Elementary Body Theory (EBT)

Foundations, Energetic Analogies, Unification of the Microcosm and the Macrocosm

Based on the work on mass-space coupling by Dirk Freyling

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Abstract

The Elementary Body Theory (EBT) represents a radical break with established theoretical physics. Instead of secondary concepts such as mass, energy, or charge, the primary, sensorily experienceable quantity of radial extension r takes centre stage. Based on a single fundamental equation, the mass-radius constant equation $m_0 r_0 = 2h/(\pi c)$, both microscopic quantities (proton radius, electron radius, Rydberg energy, neutron mass, magnetic moments, fine-structure constant) as well as macroscopic quantities (age, mass and radius of the universe, temperature of the background radiation, vacuum energy density) can be calculated analytically without free parameters. This article presents important formulations of the EBT, introduces the concept of energetic analogies and compares its predictive power with the standard models of cosmology (ΛCDM) and particle physics (SM). The EBT refutes the existence of neutrinos, quarks and dark entities as theory-laden artefacts and traces all phenomena back to the mass-radius coupling. The epistemological foundations are examined in the field of tension between Euclidean intuition and Hilbertian axiomatics.

Contents

Part I
EPISTEMOLOGICAL FOUNDATIONS

1 The Problem of Secondary Concepts

Modern physics operates with a multitude of concepts whose phenomenological basis is unclear. Mass, energy, electric charge or fields are introduced mathematically and used axiomatically without being traced back to primary, immediately experienceable quantities.

> „Proclaimers and understanders of secondary concepts believe in suggestive radiance. They 'somehow' have a good feeling of scientific proximity when they hear, for example, of electric charge, photons, mass, electric field or gravitational field, and talk about them and insert these concepts or quantities into formalisms. But all thought models that are based on secondary concepts are – especially from an epistemological point of view – not capable of bearing knowledge."

This critique is fundamental. It names a problem that is systematically ignored in modern theoretical physics: The use of concepts whose relation to empirical science is unclear leads to theories that may be mathematically consistent, but have no secure epistemological status.

2 Primary vs. Secondary Quantities

The EBT distinguishes strictly between primary and secondary quantities:

Primary Quantities	**Secondary Quantities**
Radial extension r	Mass m
Distance	Energy E
Motion in space	Electric charge q
	Fields (electric, magnetic, gravitational)
	Spin
	Magnetic moment
	Quarks, Neutrinos, Gluons

Table 1: Primary vs. secondary quantities in the EBT

> „Radial symmetry, expressed by the radius r, here stands for the sensorily experienceable and physically measurable object- or space-quantity. Spatial extension is primarily experienceable and measurable."

This places physics on a foundation that lies before all theory formation – the immediate human experience of space and extension. All secondary concepts must be reducible to this primary quantity.

3 Euclid vs. Hilbert – An Epistemological Juncture

The juxtaposition of Euclid and Hilbert is central to understanding the EBT:

> „If Euclid still searched for plausible intuition for mathematical foundations and thus established an interdisciplinary connection that could be evaluated as right or wrong, then in modern mathematics the question of right or wrong does not arise."

Euclid used **explicit definitions** that refer to extra-mathematical objects of „pure intuition": „A point is that which has no parts. A line is breadthless length. A surface is that which has only length and breadth." **Hilbert** worked with **implicit definitions**. The objects of geometry are merely elements of sets that are not further explicated. Hilbert is said to have remarked that one could just as well speak of tables and chairs instead of points and lines without disturbing the purely logical relationship between these objects.

> „Axiomatics does not examine or evaluate any contents with regard to feasible realizations. Moreover, mathematics cannot (and does not want to) distinguish between dust and dust collector."

Modern theoretical physics has become largely Hilbertian – it operates with implicitly defined concepts (quantum fields, gauge symmetries, strings), whose relation to empirical science is becoming increasingly unclear. **The EBT takes the reverse path: First the phenomenological basis (space, distance, motion), then the mathematical formalization.**

4 The Embodiment of Euclidean Distance

The fact that we live, to a very good approximation, on a spherical surface does not lead to a three-dimensional curvature of space 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 the possibility of interchanging space and time. On the contrary, it leads to a constructive „descriptive impoverishment".

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

For an elementary body with radius r_0:

$$s = r_0\sqrt{2}, \qquad \text{Euclidean distance of two points on the spherical surface} \tag{1}$$

$$\lambda = \frac{\pi}{2} r_0, \qquad \text{Orthodrome (shortest connection on the sphere)} \tag{2}$$

$$\frac{\lambda}{s} = \frac{\pi}{\sqrt{8}}, \qquad \text{Ratio of orthodrome to Euclidean distance} \tag{3}$$

$$\Delta s = s\left(\frac{\pi}{\sqrt{8}} - 1\right) \tag{4}$$

$$= r_0\left(\frac{\pi}{2} - \sqrt{2}\right) \qquad \text{Deviation from the Euclidean measure} \tag{5}$$

The „curvature” is not an additional assumption, but follows from the simple fact that we are dealing with spherical surfaces. **No spacetime, no differential geometry – only elementary geometry.**

Part II
FUNDAMENTAL EQUATIONS AND DYNAMICS

5 The Birth of Elementary Body Dynamics from the Critique of SR

In simple words: The question arose (for the first time in 1986) (and still arises) as to which mathematical (primal-)equation maps the „relativistic” factor of the dynamised Lorentz transformation. The fact is: Detached from concrete thought-model approaches, real-object interactions are always dynamic. Since SR is „inertial-system-laden”, it was imperative for a dynamic development process to replace $v =$ const. by $v = dr/dt$. Finding the function $r(t) = r_0 \sin(c \cdot t/r_0)$ was thus simple.

Historically, the Lorentz transformation was, so to speak, a „starting point” for the elementary body theory and the following geometric consideration. The invariance of the [vacuum] speed of light is a unique, controversial, phenomenologically unexplained „superposition anomaly” within „mainstream” physics and, according to the EBT, in the truest sense of the word the visible characteristic of an encapsulated transformation dynamics.

6 Pythagoras and Relativity – The Freyling Intervention

It is interesting to note that the following geometry and plausibility manages without „relativistic ideas”. In the following, it will be shown how a so-called elementary body arises from a simple geometric consideration.

6.1 Elementary Body Construction

We consider the emergence of a spherical surface as isotropic light propagation from the centre with maximal radius r_0. Due to symmetry, the further consideration reduces to a circle with radius $r_0 = c \cdot t$.

$c =$ speed of light, $t =$ time. We now consider the geometric development as a function of a variable velocity v, with the boundary condition $v \leq c$.

For the mathematical calculation, it is intuitively necessary to consider the velocity v as a snapshot, constant and perpendicular to c with a defined (spatial) direction. Within a phenomenological consideration, however, this is not the case. The spherical surface obviously develops dynamically and radially symmetrically with $v = dr/dt$ isotropically. In other words: Although A (for the mathematical calculation) is perpendicular to $v \cdot t$, A can, due to the radial symmetry, be rotated arbitrarily in the circle (or, thought further, in space) without the magnitude of A changing (**Freyling intervention**). For $v = 0$,

$A = c \cdot t = r_0$, and for $v = c$, $A = 0$.

The distance A follows from the Pythagorean theorem:

$$A^2 + (v \cdot t)^2 = (c \cdot t)^2 \tag{6}$$
$$A^2 = (c \cdot t)^2 - (v \cdot t)^2 \tag{7}$$
$$A^2 = t^2(c^2 - v^2) \tag{8}$$
$$A^2 = c^2t^2\left(1 - (v/c)^2\right) \tag{9}$$

A geometrically corresponds to a reduced radius as a function of the variable velocity v, which reaches its maximum at $r = r_0$. We seek a solution that describes $A(v) := r(v) = r(v(t)) = r(t)$ as a function of time, since we assume v to be variable, $v = dr/dt$. Solution: (Elementary body development equation:) $r(t) = r_0 \sin(ct/r_0)$

7 Time without Metaphysics

In the elementary body theory, time is a variable without substructure, which means, among other things, that time is not dilatable. Phenomenologically: Time dilation is just as unimaginable as the curvature of a three-dimensional space. Physics is described here in a three-dimensional, sensibly imaginable space which, due to radial symmetry, is constructively reduced spatially and can only be represented and formalised with the help of the radius.

In order to derive the essential relationship between mass and radius of an elementary particle in a phenomenologically founded way, a time dependence $r(t)$, dr/dt and d^2r/dt^2 is, however, initially required. In further equations for mass-radius constancy, which lead to the calculation of essential quantities such as ground-state energies, further particle masses (pion, neutron mass, ...), fine-structure constant, ... „time" does not explicitly appear.

The transformation from a photon to a mass-radius-coupled space corresponds phenomenologically not to a partial oscillation, as was initially (also) assumed within the elementary body model. The matter-forming transformation of a photon corresponds to an irreversible change of state. Time reversal, as demanded „mechanistically" from classical physics up to quantum mechanics, generally contradicts the reality of measurement.

8 The Mass-Radius Constant Equation

The heart of the EBT is of compelling elegance:

$$\boxed{m_0 r_0 = \frac{2h}{\pi c} = F_{EK}} \tag{F1}$$

The product of the rest mass m_0 and the maximal radius r_0 of an elementary body is constant and is described by the mass-radius constant equation (Freyling constant equation), where h is the Planck quantum of action and c is the speed of light.

One equation – zero free parameters.

8.1 Derivation from Time Considerations

Let us consider the Planck quantum of action h as the smallest scalar action; this action has the dimension energy times time. Division by time yields an energy. If we insert the rest energy $E_0 = m_0c^2$ for the energy, a specific time arises for every rest mass:

$$t(m_0) = \frac{h}{m_0c^2} \tag{10}$$

This time can also be expressed by the Compton wavelength λ_0 of the rest mass: $t(m_0) = \lambda_0/c$.

Now consider the elementary body development equation $r(t) = r_0 \sin(ct/r_0)$. The elementary body is fully formed when the sine of ct/r_0 is equal to one, which is the case for $ct/r_0 = \pi/2$. This yields a development time dependent on the maximal elementary body radius r_0:

$$t_0 = \frac{\pi}{2}\frac{r_0}{c} \tag{11}$$

Equating $t(m_0)$ and t_0 yields:

$$\frac{h}{m_0 c^2} = \frac{\pi}{2}\frac{r_0}{c} \quad \Rightarrow \quad m_0 r_0 = \frac{2h}{\pi c} \tag{12}$$

This derivation uses only h (empirical), c (empirical) and the assumption of a sinusoidal development (geometric). From an ontological, methodological, and phenomenological perspective, this is more satisfying than any quantum-field-theoretical derivation.

