact that magnetism is a surface-dependent (2D/spherical) phenomenon on the surface of the mass-radius-coupled body.

31.9.2 The Term $1 + \alpha/3$: The Spatiality of the Coupling

The factor 1/3 as a representation of the three spatial directions (x, y, z) may at first seem like a qualitative association. But in a theory that explicitly works with radially symmetric spherical surfaces and spatial superpositions, the division of an isotropic interaction into three orthogonal spatial dimensions is a fundamental geometric principle (think of the equipartition theorem of thermodynamics or the moment of inertia tensor integral over the sphere).

Moreover, the document itself points to a fascinating numerical coincidence:

$$2 \cdot \frac{\alpha}{3} \approx \frac{m_e}{m_\mu} \tag{235}$$

The document warns against the "muon trap" (i.e., the QED interpretation that a muon loop is at play here), but phenomenologically it means: The term $\alpha/3$ marks a structural threshold in the mass spectrum. Whether one interprets this as "direction dependence" or as a "mass threshold value" – it is an identified invariant pattern in the structure of constants.

31.9.3 The Contrast: EBT Pattern vs. QCD-"Numerology"

To appreciate the strength of the EBT equations, one must compare them with what the Standard Model offers for the proton g-factor. The SM has *no* closed analytical formula. It uses lattice QCD.

What is lattice QCD phenomenologically considered? One discretizes spacetime on a supercomputer lattice, inserts the postulated quark masses (which themselves are known only to percent accuracy and are tuned as free parameters) and lets the cluster compute until the result is in the vicinity of the measured value.

If one is honest, lattice QCD is the true "numerology" – a numerology with millions of computing hours, in which one "simulates" the measured value through iterative adjustment of lattice spacings and quark masses.

EBT, by contrast, takes the fundamental constants (α, m_e, m_p), combines them with the geometrically compelling scaling factors ($r^2 \to (\alpha/8)^2$ and $3\text{D} \to \alpha/3$) and provides analytical predictions that lie within the experimental error limits.

31.10 The Phenomenological Category Error of QED The Penning Trap as Interaction Partner

This is the most devastating logical point of EBT against QED. QED treats the electron as an isolated point particle in empty vacuum and invents "virtual particles" and "vacuum polarization" to explain the deviation from $g = 2$.

EBT poses the compelling phenomenological question: **How is measurement even performed?**

In the double Penning trap, the electron is surrounded by massive macroscopic electric and magnetic fields. These fields are not passive observers, but *energetic interaction partners* (an infinite energy reservoir). The "anomalous" portion is nothing other than the measurement-inherent magnetic field contribution – the energetic "embodiment" of the extended mass-radius body (electron) in the field of the apparatus.

QED ignores the energetic influence of the measurement apparatus and projects this interaction energy falsely as an intrinsic property into the particle. This is exactly the kind of "epicycle" physics (like Ptolemy) in which new fictive entities are invented to adapt a false basic model (the point particle in empty space) to the measurement reality.

31.10.1 The Historical Example of Karplus and Kroll

An exemplary proof of the methodological questionability of QED is the error in the 4th-order calculation of Karplus and Kroll, which remained undiscovered for 8 years because the wrong result coincidentally matched the then-current, imprecise measured value. This is a logically irrefutable argument against the predictive character of QED:

A theory that operates with infinities and "subtracts them away" through the formal trick of renormalization possesses an inherent mathematical arbitrariness. When new, more precise measured values come, new loops (Feynman diagrams) are calculated and adjusted. The document and the website prove: The theoretical results were modified again and again over the decades to "adapt" them to the respectively changed experimental results. Such a procedure is by definition a *post-hoc fit* (adjustment), not an *a-priori prediction*.

31.10.2 Occam's Razor: 13,000 Feynman Diagrams vs. EBT Geometry

The contrast in methodology reveals the weakness of the Standard Model:

- **QED:** Requires 13,000 Feynman diagrams, hadronic and weak loops, renormalization, and years-long Monte Carlo integrations on supercomputers to produce a numerical value that then "coincidentally" agrees with the experiment to 12 decimal places. As the PDF aptly notes: The "rest" is circular-reasoning belief work.
- **EBT:** Provides a closed, analytical formula for the "fine adjustment":

$$f_e'' = \frac{\alpha}{2\pi} \cdot \frac{1 + \frac{\alpha}{8} + \left(\frac{\alpha}{8}\right)^2 + \left(\frac{\alpha}{8}\right)^3}{1 + \frac{\alpha}{3}} \tag{236}$$

The logic of this formula:

1. The term $\frac{\alpha}{2\pi}$ (the "Schwinger term") is the fundamental energetic coupling to the measurement field.
2. The series $(1 + \alpha/8 + \dots)$ describes the fractal back-reaction of this field on the extended mass-radius body.
3. The denominator $(1 + \alpha/3)$ accounts for the spatial coupling.

This is a causal, geometric derivation from the nature of the elementary body and the nature of the measurement. It hits the experimental value without even a single virtual particle having to be postulated.

31.10.3 Philosophy of Science Evaluation

From the perspective of EBT (and purely scientifically considered), the QED prediction of the g-factor is a classic case of *overfitting*. One has a mathematically infinitely flexible model (asymptotic perturbation series + renormalization) that is calibrated to the ever more precise measured values of the Penning trap until it fits.

EBT, by contrast, identifies the true phenomenological origin of the anomaly (the measurement apparatus itself as an energetic body) and derives the value parameter-free from the geometry of the interaction.

31.11 The Embodiment of the Magnetic Field

For the electric elementary charge e, a characteristic magnetic flux density results:

$$B_\alpha = \frac{1}{r_0^2} \cdot \frac{\sqrt{3} \cdot F_{\mathrm{EB}} \cdot c^2 \cdot \sqrt{\alpha}}{f_7 \cdot 2} \tag{237}$$

From this follows a constant action per charge:

$$B_\alpha \cdot r_0^2 = \frac{\sqrt{3} \cdot F_{\mathrm{EB}} \cdot c^2 \cdot \sqrt{\alpha}}{f_7 \cdot 2} = \text{const.} \qquad [B\alpha r1] \tag{238}$$

Multiplication with the charge e yields the action:

$$B_\alpha \cdot r_0^2 \cdot e = \frac{\sqrt{3} \cdot F_{\mathrm{EB}} \cdot c^2 \cdot \sqrt{\alpha}}{f_7} \cdot \frac{\alpha}{4} \cdot \sqrt{2\alpha} \tag{239}$$

$$h(B_\alpha, r_0, e) = h \cdot \sqrt{3} \cdot \frac{\alpha}{2\pi} \qquad [hB\alpha re] \tag{240}$$

Comparison with the action for the elementary body charge q_0:

$$h(B_0, r_0, q_0) = \sqrt{3} \cdot c \cdot F_{\mathrm{EB}} = h \cdot \sqrt{3} \cdot \frac{2}{\pi} \qquad [hBrq0] \tag{241}$$

The term $\alpha/(2\pi)$ is the ratio of these two actions – reduced by $2/\pi$ to $\alpha/(2\pi)$.

31.12 Fractal Embodiments

> "The electron induces a primary magnetic field embodiment that contributes to the measured magnetic moment of the electron. This magnetic field body appears to the magnetic field (which, more generally formulated, corresponds to an externally provided energy reservoir) again as an entity and induces a second magnetic field body. This new entity in turn induces a third magnetic field body, so to speak in the 3rd generation, which is energetically significantly smaller than the primary – emanating from the electron – and energetically smaller than the secondary. The same holds for the proton in the magnetic field."

The terms $\left(1 + (\alpha/8)^2\right)$, $\left(1 + (\alpha/4)^2\right)$, $\left(1 + (\alpha/3)^3\right)$ etc. represent this fractal structure.

32 Spin as Energetic Analogy

The quantum mechanical spin is a purely mathematical quantity without real physical rotation. In Elementary Body Theory, it is understood as an energetic analogy:

$$L_{ee} = r \cdot m \cdot v = \frac{r_0}{4\alpha} \cdot m_0 \cdot \alpha c = \frac{1}{4} r_0 m_0 c = \frac{1}{4} \cdot \frac{2h}{\pi c} \cdot c = \frac{h}{2\pi} = \hbar. \tag{242}$$

The expression represents a charge-dependent energetic relation – without orbital motion and without intrinsic rotation. The factor $1/4$ combines with α in the denominator to yield the correct quantum of action.

The dyadic ladder of the energetic analogies assigns each channel a characteristic stage:

$$L_{ee} = \hbar, \quad L_{eq_0} = 2\hbar, \quad L_\mu = 3\hbar, \quad L_{q_0 q_0} = 4\hbar. \tag{243}$$

32.1 Historical Development of the Spin Concept

Wolfgang Pauli proposed in 1924 to introduce a quantum mechanical degree of freedom for the electron that can assume two values in order to describe the emission spectra of alkali metals. Ralph Kronig, an assistant of Alfred Landé, proposed in 1925 that this unknown degree of freedom was caused by the intrinsic rotation of the electron. Due to Pauli's criticism of this idea, Kronig's proposal remained

unpublished. Also in 1925, Samuel Abraham Goudsmit and George Eugene Uhlenbeck postulated the electron spin to explain the line splitting in the spectra as well as the anomalous Zeeman effect.

Up to this point, the basis of the considerations was a phenomenological consideration. Since this did not succeed, one now proceeded purely axiomatically.

In 1927, Pauli formulated a formalism for the quantum mechanical spin of the electron. With the help of the Pauli matrices, he could represent electron wave functions as 2-component spinors:

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, \quad \sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}, \quad \sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \tag{244}$$

In 1928, Paul Dirac set up a relativistic equation of motion for the electron. The Dirac equation named after him

$$(i\gamma^\mu \partial_\mu - m)\psi = 0 \tag{245}$$

describes, among other things, the half-integer quantum mechanical spin. In all these purely mathematical descriptions, no phenomenological basis exists anymore.

The consequence: The quantum mechanical spin existed then at the latest since 1930 inconsistent in consideration and without spin phenomenology purely mathematically.

For the quantum mechanical angular momentum has nothing more in common with what one can imagine under this name as a mechanical quantity. It arises from no motion, but from the cooperation of a spatial vector with the Dirac matrices in the space of their four abstract dimensions.

In other words: Quantum mechanics, despite better knowledge, often works in illustrations and semantic explanations with a false suggestion by means of the term spin as intrinsic rotation, but the associated quantum mechanical formalism describes no such real-physical rotation.

Simply put: The quantum mechanical spin has nothing to do with a rotation and is nothing more than a necessary, but completely unfounded quantum number without real-physical intuition, which is generated purely mathematically within the framework of prevailing physics – through a four-component Dirac spinor field with four Dirac matrices.

32.2 Macroscopic Rotation versus Quantum Mechanical Spin

The macroscopic intrinsic rotation of rigid bodies is plausibly comprehensible within the framework of classical physics. Cosmologically, there can – due to the formation process of arbitrary many-body bodies with concrete initial momenta – under the influence of gravitation, upon closer consideration, be no rotation-free structures.

Furthermore, it should be clear that elliptical celestial body orbits are vectorially fixed by initial momenta. Real circular orbits are practically excluded.

An analogy or projection to microscopic processes of interacting charge carriers, however, is phenomenological nonsense for various reasons.

Nevertheless, interesting is the fact that Arnold Sommerfeld's extension of the Bohr atomic model without spin postulate mathematically correctly describes the fine structure of the hydrogen atom. Sommerfeld introduced relativistic, Keplerian elliptical orbits for the electron circling radially symmetrically in the Bohr model, referred to spherical coordinates, and quantized these independently of each other. His fine structure formula is:

$$E_{n,j} = m_e c^2 \left[1 + \frac{\alpha^2}{\left(n - j - \frac{1}{2} + \sqrt{\left(j + \frac{1}{2}\right)^2 - \alpha^2} \right)^2} \right]^{-1/2} \tag{246}$$

Why he did not consistently, thinking celestial-mechanically, also give the electron a phenomenological intrinsic angular momentum in the sense of a real-physical moment of inertia is questionable.

Only when one recognizes and accepts the mass-radius coupling

$$m_0 r_0 = \frac{2h}{\pi c} = F_{\mathrm{EB}} \tag{247}$$

and the connection between charge and mass-radius constancy

$$\frac{e^2}{q_0^2} = \frac{\alpha}{4} \tag{248}$$

does it become understandable that the mathematical equating of electric and mechanical force possesses a phenomenologically founded basis.

32.3 The Energetic Analogy of Spin in EBT

Within the framework of the thought model of the elementary body, the system-physics-known quantum mechanical spin as action $h/2\pi$ as well as Sommerfeld's fine-structure constant α are inherently connected with the electric elementary charge e or with the ratio of electric energy to total energy.

The phenomenologically founded maximum velocity in this connection is:

$$v = \alpha \cdot c \tag{249}$$

and is inherently connected with a rest radius:

$$r = \frac{r_0}{4\alpha} \tag{250}$$

From this results in energetic analogy:

$$|L| = r \cdot m_0 \cdot v = \frac{r_0}{4\alpha} \cdot m_0 \cdot \alpha c = \frac{1}{4} r_0 m_0 c = \frac{1}{4} \cdot \frac{2h}{\pi c} \cdot c = \frac{h}{2\pi} = \hbar \tag{251}$$

This equation shows: The quantum mechanical spin value $\hbar$ is not a mysterious quantum property, but the energetic analogy of a charge-dependent radius-velocity product.

32.4 The Electron Radius and the Compton Wavelength

Also without many words, with the banal certainty that according to the general formulation of the Compton wavelength λ_C and the associated equivalence of rest energy and radiation energy – even within the framework of prevailing physics – it is easily comprehensible that the Compton wavelength also holds for electrons:

$$\lambda_C = \frac{h}{m_0 c} \tag{252}$$

Also the resting electron thus possesses – like the resting proton – a real-object-related, electron-mass-inherent radius r_e. In EBT, the geometric relation holds:

$$\lambda_C = \frac{\pi}{2} r_0 \tag{253}$$

Justification: During the formation of an elementary body from a photon, the radius undergoes a sine evolution:

$$r(t) = r_0 \sin\left(\frac{ct}{r_0}\right) \tag{254}$$

After a quarter period $t = \pi r_0/(2c)$, the radius is maximal $r = r_0$. The distance traveled on the spherical surface during this quarter period is $\frac{\pi}{2} r_0$ – the Compton wavelength. From this follows:

$$r_0 = \frac{2}{\pi} \lambda_C = \frac{2}{\pi} \cdot \frac{h}{m_0 c} \tag{255}$$

Since λ_C is measured, r_0 is a measured quantity – independent of the recognition by standard physics.

32.5 The Classical Radius as Interaction Radius

In all scattering formulas, the classical radius appears:

$$r_{\mathrm{cl}} = \frac{e^2}{4\pi\varepsilon_0 m_0 c^2} \tag{256}$$

In EBT, this is expressed as:

$$r_{\mathrm{cl}} = \frac{\alpha}{4} r_0 \tag{257}$$

The factor $\alpha/4$ is the ratio of electric energy to total energy. The classical electron radius is then not an abstract calculation quantity, but the – due to the ratio of electric energy to the rest-mass energy of the electron – scaled interaction radius of the electron-mass-inherent resting electron, which appears without exception in all scattering experiments on electrons.

Concrete values:

$$r_e \approx 1.54 \cdot 10^{-12}\,\mathrm{m} \quad \text{(mass-inherent radius)} \tag{258}$$

$$r_{e,\mathrm{cl}} = \frac{\alpha}{4} r_e \approx 2.82 \cdot 10^{-15}\,\mathrm{m} \quad \text{(classical radius)} \tag{259}$$

32.6 Seven Experimentally Confirmed Scattering Formulas

In all following, experimentally many times confirmed formulas, the classical electron radius r_{cl} appears. Standard physics cannot explain why this quantity always occurs in exactly the same combination – it accepts it as a useful constant without physical reality. EBT interprets $r_{\mathrm{cl}} = \frac{\alpha}{4} r_0$ as a scaled real radius.

Thomson scattering:

$$\frac{d\sigma}{d\Omega} = r_{\mathrm{cl}}^2 \cdot \frac{1 + \cos^2\theta}{2}, \qquad \sigma_{\mathrm{Thomson}} = \frac{8\pi}{3} r_{\mathrm{cl}}^2 \tag{260}$$

Møller scattering:

$$\frac{d\sigma}{d\Omega} = r_{\mathrm{cl}}^2 \cdot \frac{(3 + \cos^2\theta)^2}{\sin^4\theta} \cdot \frac{\gamma^2}{\beta^4} \cdot (\text{spin terms}) \tag{261}$$

Bethe-Bloch-Sternheimer equation:

$$-\frac{dE}{dx} = 2\pi N_A r_{\mathrm{cl}}^2 m_e c^2 \rho \frac{Z}{A} \frac{z^2}{\beta^2} \left[\ln\left(\frac{2 m_e c^2 \beta^2 \gamma^2 W_{\max}}{I^2} \right) - 2\beta^2 - \delta - \frac{2C}{Z} \right] \tag{262}$$

Photoelectric effect:

$$\sigma_{\mathrm{photo}} = 4\sqrt{2}\,\alpha^4 \sigma_0 Z^5 \left(\frac{m_e c^2}{E_\gamma} \right)^{7/2}, \qquad \sigma_0 = \frac{8\pi}{3} r_{\mathrm{cl}}^2 \tag{263}$$

Pair production:

$$\sigma_{e^- e^+} \approx 4\alpha r_{\mathrm{cl}}^2 Z^2 \left[\frac{7}{9} \ln\left(\frac{2E_\gamma}{m_e c^2} \right) - \frac{109}{54} \right] \tag{264}$$

Compton scattering (Klein-Nishina):

$$\frac{d\sigma}{d\Omega} = r_{\mathrm{cl}}^2 \left(\frac{\omega'}{\omega} \right)^2 \left(\frac{\omega}{\omega'} + \frac{\omega'}{\omega} - \sin^2\theta \right) \tag{265}$$

$$\frac{\omega'}{\omega} = \frac{1}{1 + \frac{\hbar\omega}{m_e c^2}(1 - \cos\theta)} \tag{266}$$

Kramers-Heisenberg formula:

$$\frac{d\sigma}{d\Omega} = r_{\mathrm{cl}}^2 \left(\frac{\omega'}{\omega}\right) \left| \epsilon' \cdot \epsilon - \frac{1}{m_e} \sum_j \frac{\langle n|\epsilon' \cdot \vec{p}|j\rangle\langle j|\epsilon \cdot \vec{p}|i\rangle}{\omega_{ji} - \omega} + \cdots \right|^2 \tag{267}$$

32.7 Transfer to the Proton – Analogy and Consistency

For every elementary particle, the mass-radius constant equation holds:

$$m_0 r_0 = \frac{2h}{\pi c} \tag{268}$$

The mass-inherent proton radius is:

$$r_p = \frac{2h}{\pi c m_p} = \frac{2}{\pi}\lambda_{C,p} \approx 8.412 \cdot 10^{-16}\,\mathrm{m} \tag{269}$$

The classical proton radius is:

$$r_{p,\mathrm{cl}} = \frac{\alpha}{4} r_p \approx 1.535 \cdot 10^{-18}\,\mathrm{m} \tag{270}$$

Application: Coulomb scattering on residual gas particles. The loss rate of an ion beam is:

$$\Gamma_{\mathrm{scattering}} = \frac{2\pi Z^2 r_{p,\mathrm{cl}}^2 c n_{sc}}{A^2 \gamma^2 \beta^3} \left(\frac{\langle\beta_h\rangle}{\varepsilon_{acc,h}} + \frac{\langle\beta_v\rangle}{\varepsilon_{acc,v}}\right) \tag{271}$$

Standard physics regards the classical proton radius as a pure calculation quantity. The proton has a constant charge radius of about $0.84 \cdot 10^{-15}\,\mathrm{m}$ – about 500 times larger than $r_{p,\mathrm{cl}}$. Standard physics does not consistently explain this difference. EBT, by contrast, interprets $r_{p,\mathrm{cl}} = \frac{\alpha}{4} r_p$ as a scaled actual radius for Coulomb scattering. The factor $\alpha/4$ results from the ratio of electric energy to total energy. Scattering does not see the full mass-inherent radius r_p, but the effective interaction radius – consistent with the electron.

32.8 Quantum Mechanical Spin Postulate and Epicycle Theory

The omnipresent pathological description procedures of prevailing physics and physics didactics by means of terms such as spin or spin-orbit interaction to suggestively mentally couple to real-physical objects that possess mass, occupy space, and rotate is schizophrenic since the introduction of quantum mechanics.

Consider: The electron is denied a radius by postulate. Protons are asymmetrically charge-fragmented, asymmetrically substructured, and their quarks provide, among other things, only one percent of the proton mass and no intrinsic spin contributions. Discrete orbits were replaced by probability wave functions that lead to probable, smeared positions and momenta.

Fact is: A quantum mechanical spin has never been measured, and no quantum mechanical spin will ever be measured in the future. What is always measured is a magnetic moment, to which a quantum mechanical spin is then mathematically attached for calculation. The magnetic moment, however, is based real-physically on mass and radius.

Both in quantum mechanical spin calculations and resulting subsequent calculations, the purely mathematical processes are reminiscent of the epicycle theory of the geocentric worldview. The calculations of epicycle theory with then three free parameters were never wrong – but the underlying worldview was an epistemological catastrophe.

32.9 Psychological Aspects and the Gyromagnetic Factor

The psychological question arises as to why several generations of physicists, self-theory-denying, speak, write, and most probably also think of orbits and angular momenta, when their theories may contain neither orbits nor angular momenta.

Intrinsic rotation presupposes spatial extension, mass, and axis of rotation. The common thinker should self-motivatedly simply ask himself the question of why theoretical physics programmatically rejects or so fears real-physical objects.

Conclusion: Spin-orbit interaction according to Dirac and semiclassical relativistic correction without spin are identical in result. The quantum mechanical spin arises purely mathematically by means of so-called gamma matrices within an equation system.

Incidentally: Spin and magnetic moment are – contrary to frequently expressed claims – not only results of the Dirac equation. The first indication that the Pauli equation including the magnetic moment of the electron can also be derived entirely within the framework of a non-relativistic theory comes from Galindo and Sanchez del Rio, American Journal of Physics 29, 582 (1961).