9 Elementary Body Dynamics

The fundamental model requirement is that maximally minimalistic equations depict both the massless photon and massive matter. The genesis equations achieve exactly that:

$$\boxed{r(t) = r_0 \sin\left(\frac{ct}{r_0}\right)} \tag{P2.3}$$

$$\boxed{m(t) = m_0 \sin\left(\frac{ct}{r_0}\right)} \tag{P2m}$$

The timeless speed of light – as a state of pure motion – does not contradict the embodiment of matter-energy. For $t = 0$, pure kinetic energy is present (photon). For $t = \frac{\pi r_0}{2c}$, the conversion into mass-radius-coupled energy is complete, and we obtain a real object with the characteristic quantities r_0 and m_0.

The velocity is obtained by differentiation:

$$v(t) = \dot{r}(t) = c\cos\left(\frac{ct}{r_0}\right) \tag{P2.3b}$$

The acceleration:

$$a(t) = \ddot{r}(t) = -\frac{c^2}{r_0}\sin\left(\frac{ct}{r_0}\right) \tag{13}$$

9.1 The Dynamised Factor

From the development equations, it follows by transformation:

$$r(t) = r_0 \sin\left(\arccos\left(\frac{v(t)}{c}\right)\right) = r_0\sqrt{1 - \left(\frac{v(t)}{c}\right)^2} \tag{14}$$

This defines the **dynamised factor**:

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

This factor is radially symmetric and independent of inertial systems – in contrast to the Lorentz factor of SR, which represents only the one-dimensional special case.

For one-dimensionally moving test bodies, according to the Lorentz transformation: The transverse components remain unchanged; length contraction occurs only in the direction of motion. In a radially symmetric motion, however, for example a spherical surface contraction, all spatial directions are equally entitled. The result is a linear combination; the spatial change leads to an isotropic radius reduction:

$$r(v) = r_0 \cdot \gamma_{\text{dyn}} \tag{15}$$

For the product of velocity-dependent mass and velocity-dependent radius:

$$m(v) \cdot r(v) = \frac{m_0}{\gamma_{\text{dyn}}} \cdot r_0 \cdot \gamma_{\text{dyn}} = m_0 r_0 = \text{constant} \tag{16}$$

This demonstrates the **inertial-system independence and radial symmetry** of the EBT in contrast to the one-dimensional Lorentz transformation of SR.

10 Elementary Body Genesis and Internal Dynamics

At time $t = 0$, a discrete amount of energy ($+E_0$) unfolds in the form of pure kinetic energy and forms a mass-coupled „space" in the „form" of a spherical surface according to equations $r(t)$ and $m(t)$, with continuous reduction of the expansion velocity dr/dt.

Epistemologically – and, if you like, philosophically – the zero point, „zero", does not stand for „nothing", but represents the maximal state of motion. This state corresponds to the (timeless) speed of light. In real-physical terms, this is the massless state, i.e., a photon.

Time	$t = 0$	$0 < t < t_0$	$t = t_0$
State	Photon	Development	Elementary body
$r(t)$	0	$0 < r < r_0$	r_0
$m(t)$	0	$0 < m < m_0$	m_0
$v(t)$	c	$0 < v < c$	0
Energy	purely kinetic	mixed	pure rest energy

Table 2: The three phases of elementary body development

The fundamental misunderstanding („outside" the elementary body theory) consists in projecting the properties of an interacting photon onto the „rest state" of the photon. According to equation [P2.3] and its time derivative [P2.3b] as well as [P2m], the „rest state" of the photon is, however, the space- and massless, „light-fast" (energy-)state of maximal motion. This means: Information propagates directionally, which only „unfolds" upon absorption of the photon according to equations [P2.3], [P2m] and their derivatives, and then displays the time-dependent measurement-typical phenomena of interference and the (massive) collision.

10.1 Derivation of $E = m_0 c^2$

The time-dependent force follows from the change in momentum:

$$F(t) = \frac{d}{dt}(m(t)v(t)) = \frac{dm}{dt}v + m\frac{dv}{dt} \tag{17}$$

Inserting the derivatives:

$$\frac{dm}{dt} = m_0 \frac{c}{r_0} \cos\left(\frac{ct}{r_0}\right) \tag{18}$$

$$\frac{dv}{dt} = -\frac{c^2}{r_0} \sin\left(\frac{ct}{r_0}\right) \tag{19}$$

The |(-)| acceleration dv/dt is, model-phenomenologically, always positive in magnitude!

$$F(t) = m_0 \frac{c^2}{r_0} \left(\cos^2\left(\frac{ct}{r_0}\right) + \sin^2\left(\frac{ct}{r_0}\right)\right) = m_0 \frac{c^2}{r_0} \tag{20}$$

The force is **time-independent** – an indication of the internal consistency of the approach.

The energy is obtained by integration:

$$E(t) = \int F(t)v(t)dt = m_0 \frac{c^3}{r_0} \int \cos\left(\frac{ct}{r_0}\right) dt \tag{21}$$

$$E(t) = m_0 c^2 \sin\left(\frac{ct}{r_0}\right) + C \tag{22}$$

With the initial condition $E(0) = 0$ (pure motion), $C = 0$ follows. For $t = \frac{\pi r_0}{2c}$, $\sin(\pi/2) = 1$, and we obtain:

$$\boxed{E_0 = m_0 c^2} \tag{23}$$

This derivation shows that $E = m_0 c^2$ is not an external assumption, but follows from the geometry of elementary body development.

11 The Photon as a Pure State of Motion

The transformation from a photon to a mass-radius-coupled space corresponds to an irreversible change of state. Time reversal, as demanded „mechanistically" from classical physics up to quantum mechanics, generally contradicts the reality of measurement (thermodynamic processes).

State	r	m	v	E
Photon (free)	0	0	c	$h\nu$
Upon interaction	> 0	> 0	$< c$	$m_0 c^2$

Table 3: The photon as a pure state of motion

> „The 'rest state' of the photon is the space- and massless, 'light-fast' (energy-)state of maximal motion. The information only unfolds upon absorption."

This solves in one stroke:

- The wave-particle duality (the photon is both, but at different times)
- The measurement problem (the „unfolding" upon interaction)
- The renormalisation problems (do not even arise)

12 Static State of the Elementary Body and (Partial) Annihilation

Phenomenologically, the conversion of motion information into space information is complete. Without external interaction, the elementary body remains in this state. If the elementary body is „stimulated" from outside, various interaction scenarios occur which, depending on the energy of the interaction partners, lead to partial annihilation or (complete) annihilation.

Matter-forming partial annihilations occur in the simplest form through the proton-electron interaction (keywords: Rydberg energy, hydrogen spectrum). Mass-coupled space annihilates according to $r(t)$ and $m(t)$. „Radiation" is absorbed or emitted.

Upon complete annihilation, the elementary body contracts according to $r(t)$ and $m(t)$ back to the origin and then exists in the form of pure kinetic energy (radiation). In this context, the invariance of the [vacuum] speed of light can be traced back to the described change of state, not to mathematics in the form of reference systems and their linkages.

Part III
THE PLANCK SCALE AND ELECTRIC CHARGE

13 The Planck Scale and the Elementary Quantum

13.1 Dimensional Analysis by Max Planck

The Planck units introduced by Max Planck at the end of the 19th and beginning of the 20th centuries result from a dimensional analysis of the gravitational constant, the speed of light, and the Planck quantum of action.

The gravitational constant has the unit:

$$\gamma_G := \frac{\mathrm{m}^3}{\mathrm{s}^2\,\mathrm{kg}} \quad \Rightarrow \quad \gamma_G = \frac{l^3}{t^2\, m} \tag{24}$$

The speed of light:

$$c = \frac{l}{t} \tag{25}$$

The Planck quantum of action (as the product of mass, length, and velocity):

$$h_x = m\, l\, c \tag{26}$$

From this, by forming quotients:

$$\frac{h_x c}{\gamma_G} = \frac{m\, l\, c^2\, t^2\, m}{l^3} = m^2 \quad \Rightarrow \quad m = \sqrt{\frac{h_x c}{\gamma_G}} \tag{27}$$

$$\frac{h_x \gamma_G}{c^3} = \frac{m\, l\, c\, \gamma_G}{c^3} = l^2 \quad \Rightarrow \quad l = \sqrt{\frac{h_x \gamma_G}{c^3}} \tag{28}$$

Planck chose $h_x = \frac{h}{2\pi} = \hbar$ for the reduced quantum of action.

13.2 The Elementary Quantum G

The energetically founded dimensioning – within the framework of the stringent mass-radius-coupled model – results from comparing gravitational energy and mass-radius-coupled total energy.

$$\gamma_G \cdot m_G^2 = F_{EK} \cdot c^2 \tag{29}$$

$$m_G \cdot r_G = \frac{F_{EK}}{\pi c} = \frac{2h}{\pi c} \approx 1.40707 \cdot 10^{-34}\,\mathrm{kg{\cdot}m} \tag{30}$$

From this follows for the elementary quantum:

$$\boxed{r_G = \sqrt{\frac{F_{EK} \cdot \gamma_G}{c^2}} = 2 \cdot \sqrt{\frac{h\gamma_G}{2\pi c^3}} = 2 \cdot r_{\mathrm{Planck}}} \tag{31}$$

$$\boxed{m_G = \sqrt{\frac{F_{EK} \cdot c^2}{\gamma_G}} = 2 \cdot \sqrt{\frac{hc}{2\pi \gamma_G}} = 2 \cdot m_{\mathrm{Planck}}} \tag{32}$$

That only the double Planck length as radius $r_G = 2 \cdot r_{\mathrm{Planck}}$ and only the inherently double Planck mass as mass $m_G = 2 \cdot m_{\mathrm{Planck}}$ can energetically form the „smallest-in-length", radius-mass-coupled single body $\{G\}$ follows effortlessly from comparing mass-radius-coupled total energy and gravitational energy.

The gravitational constant as a ratio:

$$\boxed{\gamma_G = \frac{r_G}{m_G} \cdot c^2} \tag{33}$$

The gravitational constant is **not a fundamental constant**, but follows from the ratio of radius to mass of the elementary quantum. This is an ontological reduction.

13.3 The Development Time of the Elementary Quantum

The development time of the elementary quantum corresponds to the time required to fully form the elementary quantum according to the development equation $r(t) = r_G \sin(ct/r_G)$:

$$t_G = \frac{\pi}{2c} \cdot r_G = \frac{\pi}{2c} \cdot \sqrt{\frac{F_{EK} \cdot \gamma_G}{c^2}} \tag{34}$$

With $F_{EK} = \frac{2h}{\pi c}$ and $\hbar = \frac{h}{2\pi}$:

$$t_G = \pi \cdot \sqrt{\frac{\hbar \gamma_G}{c^5}} \tag{35}$$

The Planck time is defined as $t_{\text{Planck}} = \sqrt{\frac{\hbar\gamma_G}{c^5}}$. Thus:

$$\boxed{t_G = \pi \cdot t_{\text{Planck}}} \tag{tgP}$$

With $\gamma_G = 6.67408 \cdot 10^{-11}\,\text{m}^3\text{s}^{-2}\text{kg}^{-1}$ we obtain:

$$r_G \approx 3.2324567462 \cdot 10^{-35}\,\text{m}$$
$$m_G \approx 4.352940391 \cdot 10^{-8}\,\text{kg}$$
$$t_G \approx 1.69368209503 \cdot 10^{-43}\,\text{s}$$

14 Electric Charge

14.1 The Elementary Body Charge q_0

Electric charge is a secondary concept of mainstream physics that suggests a „phenomenological entity" which is decoupled from the mass (and the radius) of the charge carrier. Based on the elementary body theory, however, all charge interactions can be traced back to mass-radius couplings.

The self-energy of a charge q_0 at distance r_0 is equal to the rest energy of the mass m_0:

$$m_0 r_0 \cdot c^2 = \frac{q_0^2}{4\pi\varepsilon_0} \tag{34}$$

With the abbreviation $f_7 = 4\pi\varepsilon_0 c^2 = 10^7\,\text{A}^2\text{s}^2\text{kg}^{-1}\text{m}^{-1}$:

$$q_0 = \pm\sqrt{8\varepsilon_0 hc} = \pm\sqrt{f_7 \cdot F_{EK}} = \pm 2 \cdot \sqrt{2\varepsilon_0 hc} \tag{35}$$

Numerically:

$$q_0 = 3.7510920453946 \cdot 10^{-18}\,\text{As} \tag{36}$$

This is the **double Planck charge**. It is velocity-invariant, since the product $m(v)r(v) = m_0 r_0$ is constant.

14.2 The Elementary Electric Charge e

The fine-structure constant α results from comparing electric energy and total energy:

$$\frac{e^2}{8\varepsilon_0 hc} = \frac{\alpha}{4} = \frac{e^2}{q_0^2} \tag{Ea4}$$

Hence follows the relationship between e and q_0:

$$\boxed{e = \frac{\sqrt{\alpha}}{2} \cdot q_0} \tag{eq}$$

Thus α is not a free natural constant, but follows from the ratio of two charges. The energetic measure in this sense is not α, but $\alpha/4$, the ratio of electric energy to mass-radius-coupled total energy.

14.3 The Extended Mass-Radius Constant Equation

From the above relationships follows:

$$\frac{4}{\alpha} \cdot \frac{e^2}{f_7} = m_0 r_0 = \frac{F_{EK}}{\pi c} = \frac{2h}{\pi c} \tag{F1}$$

This demonstrates the consistency of the entire charge concept with the fundamental mass-radius coupling.

Part IV

THE FINE-STRUCTURE CONSTANT – DETAILED EBT-BASED DETERMINATION

15 Elementary Body Charge and Fine-Structure Constant

15.1 The Fundamental Relationship from Mass-Radius Coupling

The basis for understanding the fine-structure constant in the EBT lies in the mass-radius coupling. From the fundamental equation [F1] we have:

$$m_0 r_0 = \frac{2h}{\pi c} = F_{EK} \tag{F1}$$

The self-energy of a charge q_0 at distance r_0 is equal to the rest energy of the mass m_0, as already established in equation (34):

$$m_0 r_0 \cdot c^2 = \frac{q_0^2}{4\pi\varepsilon_0} \tag{34}$$

This leads to the definition of the **elementary body charge** q_0:

$$q_0 = \pm\sqrt{8\varepsilon_0 hc} = \pm\sqrt{f_7 \cdot F_{EK}} = \pm 2\sqrt{2\varepsilon_0 hc} \tag{35}$$

with the auxiliary constant:

$$f_7 = 4\pi\varepsilon_0 c^2 = 10^7\ \mathrm{A^2 s^2 kg^{-1} m^{-1}} \tag{36}$$

This charge q_0 represents the **double Planck charge** and is the fundamental charge that is connected to the total energy of the elementary body. It is velocity-invariant, since the product $m(v)r(v) = m_0 r_0$ remains constant.

15.2 Derivation of the Fine-Structure Constant

The fine-structure constant α results from comparing electric energy and total energy. The electric energy of the elementary charge e is given by:

$$E_{\text{elec}} = \frac{e^2}{4\pi\varepsilon_0 r_0} \tag{37}$$

The total energy (rest energy) of the elementary body is:

$$E_{\text{total}} = m_0 c^2 = \frac{q_0^2}{4\pi\varepsilon_0 r_0} \tag{38}$$

The ratio of electric energy to total energy is therefore:

$$\frac{E_{\text{elec}}}{E_{\text{total}}} = \frac{e^2}{q_0^2} \tag{39}$$

From the standard definition of the fine-structure constant in quantum electrodynamics:

$$\alpha = \frac{e^2}{4\pi\varepsilon_0 \hbar c} \tag{40}$$

In the EBT, however, we obtain a more fundamental relationship. With $\hbar = h/2\pi$ we can rewrite the standard expression as:

$$\frac{e^2}{4\pi\varepsilon_0 \hbar c} = \frac{e^2}{4\pi\varepsilon_0 (h/2\pi) c} = \frac{e^2}{2\varepsilon_0 h c} \tag{41}$$

Comparing this now with the ratio $\frac{e^2}{q_0^2}$ and using the definition of q_0 from equation (35), we obtain:

$$\frac{e^2}{q_0^2} = \frac{e^2}{8\varepsilon_0 h c} \tag{42}$$

This yields the central relationship:

$$\boxed{\frac{e^2}{8\varepsilon_0 h c} = \frac{\alpha}{4} = \frac{e^2}{q_0^2}} \tag{Ea4}$$

15.3 Interpretation of the Result

Equation [Ea4] is one of the most profound results of the EBT. It shows that:

1. **The fine-structure constant is not a free parameter**, but a derived quantity that follows directly from the ratio of the electric elementary charge e to the elementary body charge q_0.
2. **The fundamental measure is** $\alpha/4$, not α itself. This factor $\alpha/4$ represents the ratio of electric energy to mass-radius-coupled total energy.
3. The relationship can be inverted to express the elementary charge through the elementary body charge, as already given in equation (eq):

$$\boxed{e = \frac{\sqrt{\alpha}}{2} \cdot q_0} \tag{eq}$$

15.4 Numerical Value

Using the CODATA recommendations we obtain:

$$\boxed{\alpha = 0.0072973525664 \quad \text{with} \quad 1/\alpha = 137.0359991381545} \tag{43}$$

This value is not an input parameter in the EBT, but follows from the fundamental mass-radius coupling and the relationship between the two charges.

15.5 Connection to the Extended Mass-Radius Constant Equation

Including the fine-structure constant, the mass-radius constant equation can be written in an extended form, as already given in equation (F1):

$$\frac{4}{\alpha} \cdot \frac{e^2}{f_7} = m_0 r_0 = \frac{F_{EK}}{\pi c} = \frac{2h}{\pi c} \tag{F1}$$

This demonstrates the complete consistency between the charge concept, the fine-structure constant, and the fundamental mass-radius coupling. The factor $4/\alpha$ naturally appears as the ratio between total energy and electric energy.

16 Implications of the EBT-Based Determination

16.1 Epistemological Significance

The fact that α emerges from such a simple ratio – $\alpha/4 = e^2/q_0^2$ – has profound epistemological implications:

> „Quantitatively, it is not α, but $\alpha/4$ that is the 'measure of all things' – the ratio of electric energy to total energy. This insight is completely obscured in standard quantum electrodynamics, where α is treated as a fundamental, inexplicable constant that must be measured experimentally."

16.2 Connection to Other EBT Results

The occurrence of $\alpha/4$ is ubiquitous throughout the EBT:

- **Hydrogen atom ground state:** In the Rydberg energy calculation the factor $(1 - \sqrt{1-\alpha^2})$ appears, which approximates $\alpha^2/2$ for small α, consistent with the $\alpha/4$ scaling.
- **Angular momentum:** In the angular momentum calculations, the characteristic values $r = r_0/(4\alpha)$ and $v = \alpha c$ directly yield $\hbar$, where the factor 4 appears from $1/(4\alpha) \cdot \alpha = 1/4$.
- **Cosmological expansion:** In the cosmic expansion velocity the connection $v_{\text{exp}} \approx c\sqrt{\alpha}$ reveals the deep connection between microphysics and macrophysics, where $\sqrt{\alpha}$ stems from the square root of the energy ratio.
- **Neutron magnetic moment:** In the calculation of the magnetic moment of the neutron, the factor $(1 + \sqrt{\alpha}/2)$ appears, which reflects the ratio $e/q_0 = \sqrt{\alpha}/2$.
- **Classical electron radius:** The classical electron radius is $r_{e,\text{cl}} = (\alpha/4)r_e$, which in turn shows the $\alpha/4$-scaling between the mass-inherent radius and the electromagnetic interaction radius.

16.3 Contrast to the Interpretation of the Standard Model

In the standard model of particle physics, the fine-structure constant α is one of about 25 fundamental parameters that must be input from experiments. There is no explanation for its value; it is simply accepted as a given natural constant. The running of α with the energy scale is calculated, but its value at any given scale remains unexplained.

In the EBT, by contrast, α arises naturally from the mass-radius coupling and the relationship between two fundamental charges. This is a clear example of the explanatory power of the theory:

- **No free parameters:** α is not an input, but an output of the theory.
- **Physical interpretation:** $\alpha/4$ has a clear physical meaning as the ratio of electric energy to total energy.
- **Unification:** The same factor appears consistently across various physical phenomena and demonstrates the unity of the theory.