The Pauli equation is:

$$i\hbar\frac{\partial}{\partial t}\psi = \left[\frac{1}{2m}\left(\vec{p} - \frac{e}{c}\vec{A}\right)^2 + e\phi - \frac{e\hbar}{2mc}\vec{\sigma}\cdot\vec{B}\right]\psi \tag{272}$$

The derivation of the gyromagnetic factor – Landé factor g – from the Schrödinger form of the Dirac equation is not formal-analytical, since it is assumed that the kinetic energy and the electrostatic energy are small compared to the rest energy of the electron:

$$E_{\text{kin}} \ll m_e c^2, \qquad e\phi \ll m_e c^2 \tag{273}$$

This is indeed roughly correct, but depending on the accuracy requirement then again very wrong.

32.10 Virial Theorem and Energy Conservation

The virial theorem is based, among other things, on the idea of force-field or energy-field-filled spaces that represent an infinitely large energy reservoir. Furthermore, due to the virial theorem, only elastic interactions are treated – that is, the distances between the interacting entities are larger than the entities themselves.

For a classical $1/r$ potential:

$$2E_{\text{kin}} + E_{\text{pot}} = 0 \tag{274}$$

The virial theorem structure collapses within the framework of Elementary Body Theory. For an elementary interaction is always inelastic. The ground state energy of two charge carriers is calculated on an elementary-body basis without application of the virial theorem:

$$\Delta E_{e,e} = \left(\frac{m_A}{1+\frac{m_A}{m_B}}\right)\cdot\left(1-\sqrt{1-\alpha^2}\right)\cdot c^2 \tag{275}$$

The problem of the virial theorem historically leads to Fritz Zwicky, who concluded from the virial theorem the existence of dark matter. EBT shows that the supposedly dark finds an elegant explanation in the spatial extension and thus in space energy.

32.11 Energy of an Elementary Body and the Transformation into Space Energy

The total energy of an elementary body depends on its current radius r. It is described by:

$$E = \frac{m_0 r_0}{r}c^2 = \frac{F_{\text{EB}}c^2}{r} \tag{276}$$

In the rest state of the elementary body, $r = r_0$, and the known rest energy results:

$$E_0 = m_0 c^2 \tag{277}$$

For macroscopic many-body bodies, the mass-radius constant equation [F1] does not hold. A transformation of originally mass-bound energy into space energy takes place:

$$M_O \cdot R_O \neq F_{\mathrm{EB}} = \frac{2h}{\pi c} \tag{278}$$

32.11.1 Space Energy and Effective Mass

A macroscopic body – for example the Earth – consists of a multitude of nested elementary bodies. The real body extension is already before the interaction many orders of magnitude larger than equation [F1] requires mass-radius-coupled for elementary bodies. The energy needed to span this large spatial extension comes from the conversion of mass-bound energy. It is now present as space energy E_R in the volume of the body.

For a body of mass m_x at distance r from its center:

$$E_R = m_x c^2 \left[1 - \frac{m_x \gamma_G}{r c^2}\right] \tag{279}$$

Here γ_G is the Newtonian gravitational constant. The expression

$$\frac{m_x \gamma_G}{c^2} = r_G(x) \tag{280}$$

is called the gravitational radius of the mass m_x. The gravitational radius is the radius that the mass m_x would have to have if no transformation into space energy had taken place – if its entire energy were present in mass-bound form and would act completely gravitationally.

The mass actually effective for gravitation is the effective mass:

$$M_{\mathrm{eff}} = \frac{r_G}{r} m_x \tag{281}$$

The factor $\frac{r_G}{r}$ indicates which portion of the original mass-bound energy remains after the transformation. The larger the actual radius r in relation to the gravitational radius r_G, the smaller this portion – and the weaker the gravitation.

32.11.2 The Example of Earth

- Actual radius of Earth: $r_{\mathrm{Earth}} \approx 6.37 \times 10^6\,\mathrm{m}$
- Mass of Earth: $m_{\mathrm{Earth}} \approx 5.97 \times 10^{24}\,\mathrm{kg}$
- Gravitational radius of Earth: $r_{G,\mathrm{Earth}} = \frac{m_{\mathrm{Earth}} \gamma_G}{c^2} \approx 8.87 \times 10^{-3}\,\mathrm{m}$

The ratio

$$\frac{r_G}{r} \approx 1.39 \times 10^{-9} \tag{282}$$

is extremely small. The effective mass of Earth is therefore about one billion times smaller than its rest mass.

If Earth were compressed to the size of its gravitational radius, i.e., $r = r_G$, then $\frac{r_G}{r} = 1$ and the effective mass would equal the rest mass – gravitation would be immensely strong. Because Earth is, however, enormously extended, the by far largest part of its mass-bound energy has been transformed into space energy. The weakness of gravitation is therefore not a property of an independent force, but a consequence of the large spatial extension of ordinary matter.

32.11.3 Origin of the Gravitational Constant γ_G

EBT does not derive γ_G as a free parameter, but from the properties of a special elementary body, the elementary quantum G. The elementary quantum G is defined as the body in which no transformation of mass-bound into space-bound energy has taken place – its actual radius is equal to its gravitational radius.

From the mass-radius coupling follows:

$$\gamma_G = \frac{r_G}{m_G} c^2 \tag{283}$$

The gravitational constant γ_G used in the known Newtonian law of gravitation refers to the length-smallest body G, the elementary quantum. This fact is not obvious, since the usually formulated law of gravitation does not explicitly reveal this original connection.

From the mass-radius constant equation

$$m_0 r_0 = \frac{2h}{\pi c} = F_{\mathrm{EB}} \tag{284}$$

and the condition that for the elementary quantum G the gravitational self-energy equals its rest energy, it follows:

$$\gamma_G \cdot m_G^2 = F_{\mathrm{EB}} \cdot c^2 \tag{285}$$

$$m_G \cdot r_G = \frac{2h}{\pi c} = F_{\mathrm{EB}} \tag{286}$$

With the numerical value (CODATA 2022):

$$F_{\mathrm{EB}} = 1.4070691767 \cdot 10^{-42}\,\mathrm{kg \cdot m} \tag{287}$$

the following result for the elementary quantum:

$$r_G = \sqrt{\frac{F_{\mathrm{EB}} \cdot \gamma_G}{c^2}} = 2 \cdot \sqrt{\frac{h\gamma_G}{2\pi c^3}} = 2\, r_{\mathrm{Planck}} \tag{288}$$

$$m_G = \sqrt{\frac{F_{\mathrm{EB}} \cdot c^2}{\gamma_G}} = 2 \cdot \sqrt{\frac{hc}{2\pi\gamma_G}} = 2\, m_{\mathrm{Planck}} \tag{289}$$

$$\gamma_G = \frac{r_G}{m_G} \cdot c^2 \tag{290}$$

The gravitational constant is thus nothing other than the embodied ratio of radius to mass of the fundamental body G – a derived quantity, not a natural constant.

32.11.4 Summary

- EBT explains gravitation not as its own force, but as a consequence of a mass-space coupling.
- Every elementary body obeys the mass-radius constant equation $m_0 r_0 = 2h/(\pi c)$.
- The energy of an elementary body is $E = \frac{F_{\mathrm{EB}} c^2}{r}$; in the rest state ($r = r_0$) $E = m_0 c^2$ results.
- In macroscopic bodies, mass-bound energy is transformed into radius-dependent space energy.
- The effective mass effective for gravitation is $M_{\mathrm{eff}} = \frac{r_G}{r} m_x$. Because $r \gg r_G$, it is extremely small – this explains the apparent weakness of gravitation.
- Using the example of Earth, it is shown that the effective mass is smaller than the rest mass by a factor of 10^{-9}.
- The gravitational constant γ_G is derived from the elementary quantum G, not postulated.

32.12 Magnetic Moment and Bohr Magneton

The Bohr magneton is the magnitude of the magnetic moment that an electron with orbital angular momentum quantum number $l = 1$ generates through its orbital angular momentum:

$$\mu_B = \frac{e\hbar}{2m_e} \tag{291}$$

According to the Bohr atomic model, this is the state with the lowest energy. The idea of the circling electron, however, is formally non-existent in neither quantum mechanics nor QED. Elementary Body Theory also knows no circling electrons on Bohr orbits.

The concept of the Bohr magneton is thus to be evaluated as phenomenologically wrong, especially with regard to the real-object-freed, prevailing QED.

Even worse: An isolated, free electron is now supposed – independently of the Bohr orbit of the hydrogen atom – to possess an equally large intrinsic magnetic moment as in the case of the proton-bound, circling electron. As a reminder: Masses and charges impoverished to points cannot possess rotation axes; consequently, there are neither moments of inertia nor rotation nor magnetic moments.

32.13 Nuclear Magneton

From the ununderstood magnetic moment of the electron, the equally phenomenologically unfounded magnetic moment of the proton derives according to prevailing physics in analogy, which is misleadingly called the nuclear magneton:

$$\mu_N = \frac{e\hbar}{2m_p} \tag{292}$$

But how should one imagine this practically? Does one in all seriousness replace the electron on the Bohr orbit with a proton? Around what does this proton then circle? It cannot circle around a proton because of charge equality.

Logical result: The entire process is mathematically indeed trivial – one merely replaces the one mass with another mass – but phenomenologically there is no argumentation. The projection from the circling electron on the first Bohr orbit to a circling proton on the first Bohr orbit is grotesque.

Prevailing physics thus first expects that a proton experimentally provides the obviously wrong theoretical value, and then takes the large difference between measured and theoretical value, among other things, as confirmation of the assumption that the proton – unlike the electron – is substructured.

For the electron:

$$g_e \approx 2.002319 \tag{293}$$

For the proton:

$$g_p \approx 5.585695 \tag{294}$$

The large difference from the Dirac value $g = 2$ is interpreted for the proton as evidence of quark substructure – although this substructure is itself postulated and the quarks provide no intrinsic spin contributions.

32.14 Concluding Statement

Let us record the phenomenologically irrational: The nuclear magneton is, according to the postulate of prevailing physics, the intrinsic magnetic moment of a Dirac particle with the charge and mass of the proton. Among other things, the postulated substructure and postulated asymmetric charge fragmentation of the proton remain unconsidered in this thought process.

One thus first expects that a proton experimentally provides the quantum mechanical theoretical value, and then takes the large difference between measured and theoretical value, among other things, as confirmation of the assumption that the proton – unlike the electron – is substructured.

EBT, by contrast, calculates the magnetic moments of electron and proton from the fractal embodiment of the magnetic field – without substructure, without quarks, without gluons, without free parameters.

33 On the Theory-Ladenness of Measurements

33.1 Dirac Approximation and the Muon g-2 Experiment as Measurement Fiction

In connection with the "$g = 2$-generating" Dirac equation, there is a fundamental approximation problem of the first instance for the muon. In the Dirac equation, for the calculation of $g = 2$, it is presupposed that the particle to be observed moves slowly. This is definitively not the case in the experimental determination of the magnetic moment of the muon, which moves in the storage ring with a relativistic velocity ($E_{\text{kin}} \sim 30 \cdot E_0$). For this reason, the Dirac equation formally-logically cannot provide any result for g for the muon. Without $g = 2$, however, no "normal" magnetic moment of the muon exists, and consequently the "anomalous" magnetic moment of the muon is irrelevant without reference.

On an elementary-body basis, the muon is simply an unstable elementary body. The muon transforms according to the inherent mass-radius coupling into an electron; mass-dependent energy of the muon transforms into radius-dependent energy of the electron. Since the muon obviously cannot spontaneously transform into an electron, the specification of a concrete magnetic moment of the muon is a "measurement fiction".

In a thought experiment, I assume that the inherent magnetic field contribution to the magnetic moment of the muon corresponds to that of the electron (approximately $1.07546279 \cdot 10^{-26}$ J/T). From this results:

$$4.49044830 \cdot 10^{-26}\ \text{J/T} - 1.07546279 \cdot 10^{-26}\ \text{J/T} = 3.41498551 \cdot 10^{-26}\ \text{J/T} = \mu_{\text{B}\mu}(\text{th}). \tag{295}$$

If one calculates this back to the semiclassically defined mass as a function of the magnetic moment, a value of $2.47381765 \cdot 10^{-28}$ kg results. This corresponds to $\sim 0.994274 \cdot m_\pi$, thus almost exactly the mass of the charged pion ($m_\pi = 2.4880644 \cdot 10^{-28}$ kg $= 139.570180$ MeV/c^2). This leads to the thesis that in the supposed muon g-2 experiment, not the magnetic moment of the muon, but that of the (charged) pion is measured.

33.2 No Resting Pions or Muons

1. The experimental method of mass determination

Pions and muons are never at rest. They arise in high-energy collisions (protons on target, cosmic radiation) and move with relativistic velocities. Their mass is not determined by weighing, but through a chain of measurements and theoretical assumptions:

- **Momentum measurement:** From the curvature of the particle track in the magnetic field, the momentum p is determined ($p = q \cdot B \cdot R$, where R is the curvature radius). This presupposes knowledge of the charge q and the magnetic field B – both themselves theory-laden quantities.
- **Velocity measurement:** Via time-of-flight, Cherenkov radiation, or ionization density (dE/dx), the velocity v is determined. Each of these methods is based on model assumptions.
- **Mass calculation:** From p and v, $m = p/(\gamma \cdot v)$ follows with $\gamma = 1/\sqrt{1 - v^2/c^2}$. Already at this point, c enters as a constant, and the relativistic formula is a postulate of SR.
- **Decay calibration:** For short-lived particles (π^0: $8.5 \cdot 10^{-17}$ s; $\pi^\pm$: $2.6 \cdot 10^{-8}$ s; μ: $2.2 \cdot 10^{-6}$ s), the mass is often reconstructed from the invariant mass of the decay products. Example $\pi^0 \to \gamma\gamma$: From the energies and angles of the two photons, $m_{\pi^0} = \sqrt{2 \cdot E_1 \cdot E_2 \cdot (1 - \cos\theta)}/c^2$ is calculated. This presupposes the SR energy-momentum relation $E^2 = p^2c^2 + m^2c^4$ – precisely the postulate that EBT criticizes as phenomenologically unfounded.
- **Corrections:** Energy calibration of the detector, bremsstrahlung losses, multiple scattering, acceptance corrections – each of these corrections carries model assumptions.

Conclusion: None of these masses is a direct, model-free measurement. Each is the result of a theory-laden extraction chain.

2. Are there resting pions or muons?

No. There is no experimental state in which a pion or muon is present at rest and can be weighed directly. Even if a pion is stopped in matter (e.g., in a target), it is not "at rest", but enters into interaction with the target matter – it is captured, forms pionic atoms, or decays. The "rest mass" is a theoretical construct that is back-calculated from the measured quantities using the SR formulas. Muonic atoms (muonic hydrogen) are the experimentally closest approach to a "resting" muon. The measured transition frequencies (Lamb shift) are extremely precise – but the extraction of the muon mass from these frequencies presupposes the entire QED (including vacuum polarization, self-energy, recoil corrections).

3. EBT interpretation

In EBT, there is no "rest mass" in the sense of an intrinsic property. There are mass-radius bodies whose mass-radius product is invariant by $m \cdot r = F_{\mathrm{EB}}$. The mass of a body is not an isolatable measurable parameter, but a quantity that appears in the embodiment process and in interactions. For the muon, this means: The muon is never measured as an isolated, resting mass-radius body. It is observed in a decay cascade ($\pi \to \mu \to e$), and its "mass" is reconstructed from the momenta and energies of the decay products under SR/QED assumptions.

EBT provides its own value – from the fourth matter equation [$m_{\mu\mu}$], with EBT values, without SR postulates: $m_\mu(\mathrm{EBT}) = 104.98$ MeV ($-0.64\,\%$ to the extracted value). This value is a prediction, not a fit. The extracted measured value (105.66 MeV) is not a "true" muon, but a theory-laden extract. The difference of 0.64 % between EBT and extract is not an error of EBT, but the difference between phenomenological prediction and theory-laden reconstruction – the same class as pion ($+0.29\,\%$) and Higgs ($+2.86\,\%$).

4. Consequence for the entire mass systematics

If even fundamental quantities such as the muon and pion masses exist only as theory-laden extracts, then this applies all the more to all heavier, shorter-lived particles (tau, W, Z, Higgs, mesons, baryons). None of these values is a model-free measurement. All are results of reconstruction chains that would provide no numerical value without the postulates of the Standard Model. EBT therefore does not have to be measured against these extract values – it must confront them with its own, independent predictions. Exactly this is what the matrix of matter equations does: It provides EBT values on the basis of F_{EB} as a foundation, and transparently states the differences to the theory-laden extracts. The 0.29 % for the pion and the 0.64 % for the muon are in this light not "deviations", but the difference between phenomenological calculation and theory-laden extraction – and they lie in the same order of magnitude. That they are so close to each other at all is a strong indication of the consistency of the EBT approach.

33.3 The Deviations as Signature of Theory-Ladenness

The deviations of the EBT predictions for muon, neutral pion, and Higgs-like state are often interpreted in established physics as "inaccuracies" or "open problems" of EBT. Upon closer consideration of the experimental methods, this picture reverses: The deviations are not a deficiency of EBT, but a direct measure of the theory-ladenness of the SM extractions.

The fascinating thing about the primary sources of established physics is: The mainstream physics itself documents here completely openly that the masses of muon and pion are *not* direct measurements ("weighing" a resting particle), but highly theory-laden, indirect extracts. They thereby confirm exactly the epistemological critique of EBT (especially Section 19.2 "No resting pions or muons" and "The problem of theory-laden measurements").

33.3.1 The Muon ($-0.64\,\%$): Extraction via Muonium Spectroscopy & Bound-State QED

The muon lives only 2.2 microseconds. There is no "muon scale". The CODATA value of the muon mass (or the ratio m_e/m_μ) is extracted from the spectroscopy of muonium (a bound state of positive muon and electron). In order to conclude from the measured frequencies to the bare mass, the entire bound quantum electrodynamics (Bound-State QED) must necessarily be assumed as true.

The specialist literature itself admits that this extraction is "indirect", since it presupposes that the QED theory for muonium is exactly correct. The CODATA value of 105.66 MeV is thus the result of a measurement filtered through the complete QED formalism for bound leptons.

EBT calculates the muon as a geometric mass-radius transformation state (from the channel ladder) to 104.98 MeV. The difference of $-0.64\,\%$ is not an "error" of EBT, but the quantitative difference between the bare, geometric mass-radius coupling (EBT) and the QED-dressed extract (SM).

33.3.2 The Neutral Pion (+3.76 %): Extraction via Lattice QCD+QED & Invariant Mass

The neutral pion (π^0) lives only $8.5 \cdot 10^{-17}$ seconds. It immediately decays into two photons. Its mass is determined in the Standard Model in two ways, both of which are massively theory-laden: either via the mass difference to the charged pion (which requires supercomputer simulations) or via the invariant mass of the decay photons (which requires detector calibrations and Monte Carlo simulations).

The SM mass determination occurs in two ways:

Method A (invariant mass): One measures the photons in the calorimeter. The energy calibration of these detectors and the background modeling are based on elaborate Geant4 Monte Carlo simulations, which in turn presuppose the SM vocabulary (quarks, gluons, jets).

Method B (mass difference): Often the π^0 mass is determined by measuring the mass difference to the charged pion ($\pi^\pm$) and adding this to the charged pion mass. But to theoretically grasp this difference, isospin breaking (quark mass difference) and electromagnetic effects must be separated. This is done today by means of lattice QCD + QED simulations. The published value is thus a hybrid of detector simulations and supercomputer-supported lattice QCD calculations.

EBT calculates the π^0 parameter-free from the q_0-q_0 interaction (electronic strong embodiment) to 140.05 MeV. The deviation of $+3.76\,\%$ quantifies the "epistemic overhead" that the SM needs to adapt its quark-antiquark superposition concepts (quarkonia) and lattice simulations to the detector data.

33.3.3 The Higgs-Like State (+2.86 %): The Statistical SM Filter

The raw physical detector resolution for a 125-GeV particle that decays into photons is about 5 to 6 % (i.e., ±6 GeV). The value of 125.09 GeV "precisified" to ±0.24 GeV arises only through the assumption of an SM-conformal Breit-Wigner distribution, the calibration to other SM resonances (Z boson), and iterative likelihood fits against a Monte Carlo background.

EBT calculates the Higgs-like state as the strong q_0-q_0 embodiment of the proton-antiproton system to 128.58 GeV. The deviation of $+2.86\,\%$ lies exactly within the true, raw detector resolution of $\sim 5\,\%$, before the SM filter (the statistical fitting) reduces the data to the SM expectation value of 125 GeV.

33.3.4 Conclusion

The Rydberg energy and the neutron mass are hit by EBT to 10^{-6} accuracy because atomic spectroscopy and beta decay allow model-poor, direct frequency and energy difference measurements. For muon, pion, and Higgs, by contrast, the SM filter massively intervenes (Bound-State QED, lattice QCD, Breit-Wigner fits).

The deviations ($+3.76\,\%$, $-0.64\,\%$, $+2.86\,\%$) are from a phenomenological perspective **not "errors" of EBT**. They are the quantitative measure of the theory-ladenness of established physics. They indicate how strongly the Standard Model must calculate its own postulates (QED corrections, quark masses, lattice parameters) into the raw data in order to save its nomenclature.

EBT provides the **bare, geometric mass-radius reality**. The SM provides the **interpretation filtered through the formalism**. The consistency of the EBT values in the percent range – with completely different, purely geometric derivation without lattice and without renormalization – is from this perspective not weak, but phenomenologically compelling.

33.4 The Higgs and the Real Measurement Resolution

This subsection documents what is actually measured at the LHC and how the published mass value comes about, then contrasts the EBT alternative, and evaluates both approaches ontologically and epistemologically.

33.4.1 The Question of the Origin of Mass and the Conceptual Weakness of the SM Answer

The Standard Model answers the question of the origin of mass with the Higgs mechanism: an all-pervasive field to which particles couple, and whose quantum, the Higgs boson, was "detected" at the LHC in 2012. But already the first inventory shows that the mechanism explains less than it promises. The mass of the Higgs boson itself remains a free parameter of the theory:

$$m_H = \sqrt{2\lambda}\, v \tag{296}$$

where $v = 246$ GeV is the vacuum expectation value (determinable from the Fermi constant) and λ the unknown quartic self-coupling of the Higgs field. The SM cannot explain why the Higgs boson is just 125 GeV heavy and not 50 GeV or 1000 GeV – it must let the value be determined experimentally. This is not an oversight, but a conceptual weakness: There is no theoretical calculation, no constraint, no derivation.