17 Historical Context: From Sommerfeld to the EBT

Arnold Sommerfeld introduced the fine-structure constant in 1916 to explain the fine structure of spectral lines. It was originally defined as:

$$\alpha = \frac{e^2}{\hbar c} \quad \text{(in Gaussian units)} \tag{44}$$

Sommerfeld recognized its significance but could not explain its value. In the course of the last century, α was measured with ever greater precision, yet its origin remained mysterious.

Wolfgang Pauli famously described the value of α as a „purely numerical gift of God".

Richard Feynman wrote:

> „There is a most profound and beautiful question associated with the observed coupling constant e – the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be about 0.08542455. (My physicist friends will not recognize this number because they prefer to remember it as the inverse of its square: about 137.03597 with an uncertainty of about 2 in the last decimal place.) It has been a mystery since its discovery more than fifty years ago, and all good theoretical physicists hang this number on their wall and worry about it. Immediately you would like to know where this number for a coupling comes from: is it related to π or perhaps to the base of natural logarithms? Nobody knows. It is one of the greatest damn mysteries of physics: a magic number that comes to us without man understanding it. You could say the „hand of God" wrote this number, and „we don't know how He guided His pencil." [11]

18 The $\alpha/4$ Factor in Detail

18.1 Physical Meaning

The factor $\alpha/4$ represents the ratio:

$$\frac{\alpha}{4} = \frac{e^2}{q_0^2} = \frac{\text{electric energy}}{\text{total energy}} \tag{45}$$

This ratio occurs in numerous contexts:

1. **Energy scaling:** When an elementary body interacts electromagnetically, only a fraction $\alpha/4$ of its total energy takes part in the electric interaction.
2. **Radius scaling:** The classical electron radius $r_{e,\text{cl}}$ is smaller than the mass-inherent radius r_e by exactly this factor: $r_{e,\text{cl}} = (\alpha/4)r_e$.
3. **Velocity scaling:** In electromagnetic interactions the characteristic velocity is $v = \alpha c$, not c.
4. **Angular momentum:** The factor $1/4$ combines with α in the denominator of the radius expression $r = r_0/(4\alpha)$ to yield the correct quantum of action $\hbar$.

18.2 Geometric Interpretation

The factor 4 in $4/\alpha$ can be understood geometrically. The elementary body is a spherical surface. When two such bodies interact electromagnetically, the interaction occurs through their surfaces. The factor 4 is probably connected to the surface $4\pi r^2$ of the sphere, whereby π cancels out in other parts of the calculation to yield the simple rational number.

18.3 Relation to the Numerical Value of the Fine-Structure Constant

With $\alpha \approx 1/137.036$ we have:

$$\frac{\alpha}{4} \approx \frac{1}{548.144} \tag{46}$$

This number appears in many EBT calculations, often in combination with other factors such as $\sqrt{\alpha/4} = \sqrt{\alpha}/2$, which is about 0.0427.

19 Conclusion on the Fine-Structure Constant

The EBT-based derivation of the fine-structure constant represents one of the most significant achievements of the theory. It transforms α from a mysterious, inexplicable „natural constant" into a derived quantity with a clear physical meaning. The relationship $\alpha/4 = e^2/q_0^2$ reveals that α is fundamentally an energy ratio – electric energy to total energy – and that its numerical value is determined by the mass-radius coupling that underlies all elementary bodies.

Like all others in the EBT, this derivation requires no free parameters. It follows directly from the fundamental postulate $m_0 r_0 = 2h/(\pi c)$ and the definition of the elementary body charge q_0. The fine-structure constant is thus not a separate „constant", but an integral part of the unified description of physics offered by the elementary body theory.

Part V

MATTER WAVES AND THE ELECTRON RADIUS PROBLEM

20 The de Broglie Matter Wave

20.1 Foundations of the de Broglie Wavelength

The de Broglie matter waves correspond to the kinetic energy of particles (in addition to rest energy) and not to the particles themselves, which are characterized by Compton wavelengths.

The de Broglie wavelength is superposed on the Compton wavelength λ_C of the particle. Based on the elementary body theory, the superposition of kinetic energy and radiation energy corresponding to the particle rest mass interferes energetically, which leads to a directed centre-of-mass motion with velocity v.

In contrast to Compton wavelengths, de Broglie matter waves are not particle-characteristic, since, for example, for neutrons, electrons, and protons at suitable velocities, de Broglie matter waves can be identical as equivalents of the kinetic energies, independent of particle type.

For the case of a velocity near 0, a de Broglie wavelength of infinite extension results ($v \to 0 \Rightarrow \lambda_{\mathrm{deB}} \to \infty$). This explains the infinite superposed interaction range of the actual particle with „discrete " rest radius, without the additional space dependent on the de Broglie matter wave itself possessing relevant mass-dependent energy.

20.2 Relationship between de Broglie and Compton Wavelength

The de Broglie wavelength is defined as:

$$\lambda_{\mathrm{deB}} = \frac{h}{p} \tag{37}$$

With the relativistic momentum $p = \frac{m_0 v}{\sqrt{1-(v/c)^2}}$:

$$\lambda_{\mathrm{deB}} = \frac{h\sqrt{1-(v/c)^2}}{m_0 v} \tag{dB}$$

With the mass-radius constant equation $m_0 r_0 = \frac{2h}{\pi c}$ follows:

$$\lambda_{\mathrm{deB}} = \frac{h \cdot r_0 \cdot \sqrt{1-(v/c)^2}}{F_{EK} \cdot v} = \frac{\pi}{2} \cdot r_0 \cdot \sqrt{\left(\frac{c}{v}\right)^2 - 1} \tag{dBC2}$$

Since the Compton wavelength $\lambda_C = \frac{\pi}{2} r_0$, we obtain:

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

Limiting cases:

- $v \to 0$: $\lambda_{\mathrm{deB}} \to \infty$
- $v \to c$: $\lambda_{\mathrm{deB}} \to 0$

21 The Electron Radius Problem

21.1 The Mass-Inherent Electron Radius

It is (or was) an intriguing question why particle physicists believe and measure that the electron has a radius smaller than 10^{-19} m and can be treated theoretically as „point-like without structure".

The mass-inherent electron radius follows from the mass-radius constant equation:

$$r_e = \frac{2h}{\pi c} \cdot \frac{1}{m_e} \approx 1.54464 \cdot 10^{-12}\,\mathrm{m} \quad (38)$$

The Compton wavelength of the electron is:

$$\lambda_e = \frac{\pi}{2} \cdot r_e = \frac{h}{m_e c} \quad (39)$$

The **classical electron radius** is the radius scaled by $\alpha/4$, which is directly related to the fine-structure constant derived in Part IV:

$$r_{e,\mathrm{cl}} = \frac{\alpha}{4} \cdot r_e \quad (40)$$

The factor $4/\alpha$ is the ratio of total energy to electric energy.

21.2 The Klein-Nishina Formula as a Test Case

The Klein-Nishina formula for the differential cross-section of Compton scattering is:

$$\frac{d\sigma}{d\Omega} = \frac{1}{2} r_e^2(\text{classical}) \left(\frac{\lambda}{\lambda'}\right)^2 \left[\frac{\lambda}{\lambda'} + \frac{\lambda'}{\lambda} - \sin^2\theta\right] \quad (41)$$

> „Outside the 'interpretation leeway' of the particle accelerator, the mass-inherent electron radius r_e, or the classical electron radius $r_{e,\mathrm{cl}} = (\alpha/4)r_e$, appears in **all** equations used for calculating cross-sections in elastic and inelastic scattering on electrons."

Examples of equations in which the electron radius appears:

- Møller scattering
- Compton scattering (Klein-Nishina)
- Electron-positron pair production
- Photoelectric effect
- Bethe-Bloch-Sternheimer equation
- Kramers-Heisenberg formula

21.3 The Point

The differential scattering cross-section for electrons always has the form:

$$\frac{d\sigma}{d\Omega} = \left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right)^2 \cdot f_W \quad (42)$$

And the term in parentheses is exactly the classical electron radius, which is now recognized as containing the fine-structure constant:

$$\frac{e^2}{4\pi\varepsilon_0 m_e c^2} = r_{e,\mathrm{cl}} = \frac{\alpha}{4} \cdot r_e \quad (43)$$

The classical electron radius is not an abstract calculation quantity, but the scaled interaction radius that appears in all scattering experiments on electrons – including in the particle accelerator.

The statement „The electron radius is not the physical extension of the electron" is merely a postulate of QED, QCD and QM.

21.4 The Accelerator Situation

Accelerated, high-energy particles change their mass-radius relations radially symmetrically due to the supplied energy. This means: They become mass-heavier with increasing velocity and proportionally radius-smaller.

An electron with 28 GeV:

$$\gamma_{\rm dyn} = \sqrt{1-(v/c)^2} \approx \frac{1}{54800} \tag{44}$$

$$r_e(28\,\mathrm{GeV}) = r_e \cdot \gamma_{\rm dyn} \approx \frac{1.54 \cdot 10^{-12}\,\mathrm{m}}{54800} \approx 2.8 \cdot 10^{-17}\,\mathrm{m} \tag{45}$$

A proton with 920 GeV:

$$r_p(920\,\mathrm{GeV}) \approx 8.6 \cdot 10^{-19}\,\mathrm{m} \tag{46}$$

> „It is not the 'typical' energy-dependent electron radii smaller than 10^{-19} m in connection with particle accelerators that are 'incorrectly' measured, but the conclusions drawn by elementary particle physics with regard to resting electrons."

The elementary body theory consistently describes both the behaviour at „conventional" scattering energies of the scattering partners of the electron as well as at high energies in the particle accelerator.

Part VI
CHARGE INTERACTIONS AND PARTICLE FORMATION

22 Superposition of Two Elementary Bodies

Two elementary bodies A and B with masses m_A, m_B and the mass-coupled radii r_A, r_B superpose with a common geometric origin:

$$A(m_A, r_A) + B(m_B, r_B) = AB(m(r_A + r_B), (r_A + r_B)) \tag{47}$$

Due to the mass-radius constant equation:

$$m_A r_A = m_B r_B = m(r_A + r_B) \cdot (r_A + r_B) = \frac{2h}{\pi c} \tag{48}$$

From this follows:

$$r_A + r_B = \frac{2h}{\pi c}\left(\frac{1}{m_A} + \frac{1}{m_B}\right) \tag{49}$$

And for the resulting mass:

$$\boxed{m(r_A + r_B) = \frac{m_A}{1 + \frac{m_A}{m_B}} = \frac{m_B}{1 + \frac{m_B}{m_A}}} \tag{MAB}$$

Formally, this is identical to the „reduced mass" of classical mechanics – but the phenomenology is completely different. It is not about centre-of-mass motion, but about **superposition in the common origin**.

23 The Three Interaction Types

23.1 e-e Interaction

This is the interaction of two elementary charge carriers with the electric elementary charge e. The most prominent example is the hydrogen atom (proton + electron).

The energy of this interaction is:

$$\boxed{\Delta E_{ee} = \left(\frac{m_A}{1 + \frac{m_A}{m_B}} \right) \cdot \left(1 - \sqrt{1 - \alpha^2}\right) \cdot c^2} \tag{HE}$$

23.2 e-q Interaction

Here an elementary body with the strong charge q_0 interacts with an elementary body with the electric elementary charge e. The most prominent example is the neutron.

First, the charge q_0 must be transformed into the mass-radius picture. Since q_0 represents the self-energy of the mass m_0, the equivalent mass is larger by a factor of $4/\alpha$, which is directly related to the fine-structure constant:

$$q_0^m A = \frac{4}{\alpha} \cdot m_A \tag{50}$$

The energy of the interaction is then:

$$\boxed{\Delta E_{e,q_0} = \left(\frac{q_0^m A}{1 + \frac{q_0^m A}{m_B}} \right) \cdot \left(1 - \sqrt{1 - \alpha}\right) \cdot c^2} \tag{Eq0e}$$

23.3 q-q Interaction

Here two elementary bodies interact via the strong charge q_0. The most prominent examples are pions.

For the case $m_A = m_B$ the equation simplifies to:

$$\boxed{\Delta E_{q_0,q_0} = \frac{2}{\alpha} \cdot m \cdot c^2} \tag{E2q0q0}$$

24 The Hydrogen Atom

24.1 The Rydberg Energy

The ground-state energy of the hydrogen atom (Rydberg energy) results from the e-e interaction between proton and electron.

$$\boxed{\Delta E_{ee} = \left(\frac{m_e}{1 + \frac{m_e}{m_p}} \right) \cdot \left(1 - \sqrt{1 - \alpha^2}\right) \cdot c^2} \tag{51}$$

With the CODATA values:

$$\begin{aligned} m_e &= 9.10938356 \cdot 10^{-31}\,\text{kg} \\ m_p &= 1.672621898 \cdot 10^{-27}\,\text{kg} \\ \alpha &= 0.0072973525664 \\ c &= 2.99792458 \cdot 10^{8}\,\text{m/s} \end{aligned}$$

Step 1: Reduced mass

$$\mu = \frac{m_e}{1 + \frac{m_e}{m_p}} = \frac{9.10938356 \cdot 10^{-31}}{1 + 0.000544617} = 9.108423 \cdot 10^{-31}\,\text{kg} \tag{52}$$

Step 2: Relativistic term

$$1 - \sqrt{1 - \alpha^2} = 1 - \sqrt{1 - 5.324 \cdot 10^{-5}} = 1 - \sqrt{0.99994676} = 1 - 0.99997338 = 2.662603 \cdot 10^{-5} \tag{53}$$

Step 3: Energy

$$\Delta E_{ee} = \mu \cdot (1 - \sqrt{1-\alpha^2}) \cdot c^2 \tag{54}$$
$$= (9.108423 \cdot 10^{-31}) \cdot (2.662603 \cdot 10^{-5}) \cdot (8.98755 \cdot 10^{16}) \tag{55}$$
$$= 2.17871478 \cdot 10^{-18}\,\mathrm{J} = 13.59846819\,\mathrm{eV} \tag{56}$$

Comparison with the experimental Rydberg energy $E_{Ry}(\exp) = 13.59843400\,\mathrm{eV}$:

$$\frac{\Delta E_{ee}}{E_{Ry}(\exp)} = 1.00000251 \tag{57}$$

This is an agreement of 2.5 millionths – without free parameters!
The associated mass difference is:

$$\Delta m = 2.4241471236633 \cdot 10^{-35}\,\mathrm{kg} \tag{58}$$

24.2 Quantisation of Energy Levels

With the postulate that the indivisible Planck quantum of action represents the smallest scalar action, quantised actions can be defined as a function of the natural number $n = 1, 2, 3, \ldots$:

$$h_n = n \cdot h \tag{59}$$

This yields discrete fractions of the fine-structure constant:

$$\alpha_n = \frac{\alpha}{n} \tag{60}$$

For the fundamental relation $\left(\frac{r}{r_0}\right) \cdot \left(\frac{v}{c}\right)^2 = \frac{\alpha}{4}$ this means:

$$\left(\frac{r}{r_0}\right) \cdot n^2 \cdot \left(\frac{v}{c}\right)^2 \cdot \frac{1}{n^2} = \frac{\alpha}{4} \quad \Rightarrow \quad \left(\frac{r}{r_0}\right) \cdot n^2 = \text{const.} \tag{61}$$

Thus:

$$r(n) = r \cdot n^2 \tag{62}$$

Since the energy $E \propto 1/r$, it follows:

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

The energy difference between two energy levels n and $n+1$ is:

$$\boxed{\Delta E_{n,n+1} = E_0 \left(\frac{1}{n^2} - \frac{1}{(n+1)^2}\right)} \tag{En2}$$

25 The Neutron

25.1 Neutron Formation from e-q Interaction

The neutron results from the interaction of a proton (with charge e) and an electron, which here interacts with the strong charge q_0.

The effective mass of the electron with the strong charge q_0 is, using the factor $4/\alpha$ derived from the fine-structure constant:

$$q_0 m_e = \frac{4}{\alpha} \cdot m_e \tag{63}$$

The mass difference from the interaction is:

$$\Delta m_n = \left(\frac{q_0 m_e}{1 + \frac{q_0 m_e}{m_p}} \right) \cdot \left(1 - \sqrt{1-\alpha}\right) \tag{64}$$

The total neutron mass is:

$$m_n = m_p + m_e + \Delta m_n \tag{65}$$

With the CODATA values we obtain:

$$\frac{m_n}{m_n(\exp)} = 1.0000065472 \tag{66}$$

This is an agreement of 6.5 millionths – without free parameters!

25.2 The Kinetic Energy in Neutron Decay

The mass difference between neutron and (proton + electron) is:

$$\Delta m = m_n - m_p - m_e \tag{67}$$

From this follows the Lorentz factor:

$$\gamma = \frac{\Delta m}{m_e} + 1 \tag{68}$$

The kinetic energy of the emitted electron is:

$$E_{\text{kin}} = (\gamma - 1) \cdot m_e c^2 \tag{69}$$
$$= 0.782265352\,\text{MeV} \tag{70}$$

This corresponds to the value of about 0.78 MeV given in the literature.

„If one takes the maximum kinetic energy (0.78 MeV) of the electron emitted in neutron decay as given in the literature, then the mass difference of the neutron relative to electron and proton follows directly from the relativistic (kinetic) energy of the electron. This can only be understood as a trivial statement if one obtains the neutron, based on the elementary body theory, from a direct proton-electron interaction."

26 The Pions

26.1 Charged Pions from e-q-q Interaction

From the proton-electron-q_0-q_0 interaction, two charged pions naturally result.

For $m_A = m_e$ and $m_B = m_p$:

$$\Delta m = \frac{q_0 m_e}{1 + \frac{q_0 m_e}{q_0 m_p}} = \frac{q_0 m_e}{1 + \frac{m_e}{m_p}} \tag{71}$$

With $q_0 m_e = \frac{4}{\alpha} m_e$ and $q_0 m_p = \frac{4}{\alpha} m_p$, the factor $4/\alpha$ cancels out:

$$\Delta m = \frac{4}{\alpha} \cdot \frac{m_e}{1 + \frac{m_e}{m_p}} \tag{72}$$

This corresponds roughly to twice the pion mass:

$$\frac{\Delta m/2}{m_\pi(\exp)} \approx 1.00289525 \tag{73}$$

Remark 26.1. *The remarkable formal fact is that, due to charge conservation, two pions (with different charges) result from one electron and one proton in terms of mass-radius energy. This is obviously „known" through the formalism expressed by the equations above.*

It is highly questionable to what extent the strongly theory-laden experimental particle physics can determine resting pion masses with sufficient accuracy at all. The neutral pion is only a „pion" due to its mass differing from the charged pions within the framework of SM requirements. The abstraction that particles with different masses are „identical" according to postulated QM superposition (keyword: quarkonia) is one of the many arbitrary theses within the SM (see, inter alia, SM quark mass uncertainties in the percent error range) and is unjustified outside the mathematical formalism of the SM.

26.2 Neutral Pions from e-e Interaction

From the primary strong electron-positron interaction, only uncharged pions are formed.

For $m_A = m_B = m_e$ in the q_0-q_0 interaction:

$$\Delta E = \frac{2}{\alpha} \cdot m_e c^2 = 140.05050232093\,\text{MeV} \tag{74}$$

The corresponding mass difference:

$$\Delta m = \frac{2}{\alpha} \cdot m_e \tag{75}$$

Comparison with the neutral pion mass assumed in the SM:

$$\frac{\Delta m}{m_{\pi^0}} \approx 1.037591 \tag{76}$$

26.3 Pion and Muon Decay as Mass-Radius Transformation

The conversion of the charged pion into a muon and of the muon into an electron shows clearly that the supposed distinction between „structureless" leptons and mesons built from quarks is a fiction of the SM.

The thesis of the elementary body theory is: **Mass-dependent energy is converted into space energy in these „decays".**

For the pion and the muon:

$$m_\pi r_\pi = m_\mu r_\mu = \frac{2h}{\pi c} \quad \text{(F1)} \tag{77}$$

For the muon and the electron:

$$m_\mu r_\mu = m_e r_e = \frac{2h}{\pi c} \quad \text{(F1)} \tag{78}$$

The mass ratio:

$$\frac{m_\mu}{m_e} = 206.7682650525 \tag{79}$$

The radius ratio:

$$\frac{r_e}{r_\mu} = 206.7682650525 \tag{80}$$

> „The muon, about 207 times heavier, transforms into an electron with an about 207 times larger radius and the electron mass m_e. This thesis is in excellent agreement with the experimentally observed muon decay and is formally represented by the mass-radius constant equation."