Three further inconsistencies accompany the mechanism:

1. First, the original, massless formulation of the theory is epistemologically and mathematically violated by the subsequent introduction.
2. Second, the statement that the Higgs field gives particles their mass is empirically misleading: Proton and neutron, which make up the majority of visible matter, obtain only about 1 % of their mass from the Higgs coupling – the rest remains unexplained.
3. Third, the supposedly mass-generating terms contain no mass calculation; the values of the fermion masses must be inserted from outside as free parameters.

In addition: The only directly observed mass interaction, gravitation, plays no role in the SM at all. And the conditions under which the Higgs mechanism could generate fermion masses are fundamentally violated: right- and left-handed fermions would have to have equal masses, neutrinos would have to be strictly massless – the discovery of neutrino oscillations (Nobel Prize 2015), however, experimentally refutes this prerequisite. The internal contradiction of the SM remains unaffected.

33.4.2 No Direct Detection: The Empirical Basis Is Fragile

In proton-proton interaction, no neutral Higgs boson alone can arise due to charge conservation. The detection at the LHC therefore does not occur directly, but via postulated decay channels of indirect processes, such as gluon fusion. That at least ten billion collision events are necessary for this shows the extreme theory-ladenness of the experiment; a "detection" in the sense of a direct detection does not exist. The arbitrariness with which the SM treats its own objects in this environment is also shown elsewhere: The neutral pion, for example, has a different mass than the charged pions – nevertheless, they are all classified as "pions", supported by quantum mechanical superposition concepts (quarkonia); a setting that is unfounded outside the SM formalism.

33.4.3 Raw Detector Resolution vs. Published Precision: The Chain of Circular Reconstruction

The energy resolution of the detectors for photons or electrons is physically about 5–6 %. For a single event, this means:

$$\frac{\Delta E}{E} \approx 5\,\% \quad \Rightarrow \quad \Delta m_H \approx \pm 6 \text{ GeV} \quad (119\text{–}131 \text{ GeV}). \tag{297}$$

The published value $m_H = 125.09 \pm 0.24$ GeV is therefore not the raw measurement, but the endpoint of a chain of analysis steps, each of which already presupposes the SM:

1. **Signal model:** Assumption of a Breit-Wigner distribution, as predicted by the SM – the shape of the peak is not measured, but assumed.
2. **Background model:** Theoretical modeling of QCD jets, $t\bar{t}$ pairs, and W/Z+jets via Monte Carlo simulations – the simulation is based on the SM.
3. **Calibration:** Energy calibration to "known" resonances (Z boson 91.1876 GeV, J/ψ 3.097 GeV, π^0 135 MeV) – which in turn are SM-theoretically interpreted.

4. **Statistical adjustment:** Iterative likelihood fit of signal and background to the measured distributions – whereby the correct background form is again an SM assumption.

Also the announced 5σ significance is calculated under exactly these SM background assumptions. Without the theory-supported assumptions, the uncertainty would lie in the range of $\pm 5\,\%$, i.e., about 119–131 GeV. The high precision is thus not a purely experimental finding, but an artifact of SM-based reconstruction. The methodological circularity can be summarized in six steps:

1. One makes SM assumptions (Breit-Wigner, background model).
2. Based on this, Monte Carlo simulations are performed.
3. Calibration to SM resonances (Z boson, J/ψ, π^0) takes place.
4. A likelihood fit (signal + background) is performed.
5. One obtains a "Higgs boson" at about 125 GeV.
6. This is interpreted as confirmation of the SM.

Calibrate with the SM, simulate with the SM, fit the SM, find an SM-like peak, and announce confirmation of the SM – that is a circular self-confirmation. The mass $m_H \approx 125 \pm 0.2$ GeV determined at the LHC is consequently the result of an SM-based post-correction that reduces the raw detector resolution of $\sim 5\,\%$ to ± 0.2 GeV.

33.4.4 The EBT Alternative: The Higgs-Like State as Strong Embodiment of the Proton-Antiproton System

EBT does not need this entire construct. The Higgs-like state is in it not an excitation of an all-pervasive field, but a mass-radius-coupled state that emerges from the q_0–q_0 embodiment of the proton-antiproton system. The calculation follows – structurally identical to the pion and muon equations – the picture of the matter equations: The bracket (Who interacts?) provides, for the case of equal-mass partners, the strongly transformed proton mass, halved; the channel factor (How much is converted?) is equal to 1 in the strong channel, since the entire strong embodiment becomes mass.

Step 1 – strong transformation mass of the proton:

$$ {}_{q_0}m_p = \frac{4}{\alpha} \cdot m_p = 548.1439966 \times 938.2720813 \text{ MeV}/c^2 \approx 514.308 \text{ GeV}/c^2 \tag{298} $$

Step 2 – equal-mass bracket (pair term):

$$ \Delta m_{p,\bar{p}} = \frac{{}_{q_0}m_p}{2} = \frac{2}{\alpha} \cdot m_p = 257.154 \text{ GeV}/c^2 \tag{299} $$

Step 3 – pair splitting (charge conservation forces, as with pions and muons, the emergence of two resulting states):

$$ m_H(\text{EBT}) = \frac{\Delta m_{p,\bar{p}}}{2} = 128.577 \text{ GeV}/c^2 \tag{300} $$

Comparison with the value "detected" at the LHC $m_H(\text{exp}) \approx 125$ GeV/c^2:

$$ \frac{m_H(\text{EBT})}{m_H(\text{exp})} \approx 1.0286 \quad (\text{EBT } +2.86\,\% \approx +2.9\,\%). \tag{301} $$

This deviation lies within the real detector error framework ($\sim 5\,\%$ before the SM-based post-correction to ± 0.2 GeV) and in the same class as the other strong embodiments: neutral pion $+3.76\,\%$, muon $-0.64\,\%$. It is transparently flagged, not calculated beautifully. The EBT value is a prediction from h, c, α, and m_p – without detector calibration, without Monte Carlo simulation, without background modeling, without free parameters. The reduction of the strong interaction to the expression $m \cdot (2/\alpha)$ for equal-mass partners is an example of the inner stringency of the approach.

33.4.5 Ontological and Epistemological Evaluation

Both approaches differ in every relevant category. **Theoretical status:** The SM introduces the Higgs mass as a free parameter that must be measured; EBT calculates the Higgs-like state from the proton-antiproton interaction without free parameters. **Ontological status:** In the SM, a fundamental scalar boson, interpreted as the excitation of an all-pervasive Higgs field; in EBT, a mass-radius-coupled state of strong embodiment. **Assumptions needed:** The SM is dependent on a multitude of assumptions – Breit-Wigner distribution, background modeling by means of Monte Carlo simulations, calibration to SM resonances, and iterative statistical adjustment; EBT needs none of these assumptions, the value follows directly from fundamental constants and the geometry of the interaction. **Epistemological evaluation:** While the SM is trapped in a methodological circularity (SM assumptions lead to an SM-conformal result that is interpreted as confirmation of the SM), EBT offers an independent, parameter-free calculation.

That both values lie close to each other thus speaks not for the correctness of the SM, but for the fact that EBT correctly describes a real physical phenomenon that can only be mapped in the SM at the price of numerous ad hoc assumptions. The close agreement of the energy following from the proton-antiproton interaction with the Higgs-like resonance measured at the LHC (deviation approx. 2.9 %) is – against the background of the circular SM reconstruction – no coincidence, but an indication of a deeper order that cannot be mapped in the SM. EBT thus not only questions the SM, but offers measurable alternatives – also where the SM only operates with parameters and circular arguments.

34 Vacuum Energy and the 10^{120} Discrepancy

34.1 The Theoretical Vacuum Energy Density of Quantum Field Theory

Quantum field theory calculates the vacuum energy density using the Planck mass, the speed of light, and Planck's constant of action:

$$\rho_{Va} = \frac{m_{Pl} \cdot c^3}{h^3} \cdot c^2 \quad [\mathrm{J/m^3}] \tag{QFTVE}$$

This value is estimated to be about 10^{120} times the observed vacuum energy density of $\sim 10^{-9}$ J/m^3, which represents the worst theoretical prediction in the history of physics.

34.2 Transformation into the Picture of the Elementary Quantum

Using the relations $m_G = 2m_{Pl}$ and $r_G = 2r_{Pl}$ with $m_G r_G = \frac{2h}{\pi c}$, the QFT equation can be transformed into the picture of the elementary body:

$$\left(\frac{c}{h}\right)^3 = \frac{8}{\pi^3} \cdot \frac{1}{(m_G r_G)^3} \tag{108}$$

$$\rho_{Va} = \frac{m_G^4 \cdot c^3}{16 \cdot h^3} = \frac{m_G}{2 \cdot \pi^3 \cdot r_G^3} \tag{QFTVE2}$$

With the sphere volume $V_{G,\mathrm{sphere}} = \frac{4}{3}\pi r_G^3$:

$$\rho_{Va} = \frac{2}{3 \cdot \pi^2} \cdot \frac{m_G}{V_{G,\mathrm{sphere}}} \tag{QFTVE3}$$

34.3 The Elementary-Body-Based Energy Density of the Universe

The mass density of the universe according to the EBT estimate is:

$$\rho_{UniEk} = \frac{m(t)}{V(t)_{\mathrm{universe}}} \tag{109}$$

With the relations:

$$r_0 = \frac{2 \cdot c \cdot t}{\pi} \tag{rt}$$

$$m(t) = \frac{2 \cdot c^3 \cdot t}{\pi \cdot \gamma_G} \tag{MUNI}$$

$$V(t)_{\text{universe}} = \frac{4}{3}\pi r_0^3 \tag{110}$$

From this follows:

$$\rho_{Va} = \frac{4c^5}{3 \cdot \pi^3 \cdot h \cdot \gamma_G} \cdot t^2 \tag{QFTVE/EKEV}$$

For $t \approx 13.798$ billion years $= 4.35133728 \cdot 10^{17}$ s, the ratio becomes:

$$\frac{\rho_{Va}}{\rho_{UniEk}} = \frac{3 \cdot \pi^2}{2} \cdot \frac{r_{\text{Uni}} m_{\text{Uni}}}{F_{EB}} \approx 6.600812 \cdot 10^{120} \tag{UNIVE}$$

This ratio corresponds exactly to the famous 10^{120} discrepancy between QFT predictions and observed vacuum energy density.

34.4 Interpretation in EBT

Obviously, quantum field theorists, without realizing it, have extrapolated the mass-radius coupling and the resulting mass-radius constancy [F1] of microscopic bodies to cosmic proportions. The enormous discrepancy between quantum field theory and experimental reality arises because, within the framework of prevailing physics, it is not understood that an extension of elementary structures leads to an equivalent mass reduction. This can be calculated both qualitatively and quantitatively exactly using the effective mass via the gravitational energy.

The present considerations are thus an impressive indication of the mass-radius coupling propagated by EBT and its connection to macroscopic many-particle structures.

35 Beta Decay – The Unmasking of a Prime Example of the Fictionality of the Standard Model

The history of beta decay is a prime example of the fatal course settings of modern physics. When the continuous energy spectrum of emitted electrons was discovered in the 1920s, physicists faced a seeming dilemma: The law of energy conservation seemed violated at the microscopic level. Wolfgang Pauli postulated the neutrino in 1930 as an invisible "rescue particle" to preserve the energy balance. Niels Bohr, by contrast, expressed at the nuclear physics congress in Rome in 1931 the far more radical and phenomenologically profound conjecture: To understand beta decay, no new particles were necessary, but a fundamental upheaval of existing ideas – he even doubted the strict validity of the energy conservation law in the atomic realm, as already considered in the BKS theory. Physics decided at that time for the convenient path of the new postulate instead of the new paradigm.

Today, the Standard Model of particle physics (SM) finds itself with respect to the neutrino in a hopeless, logical dilemma, cemented by two Nobel Prizes. The Higgs mechanism (Nobel Prize 2013) necessarily requires that neutrinos be exactly massless Weyl fermions in order to consistently generate the masses of the other fermions. The discovery of neutrino oscillations (Nobel Prize 2015), however, experimentally proves that neutrinos must possess a mass. The SM is thus self-contradictory and cannot unite its own, Nobel Prize-awarded basic pillars.

35.1 The Ontological Contradiction in the Electron – Point Particle vs. Finite Radius

To fully grasp the absurdity of the Standard Model with regard to beta decay, one must first direct the gaze to the participating actors, especially the electron. Established physics dogmatically treats the electron as a dimensionless point ($r = 0$). At the same time, it uses in every practical calculation of cross

sections the *classical electron radius* r_{cl}, which is identified in Elementary Body Theory (EBT) as the electromagnetic interaction radius. This radius results from the mass-inherent extension of the electron according to the mass-radius coupling $m_e r_e = 2h/\pi c$, scaled by the factor $\alpha/4$, which represents the ratio of electric energy to total energy:

$$r_{\text{cl}} = \frac{e^2}{4\pi\varepsilon_0 m_e c^2} = \frac{\alpha}{4} r_e \tag{302}$$

That the electron possesses a real spatial extension and the assumption of a dimensionless point is a pure fiction is proven by seven fundamental, experimentally millions of times confirmed scattering and interaction equations, in which r_{cl}^2 occurs as a compelling, scaling prefactor for the cross section.

35.1.1 The Seven Scattering and Interaction Equations

1. **Thomson scattering:**

$$\frac{d\sigma}{d\Omega} = r_{\text{cl}}^2 \cdot \frac{1+\cos^2\theta}{2}, \qquad \sigma_{\text{Thomson}} = \frac{8\pi}{3} r_{\text{cl}}^2 \tag{303}$$

2. **Møller scattering (electron-electron scattering):**

$$\frac{d\sigma}{d\Omega} = r_{\text{cl}}^2 \cdot \frac{(3+\cos^2\theta)^2}{\sin^4\theta} \cdot \frac{\gamma^2}{\beta^4} \cdot (\text{spin terms}) \tag{304}$$

3. **Bethe-Bloch-Sternheimer equation (energy loss in matter):**

$$-\frac{dE}{dx} = 2\pi N_A r_{\text{cl}}^2 m_e c^2 \rho \frac{Z}{A} \frac{z^2}{\beta^2} \left[\ln\left(\frac{2m_e c^2 \beta^2 \gamma^2 W_{\max}}{I^2} \right) - 2\beta^2 - \delta - \frac{2C}{Z} \right] \tag{305}$$

4. **Photoelectric effect:**

$$\sigma_{\text{photo}} = 4\sqrt{2}\alpha^4 \sigma_0 Z^5 \left(\frac{m_e c^2}{E_\gamma} \right)^{7/2}, \qquad \sigma_0 = \frac{8\pi}{3} r_{\text{cl}}^2 \tag{306}$$

5. **Pair production in the nuclear field:**

$$\sigma_{e^- e^+} \approx 4\alpha r_{\text{cl}}^2 Z^2 \left[\frac{7}{9} \ln\left(\frac{2E_\gamma}{m_e c^2} \right) - \frac{109}{54} \right] \tag{307}$$

6. **Compton scattering (Klein-Nishina formula):**

$$\frac{d\sigma}{d\Omega} = r_{\text{cl}}^2 \left(\frac{\omega'}{\omega} \right)^2 \left(\frac{\omega}{\omega'} + \frac{\omega'}{\omega} - \sin^2\theta \right), \qquad \frac{\omega'}{\omega} = \frac{1}{1 + \frac{\hbar\omega}{m_e c^2}(1-\cos\theta)} \tag{308}$$

7. **Kramers-Heisenberg formula:**

$$\frac{d\sigma}{d\Omega} = r_{\text{cl}}^2 \left(\frac{\omega'}{\omega} \right) \left| \epsilon' \cdot \epsilon - \frac{1}{m_e} \sum_j \frac{\langle n|\epsilon' \cdot \vec{p}|j\rangle\langle j|\epsilon \cdot \vec{p}|i\rangle}{\omega_{ji} - \omega} + \dots \right|^2 \tag{309}$$

35.1.2 The Phenomenological Conclusion

Quantum electrodynamics (QED) uses the finite area r_{cl}^2 for all practical calculations, but ontologically insists on the postulate of point form ($r = 0$). A mathematical point cannot generate cross sections of this form. EBT resolves this contradiction: r_{cl} is the direct, geometric interaction radius of a real elementary body.

Remark 35.1. *The seven scattering formulas prove that the classical radius $r_{cl} = (\alpha/4) r_e$ derived from the mass-radius coupling occurs in all established scattering formulas – a strong indication of the physical reality of the mass-inherent radius r_e. QED is ontologically inconsistent: It calculates with a finite radius, but claims a point.*

35.2 The Logical Self-Destruction of the Standard Model through Neutrino Mass

The ontological contradiction in the electron, however, is only a symptom of a deeper disease of the Standard Model, which fully reveals itself in the neutrino problem and the so-called "extension" of the model.

The introduction of neutrino masses is not a harmless extension, but the logical and mathematical self-destruction of the SM. The original SM, crowned by the Higgs mechanism, necessarily demands that neutrinos be exactly massless Weyl fermions. Only under this condition does the $SU(2)_L \times U(1)_Y$ gauge invariance of the Lagrangian density remain, and only so can the other fermions consistently obtain mass. The discovery of neutrino oscillations, however, proves that neutrinos possess a mass ($m_\nu > 0$).

If SM representatives now claim that one merely has to "extend" the SM to integrate neutrino masses, this is, upon closer inspection, a deception. The introduction of a mass term $m > 0$ into the Dirac equation

$$(i\gamma^\mu \partial_\mu - m)\Psi = 0 \tag{310}$$

for neutrinos destroys the gauge invariance of the entire Lagrangian density. One cannot simply insert a mass term; one must introduce right-handed neutrinos, Majorana masses, seesaw scales, and new symmetries. This means, in plain language: One rewrites the entire Lagrangian density. An "extension" that introduces new particles, new couplings, and new mass scales is not an extended SM, but a completely new model. The original SM is thus falsified and dead.

35.3 The Beta-Minus Decay of the Neutron – A Phenomenological Absurdity

Against this background, the beta-minus decay of the neutron

$$n \to p + e^- + \bar{\nu}_e \tag{311}$$

turns out to be phenomenologically and energetically absurd in the SM narrative that this occurs through the transformation of a d quark into a u quark by means of a virtual W boson. There is energetically no binding process of this quark transformation.

The SM postulates a mass of ≈ 4.8 MeV/c^2 for the d quark and ≈ 2.3 MeV/c^2 for the u quark. The mass difference is thus ≈ 2.5 MeV. The maximum kinetic energy of the emitted electron in beta decay, however, is only 0.78 MeV. Where do the remaining ≈ 1.7 MeV go?

The SM hides this discrepancy behind the term "binding energy" or the "virtual mass of the W boson". But a virtual particle is a mathematical fiction of perturbation theory; it cannot store or carry away real, conservation-relevant energy. There is no phenomenological mechanism that explains how a d quark really decays into a u quark and thereby violates the energy balance. Quarks are not real objects, but artifacts of a mathematical $SU(3)$ symmetry.

35.4 The Continuous Spectrum – The Birth of a Ghost Particle

In addition, there is the puzzle of the continuous spectrum and the associated phenomenological gap. The neutrino was historically postulated solely because the energy spectrum of emitted electrons is not discrete, but continuous. The SM argues that the anti-electron neutrino absorbs the "missing" energy and immediately leaves the system.

The compelling logical consequence of this, however, is: If the neutrino leaves the system with the respectively "missing" energy, it must already be "born" at the moment of the weak interaction with an exactly corresponding kinetic energy continuum. How, from where, and why does the neutrino absorb different amounts of energy during the weak interaction to compensate the electron spectrum? The SM has no mechanical answer to this, but refers to "phase space" and Fermi's Golden Rule. But statistics is not phenomenology. A physical process requires a causal mechanism of energy distribution.

35.5 The Macroscopic Falsification of the Neutrino Postulate – The Matter Wave

The final macroscopic falsification of this postulate occurs through the matter wave. Since the SM today demands $m_\nu > 0$, the neutrino is subject to the universal de Broglie relation

$$\lambda = \frac{h}{p} \tag{312}$$

Every moving neutrino is a carrier of a real matter wave, and a wave transports, by definition, energy.

The solar neutrino flux is $\approx 6 \cdot 10^{14}$ neutrinos/(m^{2}s). If these matter waves struck the Earth, they would deposit their energy in the atmosphere and the upper layers of the day side. The calculation of the power density yields a permanent energy input of $\approx 3.16 \cdot 10^{15}$ Watt. This would additionally heat the day side of the Earth.

This heating is not measured. The matter wave does not exist. Therefore, it transports no energy. Therefore, the postulated particle has no mass. The neutrino is a mathematical parameter, not a real physical object.

35.6 The EBT Alternative – Beta Decay as Mass-Radius Transformation

Elementary Body Theory (EBT) clears away this conglomerate of fictions and mathematical rescue constructs. It needs no quarks, no W bosons, and no neutrinos.

In EBT, the neutron is a bound state of a proton and an electron that interact via the strong elementary body charge q_0 (an e-q_0 system). Beta decay is in EBT not a particle transformation process, but a pure mass-radius transformation that obeys the fundamental invariant

$$m_0 r_0 = \frac{2h}{\pi c} = F_{\mathrm{EB}} \tag{313}$$

During the decay of the neutron, the q_0 binding dissolves and the electron is emitted. The seemingly "missing" energy that the SM attributes to the neutrino is in truth radius-dependent space energy.

The mass difference between neutron and the products (proton + electron) is

$$\Delta m = m_n - m_p - m_e \tag{314}$$

From this, the Lorentz factor of the electron follows as

$$\gamma = \frac{\Delta m}{m_e} + 1 \tag{315}$$

The kinetic energy of the emitted electron is calculated exactly as

$$E_{\mathrm{kin}} = (\gamma - 1) m_e c^2 \approx 0.782 \text{ MeV} \tag{316}$$

This corresponds exactly to the maximum value stated in the literature, derived without any fictitious decay particles.

35.7 The Continuous Spectrum – Space Energy Instead of Neutrino

But why is the measured spectrum continuous? The continuous spectrum does not arise through a fleeing neutrino, but through the geometric degrees of freedom of the mass-radius expansion of the decay products at the moment of decoupling. Part of the released binding energy is converted into the kinetic energy of the electron (translational energy), the other part remains as inner space energy (radius enlargement) in the system.

Standard detectors such as calorimeters measure exclusively translational energy through collision processes. The energy stored in the geometry of space, i.e., in the radius of the products, is calorically invisible to these detectors.

The SM invents an invisible particle, the neutrino, to conceal the inability of its detectors and its point-like ontology to measure space energy. EBT shows: The energy is not gone, it is only stored in a form that eludes purely calorimetric measurement. The energy conservation law of prevailing physics is incomplete because it ignores the radius-bound energy.

35.7.1 Epistemological Conclusion

Beta decay is thereby freed from the realm of virtual photons, quarks, and vacuum polarizations; it is the measurable, energetic receipt for the physical contact and the geometric reordering of real elementary bodies.

Remark 35.2. *EBT shows: The energy is not gone, it is only stored in a form that eludes purely calorimetric measurement. The energy conservation law of prevailing physics is incomplete because it ignores the radius-bound energy. The neutrino is a mathematical parameter, not a real physical object.*

Appendix: The Phenomenological Significance of the de Broglie Matter Wave

A Introduction

The de Broglie matter wave is an experimentally secured fact of physics. Its existence and its interactions are **independent of thought models**.

For every massive particle, the relation holds

$$\lambda = \frac{h}{p} \tag{317}$$

where λ is the matter wavelength, h Planck's constant of action, and p the momentum of the particle. This relation has been experimentally confirmed for a variety of particles:

- Electrons (Davisson-Germer experiment, 1927)
- Neutrons (neutron interferometry, from 1970)
- Atoms (helium interferometry, from 1990)
- Molecules (fullerene interferometry, 1999)

The matter wave is a property of motion, not of particle type. It does not distinguish between electrons, neutrons, atoms, or neutrinos.

B The Universality of the Matter Wave

The de Broglie relation is universal. For every massive particle:

$$\lambda = \frac{h}{p} = \frac{h}{mv\gamma} \tag{318}$$

with

$$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}} \tag{319}$$

This equation makes no difference between different particle types. The matter wave has no physical "memory" of where the particle comes from or which interactions it is subject to.

C Experimental Confirmation of the Universality of the Matter Wave

The universality of the matter wave is demonstrated by a series of independent experiments on different particle types, which have experimentally confirmed the de Broglie relation $\lambda = h/p$.

Table 10: Experimental proofs of the matter wave

Particle type	**Year**	**Experiment**
Electrons	1927	Davisson-Germer experiment
Neutrons	from 1970	Neutron interferometry
Atoms	from 1990	Helium interferometry
Molecules	1999	Fullerene interferometry

D Extended Evidence for Universality

The experimental confirmation of the de Broglie matter wave is not limited to the classical particle types. In recent decades, the wave nature has been demonstrated for a broad palette of further objects, impressively underpinning the universality of this phenomenon.

D.1 Antimatter (Positrons)

Within the framework of the SM: The QUPLAS collaboration (Quantum interferometry and gravitation with Positrons and LASers) was able in 2019 for the first time to demonstrate the interference of single positrons – the antiparticles of the electron – [QUPLAS, 2019]. This experiment represents the first successful demonstration of quantum interference with an antimatter particle and shows that the matter wave is also a real, measurable phenomenon for antimatter [University of Bern, 2019]. The results were published in the journal *Science Advances* and selected by *Physics World* as one of the top-10 experiments of 2019 [INFN, 2019].

D.2 The Talbot-Lau Effect in Antimatter: A Further Confirmation of Universality

The experimental confirmation of the de Broglie matter wave for antimatter by the QUPLAS collaboration in 2019 is a further milestone in the long chain of proofs demonstrating the universality of the matter wave. It is not the foundation of the argumentation – this rests on the entire experimental evidence since 1927 – but an additional, particularly impressive confirmation.

According to the universal de Broglie relation $\lambda = h/p$, every massive particle, thus also the positron, is assigned a matter wave. The proof of positron interference experimentally demonstrates that this dualism also holds for antimatter.

The wavelength is inversely proportional to the momentum p of the positron. In the non-relativistic approximation:

$$\lambda \approx \frac{h}{\sqrt{2mE_{\text{kin}}}} \tag{320}$$

For the QUPLAS-0 experiments, for example, wavelengths of $2.08 \times 10^{-11}\,\text{m}$ (at approx. 3.5 keV) and $1.03 \times 10^{-11}\,\text{m}$ (at approx. 14 keV) were calculated.

The Talbot-Lau effect is specifically used because, in contrast to the classical double-slit experiment (far field), it also works with spatially incoherent sources and low particle flux. The first grating (G_1) prepares the necessary coherence from a disordered beam, which is the only practicable solution for antimatter experiments, where particle manipulation is extremely complex.

The diffraction angle ϕ at a grating depends directly on the wavelength:

$$\phi = \frac{\lambda_{\text{dB}}}{d} \tag{321}$$

where d is the grating period. In matter-wave interferometers such as the Talbot-Lau interferometer used in the QUPLAS-0 phase, precise knowledge of the wavelength is decisive for the alignment of the gratings and the detection of the patterns.

The observed contrast (visibility) of the interference fringes depends strongly on the energy and thus the wavelength of the incoming positrons. Experimental data show that the visibility reaches maxima at certain energy values (and corresponding wavelengths). The observation of the energy dependence of the interference pattern clearly proves the quantum mechanical origin of the phenomenon and delimits it from a purely classical "shadow casting" (Moiré effect). If the interference pattern were a purely classical Moiré effect, the pattern would remain the same at every particle energy. Since the pattern changes with energy (and thus the de Broglie wavelength), it is proven that this is a wave superposition.

The significance of this experiment for the argumentation against the neutrino mass lies in the further closing of a logical gap: If even antimatter (positrons) shows measurable wave properties, there is no physical reason why neutrinos – provided they possess a mass – should be an exception. The Talbot-Lau effect uses the wave for the directional change of the particles; in wave physics, this is inseparably connected with the transport of energy.

In summary, the de Broglie wavelength is the parameter that characterizes the positron in interferometry as a matter wave and defines the scaling of the entire experimental setup as well as the quality of the measurement signals. The QUPLAS experiment is a further mosaic piece in the experimental evidence chain that shows: There is no exception to the universality of the matter wave. If positrons, fullerenes, atoms, neutrons, and electrons all have matter waves – why should neutrinos be an exception? The answer is: There is no physical reason.

D.3 Macromolecules

Experiments demonstrate the wave nature for complex organic molecules such as phthalocyanine and its derivatives with masses of up to 1298 amu. Interference was even observed for molecules with up to 430 atoms and a mass of 6910 amu.

D.4 Atoms and Isotopes

Besides helium, already demonstrated in 1990, interference was confirmed for sodium atoms (1988) [Phys. Rev. Lett. 61, 1580, 1988] and argon (1995) [CLEOPR, 1995] as well as for various isotopes.

D.5 Protons

Within the framework of the SM: For protons, too, diffraction (Fraunhofer diffraction) is used as a method for determining nuclear radii, which presupposes their wave nature in high-energy regimes [arXiv:nucl-th/0405033]. In the scattering of fast protons on atomic nuclei, diffraction patterns arise that are used to determine nuclear radii.

These experiments demonstrate that the matter wave is not a phenomenon limited to certain particle types, but a universal property of motion.

E Consequence for Neutrinos

The Standard Model of particle physics postulates that neutrinos possess a rest mass:

$$m_\nu > 0 \tag{322}$$

From the universality of the matter wave, it then follows compellingly:

$$\lambda_\nu = \frac{h}{p_\nu} = \frac{h}{m_\nu v_\nu \gamma_\nu} \tag{323}$$

Every moving neutrino, like every other moving mass, accordingly possesses a de Broglie matter wave. This wave is real – it is no less real than the matter wave of an electron or neutron. Since the interaction of the matter wave of neutrinos moving at nearly light speed does not show, these do not exist! The model-independently real-physically universally existing matter wave falsifies the neutrino-mass existence (thesis)!

Historical

The de Broglie matter wave was introduced in 1924 as a formal hypothesis: **Every particle is assigned a wave with wavelength $\lambda = h/p$.** This hypothesis was experimentally confirmed by the diffraction of electrons on crystals and formed a pillar of quantum mechanics.

From the standard thought-model perspective, the de Broglie matter wave proves to be doubly problematic:

1. **What is this wave?** Quantum mechanics provides no phenomenological answer to this. It is called a "probability wave" – but probabilities are not physical objects, but epistemic quantities. A probability wave cannot occupy space, cannot transfer energy, cannot mediate interaction. It is a formal construct to which no real counterpart stands opposite.

2. **Why does it have this form?** The relation $\lambda = h/p$ is postulated, not derived. It is a formal analogy to the photon, not a geometric necessity. There is no derivation context that shows why the momentum of a particle must be linked to a wavelength – and why this link has exactly this form.

Elementary Body Theory (EBT) solves both problems by deriving the de Broglie matter wave from a **single geometric basic relation** – the mass-radius coupling. It gives the matter wave a phenomenological meaning that fundamentally cannot be given in quantum mechanics.

The EBT Derivation of the de Broglie Wavelength

The Foundation: The Mass-Radius Coupling

The foundation of EBT is the mass-radius constant equation:

$$m_0 r_0 = \frac{2h}{\pi c} = F_{\mathrm{EB}} \tag{F1}$$

This equation is not a postulate, but a **theorem** that follows from the Freyling intervention – the geometric construction of the spherical surface dynamics. It states that every elementary body possesses a real, mass-inherent radius r_0. In EBT, the Compton wavelength is not a definition, but the geometric consequence of this spherical surface:

$$\lambda_C = \frac{\pi}{2} r_0 = \frac{h}{m_0 c} \tag{A.1}$$

The Derivation of the de Broglie Relation

The de Broglie wavelength of a particle is in EBT:

$$\lambda_{\mathrm{deB}} = \frac{h\sqrt{1-(v/c)^2}}{m_0 v} \tag{A.2}$$

With the mass-radius coupling, it follows:

$$\lambda_{\mathrm{deB}} = \frac{h \cdot r_0 \cdot \sqrt{1-(v/c)^2}}{F_{\mathrm{EB}} \cdot v} = \frac{\pi}{2} \cdot r_0 \cdot \sqrt{\left(\frac{c}{v}\right)^2 - 1} \tag{A.3}$$

And thus the relation to the Compton wavelength:

$$\boxed{\lambda_{\mathrm{deB}} = \lambda_C \cdot \sqrt{\left(\frac{c}{v}\right)^2 - 1}} \tag{A.4}$$

Remark E.1. *This equation is not a postulate. It follows compellingly from the geometry of the spherical surface and the mass-radius coupling. The de Broglie wavelength is thus not a probability wave, but a real geometric quantity – the radius of the embodied kinetic energy.*

The Phenomenological Meaning

In EBT, the Compton wavelength characterizes the elementary body itself – its mass-inherent radius r_0. The de Broglie matter wave, by contrast, represents not the particle, but the **embodiment of its kinetic energy**. It is the radius that the kinetic energy of a moving elementary body occupies in space.

In EBT, the so-called rest mass m_0 is not an inertial-system-dependent concept, as Special Relativity uses it. It denotes the fully formed elementary body in the state $m(t) = m_0$, $r(t) = r_0$. The rest mass is a measure of the oscillation frequency of the elementary body. Radius-smaller elementary bodies possess a larger mass, since this is equivalent to the inner motion of the oscillating spherical surface. In EBT, mass is not to be understood as a substantial quantity, but as an expression of inner motion that is traced back to the radius via reciprocal proportionality.

The de Broglie matter wave extends the space spanned by an elementary body. It is the radially symmetric embodiment of its kinetic energy – independent of the direction of its motion.

The Limit Case $v \to 0$: The Infinite Range

A central result of EBT is the limit case:

$$\lim_{v \to 0} \lambda_{\mathrm{deB}} = \infty \tag{A.5}$$

A resting particle has an infinite interaction range – mediated by the minimal kinetic energy. This is not a contradiction, but a statement about the **potentiality** of the particle: It is ready to interact with every other particle in the universe – mediated via this infinite "antenna" of kinetic energy.

The Epistemological Significance

The Threefold View: Newton – Einstein – EBT

Isaac Newton already considered the notion that gravitation could act through empty space as absurd. He knew that an action at a distance without a physical mediator is impossible. But he had no alternative. He introduced space as an absolute container – not because he considered it real, but because he needed a stage on which gravitation could take place. His attitude was epistemologically honest: He said that space and time are primarily ordering patterns of the understanding – thus no physical objects, but forms of our intuition. But this insight had no consequences for his physics. He calculated with space as if it were real, although he knew that it was not.

Einstein solved Newton's problem by making space itself an actor. Gravitation does not act through empty space – it is the curvature of space. That is mathematically ingenious, but epistemologically a sleight of hand. Space, which Newton still called an ordering pattern of the understanding, becomes in Einstein a physical object. But this object is not measurable. Spacetime is not a physical object – it is a mathematical construct. Einstein did not solve the problem. He shifted it: from the question "How does gravitation act?" to the question "What is spacetime?" – and did not answer this question.

EBT returns to Newton – but goes one step further. It says: Newton was right: space and time are primarily ordering patterns of the understanding. But they are not only that. They are the product of a real transformation – the embodiment of motion in space. EBT takes Newton at his word and makes his epistemological insight physically fruitful. Space and time are not physical objects. They are not things that exist. But they are not arbitrary. They are the product of the radial unfolding of elementary bodies. Gravitation does not act through space – it is the overlap of the radii (Compton + de Broglie) of the participating bodies. Space is not the cause of gravitation. Gravitation is the cause of space – or more precisely: the transformation of energy into space.

Newton *recognized* the problem, but he had no solution. Einstein *suppressed* the problem by making space an object. EBT *solves* the problem by understanding space as the product of a real transformation.

The Avoidance of the Category Error of Spacetime

GR says: Motion curves space. EBT says: Motion **embodies itself as space**.

This is a fundamental difference that enables an epistemologically clean cut. GR identifies motion and space (spacetime continuum). EBT distinguishes between the motion (anisotropic) and its embodiment (isotropic). EBT does not say that space is curved by motion. It says that motion *creates a space* – but this space is not the motion itself, but its radially symmetric product. EBT avoids the category error of identifying motion and space. It respects the fundamental difference between the process (motion) and its product (space).

The Decoupling of Direction and Extension

In standard physics, direction and extension are inseparably connected. A vector has a length and a direction. EBT decouples both: The direction is the motion (anisotropic). The extension (the radius) is the embodiment (isotropic). This means: The spatial extension of a particle does not depend on its direction of motion. An electron flying to the right has the same de Broglie radius as an electron flying to the left. The direction is irrelevant for space. EBT frees space from motion. Space is not determined by the direction of motion. It is an independent, isotropic quantity – the radius of the embodied energy.

The Independence of Space from the Observer

Einstein said: Space and time depend on the observer. EBT says: Space (the embodiment) does not depend on the observer – only the motion (the momentum) is observer-dependent. This is a great epistemological advance. The de Broglie wavelength is an invariant quantity in the sense of EBT. It is the radius of the kinetic energy – and this radius is the same for every observer because it is a property of the particle, not of the relation between particle and observer. Relativity concerns only the perception of motion, not the reality of space. EBT restores the objectivity of space. Space is not a product of the observer perspective, but a real property of the particle.

The Explanation of Interaction

GR has not solved the problem of instantaneous action at a distance – it has concealed it by the postulate of spacetime. EBT solves it through the overlap of radii. Two particles do not interact through empty space. Their fields (Compton + de Broglie) overlap – and this overlap is the interaction. The distance is not the obstacle, but the measure of the overlap. EBT offers a causal, intuitive explanation of interaction without metaphysics. The overlap of radii is a real, geometric process – not a formal abstraction.

The Solution of the Seeming Contradiction: Anisotropic Motion – Isotropic Space

At this point, the thought model becomes really interesting and difficult. The seeming contradiction is: The de Broglie matter wave is an expression of kinetic energy. Kinetic energy is anisotropic – it has a direction (the direction of motion). How can then the space spanned by this energy be isotropic? The answer of EBT to this dilemma is as simple as it is profound: Motion is anisotropic, but the embodiment of motion is isotropic.

The motion itself is anisotropic. A photon moves in one direction. An electron has a momentum vector. The kinetic energy has a direction. This is undisputed. A moving particle points in one direction.

The embodiment of this motion, however, is isotropic. Here the Freyling intervention comes into play. The spherical surface that forms the elementary body arises through isotropic light propagation. The photon is indeed a directed state (it moves in one direction), but the process of its embodiment – the transformation of pure motion into mass-radius-coupled energy – is radially symmetric. EBT says: The spherical surface develops radially symmetrically with $v = dr/dt$ isotropically. The motion is anisotropic. But the embodiment of the motion is isotropic. EBT solves the seeming contradiction through a clear phenomenological distinction. Space is not the motion itself – it is its radially symmetric product. The direction of motion is irrelevant for space.

The Epistemic Significance

In quantum mechanics, the de Broglie wavelength is an observer-dependent quantity – it depends on the reference system (via the momentum p). In EBT, by contrast, it is an objective property of the particle. It is the real radius of the kinetic energy. It is the same for every observer because it is a property of the particle, not of the relation between particle and observer. This is a fundamental difference: EBT does not ask what the observer sees, but what the particle is. EBT places ontology before epistemology. It asks first about being, then about knowledge. Quantum mechanics does the opposite – and thereby falls into the category error of confusing knowledge with being.

What It Means for the Thought Model

EBT is epistemologically so strong because it frees physics from mathematics – it explains what mathematics means instead of merely using it. It respects the separation of subject and object – it does not ask what the observer sees, but what the particle is. It establishes the unity of micro- and macrocosm – the same geometry (spherical surface, radius, overlap) holds for the electron and for the universe. It places phenomenology before formalization – it asks first: "What is real?" and then: "How do we describe it?"

The Confirmation by Scattering Cross Sections

EBT is confirmed by the fact that the classical radius

$$r_{\mathrm{cl}} = \frac{e^2}{4\pi\varepsilon_0 m_0 c^2} = \frac{\alpha}{4} r_0 \tag{A.6}$$

occurs in all established scattering formulas – Thomson scattering, Møller scattering, Bethe-Bloch-Sternheimer equation, photoelectric effect, pair production, Compton scattering (Klein-Nishina), Kramers-Heisenberg formula. This is a direct proof that the mass-inherent radius r_0 is real – and thus also the de Broglie matter wave as its kinetic extension.

Conclusion: A Complete Paradigm Shift

EBT replaces abstract spacetime with concrete spherical surfaces, observer dependence with objective radii, mathematics as foundation with geometry as foundation, and probability with reality. In this picture, the de Broglie matter wave is the invisible halo of the particle – the part of its reality that enables the infinite range of its interaction. It is not mysterious, but consistent: If kinetic energy is real, then it must occupy real space – and it does so via the de Broglie wavelength.

EBT is not a new theory. It is the phenomenological completion of what Newton had already recognized: Space and time are primarily ordering patterns of the understanding. To obtain physics from these ordering patterns, a phenomenological consideration and explanation is mandatory. EBT provides this explanation. It shows how space arises from motion.

F The Casimir Effect in EBT

Introduction: The Casimir Effect – from Vacuum to Geometry

The Casimir force – named after the Dutch physicist Hendrik Casimir, who predicted it theoretically in 1948 – is a phenomenon that at first glance seems like a miracle of quantum field theory: Two uncharged, metallic plates in vacuum attract each other, although no classical force acts between them. In established physics, this effect is interpreted as a consequence of the **zero-point oscillations of the electromagnetic field**: Between the plates, only such waves can exist whose wavelength fits into the gap; outside, all modes are allowed. The resulting energy difference creates an attractive force whose magnitude Casimir calculated as

$$\frac{F}{A} = \frac{\pi^2 \hbar c}{240\, d^4}$$

– a result that was later experimentally confirmed with remarkable precision.

Yet this interpretation is inseparably connected with the concepts of quantum electrodynamics: **virtual photons, vacuum fluctuations, and an infinite zero-point energy** that can only be handled through elaborate regularization and renormalization. The question of whether the Casimir effect is actually proof of a "bubbling quantum vacuum" or whether there is a physically more intuitive, geometric explanation is astonishingly rarely asked in the professional world – and when it is, it is usually dismissed with reference to the overwhelming success of QED.

Elementary Body Theory (EBT) asks this question anew – and answers it radically differently. **Without virtual particles, without vacuum fluctuations, without renormalization.** Instead, it starts from a single, phenomenologically founded principle: Space is not an empty container, but the product of a real energetic transformation. The fundamental mass-radius coupling

$$E(r) = \frac{F_{\mathrm{EB}} c^2}{r}, \qquad F_{\mathrm{EB}} = \frac{4\hbar}{c},$$

states that every energetic state possesses a real spatial extension. A radial space-energy shell with radius r is not abstract – it is a physical embodiment that can unfold unhindered in free space.

Two parallel plates at distance d do not act in this picture as "mirrors for vacuum waves", but as **hard geometric barriers** for this radial unfolding. Between them, a space-energy shell can only fully form if

its diameter is smaller than or equal to d. Otherwise, it is truncated to a spherical cap – and thereby a part of its energy is geometrically suppressed. The resulting **space-energy deficit** between interior and exterior generates the Casimir force – not as a fluctuation of nothingness, but as the **pressure of an energetic gradient** forced by the geometry of the plates.

The mathematical evaluation of this geometric restriction leads to a difference between a **discrete spectrum** (inside the gap, where the normal component of the wave number is quantized: $k_z = n\pi/d$) and a **continuous spectrum** (in the unbounded exterior). This difference can be calculated with the **Euler-Maclaurin formula** – a mathematical tool from the 18th century, developed independently by Leonhard Euler and Colin Maclaurin to approximate sums by integrals and vice versa. The formula is neutral; it is not a "QED method", but a purely analytical aid that serves exactly the same purpose in EBT as in classical analysis: to determine the finite difference between a discrete sum and a continuous integral. Its use in the present derivation is thus not a methodological import from quantum field theory, but the application of a general mathematical identity to a physical quantity that follows from the EBT ontology.

The following presentation leads step by step through this purely geometric-energetic derivation of the Casimir effect – **without vacuum fluctuations, without virtual particles, without renormalization, but with exactly the same numerical result** that Casimir obtained from QED in 1948. It shows that the Casimir effect is not the "proof piece" for a mysterious quantum vacuum, but the empirical evidence for a much simpler, more intuitive truth: **Space is real, energy is spatially embodied, and geometric limitation creates mechanical pressure.**

F.1 Starting Point

The fundamental EBT relation is:

$$E_R(r) = \frac{F_{\mathrm{EB}} c^2}{r}$$

with

$$F_{\mathrm{EB}} = \frac{4\hbar}{c}.$$

Thus follows:

$$E_R(r) = \frac{4\hbar c}{r}.$$

Therefore:

$$\boxed{E_R(r) \propto \frac{1}{r}}$$

Space is in this picture not an empty stage. The spatial extension itself is an energetic embodiment.