In all particle transformations, mass-dependent energy is converted into radius-dependent energy. The energy conservation law of mainstream physics is simply false, as it only takes into account energy coupled to mass.

Part VII

27 Exact Theoretical Proton Radius Calculation

The product of the proton mass and the proton radius depends only on fundamental constants:

$$m_p \cdot r_p = \frac{2h}{\pi c} \quad \Rightarrow \quad r_p = \frac{2h}{\pi c} \cdot \frac{1}{m_p} \tag{81}$$

With the values:

$$h = 6.62606957 \cdot 10^{-34}\,\text{Js}$$
$$c = 2.99792458 \cdot 10^{8}\,\text{m/s}$$
$$m_p = 1.672621777 \cdot 10^{-27}\,\text{kg}$$

we obtain:

$$\boxed{r_p = 8.412356415 \cdot 10^{-16}\,\text{m} = 0.84124\,\text{fm}} \tag{82}$$

28 Comparison with Experimental Data

The theoretically calculated value agrees excellently with various experimental measurements, in particular with the high-precision results of muonic hydrogen spectroscopy at the Paul Scherrer Institute (PSI).

28.1 The Muonic Hydrogen Experiment at PSI

An international research team confirmed, by means of laser spectroscopy on exotic hydrogen at the Paul Scherrer Institute (PSI) in Switzerland – the world's only research centre that produces sufficient muons for such investigations – an unexpectedly small proton radius [2]. Researchers from the Max Planck Institute for Quantum Optics (MPQ) in Garching, ETH Zurich, the University of Freiburg (Switzerland), the University of Stuttgart and others participated in the experiment.

In this experiment, hydrogen was bombarded with muons (particles that are, in most properties, identical to electrons, but 200 times heavier) from an accelerator at PSI. Due to their large mass, muons approach the proton much closer than electrons, which leads to a significantly stronger shift of the energy levels. The technical requirements are extremely high: Since muonic hydrogen atoms are very short-lived (muons live only about 2 millionths of a second), the light pulses for exciting the resonance must be fired at the hydrogen target within nanoseconds of the registration of a muon.

> „The value of 0.84087(39) femtometers (1 fm = 0.000000000000001 metre) agrees with the value published in 2010 (0.84184 fm), but is 1.7 times more precise. The discrepancy with the measurements on normal hydrogen or electron-proton scattering has thus gained weight." [2]

28.2 Experimental Values

- **2010 (muonic hydrogen):** $r_p = 0.84184\,\text{fm}$ [3]
- **2013 (muonic hydrogen):** $r_p = 0.84087(39)\,\text{fm}$ (1.7 times more precise) [1]
- **2013 (normal hydrogen):** $r_p = 0.84087(39)\,\text{fm}$ (consistency check)
- **2017 (normal hydrogen):** $r_p = 0.8335(95)\,\text{fm}$ [4]
- **2019 (e-p scattering, PRad experiment):** $r_p = 0.831 \pm 0.007 \pm 0.012\,\text{fm}$ [5]

28.3 Magnetic Radius Determination

The new measurement also enabled the determination of the magnetic radius of the proton from laser spectroscopy of muonic hydrogen for the first time:

$$r_m = 0.87(6)\,\text{fm} \tag{83}$$

This value agrees well with earlier measurements. Although the accuracy is currently not better than in earlier measurements, laser spectroscopy of muonic hydrogen has the potential to significantly increase the measurement accuracy for the magnetic radius in the future [2].

28.4 Interpretation of the Proton Radius Puzzle

> „Getting to the bottom of the causes of the proton radius puzzle is motivation worldwide for manifold investigations. On the one hand, the old measurements on hydrogen and in electron scattering are being reanalysed or repeated. On the other hand, theoreticians from many disciplines participate intensively in the search for a solution. Extremely exciting proposals attempt to explain the observed discrepancy by physics beyond the standard model. However, it could also be that the proton has a much more complex structure than previously assumed, which only becomes apparent under the influence of the heavy muon. To clarify this effect, further measurements are necessary." [2]

From the perspective of the EBT, there is no „puzzle" at all. The theoretical value $r_p = 0.84124$ fm is parameter-free and lies exactly within the range of the most precise experimental values. The slight deviations between different experimental methods are due to the strongly theory-laden nature of the interpretation of scattering data, as critically discussed by Bernauer and Distler [6]:

> „Extracting the proton radius from scattering data is a tricky business."

28.5 Historical Measurements

As early as 1958, Robert Hofstadter and colleagues obtained a value consistent with the EBT:

> Electron-proton scattering, Hofstadter et al. 1958: $r_p = 0.80 \pm 0.04$ fm [7]

In their publication „Electromagnetic Structure of the Proton and Neutron" they stated on page 487:

> „The new data in Fig. 12 (filled points) now serve to distinguish between the various models and show that for F1 = F2 the exponential model with the root-mean-square radii $r_e = 0.80 \cdot 10^{-13}$ cm and $r_m = 0.80 \cdot 10^{-13}$ cm fits the data very well..."

29 The Problem of Theory-Laden Measurements

Energy splittings are mostly not self-induced. Splittings occur only when energy is supplied from outside in the form of electric or magnetic fields. Phenomenologically, physical fields are unjustified. From the perspective of an investigated object (electron, atom, molecule), they represent infinite energy reservoirs that interact with the „test objects".

Thus, spectroscopic investigations of interaction partners – proton-electron or proton-muon – are only meaningful (free of methodical distortions) when „self-induced" transitions occur without external energy supply. As Werner Heisenberg noted in 1931:

> „Every measurement of a quantum-theoretical quantity requires an intervention into the system to be measured, which can considerably disturb the system. Measuring the radiation energy in a mathematically sharply delimited part of a cavity would only be possible through an 'infinite' intervention and is therefore a useless mathematical fiction. A practically feasible experiment can, however, only provide the energy in a region with blurred boundaries."

The uncertainty and subsequent „variation" of nuclear and nucleon radii, exemplified by the proton radius, based on theoretical models and associated various experiments, leads to differences in results in the percent range. The „theoretically" shaped so-called form factors and structure factors of high-energy elastic and inelastic proton-electron scattering, proton-proton collisions, etc. reflect electric and magnetic distributions. From this, a radius is „calculated" in a heavily theory- and approximation-laden manner.

29.1 Critical Voices

Douglas W. Higinbotham shows in „Extracting the Proton Radius from Electron Scattering Data" that the proton radius can also be measured at ~ 0.84 fm in typical electron scattering experiments if the right theoretical assumptions are made.

29.2 Real-Physically Measurable Result

Accelerated, high-energy particles – usually protons and electrons in accelerators – change their mass-radius relations radially symmetrically due to the supplied energy. This means: They become mass-heavier with increasing velocity and proportionally radius-smaller. The cross-sections become smaller with r^2, or with $1/m^2$.

In the mass-radius-coupled reality, the proton scattering centres with cross-sections smaller than the proton cross-section – which are theory-inducedly interpreted as (quark-gluon) substructure – are the radially symmetrically radius-reduced protons themselves.

Part VIII
THE CONCEPT OF ENERGETIC ANALOGY

30 Definition of Energetic Analogy

With respect to the elementary body, quantities such as angular momentum, spin, velocity, and electric charge always express **purely energetic relationships** of the radius-mass-coupled, possible internal changes in elementary body interactions. In this context, the EBT speaks of **energetic analogies**.

Due to radial symmetry, the consideration reduces to the elementary body radius and, in the context of interactions, to the resulting change in the object radius – a **constructive descriptive impoverishment**.

30.1 Example: Angular Momentum in Energetic Analogy

Two elementary bodies superposed at the geometric origin lead, via the electric elementary charge interaction, to an object with an enlarged total radius. The quantities characteristic of the electric interaction, including the fine-structure constant, are:

$$r = \frac{r_0}{4\alpha}, \quad v = \alpha c \tag{84}$$

Thus we obtain:

$$L = |\mathbf{L}|_{ee} = r \cdot m \cdot v = \frac{r_0}{4\alpha} \cdot m_0 \cdot \alpha c = \frac{1}{4} r_0 m_0 c \tag{85}$$

With the mass-radius constant equation $F_{EK} = r_0 m_0 = \frac{2h}{\pi c}$ follows:

$$\boxed{L = \frac{1}{4} \cdot \frac{2h}{\pi c} \cdot c = \frac{h}{2\pi} = \hbar} \quad \text{[eL]} \tag{86}$$

Remark 30.1. ***Important:*** *This expression „looks like" an angular momentum, but represents a charge-dependent energetic relationship –* ***without orbital motion and without intrinsic rotation****. Nothing rotates in the elementary body model. The factor* $1/4$ *combines with* α *in the denominator to yield the correct quantum of action, which is directly connected to the* $\alpha/4$ *ratio derived in Part IV.*

31 The Quantum-Mechanical Spin – A Purely Mathematical Quantity

Quantum mechanics often works with the false suggestion of the term „spin" as intrinsic rotation. However, the associated formalism describes no real physical rotation:

> *„Dirac's electron theory 1928: 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."*

Remark 31.1. ***Simply put:*** *The quantum-mechanical spin has nothing to do with rotation – it is a necessary, but completely unjustified quantum number (without real physical intuition), which is generated purely mathematically (four-component Dirac spinor field with four Dirac matrices).*

32 The Electric Interaction of Two Charges

For two equally strong charges q_e at distance r with a common charge centre:

$$\mathcal{E}(r, q_e) = \frac{1}{r} \cdot \frac{q_e^2}{4\pi\varepsilon_0} \tag{87}$$

In the case of proton-electron interaction, half the distance is equal to the Bohr radius:

$$\frac{1}{2}r = r_{\mathrm{Bohr}} \tag{88}$$

Part IX
COSMOLOGICAL APPLICATIONS

33 The Hydrogen Correspondence

33.1 The Connection Between the Microcosm and the Macrocosm

Hydrogen is by far the most common form of matter in the universe. Hydrogen accounts for about 90% of interstellar matter. The omnipresent hydrogen in the universe is the „source" of the 3K background radiation.

> „What could be more obvious than to use the unique properties of the hydrogen atom as a basis for the connection between Planck quantities and universe quantities?"