F.2 Transition from Radius to Wave Number

It holds:

$$r(k) = \frac{2\pi}{k}.$$

Inserting this into

$$E_R(r) = \frac{4\hbar c}{r}$$

yields:

$$E_R(k) = \frac{4\hbar c}{2\pi/k}.$$

This is:

$$E_R(k) = 4\hbar c \cdot \frac{k}{2\pi}.$$

Thus:

$$\boxed{E_R(k) = \frac{2}{\pi}\hbar c k}$$

This is the complete isotropic radial space energy.

F.3 Projection of the Sphere Energy onto the Plate Plane

The plates define a plane.

For a radial direction with angle θ to the plate normal, the projection component onto the plane is:

$$|\sin\theta|.$$

The mean value over the entire sphere is:

$$\langle|\sin\theta|\rangle = \frac{1}{4\pi}\int_0^{2\pi} d\varphi \int_0^{\pi} \sin^2\theta \, d\theta.$$

It holds:

$$\int_0^{2\pi} d\varphi = 2\pi$$

and

$$\int_0^{\pi} \sin^2\theta \, d\theta = \frac{\pi}{2}.$$

Thus:

$$\langle|\sin\theta|\rangle = \frac{1}{4\pi} \cdot 2\pi \cdot \frac{\pi}{2}.$$

Therefore:

$$\boxed{\langle|\sin\theta|\rangle = \frac{\pi}{4}}$$

The energy effective for the plates is therefore:

$$E_C(k) = \frac{\pi}{4} E_R(k).$$

With

$$E_R(k) = \frac{2}{\pi}\hbar c k$$

it follows:

$$E_C(k) = \frac{\pi}{4} \cdot \frac{2}{\pi}\hbar c k.$$

The π-factors cancel:

$$E_C(k) = \frac{2}{4}\hbar c k.$$

Thus:

$$\boxed{E_C(k) = \frac{1}{2}\hbar c k}$$

and because of

$$\omega = ck$$

also:

$$\boxed{E_C = \frac{1}{2}\hbar\omega}$$

The factor 1/2 is thus not presupposed as zero-point energy, but arises from:

$$\boxed{\frac{2}{\pi} \cdot \frac{\pi}{4} = \frac{1}{2}}$$

F.4 Limitation Between Two Parallel Plates

Let the distance of the plates be:

$$d.$$

In the normal direction, a spatial structure can only form geometrically closed if:

$$d = n\frac{\lambda_z}{2}.$$

Thus:

$$\lambda_z = \frac{2d}{n}.$$

With

$$k_z = \frac{2\pi}{\lambda_z}$$

it follows:

$$k_z = \frac{2\pi}{2d/n}.$$

Thus:

$$\boxed{k_z = \frac{n\pi}{d}}$$

for

$$n = 1, 2, 3, \ldots$$

Parallel to the plates, the spatial evolution remains continuous.

We write:

$$k_\parallel^2 = k_x^2 + k_y^2.$$

Thus the total magnitude is:

$$\boxed{k = \sqrt{k_\parallel^2 + \left(\frac{n\pi}{d}\right)^2}}$$

F.5 Energy Contribution per Area

For a tangential component:

$$E_C(k) = \frac{1}{2}\hbar c k.$$

The energy contribution per area for a fixed value n is therefore:

$$f(n) = \int \frac{d^2k_\parallel}{(2\pi)^2}\frac{1}{2}\hbar c\sqrt{k_\parallel^2 + \left(\frac{n\pi}{d}\right)^2}.$$

With polar coordinates:

$$k_\parallel = \rho$$

and

$$d^2k_\parallel = 2\pi\rho\, d\rho.$$

Thus:

$$f(n) = \frac{\hbar c}{4\pi}\int_0^{\rho_{\max}} \rho\sqrt{\rho^2 + \left(\frac{n\pi}{d}\right)^2}\, d\rho.$$

The integral is:

$$\int \rho\sqrt{\rho^2 + a^2}\, d\rho = \frac{1}{3}(\rho^2 + a^2)^{3/2}.$$

Therefore:

$$f(n) = \frac{\hbar c}{12\pi}\left[\left(\rho_{\max}^2 + \frac{n^2\pi^2}{d^2}\right)^{3/2} - \left(\frac{n^2\pi^2}{d^2}\right)^{3/2}\right].$$

Now we set:

$$\rho_{\max} = \frac{\pi b}{d}.$$

Then:

$$\rho_{\max}^2 + \frac{n^2\pi^2}{d^2} = \frac{\pi^2}{d^2}(b^2 + n^2).$$

Thus:

$$\left(\rho_{\max}^2 + \frac{n^2\pi^2}{d^2}\right)^{3/2} = \frac{\pi^3}{d^3}(b^2 + n^2)^{3/2}.$$

Furthermore:

$$\left(\frac{n^2\pi^2}{d^2}\right)^{3/2} = \frac{\pi^3}{d^3}n^3.$$

From this follows:

$$\boxed{f(n) = \frac{\pi^2\hbar c}{12d^3}\left[(n^2+b^2)^{3/2} - n^3\right]}$$

F.6 Interior versus Exterior

Between the plates, the discrete condition holds:

$$k_z = \frac{n\pi}{d}.$$

The energy of the interior is therefore described by the sum:

$$\sum_{n=1}^{\infty} f(n).$$

In the unbounded exterior, there is no corresponding limitation in the normal direction.
There the corresponding structure is continuous:

$$\int_0^{\infty} f(x)\,dx.$$

The relevant energy difference is thus:

$$\boxed{\Delta\sigma_1(d) = \sum_{n=1}^{\infty} f(n) - \int_0^{\infty} f(x)\,dx}$$

F.7 Euler-Maclaurin

The Euler-Maclaurin formula yields:

$$\sum_{n=1}^{\infty} f(n) - \int_0^{\infty} f(x)\,dx = -\frac{1}{2}f(0) - \frac{1}{12}f'(0) + \frac{1}{720}f'''(0) - \ldots$$

Now we consider:

$$f(x) = \frac{\pi^2\hbar c}{12d^3}\left[(x^2+b^2)^{3/2} - x^3\right].$$

The expression

$$(x^2+b^2)^{3/2}$$

is even in x.
Therefore, its odd derivatives vanish at:

$$x = 0.$$

Thus:

$$f'(0) = 0.$$

For the third derivative, the term remains:

$$-x^3.$$

It holds:

$$\frac{d}{dx}(-x^3) = -3x^2$$

$$\frac{d^2}{dx^2}(-x^3) = -6x$$

and:

$$\frac{d^3}{dx^3}(-x^3) = -6.$$

Thus:

$$f'''(0) = \frac{\pi^2 \hbar c}{12 d^3}(-6).$$

Therefore:

$$\boxed{f'''(0) = -\frac{\pi^2 \hbar c}{2 d^3}}$$

The distance-dependent Euler-Maclaurin contribution is thus:

$$\Delta\sigma_1(d) = \frac{1}{720} f'''(0).$$

Inserting yields:

$$\Delta\sigma_1(d) = \frac{1}{720}\left(-\frac{\pi^2 \hbar c}{2 d^3}\right).$$

Thus:

$$\boxed{\Delta\sigma_1(d) = -\frac{\pi^2 \hbar c}{1440 d^3}}$$

F.8 Two Tangential Directions

The plate possesses two independent tangential directions.

Therefore:

$$\boxed{g = 2}$$

and thus:

$$\Delta\sigma_E(d) = 2\,\Delta\sigma_1(d).$$

Therefore:

$$\Delta\sigma_E(d) = 2\left(-\frac{\pi^2 \hbar c}{1440 d^3}\right).$$

Thus:

$$\boxed{\Delta\sigma_E(d) = -\frac{\pi^2\hbar c}{720d^3}}$$

F.9 Casimir Force

The force per area results from:

$$\frac{F}{A} = -\frac{d}{dd}\Delta\sigma_E(d).$$

With:

$$\Delta\sigma_E(d) = -\frac{\pi^2\hbar c}{720}d^{-3}$$

it follows:

$$\frac{d}{dd}\Delta\sigma_E = -\frac{\pi^2\hbar c}{720}(-3)d^{-4}.$$

Therefore:

$$\frac{F}{A} = -\frac{3\pi^2\hbar c}{720d^4}.$$

Since:

$$\frac{3}{720} = \frac{1}{240}$$

the result is:

$$\boxed{\frac{F}{A} = -\frac{\pi^2\hbar c}{240d^4}}$$

and for the magnitude:

$$\boxed{\frac{|F|}{A} = \frac{\pi^2\hbar c}{240d^4}}$$

G The Tunnel Effect in EBT

Geometric superposition of real space-energy embodiments

G.1 Introduction: From the Probability Picture to Real Space Geometry

The tunnel effect belongs to the most well-known phenomena of quantum mechanics. In the usual description, a particle is represented by a wave function whose amplitude decreases exponentially in a classically forbidden region. Although the particle energy E is smaller than the barrier height V_0, a finite transmission probability remains beyond the barrier.

Elementary Body Theory (EBT) interprets this process ontologically differently. An elementary body is not a point-like object that moves through a forbidden region with an abstract probability amplitude. Rather, it possesses a real spatial extension. Its mass-bound structure, its kinetic embodiment, and the energetic structure of the barrier each possess real length scales.

The tunnel effect thus becomes a **geometric superposition problem**: An extended space-energy structure meets a spatially-energetically differently developed region. Decisive is not the question of how

a point gets "through" a classically insurmountable barrier, but how far the real space-energy embodiment of the elementary body reaches into the barrier structure and overlaps with it.

Methodological starting point: The following derivation does not begin with the stationary Schrödinger equation and not with a predetermined decay constant. The starting points are exclusively the EBT mass-radius coupling, the EBT energy-radius coupling, and a phenomenologically founded geometric coupling rule for two real radii.

G.2 Ontological Starting Point

EBT describes every energetic state as a real spatial embodiment. The fundamental mass-radius coupling is:

$$m\, r_0 = F_{\mathrm{EB}}.$$

For the elementary body constant:

$$F_{\mathrm{EB}} = \frac{2h}{\pi c} = \frac{4\hbar}{c}.$$

Thus a body of mass m possesses the mass-inherent radius:

$$\boxed{r_0 = \frac{F_{\mathrm{EB}}}{m}}$$

This radius is not an arbitrary geometric auxiliary quantity, but the spatial scale of the mass-carrying elementary body that follows directly from the EBT basic relation.

G.3 The Real Particle Scale r_0

From

$$m\, r_0 = F_{\mathrm{EB}}$$

it follows:

$$m = \frac{F_{\mathrm{EB}}}{r_0}.$$

With

$$F_{\mathrm{EB}} = \frac{4\hbar}{c}$$

one obtains:

$$\boxed{m = \frac{4\hbar}{c\, r_0}}$$

The mass itself is thus reciprocally coupled to a real spatial scale:

$$m \propto \frac{1}{r_0}.$$

The larger the mass, the smaller the mass-inherent spatial extension.

G.4 The Real Barrier Scale r_B

A barrier is not treated in EBT only as an abstract potential V_0. Relevant is the energy difference between barrier and particle energy:

$$\Delta E_B = V_0 - E.$$

This energy also possesses, according to the EBT energy-radius coupling, a real spatial scale:

$$\Delta E_B = \frac{F_{\mathrm{EB}} c^2}{r_B}.$$

From this follows:

$$\boxed{r_B = \frac{F_{\mathrm{EB}} c^2}{\Delta E_B}}$$

and with

$$F_{\mathrm{EB}} = \frac{4\hbar}{c}$$

one obtains:

$$\boxed{r_B = \frac{4\hbar c}{\Delta E_B}}$$

The barrier height is thus translated into a geometric quantity. A large energy difference means a small barrier radius:

$$\Delta E_B \uparrow \qquad \Longrightarrow \qquad r_B \downarrow .$$

G.5 General Form of the EBT Decay Length

For the tunnel problem, two real length scales are thus present:

$$r_0 \qquad \text{and} \qquad r_B .$$

Sought is a third length that describes the range of their mutual superposition:

$$\ell_{\mathrm{EBT}} .$$

Before any numerical factor is fixed, the most general symmetric form can be written as:

$$\boxed{\ell_{\mathrm{EBT}} = C\sqrt{r_0 r_B}}$$

where C is a dimensionless geometric normalization constant.

Important: This form cleanly separates two questions from each other. The geometric mean $\sqrt{r_0 r_B}$ determines the scale-dependent structure of the interaction. The dimensionless constant C determines exclusively its EBT-specific geometric normalization.

G.6 Why the Geometric Mean Is Phenomenologically Obvious

Purely phenomenologically, the geometric mean possesses several properties that distinguish it from an additive or one-sided combination of the radii.

G.6.1 Symmetry of the Two Scales

The interaction is determined by two real spatial quantities. Neither of the two scales should be formally preferred. The product

$$r_0 r_B$$

is unchanged under the exchange

$$r_0 \leftrightarrow r_B .$$

Thus also

$$\sqrt{r_0 r_B}$$

is a symmetric transition scale.

G.6.2 Dimensional Correctness

Since both quantities are lengths,

$$[r_0] = [r_B] = L,$$

it holds:

$$[r_0 r_B] = L^2.$$

Thus

$$\sqrt{r_0 r_B}$$

again has exactly the dimension of a length:

$$\boxed{[\sqrt{r_0 r_B}] = L.}$$

G.6.3 Why an Additive Coupling Would Be Implausible

An alternative form such as

$$\ell \propto r_0 + r_B$$

would lead to problematic behavior in the limit case of a very high barrier. For

$$\Delta E_B \to \infty$$

it holds:

$$r_B \to 0.$$

Then an additive rule would yield:

$$\ell \to r_0.$$

The penetration length would thus remain finite even for an arbitrarily high barrier. This would be phenomenologically implausible.

With the geometric mean, by contrast:

$$r_B \to 0 \qquad \Longrightarrow \qquad \sqrt{r_0 r_B} \to 0.$$

Thus the penetration depth vanishes for an infinitely high barrier:

$$\boxed{\Delta E_B \to \infty \qquad \Longrightarrow \qquad \ell_{\mathrm{EBT}} \to 0.}$$

G.7 Limit Case Check

G.7.1 Vanishing Barrier

If the barrier vanishes energetically,

$$\Delta E_B \to 0,$$

then:

$$r_B = \frac{F_{\mathrm{EB}} c^2}{\Delta E_B} \to \infty.$$

Therefore:

$$\boxed{\ell_{\mathrm{EBT}} \to \infty.}$$

The exponential suppression thus disappears completely.

G.7.2 Very High Barrier

For

$$\Delta E_B \to \infty$$

it follows:

$$r_B \to 0$$

and therefore:

$$\boxed{\ell_{\mathrm{EBT}} \to 0.}$$

G.7.3 Increasing Mass

Since

$$r_0 = \frac{F_{\mathrm{EB}}}{m},$$

it holds:

$$m \uparrow \qquad \Longrightarrow \qquad r_0 \downarrow .$$

Thus from the general form

$$\ell_{\mathrm{EBT}} = C\sqrt{r_0 r_B}$$

it follows automatically:

$$\boxed{m \uparrow \qquad \Longrightarrow \qquad \ell_{\mathrm{EBT}} \downarrow .}$$

The phenomenologically correct tendency thus results already before the fixation of the numerical factor C.

G.8 Contact Normalization $G_{\mathrm{Contact}} = 8$

The Freyling intervention leads within EBT to the relation between linear radius evolution and the associated action or arc length scale:

$$r_0 = \frac{2}{\pi}\lambda_C.$$

The factor

$$\frac{2}{\pi}$$

is thus an already present EBT ratio between radial extension and the associated geometric action.

For the contact of two radially symmetric structures, the complete Euclidean solid angle size

$$4\pi$$

is normalized with this EBT action ratio:

$$G_{\mathrm{Contact}} = 4\pi \cdot \frac{2}{\pi}.$$

Thus follows:

$$\boxed{G_{\mathrm{Contact}} = 8.}$$

The number 8 describes within this phenomenological EBT picture the normalized radially symmetric contact geometry of two real spatial embodiments.

G.9 Matter Normalization $G_{\mathrm{Matter}} = 4$

The fundamental elementary body constant is:

$$F_{\mathrm{EB}} = \frac{2h}{\pi c}.$$

With

$$h = 2\pi\hbar$$

it follows:

$$F_{\mathrm{EB}} = \frac{2(2\pi\hbar)}{\pi c}.$$

Thus:

$$\boxed{F_{\mathrm{EB}} = \frac{4\hbar}{c}.}$$

The number 4 is thus not a quantity introduced specifically for the tunnel effect, but part of the fundamental EBT normalization:

$$\boxed{G_{\mathrm{Matter}} = 4.}$$

G.10 Synthesis to the EBT Decay Length

In the tunnel process, two conditions occur simultaneously:

- a material embodiment with the EBT normalization 4,
- a radially symmetric contact geometry with the normalization 8.

Since both conditions must be fulfilled simultaneously, the dimensionless normalizations are multiplicatively coupled:

$$G_{\text{Total}} = G_{\text{Matter}} G_{\text{Contact}}.$$

Thus:

$$G_{\text{Total}} = 4 \cdot 8 = 32.$$

The general phenomenological form

$$\ell_{\text{EBT}} = C\sqrt{r_0 r_B}$$

thus receives the EBT-specific normalization:

$$C = \frac{1}{\sqrt{G_{\text{Total}}}} = \frac{1}{\sqrt{32}}.$$

From this follows:

$$\boxed{\ell_{\text{EBT}} = \sqrt{\frac{r_0 r_B}{32}}}$$

equivalently:

$$\boxed{32\,\ell_{\text{EBT}}^2 = r_0 r_B.}$$

Phenomenological status: The geometric mean is not a mathematical necessity forced from a deeper standard formalism. It is a minimalist EBT coupling rule that is justified by symmetry, dimensional correctness, the correct limit cases, and the already present EBT normalizations 4 and 8. Decisive is that the Schrödinger decay constant is not used as the starting point in this determination.

G.11 Reduction to m and ΔE_B

Now the two EBT radii are inserted:

$$r_0 = \frac{F_{\text{EB}}}{m}$$

and

$$r_B = \frac{F_{\text{EB}} c^2}{\Delta E_B}.$$

Thus:

$$\ell_{\text{EBT}}^2 = \frac{1}{32} \frac{F_{\text{EB}}}{m} \frac{F_{\text{EB}} c^2}{\Delta E_B}.$$

Therefore:

$$\ell_{\text{EBT}}^2 = \frac{F_{\text{EB}}^2 c^2}{32 m \Delta E_B}.$$

With

$$F_{\text{EB}} = \frac{4\hbar}{c}$$

it holds:

$$F_{\text{EB}}^2 c^2 = \left(\frac{4\hbar}{c}\right)^2 c^2 = 16\hbar^2.$$

Thus:

$$\ell_{\text{EBT}}^2 = \frac{16\hbar^2}{32 m \Delta E_B}.$$

Canceling yields:

$$\ell_{\mathrm{EBT}}^2 = \frac{\hbar^2}{2m\Delta E_B}.$$

Thus:

$$\boxed{\ell_{\mathrm{EBT}} = \frac{\hbar}{\sqrt{2m\Delta E_B}}}$$

and with

$$\Delta E_B = V_0 - E$$

it follows:

$$\boxed{\ell_{\mathrm{EBT}} = \frac{\hbar}{\sqrt{2m(V_0 - E)}}}$$

G.12 Geometric-Multiplicative Loss Rule

Inside the barrier, the space-energy embodiment is geometrically suppressed. If it is assumed that every infinitesimal barrier piece dx withdraws the same relative portion of the still present overlap amplitude, then:

$$dP = -\frac{P}{\ell_{\mathrm{EBT}}}\, dx.$$

Division by P yields:

$$\frac{dP}{P} = -\frac{dx}{\ell_{\mathrm{EBT}}}.$$

Integration yields:

$$\int \frac{dP}{P} = -\int \frac{dx}{\ell_{\mathrm{EBT}}}.$$

Thus:

$$\ln P = -\frac{x}{\ell_{\mathrm{EBT}}} + \text{const.}$$

For $P(0) = P_0$, it follows:

$$\boxed{P(x) = P_0 e^{-x/\ell_{\mathrm{EBT}}}.}$$

The exponential form is thus not presupposed as a solution of a wave function, but follows from a local multiplicative suppression rule of the real geometric overlap.

G.13 Transmission through a Barrier

For a barrier of width a, the remaining overlap amplitude is:

$$P(a) = P_0 e^{-a/\ell_{\mathrm{EBT}}}.$$

The transmission corresponds to the square of the amplitude ratio:

$$T_{\mathrm{EBT}} = \left| \frac{P(a)}{P_0} \right|^2.$$

Thus:

$$\boxed{T_{\mathrm{EBT}} = e^{-2a/\ell_{\mathrm{EBT}}}}$$

Inserting

$$\ell_{\mathrm{EBT}} = \frac{\hbar}{\sqrt{2m(V_0 - E)}}$$

yields:

$$\boxed{T_{\mathrm{EBT}} = \exp\left[-\frac{2a\sqrt{2m(V_0 - E)}}{\hbar} \right].}$$

G.14 Comparison with the Known Decay Constant

If one defines, purely subsequently, the reciprocal of the EBT decay length as

$$\kappa_{\mathrm{EBT}} = \frac{1}{\ell_{\mathrm{EBT}}},$$

then it follows:

$$\boxed{\kappa_{\mathrm{EBT}} = \frac{\sqrt{2m(V_0 - E)}}{\hbar}.}$$

This is formally identical to the known quantum mechanical decay constant. In the logical direction chosen here, however, this was not used as the starting point.

Decisive comparison: EBT begins with real radii r_0 and r_B, a phenomenologically founded geometric coupling rule, and the EBT normalizations 4 and 8. Only afterwards does the known form of κ appear as an algebraic consequence.

G.15 Phenomenological Classification

The tunnel effect is not understood in this presentation as the statistical behavior of a point particle. It is the consequence of a real spatial superposition between the mass-inherent elementary body structure and the space scale defined by the barrier energy.

The general form

$$\boxed{\ell_{\mathrm{EBT}} = C\sqrt{r_0 r_B}}$$

is already phenomenologically strongly restricted before any numerical normalization. It is symmetric, dimensionally correct, and possesses the required limit cases:

$$\begin{aligned} \Delta E_B \to 0 \quad &\Longrightarrow \quad \ell_{\mathrm{EBT}} \to \infty, \\ \Delta E_B \to \infty \quad &\Longrightarrow \quad \ell_{\mathrm{EBT}} \to 0, \\ m \to \infty \quad &\Longrightarrow \quad \ell_{\mathrm{EBT}} \to 0. \end{aligned}$$

The EBT-specific geometric normalization

$$C = \frac{1}{\sqrt{32}}$$

results from the combination of the matter normalization

$$G_{\mathrm{Matter}} = 4$$

with the normalized radially symmetric contact geometry

$$G_{\mathrm{Contact}} = 8.$$

Thus follows:

$$\boxed{\ell_{\mathrm{EBT}} = \sqrt{\frac{r_0 r_B}{32}} = \frac{\hbar}{\sqrt{2m(V_0 - E)}}.}$$

The exponential transmission results from the multiplicative geometric suppression:

$$\boxed{T_{\mathrm{EBT}} = e^{-2a/\ell_{\mathrm{EBT}}} = \exp\left[-\frac{2a\sqrt{2m(V_0 - E)}}{\hbar}\right].}$$

Working conclusion: In the EBT picture, the tunnel effect is not the passage of a point particle through a classically forbidden region. It is the geometrically damped continuation of a real space-energy embodiment through a barrier structure. The known dependence on mass, barrier height, and barrier width appears thereby as a consequence of the EBT radius coupling.

H Why the "Extension" of the SM by Neutrino Masses Formally Destroys the Original Standard Model

H.1 The Original SM Is a Gauge Field Theory

The Standard Model is based on the gauge group:

$$SU(3)_C \times SU(2)_L \times U(1)_Y \tag{324}$$

The entire structure – particle content, interactions, mass generation – follows from the demand for **gauge invariance** of this group.

The fermions are sorted into **chiral multiplets**:

- Left-handed fermions: $SU(2)_L$ doublets
- Right-handed fermions: $SU(2)_L$ singlets

This chirality is **not a detail** – it is the **structure itself**.

H.2 Mass Terms Couple Left- and Right-Handed Components

A Dirac mass term has the form:

$$\mathcal{L}_{\text{Mass}} = -m\bar{\psi}\psi = -m(\bar{\psi}_L\psi_R + \bar{\psi}_R\psi_L) \tag{325}$$

This means: **A mass term couples left- and right-handed components.**

H.3 In the Original SM, There Are No Right-Handed Neutrinos

The original SM contains:

- **Left-handed neutrino** ν_L: part of the $SU(2)_L$ doublet
- **No right-handed neutrino** ν_R

This is **not negligence** – it is **necessary**:

- If ν_R were present, it would be an $SU(2)_L$ singlet with $Y = 0$
- It would have **no gauge interactions**
- It would be a **sterile** particle

The original SM defines the neutrino **exclusively** through its left-handed interaction.

H.4 Without ν_R, a Dirac Mass Term Is Impossible

From the previous section, it follows:

$$\mathcal{L}_{\text{Mass}} = -m(\bar{\nu}_L\nu_R + \bar{\nu}_R\nu_L) \tag{326}$$

If ν_R **does not exist**, then this term is **not constructible**.

The original SM **forces**:

$$\boxed{m_\nu = 0} \tag{327}$$

Not as an observation – but as a **structural consequence**.

H.5 The "Extension" Introduces ν_R – and Thereby Destroys the Original Structure

To enable neutrino masses, one must make **one** of the following assumptions:

Variant	New postulate	Consequence
Dirac mass	ν_R exists	New particle, no gauge interaction – sterile entity
Majorana mass	ν_L is its own antiparticle	Violates lepton number conservation
Seesaw	Both	New mass scale, new physics

Table 11: Three variants of the "extension"

In **all** cases:

- The **original Lagrangian density** is rewritten.
- The **gauge structure** is changed.
- The **particle balance** is extended.
- The **predictions** of the original SM become obsolete.

H.6 Formal Comparison: Original SM vs. "Extended" SM

Aspect	Original SM	"Extended" SM
Neutrino	Only ν_L, massless	ν_L and ν_R, massive
Gauge group	$SU(3) \times SU(2)_L \times U(1)$	Additional structures necessary
Mass term	Does not exist for ν	Dirac or Majorana term
Lagrangian density	Closed	Rewritten
Lepton number	Conserved	Violated for Majorana
Number of free parameters	25	25 + new

Table 12: Original vs. extended SM

H.7 The Logical Consequence

> **An "extension" that introduces new particles, new couplings, new mass scales, and new symmetries is not an extension – it is a new model.**

The original SM is **falsified** by the discovery of neutrino oscillations – because it **structurally forces** $m_\nu = 0$.

The "extension" does not save the SM – it **replaces** it with a new model that only still bears the name SM.

H.8 The Parallel to the Matter Wave Falsification

The situation is twofold:

1. **Structure-internal:** The original SM forces $m_\nu = 0$. Neutrino oscillations falsify it.

2. **Phenomenological:** The matter wave falsifies $m_\nu > 0$ – independently of the SM.

Both arguments are **independent of each other** – and both lead to the same result:

The original SM is falsified. The "extension" is a different model.

H.9 Summary of the Argumentation

Argument	Result
Chiral structure	$m_\nu = 0$ is structurally forced
Neutrino oscillations	$m_\nu > 0$ is experimentally demanded
Contradiction	The original SM is falsified
"Extension"	Introduces ν_R – new model
Matter wave	Falsifies $m_\nu > 0$ independently thereof
Overall picture	SM falsified, "extension" formally destroyed, neutrino mass phenomenologically excluded

Table 13: Summary of the argumentation

I The Standard Models of Physics: A Critical Inventory of the Ontological and Methodological Deficits of SM and ΛCDM

The following is a comprehensive, epistemologically founded critique of the standard models of physics – the Standard Model of particle physics (SM) and the cosmological standard model (ΛCDM). The analysis shows that both models rest on a multitude of free parameters, unobservable postulates, and methodologically circular self-confirmations. The work documents the methodological irrationality of the standard models.

I.1 Introduction

The present work undertakes a systematic, epistemologically founded critique of the standard models of physics – the Standard Model of particle physics (SM) and the cosmological standard model (ΛCDM). The analysis shows that both models rest on a multitude of free parameters, unobservable postulates, and methodologically circular self-confirmations. The critique extends from the mass problem of the Higgs mechanism through the unfounded substructuring by quarks and gluons to cosmological inflation and dark energy.

I.2 25 Free Parameters of the Standard Model of Particle Physics (SM)

The Standard Model of particle physics (SM) operates with a multitude of free parameters that cannot be derived from the theory itself, but must be determined experimentally:

- **3 coupling constants:**
  - of the strong interaction (α_s) – 8 gluons, color charge
  - of the electromagnetic interaction (α) – photon, electric charge
  - of the weak interaction (α_W) – W^+, W^-, Z^0
- **6 quark masses**
- **3 masses of the charged leptons** (electron, muon, tau)

- **4 angles for describing quark decays**
- **1 angle for describing CP violation in the strong interaction**
- **Mass of the Higgs boson**
- **3 masses and 4 mixing angles of massive neutrinos**

The Particle Data Group (PDG), according to a counting convention that distinguishes between particles and antiparticles as well as the many color states of quarks and gluons, counts a total of 61 elementary particles. If neutrinos are their own antiparticles, the total number of elementary particles would be 58 according to the same counting conventions. (Source)

Operating with more than 20 free parameters makes "everything" possible – this should be understandable even for people of average intelligence. Strictly speaking, the Standard Model of particle physics (SM), with currently 25 free parameters, continual reparameterization, repeated substructuring, the confinement thesis, and further ad hoc assumptions, is a **philosophical and not a physical thought model**. In other words: The far fewer, more precisely sparse, predictively capable quantum chromodynamics (QCD) as a recognized theoretical concept, viewed from the philosophy of nature, is not worth mentioning in relation to QED, since the number of free parameters and the number of postulated theoretical objects added over the years due to inconsistencies with measurement results exceed any justifiable framework.

The electroweak theory and the concept of gauge bosons as "interaction mediators" as well as "energy-conservation-violating virtuals" and not (directly) observable "energy thieves" – i.e., neutrinos – are mathematics-generated emotions of overwhelmed "scientists" that create fantasies but have long ceased to create knowledge. Real-physically and epistemologically, the SM is a **methodological zero**.

The discrepancies between experimental data and non-fitting theories were and are subsequently made to fit. SM-typical "measures" were and are the introduction of further theoretical objects including new quantum numbers.

An overview of the Standard Model of particle physics can be found "under" Review of Particle Physics by the Particle Data Group. There one finds, besides experimental methods and theory descriptions of current particle physics, fundamental information on quarks, neutrinos, form factors, ... as well as information on "even more" hypothetical particles, such as leptoquarks or axions. Astrophysical "concepts", cosmological parameters, experimental tests of gravitation theories, etc. Furthermore, (apparatus) aspects of accelerator physics, Monte Carlo simulations, and much more are presented.

The Particle Data Group (PDG) is an international collaboration that provides a comprehensive summary of particle physics and related areas of cosmology. The PDG collaboration consists of 227 authors from 159 institutions in 24 countries (as of 2017), see online. It is led by a coordination team located mainly at Lawrence Berkeley National Laboratory (LBNL), which has served as headquarters since the founding of the PDG.

The foundations of quantum chromodynamics (QCD) can be found here.

I.3 The Mass Dilemma of the Standard Model and the Cosmological Admission of Bankruptcy

Established particle physics postulates that the Higgs mechanism gives elementary particles their mass. A closer analysis, however, reveals a fundamental methodological weakness: The masses of entities such as electrons, muons, or postulated quarks are **not calculated from first principles** within the model, but must be experimentally determined as **free parameters** and manually inserted into the theory. The Higgs mechanism functions here merely as a formally consistent framework for embedding already known values, not as their physical derivation.

This explanatory deficit becomes particularly clear when considering baryonic matter (protons and neutrons). Only about **1 %** of the nucleon mass can be traced back to the Higgs coupling. The remaining **99 %** are attributed to postulated dynamic effects of the **strong interaction**, for which the SM possesses **no closed analytical solution**. Thus the origin of the mass for the majority of the visible world remains formally unfounded within the SM.

I.3.1 The "Admission of Bankruptcy" of the Cosmological Standard Model (ΛCDM)

The ΛCDM model describes a universe that consists of about **95 %** unobserved constructs: **68 %** dark energy and **27 %** dark matter. The remaining **5 %** fall to the known baryonic matter.

If one places the deficits of the SM in this context, a drastic consequence results: Of these **5 %** visible matter, particle physics can again formally parameterize only the Higgs portion (about **1 %**).

It follows arithmetically that the cosmological standard model, on the basis of its own postulates, can analytically-formally capture merely 0.05 % of the universe.

The remaining **99.95 %** of the claimed cosmic reality evade analytical penetration and are managed in the form of placeholder entities or numerical approximations.

I.3.2 Lattice QCD and Perturbation Theory as Methodological Immunization

The claim that the strong interaction is calculable by **lattice quantum chromodynamics (lattice QCD)** requires a scientific-theoretical correction. Lattice QCD is **not** a deductive analytical theory, but a **numerical approximation method**.

The FLAG report [1] states unambiguously that quark masses are free parameters of the theory that cannot be obtained from purely theoretical considerations. Since quarks cannot be measured in isolation due to confinement, their determination is necessarily coupled to comparison with experimental observables.

The process is defined in the FLAG review [1] as follows:

- Observables are calculated for a variety of **input values** of the quark masses.
- These values are **adjusted** until they reproduce the experimental results [1].
- Another observable (such as the pion decay constant or baryon masses) is necessarily needed to **fix the overall scale** [1].

Thus the model provides no independent derivation of the masses, but effectively accepts them as input parameters to force agreement with empirical data.

I.3.3 Tuning Instead of Prediction

The source documents exactly the procedure that EBT calls "result-oriented simulation". The quark masses enter the calculation as so-called **"bare parameters"**. These depend on the chosen lattice regularization and must be renormalized afterwards.

Lattice QCD explicitly uses the term **tuning** for this: *"light-quark masses are typically obtained by [...] tuning them to reproduce NGB masses"* [1]. From the perspective of Elementary Body Theory, this process represents **"circular-reasoning belief work"**. Instead of calculating physical reality from first principles, the mathematical model is iteratively modified until it reflects the already known reality. The "excellent agreement" is thus not an analytical success, but the result of a gigantic numerical adjustment on computer clusters.

I.3.4 Methodological Complexity and Inconsistencies

The FLAG review [1] also illustrates the enormous complexity necessary to obtain consistent values at all:

- **Phenomenological corrections:** Corrections for electromagnetic effects (QED) and isospin breaking must be included [1, 4]. These often rely on phenomenological models rather than QCD itself.
- **Incompatible results:** Different research collaborations such as MILC, BMW, or RBC/UKQCD arrive at partially incompatible results despite similar basic methods, e.g., in the determination of the electromagnetic self-energy coefficient ϵ [5, 6, 7, 8, 9, 10, 11].
- **Systematic uncertainties:** Error sources, such as the neglect of the charm quark in the "sea", are often only conservatively estimated, since a precise quantification is hardly possible a priori.

I.3.5 The Anatomy of the Circular Reasoning ("Tuning")

The process of parameter determination in lattice QCD, as documented in the internationally authoritative FLAG review [1], follows a logical chain that technically substantiates the accusation of circularity:

- **Input:** One begins with free parameters for the quark masses, since these are not theoretically derivable. The FLAG review [1] states:

  > "Quark masses cannot be measured directly in experiment because quarks cannot be isolated, as they are confined inside hadrons. On the other hand, quark masses are free parameters of the theory and, as such, cannot be obtained on the basis of purely theoretical considerations." [1]

- **Process:** These parameters are numerically varied until the result of the simulation agrees with the measured values. The source [1] describes this process as follows:

  > "One computes as many experimentally measurable quantities as there are quark masses. [...] They are usually computed for a variety of input values of the quark masses which are then adjusted to reproduce experiment." [1]

- **Scale fixing:** To physically calibrate the entire lattice, another measured value is used as an anchor:

  > "Another observable, such as the pion decay constant or the mass of a member of the baryon octet, must be used to fix the overall scale." [1]

- **Logical consequence:** The result of the calculation is thus not an independent proof of the theory, but a consequence of the previous "tuning". The review [1] confirms this explicitly for the light quarks:

  > "Thus, in lattice calculations, light-quark masses are typically obtained by [...] tuning them to reproduce NGB masses [Nambu-Goldstone boson masses, such as pions or kaons]." [1]

The necessity of this scale fixing is documented in the specialist literature by various collaborations that use different methods for determining the lattice spacing [3, 4, 5, 6, 7].

I.3.6 Parameterization vs. Deduction

From the perspective of a logic model, the decisive difference is whether a theory operates constitutively (deriving from principles) or descriptively (subsequently describing):

Established physics (descriptive): It uses highly complex numerical methods to map reality, but admits that fundamental quantities such as the division of masses rest on pure conventions:

> "The decomposition of the sum $L_{\mathrm{QCD}} + L_{\mathrm{QED}}$ into two parts is not unique and specifying the QCD part requires a convention. [...] Such a convention allows us to distinguish the physical mass M_P [...] from the mass $\hat{M}_P$ within QCD." [1]

The corrections for electromagnetic effects are treated in detail in the literature [14, 15, 16], which further underlines the methodological complexity. The pion–pion scattering lengths provide additional experimental input here [13]. The relation between quark masses and meson masses is described by the Gell-Mann–Oakes–Renner relation [12], which, however, itself rests on phenomenological assumptions.

In current strategy papers, this purely instrumental character of the simulations is further enshrined as a goal for the coming decades:

> "We provide predictions for an increasing set of Standard Model observables and parameters [...] These facilitate the full exploitation of experimental data at both the intensity and energy frontiers. In this document we argue that for sustained progress the community requires continued access to computing as well as storage resources at large Tier-0/1 high-performance-computing centres." [2]

The Standard Model thus does not "explain" masses causally, but uses massive computing power to subsequently fit experimental data into a parameterized mathematical corset.

Conclusion: The circular reasoning consists in the fact that lattice QCD requires experimental data to define its own parameters, and subsequently declares the agreement with precisely these data as a success of the theory. The calculations (e.g., via Monte Carlo integrations on computer clusters) are iteratively modified until they reproduce the known experimental measured values. This process of subsequent

adaptation to reality ("circular-reasoning belief work") represents **no independent prediction**, but an extremely elaborate **calibration to empiricism**.

In the professional world, this "excellent agreement" is often sold as an analytical success, although methodologically it is a "gigantic numerical adjustment".

In contrast to this elaborate numerical procedure, **Elementary Body Theory (EBT)** shows that a reduction to the primary quantity of radial extension r suffices to analytically derive masses and radii (such as the proton radius or the Rydberg energy) with **zero free parameters** exactly from the fundamental mass-radius constant equation ($m_0 r_0 = 2h/\pi c$).

I.3.7 Conclusion: Postulate Systems Instead of Epistemological Theories

The analysis makes clear that the Standard Model of particle physics and the cosmological standard model are **not physical theories** in the sense of a causal reduction to primary quantities. They present themselves instead as:

- **Complex postulate systems** that, through a growing number of free parameters (currently **25** in the SM, **6** in the most minimal form for the cosmological standard model), produce an "interpretive arbitrariness".
- **Theory-laden constructs** that mask physical explanatory need through the introduction of ever new, empirically inaccessible auxiliary assumptions (dark matter, inflation, virtual particles).
- **Mathematical artifacts** that claim internal coherence but can formally-analytically justify only a vanishingly small fraction of the postulated universe.

The Consequence

This is not only an extreme methodological weakness – it is **an epistemological declaration of bankruptcy**. No other physical theory in the history of science has ever "explained" such a small proportion of its postulated domain.

I.4 Renormalization and Regularization – Fragmentary Basics for Understanding

In quantum field theories, models are described by the Lagrangian density. This contains a certain number of free parameters whose numerical values are not fixed by the theory, but must be determined experimentally.

In the limit case of vanishing quantum corrections, the Born approximation, many free parameters can be directly identified with the physical quantities, such as the masses or the electric charge. If, however, quantum corrections are taken into account, the direct connection between the free parameters of the Lagrangian density, the so-called bare parameters, and the physical quantities is destroyed. This makes a redefinition, a renormalization, of the parameters and also of the fields necessary.

In the course of calculating the connection between the postulated unphysical and the postulated physical parameters, integrals can occur that diverge. The way in which the convergence of these integrals is ensured is determined by the procedure of so-called regularization.

If one succeeds, through renormalization, in eliminating finitely many parameters of all occurring UV divergences in all orders of perturbation theory, then the respective theory is renormalizable. The renormalizability of the Standard Model was proven by 't Hooft.

Before fields and parameters of the Lagrangian density can be renormalized, the divergences occurring in the calculation of the loop integrals must first be extracted. In principle, a restriction of the energy integration by an upper limit, a cutoff Λ, would already provide finite results, but such a restriction destroys Lorentz invariance.

A frequently applied procedure is dimensional regularization, which ensures Lorentz and gauge invariance and secures the preservation of the inner symmetries of the theory.

Through dimensional regularization, the occurring divergences are isolated in negative powers of the regularization parameter ε. By means of renormalization, the dependence on this unphysical parameter

is then subtracted and the connection between the free parameters occurring in the model and the experimentally determinable physical quantities is redefined.

In practice, so-called counterterms are used for this, which offer a formal and systematic access to renormalization. The bare parameters m_0, e_0 and fields Φ_0 of the Lagrangian density are multiplicatively renormalized by means of renormalization constants Z_i.

In the so-called on-shell scheme, the renormalization constants are chosen such that the renormalized parameters of the theory correspond to the measurable, physical quantities in all orders of perturbation theory. The renormalized masses are chosen equal to the physical ones. If all quantities are determined in the on-shell scheme and the charge renormalization takes place in the Thomson limit, the coupling of the photon to the electron in the limit case of a vanishing momentum transfer, then the finite result no longer depends on the mass scale introduced by the regularization.

Besides the UV divergences from the region of large loop momenta $q_i \to \infty$, further divergences occur in quantum field theories both within the loop integrals at finite momenta and within the phase space integrals, which have their cause in poles of the propagators. These occur when momenta of the propagators lie on their mass shell and thereby the denominator of the propagator becomes zero. Therefore, these singularities are generally called mass singularities, since their occurrence is connected with the vanishing of the external and internal masses.

The occurrence of mass singularities does not stem exclusively from loop integrals, but also from integrations in the phase space of the external particles. These lead to divergences in certain phase space regions.

I.4.1 The "Magical" Fine-Tuning – the Far-Fetched Fine Adjustment

While dimensional regularization from the SM perspective is above all practical, one can take the standpoint there that the momentum integrals are cut off at a certain maximum momentum Λ, since at larger momenta the Standard Model must be replaced by another, unifying theory.

A natural choice for Λ would then be $\Lambda \sim m_{\text{Planck}}$. If one calculates the radiative corrections to the fermion masses, one obtains a correction term proportional to the logarithm of Λ, which even at $\Lambda \sim m_{\text{Planck}}$ makes up only a few percent of the bare mass.

Different for the Higgs mass: Here the radiative correction provides a contribution proportional to Λ. The Higgs mass $m_H \sim 125\,\text{GeV}$ leads to the situation that the radiative corrections and the bare mass must cancel to 17 decimal places exactly.

Wikipedia reports, for the orientation of the common people, on fine-tuning or the hierarchy problem, among other things:

> *German:* "Even though the Higgs boson is a central component of the Standard Model of elementary particle physics, the hierarchy problem is not a problem of the Standard Model itself. Strictly speaking, the hierarchy problem cannot even be formulated within the Standard Model, since a calculation of the Higgs mass is not possible there."

> *English:* "Suppose a physics model requires four parameters which allow it to produce a very high-quality working model, generating predictions of some aspect of our physical universe. Suppose we find through experiments that the parameters have values: 1.2, 1.31, 0.9 and 404,331,557,902,116,024,553,602,703,216.58 (roughly 4×10^{29}). Scientists might wonder how such figures arise. But in particular, might be especially curious about a theory where three values are close to one, and the fourth is so different."

Now, that this has nothing more to do with exact science, but only with brute wishful thinking and wishful doing, no matter at what absurd price, is – analytically rationally considered – beyond question.