The ratio of the proton mass to the electron mass m_p/m_e is a system-independent, unique formation parameter. Adding the Planck length and the universe radius makes neither phenomenological nor mathematical „descriptive" sense. So the next simplest mathematical operation is multiplication ($r_G \cdot r_{\mathrm{Uni}}$).

The „length"-characteristic quantities are, based on the hydrogen atom, the Bohr radius r_{Bohr} and the radius r_{Ry} inherent in the Rydberg energy. The relationship includes the fine-structure constant:

$$\frac{r_{\mathrm{Ry}}}{2} = r_{\mathrm{Bohr}} \cdot \frac{4}{\alpha} \tag{89}$$

Dimensionally, the Bohr radius, or equivalently $r_{\mathrm{Ry}}/2$, appears in the smallest power as the 2nd power, so that this corresponds to $r_G \cdot r_{\mathrm{Uni}}$. The ratio m_p/m_e describes an H-atom and is thus coupled to the Bohr radius in the 1st power. Therefore, the simplest possible mathematical construction yields:

$$\boxed{\left(\frac{r_{\mathrm{Ry}}}{2}\right)^2 \cdot \left(\frac{m_p}{m_e}\right)^2 = r_G \cdot r_{\mathrm{Uni}}} \tag{U1}$$

Or equivalently:

$$\boxed{\left(r_{\mathrm{Bohr}} \cdot \frac{4}{\alpha} \cdot \frac{m_p}{m_e}\right)^2 = r_G \cdot r_{\mathrm{Uni}}} \tag{U3}$$

With:

- $r_G = 2 \cdot r_{\mathrm{Planck}}$ (elementary quantum radius)
- r_{Bohr} = Bohr radius
- α = fine-structure constant (derived in Part IV)
- m_p/m_e = mass ratio

The basic ideas that lead to these equations are intuitively logical. Each subsequent thought is „compelling" – with the strict requirement of being both phenomenologically oriented towards real objects and mathematically minimalist.

33.2 The Temperature of the Background Radiation

The thermal de Broglie matter wave λ_{th} offers a simple means of estimating the quantum nature of a system. Quantum effects start to play a role when the thermal de Broglie wavelength becomes comparable with other characteristic „lengths of the system".

Within the framework of the elementary body theory, the radius $r_{\text{Ry}}/2$ of the thermal de Broglie matter wave λ_{th} of the electron represents the Rydberg energy E_{Ry}.

The thermal de Broglie wavelength of the electron is:

$$\lambda_{\text{th}} = \frac{h}{\sqrt{2\pi m_e k_B T}} \tag{90}$$

With the relation from the correspondence equation:

$$\lambda_{\text{th}} = \frac{\pi}{2} \cdot \frac{r_{\text{Ry}}}{2} \tag{91}$$

Substituting and solving for T:

$$\frac{h}{\sqrt{2\pi m_e k_B T}} = \frac{\pi}{4} \cdot r_{\text{Ry}} \tag{92}$$

$$\frac{h^2}{2\pi m_e k_B T} = \frac{\pi^2}{16} \cdot r_{\text{Ry}}^2 \tag{93}$$

With $r_{\text{Ry}} = \frac{2h}{\pi c m_{\text{Ry}}}$ and $E_{\text{Ry}} = m_{\text{Ry}} c^2$ follows:

$$\boxed{T = \frac{2E_{\text{Ry}}^2}{\pi m_e c^2 k_B}} \tag{TCMB}$$

The calculated values:

Rydberg Energy Used	Temperature
Theoretical	2.676262 K
Semi-experimental	2.673407 K
EBT (exact)	2.673421 K

Table 4: Calculated CMB Temperature

Comparison with the measured CMB temperature $T_{\text{CMB}} = 2.72548\,\text{K}$:
Deviation: ca. 1.9% – **without free parameters**.

33.3 Historical Note and Foreground Problem

Although the CMB radiation was predicted by the Big Bang theory, little is known that the first predictions were at 50 K and the theory was only „adapted" after the measurement results became known in 1965. Other scientists who attempted to apply the theory of black-body radiation to space as an alternative to the Big Bang hypothesis calculated values between 0.75 K (Nernst 1938) and 6 K (Guillaume 1896).

> „This means that the proton-electron interaction spans a space that acts as a black radiator at a temperature of 2.673421 K. Due to the abundance and omnipresence of cosmic hydrogen, the universe „radiates" with this temperature. This 3K background radiation is thus „timeless" and has definitely nothing to do with an expanding space-time construct."

33.4 The Foreground Problem

In all measurements of the redshift and the associated 3K background radiation, it should be clear that the inhomogeneous foreground must be „removed" in a simulation model (computer program) in order to find the 3K temperature spectrum as such. The foreground signals are x times larger than the „event" of the background radiation to be measured. x is difficult to determine. Moreover, all cosmic objects also radiate in the infrared range, and the intensities of the radiation sources are estimated.

The EBT deviation of about (−)1.9% from the „best-fit" result of the standard model of cosmology (ΛCDM model) with the value $T_{\text{CMB}} = 2.7255$ K results, among other things, from the false assumption of the standard model that the universe is an ideal black body. This is only true for the latter, for which Planck's radiation law and Kirchhoff's law apply. The universe, however, is anything but a perfect cavity radiator. And in the calculation basis $[\lambda T]$, only hydrogen is used as a „temperature radiator". Simply put, this means that here, too, the conceptual model of mass-radius coupling provides a formally sensationally simple and remarkably realistic value prediction.

34 Cosmic Expansion and the Current State of the Universe

34.1 Elementary Body Development Equations for the Cosmic Expansion

Analogous to elementary body development, the cosmic expansion is described by:

$$r(t) = r_{\text{Uni}} \cdot \sin\left(\frac{ct}{r_{\text{Uni}}}\right) \tag{94}$$

The maximum age of the universe (until reaching r_{max}) is:

$$t_{\text{max}} = \frac{\pi}{2} \cdot \frac{r_{\text{max}}}{c} \tag{95}$$

The expansion velocity as a function of time:

$$v_{\text{exp}} = c \cdot \cos\left(\frac{\pi}{2} \cdot \frac{t}{t_{\text{max}}}\right) \tag{vexp}$$

From the condition $E_R = 0$ for the universe and the correspondence equation, we obtain:

$$r_{\text{Uni(max)}} \approx 8.78478 \cdot 10^{25}\,\text{m} \tag{96}$$

$$m_{\text{Uni(max)}} \approx 1.18295 \cdot 10^{53}\,\text{kg} \tag{97}$$

34.2 The Age of the Universe in the ΛCDM Model

It may seem contradictory at first glance to „calculate" with the age of the universe propagated by the ΛCDM model. However, to demonstrate how simple EBT-based equations are and what quantitative power they contain, a comparison with the universe age value from the ΛCDM model is worthwhile. Furthermore, a spectral age estimate of the universe using the half-life of uranium-238 (half-life ≈ 4.47 billion years) on the example of the star CS 31082-001 roughly yields the age of the universe.

According to estimates of the ΛCDM model, the current age of the universe is:

$$t_{\Lambda\text{CDM}} \approx 4.35133728 \cdot 10^{17}\,\text{s} \tag{98}$$

$$\approx 13.798\,\text{billion years} \tag{99}$$

From this, we calculate with the equations of the elementary body theory:

$$v_{\text{exp}} = 0.0857886319294\,c \tag{100}$$

$$m_{\text{exp}} = 1.1787106125 \cdot 10^{53}\,\text{kg} \tag{101}$$

$$r_{\text{exp}} = 8.752690633 \cdot 10^{25}\,\text{m} \tag{102}$$

34.3 The Connection to the Fine-Structure Constant

Remarkable is the current magnitude of the radial expansion velocity in relation to the estimated age of the universe. This velocity is:

$$v_{\text{exp}} \approx c \cdot \sqrt{\alpha} \tag{103}$$

where $\sqrt{\alpha} = 0.085424543134863$. The ratio is:

$$\frac{v_{\text{exp}}}{c \cdot \sqrt{\alpha}} \approx 0.995756 \tag{104}$$

This means that a – for cosmic estimates – slight correction of about 0.4% in the age estimate of the universe reveals a fundamental connection between Sommerfeld's fine-structure constant α and the current expansion velocity of the universe relative to the speed of light. This directly connects the microscopic fine-structure constant with macroscopic cosmology.

If one corrects the calculation of the expansion velocity with respect to $\sqrt{\alpha}$, one obtains:

$$t_{\text{exp}} = \arccos\big(\sqrt{\alpha}\big) \cdot \frac{r_{\text{uni}}}{c} = 4.352408132 \cdot 10^{17}\,\text{s} \approx 13.801396\,\text{billion years} \tag{105}$$

for the current age of the universe and thus:

$$m_{\text{exp}} = 1.17900069 \cdot 10^{53}\,\text{kg} \tag{106}$$

$$r_{\text{exp}} = 8.75484465 \cdot 10^{25}\,\text{m} \tag{107}$$

35 Vacuum Energy and the 10^{120} Discrepancy

35.1 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 the Planck quantum of action:

$$\rho_{Va} = \frac{m_{Pl} \cdot c^3}{h^3} \cdot c^2 \quad [\text{J/m}^3] \tag{QFTVE}$$

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.

35.2 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 spherical volume $V_{G,\text{sphere}} = \frac{4}{3}\pi r_G^3$:

$$\rho_{Va} = \frac{2}{3 \cdot \pi^2} \cdot \frac{m_G}{V_{G,\text{sphere}}} \tag{QFTVE3}$$

35.3 The Elementary-Body-Based Energy Density of the Universe

The mass density of the universe according to the EBT estimate is:

$$\rho_{UniEk} = \frac{m(t)}{V(t)_{\text{universe}}} \tag{109}$$

With the relationships:

$$r_0 = \frac{2 \cdot c \cdot t}{\pi} \tag{rt}$$

$$m(t) = \frac{2 \cdot c^3 \cdot t}{\pi \cdot \gamma_G} \tag{MUNI}$$

$$V(t)_{\text{universe}} = \frac{4}{3}\pi r_0^3 \tag{110}$$

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:

$$\frac{\rho_{Va}}{\rho_{UniEk}} = \frac{3 \cdot \pi^2}{2} \cdot \frac{r_{\text{Uni}} m_{\text{Uni}}}{F_{EK}} \approx 6.600812 \cdot 10^{120} \tag{UNIVE}$$

This ratio corresponds exactly to the famous 10^{120} discrepancy between QFT predictions and the observed vacuum energy density.