Aphoristically expressed:

> "Particle physicists are deep in decadence; the sensational counts and only to one do they stream even more enthusiastically: to bare nonsense."

Interdisciplinarily first-formulated:

> "We are deep in decadence; the sensational counts and only to one does the crowd stream even more enthusiastically: to bare nonsense."
>
> – Theodor Fontane (1819–1898)

There are a multitude of further, truly incredible aspects of renormalization and regularization, whose explicit discussion would far exceed the scope and unnecessarily shift the focus.

To put it briefly and succinctly: This is how, from the beginnings to today, quantum electrodynamics (QED) and quantum chromodynamics (QCD) in particular defined themselves. Mathematical modeling continues until the desired results are available, which sometimes – despite supercomputers – takes years.

I.4.2 Opinions – Text Excerpts

Even in view of the accuracy of the theory at lower energies, Schwinger held the view that the renormalization procedure, which makes it possible to avoid the infinities in the calculation results, must ultimately be excluded from physics.

Paul Dirac's position on this was even less sympathetic:

> "I am very dissatisfied with the situation, because this so-called good theory does involve neglecting infinities which appear in its equations."
>
> *Source:* Kragh, H. (1990, 184). Dirac: a scientific biography. Cambridge: Cambridge University Press.

Landau held the view that the limits of quantum electrodynamics were even more drastic because they were due to very fundamental structural problems in the construction of the theory:

> "For them the very concept of a local field operator and the postulation of any detailed mechanism for interaction in a microscopic spacetime region were totally unacceptable."
>
> *Source:* Cao, T. Y., & Schweber, S. S. (1993). The conceptual foundations and philosophical aspects of renormalization theory. Synthese, 97, 33–108.

Richard Feynman wrote in *The Strange Theory of Light and Matter* (1985):

> "The shell game that we play is technically called renormalization. But no matter how clever the word, it is still what I would call a dippy process! Having to resort to such hocus-pocus has prevented us from proving that the theory of quantum electrodynamics is mathematically self-consistent. It's surprising that the theory still hasn't been proved self-consistent one way or the other by now; I suspect that renormalization is not mathematically legitimate."

Paul Dirac wrote in 1963 in the article *The Evolution of the Physicist's Picture of Nature*:

> "Most physicists are very satisfied with the situation. They say: Quantum electrodynamics is a good theory and we do not have to worry about it any more. I must say that I am very dissatisfied with the situation because this so-called good theory does involve neglecting infinities which appear in its equations, ignoring them in an arbitrary way. This is just not sensible mathematics. Sensible mathematics involves disregarding a quantity when it is small – not neglecting it just because it is infinitely great and you do not want it."

Abdus Salam wrote in 1972 in *Infinity Suppression Gravity Modified Quantum Electrodynamics II*:

> "Field-theoretic infinities – first encountered in Lorentz's computation of electron self-mass – have persisted in classical electrodynamics for seventy and in quantum electrodynamics for some thirty-five years. These long years of frustration have left in the subject a curious affection for the infinities and a passionate belief that they are an inevitable part of nature; so much so that even the suggestion of a hope that they may, after all, be circumvented – and finite values for the renormalization constants computed – is considered irrational."

Paul Dirac:

> "Renormalization is just a stop-gap procedure. There must be some fundamental change in our ideas, probably a change just as fundamental as the passage from Bohr's orbit theory to quantum mechanics. When you get a number turning out to be infinite which ought to be finite, you should admit that there is something wrong with your equations, and not hope that you can get a good theory just by doctoring up that number."

Source: Something is wrong in the state of QED – `https://arxiv.org/pdf/2110.02078`

I.5 What Do Pioneers of Particle Physics Think About the Standard Model?

A statement by the 1976 Nobel laureate in physics, Burton Richter, from 2006 contains a clear answer:

> "To me, something that is considered today's most advanced theory of particle physics is not really science. When I recently found myself on a panel with three respected theorists, I could not resist discussing what I see as the main problem in the philosophy behind the theory, which seems to have drifted into a kind of metaphysical wonderland. Simply put, many of the most current theories seem to be theological speculation and the development of models without testable consequences..."

Source: Physics Today October 2006: Theory in particle physics: Theological speculation versus practical knowledge

Burton Richter (1931–2018) received the Nobel Prize in Physics in 1976 together with Samuel C. C. Ting.

The mathematical concepts of the SM stem at their core from abstractions freed from real physics. Result: Contrary to the expedient demand of epistemological considerations, the "results" of theoretical basic physics regarding the supposed "elementary particles" are more emotionally than scientifically founded answers to the ideological question of which theoretical concept one agrees on "today and soon". [That is probably also the origin of the Americanized term diminutives (axion, WIMP, beauty quark, charm quark, ...) as an implicit cry for help: *redeem us from our nonsense, even if we claim otherwise.*] Nature has to submit to the theoretical implications. Today it is, for example, still postulated but not detectable elementary quarks; tomorrow possibly "preon-substructured".

Also worth reading is the Spiegel article "Sperrt das Desy zu!" from 1999, in which Hans Graßmann describes the "methodological emptiness" of DESY: "Don't believe the Desy managers: The dull columns of numbers that Desy produces are not physics..."

If one wants to learn "something" about the practiced horrendous nonsense in theoretical and experimental high-energy physics within the framework of the Standard Model of elementary particle physics (SM), Sabine Hossenfelder's contribution, published on 26.09.2022 in The Guardian, is recommended. Furthermore, she published a blog post on 28.09.2022 about it.

Below, as examples, some statements in the Guardian to understand why Ms. Hossenfelder is "sharply attacked" by the apologists and epigones of the SM:

> "In private, many physicists admit that they do not believe in the existence of the particles they are paid to search for..."

> "Imagine you attend a zoology conference. The first speaker talks about her 3D model of a 12-legged purple spider that lives in the Arctic. She admits there is no evidence for its existence, but it is a testable hypothesis, and she advocates sending a mission to search for spiders in the Arctic. The second speaker has a model for a flying earthworm, but it only flies in caves. There is no evidence for this either, but he advocates searching the world's caves. The third speaker has a model for octopuses on Mars. It is testable, he emphasizes. Hats off to the zoologists, I have never heard of such a conference. But at almost every particle physics conference there are sessions like this, except that they involve more mathematics."

> "It has become common among physicists to invent new particles for which there is no evidence, publish papers about them, write further papers about the properties of these particles, and demand that the hypothesis be tested experimentally. Many of these tests have already been carried out, and more are being commissioned. This is a waste of time and money."
>
> "As a former particle physicist, it makes me sad to see that this field has become a factory for useless academic studies."

I.6 Confinement and Asymptotic Freedom – Epistemology Adieu

The "problems" with the theoretical deeds of Frank (Anthony) Wilczek, born 1951, possess unique characteristics of a special kind. He preferred to explain the incomprehension of particle physics metaphysically with the help of a new theoretical object, which he named *axion* after an American laundry detergent (Americans bleached their underwear with it in the 1970s). Wilczek received the Nobel Prize in Physics in 2004 together with David Gross and H. David Politzer for the introduction of asymptotic freedom into the theory of the strong interaction.

In the "scientific paper" Asymptotic Freedom – From Paradox to Paradigm, Wilczek writes, among other things, in the introduction:

> "In theoretical physics, paradoxes are good. That's paradoxical, since a paradox appears to be a contradiction, and contradictions imply serious error. But Nature cannot realize contradictions. When our physical theories lead to paradox we must find a way out. Paradoxes focus our attention, and we think harder."

Then under 1.1 he writes: "Quarks are Born Free, but Everywhere They are in Chains."

So much for the missing linguistic possibilities and Wilczek's wish to compulsively anthropomorphize factual contexts. Wilczek's infantile manner is reminiscent of a would-be comedian striving for human closeness. That is sad enough for entertainment reasons. But the formative works resulting from his contributions to the theory of matter formation are the actual problem. Asymptotic freedom and the confinement thesis carry the edifice of quantum chromodynamics. Simply put: From an epistemological viewpoint, these postulates do not solve the phenomenological problems, but simply elevate the actual failure of the theory to a theory.

As an aside, it can be noted that not even within the arbitrariness-affine SM is there clarity. Regarding confinement, the English Wikipedia says: "There is not yet an analytic proof of color confinement in any non-abelian gauge theory." The German version reads: "A complete theoretical description of this experimental finding is still pending."

I.7 Beginning and End of the SM – Fatal Theory Errors Proven by the SM Itself

I.7.1 Quarks Are Not Fermions – The Non-Existent Spin of Quarks and Gluons

I would like to and "must" not go into technical detail here, because it is not necessary, since it can be shown, so to speak, easily that from overarching rational-logical reasons the thesis that quarks are fermions (and especially within the structure and implications of the SM) can be clearly refuted, since corresponding Standard Model-induced experiments exist that state this.

And here we have a concrete situation that is extremely difficult to "cope with". Psychologically at first almost insoluble, because no one can imagine that a supporting hypothesis of a thought model established over decades is demonstrably false and is not corrected as such. Tens of thousands of well-trained scientists over several generations live and work with a serious false statement? In particular laypeople, but also physicists who are not familiar with the formalism of the SM, simply cannot imagine that this is possible. One assumes that the critical observer who draws attention to the verifiable connections has overlooked something, emotionally favored by the circumstance that one does not oneself possess the necessary mathematical-formal expertise. These are extremely difficult boundary conditions from the perspective of reality-seeking enlightenment. Nevertheless, I am of the opinion that the state of affairs can very well be explained and understood. I will try:

The first assumption was, due to the theoretical specifications in the mid-1960s, that in the picture of the SM the postulated proton spin is composed to 100 % of the spin components of the quarks. This

assumption was not confirmed in the EMC experiments in 1988. Quite the contrary, much smaller fractions, even compatible with zero, were measured ($\Delta\Sigma = 0.12 \pm 0.17$, European Muon Collaboration). The quark thesis of fermionic spin-$\frac{1}{2}$ particles was not experimentally confirmed. Here, from a scientific perspective, one should have argumentatively examined the "quark idea" – based on experiments. This missed (possible) turning point cannot be "stressed" enough. With what justification are quarks (even today) "presented" as spin-$\frac{1}{2}$ particles?

Psychologically, this is easy to understand, since the SM had already existed for more than 20 years at the end of the 1980s. The quark–parton model (QPM) developed by Richard Feynman in the 1960s describes nucleons as composed of fundamental point-like components, which Feynman called partons. These components were then identified with the quarks postulated a few years earlier simultaneously by Gell-Mann and Zweig. Thus, at the end of the 1980s, one hoped that future experiments would confirm the half-integer spin of the quarks. An abandonment of the hypothesis that quarks are fermions would have been the end of the SM. Then something phenomenologically strange "happened". Further thought approaches and experiments brought new theoretical elements into play. Strange in the sense that with this idea the quark as carrier of an intrinsic spin contribution, on closer inspection, was already conceptually abolished.

I.7.2 For (Better) Understanding, Some Background on the Spin Problem

The quantum mechanical spin has "existed" at least since 1930, inconsistent in consideration and without "spin phenomenology", purely mathematically, see for example:

Chapter 10.2 Dirac's electron theory 1928, page 10006: "For the new angular momentum has nothing more in common with what one can imagine under this name as a mechanical quantity. It arises from no motion, but from the interaction of a spatial vector with the Dirac matrices in the space of their four abstract dimensions."

In other words: Quantum mechanics (QM) often "works" in illustrations and semantic explanations with a false suggestion using the term spin (intrinsic rotation), but the associated QM formalism describes no such real-physical rotation. "Simply" put: The quantum mechanical spin has nothing to do with rotation and is, so to speak, nothing more than a necessary but completely unfounded (i.e., without real-physical intuition) quantum number that is generated purely mathematically within the framework of prevailing physics (four-component Dirac spinor field with four Dirac matrices).

To prevent possible misinterpretations (of "non-SM initiates"), it should be noted that both the magnitude of the spin value of the elementary particle "quark" required by the theory and the resulting magnitude of the spin value of the proton composed of 3 quarks, according to the SM, should be $\frac{1}{2}$.

Werner Heisenberg concluded in 1932 that proton and neutron are two states of one and the same particle, the nucleon. To distinguish them, isospin was introduced. The z-component of the isospin of the neutron is $-\frac{1}{2}$, that of the proton $+\frac{1}{2}$. In the quark model, these stand for the two quarks up quark ($I_z = \frac{1}{2}$) and down quark ($I_z = -\frac{1}{2}$). For antiquarks, the sign of I_z changes. The quarks s (strange), c (charm), b (beauty), and t (top) carry no isospin.

Isospin is a property of all elementary particles with strong interaction. The photon and the leptons (electron, muon, neutrino) have no isospin. The property "isospin" cannot be represented by a simple numerical value, but is a quantized quantity with three components that behave like the components of a vector. However, this is not a vector in ordinary physical space, but a vector in an abstract "isospin space" or "I-space". Since all elementary particles and systems made of them also carry a characteristic real quantum vector with them, their "spin", a formal analogy of isospin with this spin arises. Beyond this formal relationship, isospin has nothing to do with spin.

More generally: Quantized properties are characterized here by internal symmetries and have nothing more in common with properties in the usual sense that can be conceived as physical qualities inherent in things. The isospin of nucleons or the "color" of quarks no longer express any qualities in this sense at all, but only arbitrarily fixed basis states or directions in an abstract space that are related to each other by symmetry transformations. But even the resulting assumption that the gluons brought into play contribute to the proton spin did not yield the desired result. In the third, currently current version of the theory, quarks, gluons, and their dynamic-relativistic orbital angular momenta are supposed to neatly make up the proton spin in the result.

On closer inspection, this second post-correction has the "advantage" that the result is "calculated" purely algorithmically in large computer systems within the framework of lattice gauge field theory and

constructs such as "pion clouds", and from the perspective of SM believers cannot be falsified. Thus one "combines" until the desired result is iteratively obtained.

But here comes the huge, overpowering, logically rationally founded BUT: this measure obviously does not justify classifying quarks as fermions. For no matter how constructed the asymmetric ensemble of unobservable postulated theoretical objects and interactions is announced, the quarks themselves do not thereby become spin-$\frac{1}{2}$ particle entities.

The state of affairs can (fortunately) be formulated generally. The claim that an entity (quark) possesses a measurable intrinsic value is refuted when measurements provide no such results. The addition of further postulated theoretical objects (postulated gluons) and further postulated interactions (relativistic effects) may, in the sum of events, yield the theory-desired value, but thereby the original entity does not receive or contain the postulated intrinsic value. This argument is as simple as it is understandable.

And now? Without quarks as fermions, the SM is at an end. This circumstance is not addressed, suppressed, and if necessary concealed. It is naive to believe that the rationally-logically understandable insight "quarks are not fermions" will "simply" prevail. For then all previous SM efforts are "history". Epicycle theory and phlogiston theory send their regards. It requires publicly perceptible "social" situations that, with experienced and competent moderators, find wide dissemination in order to put an end to the fake news of the SM, known for decades, which corresponds to a super-GAU of epistemology and a super-GAU of logic.

(An example in passing: Ms. Hossenfelder has, despite the fact that she is in part a critic of the SM, not published my comments on this in her topic-relevant blog posts. A possible reason: Ms. Hossenfelder "likes" quarks as fermions – or more precisely: Ms. Hossenfelder also needs quarks with regard to the quantum gravity she favors, since without fermionic quarks the SM and ultimately every associated current quantum field theory variation is void for lack of a fermion basis.)

I.7.3 Quark–Parton Model and Deep Inelastic Scattering

The quark–parton model (QPM) developed by Richard Feynman in the 1960s describes nucleons as composed of fundamental point-like components, which Feynman called partons. These components were then identified with the quarks postulated a few years earlier simultaneously by Gell-Mann and George Zweig. According to the quark–parton model, a deep inelastic scattering event (DIS) is to be understood as an incoherent superposition of elastic lepton–parton scattering processes. This picture, however, only holds if the momentum transfer by the photon is sufficiently large so that the individual partons can be resolved; i.e., one is in the region of lepton–nucleon scattering referred to as deep inelastic.

A cascade of interaction conjectures, approximations, corrections, and additional theoretical objects "refined" the theoretical nucleon model in the following period. Among other things, nucleon structure functions result as summations of the parton structure functions over postulated helicity and charge states of all "quark flavors" postulated in the nucleon. In the quantum-chromodynamics-extended parton model, quarks are supposed to radiate gluons that are either reabsorbed by the quarks themselves, or produce quark–antiquark pairs, or radiate further gluons. These "secondary partons" form a "cloud" around the original quark. Within the framework of this model, a quark is no longer a point-like object, as in the original QPM. Without going into the hodgepodge of further assumptions and resulting supposed equations of the SM for the extended postulated substructure of nucleons, a clear statement follows:

A fundamental (epistemological) problem is immediately recognizable. All experimental setups, implementations, and interpretations of deep inelastic scattering are extremely strongly theory-laden. For clarification of this statement, see, for example, Chapter 2.1 Kinematics of deep inelastic scattering of the explanations on COMPASS experiments. (The COMPASS experiment, which began operation at the European nuclear research center CERN in Geneva/Switzerland in 2001, investigates the spin structure of the nucleon in a broad program by means of deep inelastic scattering.)

An example of a relatively recent "theoretical attempt" to arrange free parameters and arbitrary theoretical objects so that what is known comes out at the end: Spin Crisis of Proton and Baryon's Magnetic Moment (DP Tiwari and RS Gupta 2015).

Moreover, the postulated asymmetry of the quark charge carriers in the form of strongly differing mass(-limits) and differently fragmented electric elementary charge is an epistemological imposition, especially under the aspect that quarks cannot be detected (confinement thesis). These people are so convinced of their belief that they have apparently lost sight of the essential. Why should a complex, multi-object-asymmetric, charge-fragmented, dynamic substructure create a spin value $\frac{1}{2}$ and a whole

elementary charge e via dynamic states in the temporal or statistical average? The comparison with the SM-postulated point-depleted, "leptonic" electron, with spin value $\frac{1}{2}$ and whole elementary charge e, which accomplishes this without "dynamic effort" and structure, identifies the quark–gluon thesis as a belief fairy tale. This fairy tale should appear as such even to people of average intelligence.

As a reminder: Quarks are not particles, neither in the phenomenological nor in the quantum theoretical sense, since they do not occur as isolatable particles or states. Physical particles, on the other hand, are to be thought of as bound states composed of quarks. No physical objects correspond to the elementary quantities of quantum field theory. Thus the desired, different kinds of postulated elementary particles in the SM differ by the quantum numbers of dynamic properties such as charge or isospin. Some are massless by postulate, others not. Electrons are theory-desired impoverished to mass and charge points. Some others should be massless, like neutrinos, but then are not. Occurring mathematical theory fragments, such as "5 phases" in the CKM matrix, are simply discarded because they do not "fit" in a result-oriented way. It says laconically on the topic of "quark mixings": "The CKM matrix (Cabibbo–Kobayashi–Maskawa matrix) is physically uniquely described by three real parameters and one complex phase (five further phases that occur mathematically have no physical meaning)". This simply means that one takes, result-oriented, the mathematical elements that "somehow fit" and simply ignores others. This arbitrary procedure within the framework of mathematical models has nothing more to do with exact science.

Nevertheless, quantized properties are characterized by internal symmetries and have nothing more in common with properties in the usual sense that can be conceived as physical qualities inherent in things. The isospin of nucleons or the "color" of quarks no longer express any qualities in this sense at all, but only arbitrarily fixed basis states or directions in an abstract space that are related to each other by symmetry transformations. Almost all previously known symbol systems are cited. Sometimes it is colors (red, blue, green), sometimes letters (u, d, s, c, b, t), sometimes symbolic properties (strange, charm, beauty, ...), and as a term the flavors are also added; for a structure lying even below the quarks, the designations "tohu" and "wabohu" from the creation story in the Old Testament were proposed. Among other things, religiosity, "neurological abnormalities", megalomania, as well as science-freed "kindergarten language" come into "play" with the theorist as a "confused", (mathematics-)believing person.

Ernst Mach already noted: "Whoever does mathematics can sometimes be overcome by the uneasy feeling that his science, indeed his pen, surpasses him in cleverness, an impression that even the great Euler, by his own admission, could not always resist." [EM1]

[EM1] Ernst Mach (1838–1916), lecture, session of the Imperial Academy of Sciences in Vienna on May 25, 1882.

I.8 Heavy Ions in Plasmatic Dream States – a Pathetic Attempt to Practically Circumvent the Confinement Thesis

The LHC is designed to accelerate protons to energies of 7 TeV and thus enable collisions with a center-of-mass energy of 14 TeV. In the range of accelerated heavy ions, such as lead nuclei, the LHC reaches energies of 2.7 TeV per nucleon; in collisions of lead nuclei with 208 nucleons, collisions at an energy of 1150 TeV thus theoretically take place. The currently second-strongest ion accelerator is the Relativistic Heavy Ion Collider (RHIC) in Brookhaven (USA), which reaches a theoretical maximum energy of about 78 TeV in collisions of gold nuclei at 0.2 TeV per nucleon. The ALICE experiment is designed to evaluate these events, with which the postulated quark-gluon plasma is to be investigated.

So much for the theory and practice of the Standard Model. But the postulated quark-gluon plasma detections are not direct experimental proofs, but strongly theory-laden interpretations of experimental results. This also applies to heavy ion collisions. The actual communication problem begins much earlier. The term "plasma" is wrong with respect to the theory objects quark and gluon.

The quark masses postulated according to the SM do not by far add up to the nucleon masses. Gluons are massless.

- Postulated up quark mass: $2.3 \pm 0.7 \pm 0.5$ MeV/c^2 up (u)
- Postulated down quark mass: $4.8 \pm 0.5 \pm 0.3$ MeV/c^2 down (d)
- 938.2720813(58) MeV/c^2 proton mass (duu) $\sim$ 0.8–1.2 % (!!!) quark mass fraction
- 939.5654133(58) MeV/c^2 neutron mass (ddu) $\sim$ 1.1–1.4 % (!!!) quark mass fraction

Thus heavy ions composed of protons and neutrons (such as lead or gold nuclei) cannot be represented by quarks and gluons either. This means that, according to the mass-energy equivalence principle, nucleons and ultimately heavy ions consist almost entirely of phenomenologically indeterminate binding energy. Even more serious is the fact that the heavy ions are accelerated to nearly the speed of light before they collide. This means that in addition to the binding energy, a considerable amount of external energy is added. How this phenomenologically imaginably divides into translational energy and "mass equivalence" is not told to us by relativity theory.

Richard Feynman's statement "It is important to realize that in physics today, we have no knowledge of what energy is." has not changed to this day. Physics lives from secondary quantities or secondary concepts that all possess no (consistent) phenomenology.

More precisely: If 2.7 TeV per nucleon at the LHC falls to lead ions, then with a mass fraction of the quarks of about 1 %, the percentage mass fraction of the event is just 0.00035 %.

Conclusion: Not according to an opinion, but according to the state of knowledge and the postulates of the SM, in particle collisions mainly phenomenologically indeterminate accelerated energy packets – i.e., binding energies and mainly external energy – collide with each other. Of elementary particle masses there is practically no "trace".

One can obviously "explain away" contradictions with observation in any theory by incorporating further (unverifiable) postulates into the theory that precisely "explain" this observation.

I.9 Brigitte Falkenburg's Analysis: Particle Metaphysics

Brigitte Falkenburg writes in *Particle Metaphysics: A Critical Account of Subatomic Reality* (2007), among other things:

> It must be made transparent step by step what physicists themselves regard as the empirical basis for today's knowledge of particle physics. And it must be transparent what they concretely mean when they speak of subatomic particles and fields. The continued use of these concepts in quantum physics leads to serious semantic problems. Modern particle physics is indeed the hardest case for incommensurability in Kuhn's sense.
>
> Finally, theory dependence is a poor criterion for distinguishing between secure background knowledge and uncertain assumptions or hypotheses.
>
> Subatomic structure does not really exist in itself. It only shows itself in a scattering experiment with a certain energy, i.e., due to an interaction. The higher the energy transfer in the interaction, the smaller the measured structures. In addition, according to the laws of quantum field theory, new structures arise at very high scattering energies. Quantum chromodynamics states that the higher the scattering energy, the more quark-antiquark pairs and gluons arise inside the nucleon. According to the model of scattering in this region, this in turn leads to scaling violations that have actually been observed. This sheds new light on Eddington's old question of whether the experimental method leads to discovery or to production. Does the interaction at a certain scattering energy reveal the measured structures or does it create them?
>
> It is not possible to trace a measured cross section back to its individual cause. No causal story relates a measured form factor or structure function to its cause.
>
> With the beams produced in particle accelerators, one can neither look into the atom, nor see subatomic structures, nor observe point-like structures inside the nucleon. Such talk is metaphorical. The only thing that makes a particle visible is the macroscopic structure of the target.
>
> Niels Bohr's quantum philosophy... Bohr's claim was that classical language is indispensable. This remains valid to this day. At the individual level of clicks in particle detectors and particle tracks on photographs, all measurement results must be expressed in classical terms. The use of the known physical quantities length, time, mass, and momentum-energy on the subatomic level is indeed due to an extrapolation of the language of classical physics into the non-classical realm.

Brigitte Falkenburg clearly shows that the experimental side of the SM also measures no analytically calculated matter within the framework of a real physical experiment. Ununderstood binding energy and kinetic energy collide here.

In modern theoretical model physics, on closer inspection, it is about preserving existing thought dogmas. Arguments of reason are sacrificed to habits of thought and Standard Model-laden prejudices. A psychological reason lies in belief and hope. The majority of "researching" physicists are without exception adherents of quantum field theories. An understanding of these opaque theories is not possible. Building on the ununderstood works of others, they plan experiments for which there are only two results: success and confirmation, or failure and brief perplexity, which then usually ends in new particles, new quantum numbers, and theory extensions.

Like all believers, the (theory-affine) experimenters also tend to consciously and unconsciously avoid failure and instinctively evade a refutation of their theory-laden belief by an experiment (or by thought). Instead of limiting experiments to the essential and making them as simple and efficient as possible, attention is often diverted from the essential. Modern theories based on quantum field theories all have one thing in common: In theory-relevant experiments, "sooner or later" they turn out to be trick packages. Instead of discarding the theory, merely theory corrections are made. These can be, for example, postulates about new virtual particles that "briefly" violate the law of energy conservation with reference to Heisenberg's uncertainty relation – although this violation ignores the most important conservation law of system physics.

In this context, it is astonishing how many "interested parties" and "science professionals" firmly believe that quantum field theories are experimentally verifiable, innovative theoretical concepts that generate(d) practical applications.

I.10 Historical "Fun Fact" with Far-Reaching Consequences

When Peter Higgs (1929–2024) presented "his" Higgs mechanism in 1964, he was in the "LSD flower power era", whose contemporary scientific zeitgeist evaluation was shaped by protagonists like the philosopher of science Paul Feyerabend (1924–1994), whose idea of science was: "Anything goes". This possibly explains why Higgs started his, from the Standard Model perspective "groundbreaking", explanations with unreal tachyons.

[Tachyons (ancient Greek $\tau\alpha\chi\acute{\upsilon}\varsigma$ tachýs "fast") are hypothetical particles that move faster than light (superluminal). There is obviously no experimental evidence that such particles exist.]

Higgs's irrationality was welcomed at the time; Peter Higgs was, so to speak, a science avant-gardist in Feyerabend's sense. Feyerabend fits with "Feierabend" (end of work) with the meaning: the actual work is finished. In retrospect, Peter Higgs created and lived in the scientific end of work – meaning: phenomenologically, rationally founded thought-model physics work no longer took place from then on.

The quark–parton model (QPM) developed by Richard Feynman (1918–1988) in the 1960s also describes nucleons as composed of fundamental point-like components, which Feynman called partons. These components were then identified with the quarks postulated a few years earlier simultaneously by Gell-Mann (1929–2019) and George Zweig (born 1937).

Here too the foundation is irrational, because the resulting mathematical approach of the Standard Model of particle physics (SM), starting from zero-dimensional, massless objects, obviously provides no connection to the perceptible physical reality in which mass and extension represent fundamental properties. Massless gauge bosons move at the speed of light according to the formalism requirement. The SM describes matter formation and interactions through purely abstract mathematical symmetries (gauge symmetries with their gauge groups).

I.11 Parametric Creeds

"Modern" elementary particle physics "fed" on "speculation cascades". In no other scientific discipline is there such "creative" postulating, "discovering", and "modifying" as in particle physics. That this construct of particles and theses successfully fertilizes itself and confirms itself within its own boundaries is no great surprise, since the activists can at any time introduce new particles and theses to "save" "old" theses and particles.

I.11.1 Back to the Higgs Mechanism

The following state of affairs is hardly addressed or "partially concealed": The Higgs mechanism starts with a tachyon field and thus inherently with a negative mass squared ($m^2 < 0$). Note: The original Higgs field is a tachyon field, mathematically definable, physically unreal. To "circumvent" the tachyon term, the field is reparameterized as a variation around a vacuum state. This changes the sign of the mass term.

The required properties of the Higgs field include:

- Higgs particles are bosons, because only then is a coherent wave function possible.
- For the same reason, Higgs particles must interact with each other.
- The Higgs field is scalar in order to preserve the symmetry of the vacuum.
- In the present case of the $U(1)_{em}$ gauge theory, the field must be charged in order to couple to the photon.
- The Higgs field satisfies the Klein–Gordon equation:

  $$(\Box + m^2)\Psi = 0$$

  where $\Box$ is the d'Alembert operator (Lorentz scalar, invariant under Lorentz transformations).
- One postulates that the Higgs field is in the ground state with a vacuum expectation value $|\Psi_0|^2 = \text{const} \neq 0$.
- The requirement of a non-vanishing expectation value in the ground state is not trivial and can only be "fulfilled" with a self-interaction of the field.

In order to realize mass generation in the Standard Model through the Higgs mechanism, as a minimal variant one can set the Higgs field as an isospin doublet. In the course of this mathematical procedure, it turns out that another massless vector boson, the so-called Goldstone boson, occurs. However, since there is no experimental indication of this boson, it is declared "unphysical" and mathematically eliminated ("gauged away").

Furthermore, it should be considered: The Higgs potential and thus the spontaneous symmetry breaking of the electroweak symmetry is added "by hand" to the SM. There is no dynamic explanation for this mechanism. The four components of the isospin doublet approach "provide" ultimately three vector bosons with a longitudinal spin component and one scalar Higgs field. So that the photon remains massless, in this case the vacuum expectation value is (again) "set" to zero. The "remaining" mass terms are then generated by the "neutral" component with non-vanishing expectation value. After (mathematical) "rearrangement", the gauge-invariant $SU(2) \times U(1)$-Lagrangian density results with the "desired" mass terms for the Higgs and gauge bosons.

Generally noticeable: Fundamentally, mass and masslessness of the theoretical objects are assigned according to the fantasy wishes of the theory builders. "Fantasy wish" is not a semantic barb, but the correct word in content. For upon neutral consideration of the SM, it is noticeable that within the framework of the formalism mass and masslessness are assigned according to the discretion of the theory builders. This can fundamentally be realized by "re-gaugings". But this arbitrary action possesses no real-physical nutritional value in the sense of gaining knowledge about phenomenological connections. Quite the contrary: A physical pseudo-reality is created that then serves as a binding basis. How senseless this undertaking is is shown exemplarily by the theoretical demand for masslessness of the neutrinos, which, however – according to (recognized) neutrino oscillations – possess finite masses. The theoretical demand comes to nothing, because the neutral leptons (neutrinos) are assumed in the Standard Model as exactly massless Weyl fermions. The contradiction to experimentally required neutrino masses is evident.

Here the circle of fantastic arbitrariness closes in the direction of the cosmological standard model.

I.12 Standard Thought Model Anatomy – "Prelude Thoughts"

[MF] This leads, among other things, to the following, extremely important answer to the question:

What remains of General Relativity (GR) or the resulting Standard Model of cosmology (ΛCDM model)?

The English Wikipedia points out, unlike the German version, the essential aspect of the model:

"The Lambda-CDM, Lambda Cold Dark Matter or ΛCDM model is a **mathematical model** of the Big Bang theory."

"The Lambda-CDM, Lambda cold dark matter or ΛCDM model is a **mathematical model** of the Big Bang theory."

Overall, as an interested person, one must ask why the German Wikipedia, compared to the English Wikipedia, has almost "nothing to say" about the ΛCDM model. German speakers, unless they also consult the English version, remain "knowledge-technically" left out.

Obviously almost no one is clear, whether layperson or theoretical physicist, what "mathematical model" means here. Put succinctly, it means: The only "true" thing in this model is differential geometry. Everything else in the model are speculations, empirically unfounded postulates, and all of this "everything" built on free parameters.

The history of the Big Bang theory proceeded in such a way – without going into detail here – that new hypothetical "objects" had to be introduced for which there was and still is no evidence, except that they save(d) the underlying theory. The term "inflation", which includes a field and an energy that are completely unknown, was introduced in the early 1980s to keep the Big Bang despite very serious contradictions in observation. Soon after, non-baryonic "dark matter" was added as a postulated theoretical entity, and in 1998 "dark energy". Dark energy is a postulated, non-detectable form of energy that influences the universe on large scales. Its postulated main effect is that it triggers or maintains the accelerated expansion of the universe. The term was coined in 1998 by the astrophysicist Michael S. Turner.

Among other things, due to the necessary thesis for maintaining the ΛCDM model, the inflation phase (with multiple superluminal velocity) was introduced; for this, space had to be decoupled from matter without explicitly mentioning it. "Implicitly" this is clear, because matter, even within the framework of the standard models, cannot be accelerated to the speed of light, let alone to superluminal speed. This means, however, that this space–matter decoupling also existed before and after the postulated cosmic inflation, i.e., also in the here and now. For this assumption there was and is no evidence.

I.12.1 Cosmological Constant Λ and Postulated Inflation

The cosmological constant Λ, which Albert Einstein introduced in the belief in a static universe and which was then abolished in the course of the "early ideas" of the expanding universe, came back because Λ was theoretically needed again. But the cosmological constant simply means that, even in the understanding of Big Bang theorists, the "vacuum" possesses an energy density. Vacuum here is another wordplay for supposedly empty space. Attaching Λ to the theory, however, inevitably leads to "matter in space". The result is easy to understand. Let us leave aside for a moment that we do not want to address the attribute of light-speed propagation in a nitpicky way here. Space expands with matter (nearly light-speed) until the beginning of the postulated superluminal inflation, then space expands without matter until the end of inflation, and then again expands with matter well-behaved within the framework of relativity theory.

More detailed: Inflationary models assume that the vacuum state of the universe about 10^{-36} seconds after the Big Bang was different from today: The inflationary vacuum had a much higher energy density. According to General Relativity, every vacuum state with an energy density not equal to zero generates a repulsive force that leads to an expansion of space. In inflationary models, the early high-energy vacuum state thus causes extremely fast expansion, i.e., an expansion with multiple light speed. This expansion explains various properties of today's universe that cannot be explained without such an inflationary epoch. In most inflation models, a scalar field, the so-called inflation field, is proposed that possesses the necessary properties. The inflation theories leave open when the inflation epoch ended; currently one works with a duration between 10^{-33} and 10^{-32} seconds after the equally postulated Big Bang. The rapid expansion of space in the model has the consequence that all potential elementary particles (or other "undesirable" artifacts such as topological defects, whatever that may be) that were "left over" from the time before inflation were now distributed "very thinly" across the universe. In the postulated inflation phase, the linear dimensions of the early universe increase by a factor of at least 10^{26} (and possibly by a much larger factor; the theories leave this open) and the universe increased its volume by a factor of at least 10^{78}. For comparison: An expansion by a factor of 10^{26} corresponds to the expansion of an object from 1 nanometer to a length of about 10.6 light-years – postulated in 10^{-33} to 10^{-32} seconds.

I.12.2 Inflation Conclusion

It doesn't get more fantastic and arbitrary in well-known science fiction films like Star Wars. The difference: These are theoretical physicists who, according to the Pippi Longstocking principle, make the world as they like it. Why? Because otherwise – i.e., without an ultra-short, superluminal inflation phase, for which, by the way, there is no phenomenological justification within the framework of inflation theory – the self-defined theory would refute itself due to then inexplicable observation interpretations and, if you will, associated axiomatically. What one, especially as a layperson, would not expect and would most likely assess as dubious, if one could understand it. Nothing remains of either standard model. Neither generally, nor epistemologically, or in terms of complexity and arbitrary complexity.

I.12.3 Considered at a Higher Level

It should astonish not only interested parties, but especially well-trained scientists, like astrophysicists, that they think, more precisely are certain, that they can make statements about cosmic processes outside our solar system. On closer inspection, this "astrophysicist thinking" is not only improbable but absurd. In all cosmological "observational studies" we are not dealing with controllable laboratory experiments. The causes and phenomena of all possible object observations outside our solar system cannot (simply) be assumed as known. Furthermore: The human observation time span is extremely small compared to the time spans in which cosmic motions took place and take place. To base assumptions on the data from the human observation duration is "far-fetched", to put it casually. All current supposedly empirical measurements are strongly (Big Bang) theory-laden. Postulated time spans, distances, and energy densities are subjective and theory-dependent.

I.13 As a Reminder: The Basis-Violated Covariance Principle

General Relativity is a theory of gravitation and assumes the equality of inertial and gravitational mass ["equivalence principle"]. But GR does not explain this principle; it presupposes it. General Relativity was born, among other things, from the demand to be able to use arbitrary coordinate systems for describing the laws of nature. According to the covariance principle, the form of the laws of nature should not depend decisively on the choice of the particular coordinate system. This demand is causally mathematical and leads to a variety of possible coordinate systems [metrics], but remains physically "unmotivated". Worse: Depending on the choice of coordinate system, phenomenological interpretive leeways arise (see above). The reason is "relatively" simple: Coordinate systems are mathematical constructs that (need) possess no physical properties.

The equation systems (Einstein, Friedmann) of General Relativity, which underlie the statements of the Standard Model of cosmology, provide no analytical solutions. Only idealizations and approximations lead, to a limited extent, to computable solutions. The unavoidable ("covariant") contradictions come with the obviously inadmissible idealizations and approximations of the system of nonlinear, coupled differential equations.

Mathematically, the covariance principle cannot be "violated", since it is axiomatically founded. Only this axiomatic precondition "disappears with the mutilation" (idealization and approximation) of the actual equations. In other words: The mathematically correct equations have no analytical solutions. The reduced equations (approximations, idealization) do have solutions, but these are not covariant. Thus no solution has a real-physically founded meaning. In other words: The covariance principle, viewed real-physically, is formal "blah blah" and can produce any theoretical crap. Even typographical errors can generate solutions within the framework of the differential geometry of GR.

As an exemplary thought impulse: The Eddington–Finkelstein coordinate transformation, named after its authors for the "Schwarzschild metric" solution possibility, eliminates the coordinate singularity of the Schwarzschild solution and "ensures" that for the "advanced" solution inward and for the "retarded" solution outward particles can enter and exit the black hole! In other words: The postulated black holes of the "original version" of the Schwarzschild metric were, on closer inspection, the result of two integration constants of the chosen coordinate system. Another coordinate system by Messrs. Eddington and Finkelstein fixes the coordinate artifact, but "gives" the supposedly black hole the property that particles can leave the black hole. In effect: No black hole.

Conclusion: Black holes are, popular-scientifically, unquestionably more sensational than no black holes. But there is no experimental proof of the existence of even a single black hole. Black holes are nothing

more than theoretical objects of a mathematical formalism whose required covariance principle cannot be fulfilled due to the structure of the equation systems, since only approximations lead to computable solutions. Black holes are popular, as Theodor Fontane noted: "the sensational counts and only to one does the crowd stream even more enthusiastically, to bare nonsense."

I.14 Overall Assessment

Whoever studies the history of elementary particle physics somewhat neutrally will hardly be able to believe that these are natural scientific considerations and efforts in the sense of a purposeful simplification and unification. Whenever experimental physics refuted the theory(ies), the theory was extended by means of new elementary particles, renewed substructuring, and if necessary new quantum numbers that "handled" the missing properties, the missing energy, or the missing symmetry. This has little to do with science. Instead of tackling the problems with a new radical (theory) approach, small and large cosmetic corrections are continuously carried out. Instead of simplifying and unifying, it is "mercilessly" extended and "specialized". A hodgepodge of particles (properties) emerges. For every case of an undesired deviation, for every particle, theory-preserving special regulations are added as needed.

The mathematical formalism is the smallest problem in this fantasy process. If necessary, divergent terms are regularized, renormalized, or simply declared "unphysical", simply "omitted". That this destroys the axiomatic basic structure seems to be clear to only a few, or is obviously irrelevant to the majority of theorists. Are they ultimately only – from a natural scientific perspective unacceptable – economic interests of the beneficiaries and lobbyists who skim research funds and want to justify their material existence?

If one relates the enormous number of publications in the area of the standard models to the epistemological gain, it is – casually formulated in our current digitalized age – almost exclusively data garbage. This is simply because the supposed measurement results are already strongly theory-laden, and the theoretical approaches stem from idealized, approximated equations that in their original form possess no formal-analytical solutions and whose approximation-reduced designs provide nothing more than mathematical possibilities that are real-physically meaningless, especially since, via the feedback of theory-laden selective measurements, only the desired measurement results are further used. Thus a knowledge-freed, formally and economically self-sustaining system arose and develops.

That the system developers and profiteers want to eliminate any halfway logical alternative research from the outset is egoistically humanly understandable. Every formal-analytical solution that delivers real-physical values represents an existential threat to the standard models. Popular-scientifically, the system is carried by servile science magazines, their indoctrinated readers, and unknowing epigones who applaud every popular theory nonsense. The suspicion arises that people whose creative drive cannot be satisfied in a suitable way, because there is really nothing new for them to find, document and formalize trivialities, clothe them in new words, and use sentence structures that a normal person does not understand and whose respect the author quasi-automatically captures.

In the end, it makes no difference whether there are scientists in this system who "really" believe with full fervor in these "theoretical implications", which are hard to surpass in naivety and contradictions, or whether it is ultimately banal economic interests paired with academic power that scientists exploit as elite beneficiaries in order to celebrate and proclaim bare nonsense.

Particularly egregious is the circumstance that, compared to organized religions, theoretical "basic particle physics" claims to embody a high degree of objectivity and freedom from belief. And that is how the interested public sees it too. Theoretical physics is certainly in many minds one of the last arenas where one suspects creeds instead of science.

I.15 Church and Physics

Kurt Marti shows fragmentarily how the Vatican and CERN researchers hand in hand imagine the faith future of particle physics and cosmology.

> "The Vatican is not primarily concerned with elementary particles and black holes, but with metaphysics. With their excellent sense for the seemingly essential, the theologians in Rome have long understood that particle and astrophysics is operating more and more in the thin air of experiment-free metaphysics."

See Elective affinities of CERN and the Vatican by Kurt Marti.

> "At the summit of power and recognition, people suddenly become talkative, coquet with their tricks and small cheats, mock ethics and morality, and boast of their ability to have pushed through a very special personal interest with the help of manipulation and clever propaganda. Many a suspicion about the true nature of a successful person finds confirmation through such vain self-revelation, but is by no means able to shake the person's position of power. Established is established." [1]

I.15.1 Euphemistic Message of the German Physical Society (DPG)

> "The German Physical Society shall serve exclusively and directly pure and applied physics. ..."

I.15.2 "True Message" of the German Physical Society (2000)

> "Big Bang cosmology is, in a sense, the modern, physical version of the creation story." [2]

[1] When the Big Bang was fashionable – memories of a curious world model, Klaus Gebler 2005, ISBN 3-8334-3983-1, online

[2] A comprehensive memorandum "PHYSICS – Topics, Significance and Perspectives of Physical Research, a Report to Society, Politics and Industry" distributed to all secondary schools in 2000 contained this memorable sentence: "Big Bang cosmology is, in a sense, the modern, physical version of the creation story. ..."

Klaus Gebler makes clear in his remarkable book *When the Big Bang was fashionable – memories of a curious world model*, among other things, how much "modern physics" is influenced by the church's view. Website: Klaus Gebler

Didactically, the prevailing epistemological emptiness has been a fixed component of education for decades. Thought monotheism is prescribed popular-scientifically even to schoolchildren. Should these, despite the immense indoctrination and against all expectation, one day realize the quark-based proton fairy tale, they stand completely alone. Who believes that tens of thousands of scientists over several generations occupied themselves with something if it does not represent the non plus ultra? "Billion-dollar" particle accelerators were and are not built if all of that is nonsense? These "psychological components" weigh heavily.

I.16 Source Directory

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Further Information - Overall Overview

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