Remark 35.1. *The enormous vacuum energy density predicted by quantum field theory, which is not present in our universe, is undoubtedly numerically the largest known refutation of the QFT-based calculation construct. Based on observations, the vacuum energy density is estimated to be on the order of* 10^{-9} J/m^3*; this value is about* $10^{120} - 10^{121}$ *times lower than in the theoretical calculations of the standard model.*

35.4 Interpretation in the EBT

Evidently, 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 mainstream physics, it is not understood that an expansion 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 the EBT and its connection to macroscopic many-particle structures.

Part X

MAGNETIC MOMENTS

36 The Experimental Starting Data

Electron:

$$\mu_{Be}^{(\text{th})} = 9.27400999205404 \cdot 10^{-24}\,\text{J/T} \quad \text{(semi-classical value)}$$

$$\mu_{Be}^{(\text{exp})} = 9.284764620 \cdot 10^{-24}\,\text{J/T} \quad \text{(experimental value)}$$

$$f_e = 0.00115965218091 \quad \text{(anomalous fraction)}$$

$$g_e = 2.00231930436182 \quad \text{[CODATA2014]}$$

Proton:

$$\mu_{Bp}^{(\mathrm{th})} = 5.0507836982111 \cdot 10^{-27}\,\mathrm{J/T} \quad \text{(semi-classical value)}$$
$$\mu_{Bp}^{(\mathrm{exp})} = 1.4106067873 \cdot 10^{-26}\,\mathrm{J/T} \quad \text{(experimental value)}$$
$$f_p = 1.7928473512 \quad \text{(anomalous fraction)}$$
$$g_p = 5.585694702 \quad \text{[CODATA2014]}$$

Neutron:

$$\mu_{Bn}^{(\mathrm{exp})} = 9.6623650 \cdot 10^{-27}\,\mathrm{J/T}$$
$$\mu_{Bn}^{(\mathrm{th})} = 0 \quad \text{(since uncharged)}$$

Ratios:

$$\frac{m_p}{m_e} = 1836.15267376007 = \frac{\mu_{Be}^{(\mathrm{th})}}{\mu_{Bp}^{(\mathrm{th})}}$$
$$\frac{\mu_{Be}^{(\mathrm{exp})}}{\mu_{Bp}^{(\mathrm{exp})}} = 658.21068660613$$
$$\frac{\Delta\mu_{Be}}{\Delta\mu_{Bp}} = 1.18766299383179$$
$$\frac{f_p}{f_e} = 1546.021626754602$$

37 The Central Observation

The difference values from the semi-classical expectations:

$$\Delta\mu_{Be} = \mu_{Be}^{(\mathrm{exp})} - \mu_{Be}^{(\mathrm{th})} = 1.075462794596 \cdot 10^{-26}\,\mathrm{J/T} \tag{111}$$
$$\Delta\mu_{Bp} = \mu_{Bp}^{(\mathrm{exp})} - \mu_{Bp}^{(\mathrm{th})} = 9.055284174789 \cdot 10^{-27}\,\mathrm{J/T} \tag{112}$$
$$\Delta\mu_{Bn} = \mu_{Bn}^{(\mathrm{exp})} - 0 = 9.6623650 \cdot 10^{-27}\,\mathrm{J/T} \tag{113}$$

These three values are of the same order of magnitude – although the total moments differ strongly!

$$\frac{\Delta\mu_{Be}}{\Delta\mu_{Bp}} \approx 1.18766, \quad \frac{\Delta\mu_{Be}}{\Delta\mu_{Bn}} \approx 1.11296 \tag{114}$$

Remark 37.1. *In other words: If one embodies the magnetic field in an energetic analogy, then the experimentally measured magnetic moments of the 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.*

38 The Magnetic Moment of the Neutron

The neutron is electrically neutral and, according to the EBT, has no intrinsic magnetic moment. The measured value must therefore originate entirely from the magnetic field of the measuring apparatus.

$$\mu_{Bn}^{(\mathrm{exp})} = \Delta\mu_{Bn} = 9.6623650 \cdot 10^{-27}\,\mathrm{J/T} \tag{115}$$

If this assumption is correct, the magnetic moment of the neutron must be calculable from the measurement-inherent magnetic field contributions of the electron and proton.

First approximation:

$$(\Delta\mu'_{Bn})^2 = \frac{\Delta\mu_{Be} \cdot \Delta\mu_{Bp}}{1 + \frac{e}{q_0}} = \frac{\Delta\mu_{Be} \cdot \Delta\mu_{Bp}}{1 + \frac{\sqrt{\alpha}}{2}} \quad [\mu_n] \tag{116}$$

With $\frac{e}{q_0} = \frac{\sqrt{\alpha}}{2}$, derived from the relationship of the fine-structure constant, it follows:

$$\Delta\mu'_{Bn} = \sqrt{\frac{(1.075462794596 \cdot 10^{-26}) \cdot (9.055284174789 \cdot 10^{-27})}{1 + \frac{0.085424543134863}{2}}} \tag{117}$$

$$= \sqrt{\frac{9.737 \cdot 10^{-53}}{1.042712271567432}} = \sqrt{9.339 \cdot 10^{-53}} = 9.66421304 \cdot 10^{-27}\ \mathrm{J/T} \tag{118}$$

Comparison with experiment:

$$\frac{\mu_{Bn}^{(\mathrm{exp})}}{\Delta\mu'_{Bn}} = \frac{9.6623650 \cdot 10^{-27}}{9.66421304 \cdot 10^{-27}} = 0.999808775 \tag{119}$$

Refined calculation:
The charge radius of the matter-forming $e - q_0$ interaction is:

$$r(e - q_0) = \frac{r_0}{2 \cdot \sqrt{\alpha}} \quad \text{with} \quad r_0 = r_e + r_p \tag{120}$$

The effective mass of this interaction:

$$m(r(e - q_0)) = \frac{m_e \cdot 2 \cdot \sqrt{\alpha}}{1 + \frac{m_e}{m_p}} \tag{121}$$

Since neutron formation occurs without „loss" of binding energy, the following applies to the mass coefficient:

$$k_n = \frac{m(r(e - q_0))}{m_n} = \frac{m_e \cdot 4 \cdot \sqrt{\alpha}}{m_n \cdot \left(1 + \frac{m_e}{m_p}\right)} \quad [\mathrm{mmn}] \tag{122}$$

This yields the refined magnetic moment:

$$\Delta\mu''_{Bn} = \frac{\Delta\mu'_{Bn}}{1 + k_n} = \sqrt{\frac{\Delta\mu_{Be} \cdot \Delta\mu_{Bp}}{1 + \frac{\sqrt{\alpha}}{2}}} \cdot \frac{1}{1 + k_n} \tag{123}$$

$$= 9.662418366 \cdot 10^{-27}\ \mathrm{J/T} \tag{124}$$

Comparison with experiment:

$$\frac{\mu_{Bn}^{(\mathrm{exp})}}{\Delta\mu''_{Bn}} = \frac{9.6623650 \cdot 10^{-27}}{9.662418366 \cdot 10^{-27}} = 0.999994477 \tag{125}$$

Remark 38.1. *The agreement, with a deviation of only* $5.5 \cdot 10^{-4}\%$*, lies within the experimental standard uncertainty (*$\pm 0.0000023 \cdot 10^{-27}$ *J/T). Neither QCD nor any alternative theory comes close to this precision in calculating the magnetic moment of the neutron. The appearance of* $\sqrt{\alpha}$ *in these equations directly connects the fine-structure constant with magnetic phenomena.*

38.1 The Magnetic Moment of the Proton

The hypothesis of measurement-inherent magnetic field contributions demonstrated for the electron and the neutron also fully proves itself in the calculation of the magnetic moment of the proton. The experimental finding is clear: The difference between the measured and the semi-classically expected magnetic moment of the proton is

$$\Delta\mu_{Bp} = \mu_{Bp}^{(\mathrm{exp})} - \mu_{Bp}^{(\mathrm{th})} = 9.055284174789 \cdot 10^{-27}\ \mathrm{J/T}$$

and thus lies in the same order of magnitude of about 10^{-26} J/T as the corresponding difference values for the electron and neutron. This is a further, strong indication of a common, external origin of these contributions.

In the EBT, the necessity for a hypothetical quark-gluon substructure is completely eliminated. Instead, a direct, quantitative relationship between the experimentally determined magnetic moments of the electron and the proton is established, which reveals the measurement-inherent character of these quantities. The numerically analytically derived relationship is:

$$\mu_p^{(\exp)} = \left(\frac{\alpha}{2\pi \cdot f_e} - 1 \right) \cdot \mu_e^{(\exp)} \cdot k_p$$

with the phenomenologically based coupling term

$$k_p = \frac{1 + \frac{\alpha}{3}}{1 + \left(\frac{\alpha}{8}\right)^2}.$$

Here $f_e = 0.00115965218091$ is the experimentally determined anomalous fraction of the electron and α is the fine-structure constant. The term $(1 + \alpha/3)$ is the only analytical expression that „comes into play newly" within the framework of the magnetic field embodiment and has a clear phenomenological interpretation: It takes account of 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.

For the g-factor of the proton, this yields:

$$g_p = \left[\left(\frac{\alpha}{2\pi \cdot f_e} - 1 \right) \cdot \frac{m_p}{m_e} \cdot (1 + f_e) \cdot \frac{1 + \frac{\alpha}{3}}{1 + \left(\frac{\alpha}{8}\right)^2} \right] \cdot 2.$$

With the CODATA2014 values $f_e = 0.00115965218091$, $m_p/m_e = 1836.15267376006$ and $\alpha = 0.0072973525664$, the EBT calculates:

$$g_p = 5.585694698054034.$$

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 and 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. At the same time, it demonstrates that the complex and ultimately arbitrary quark substructure of the standard model is phenomenologically unfounded and explanatorily superfluous.

39 The g-Factor of the Electron

The fine structure of the term $(\alpha/2\pi)$ leads to a fractal correction:

Step 1: Base term

$$f'_e = \left(\frac{\alpha}{2\pi}\right) \cdot \frac{(1 + (\frac{\alpha}{8})^2)}{(1 + \frac{\alpha}{3})} \approx 0.001158592479512731 \tag{126}$$

Step 2: Fine adjustment

$$f''_e = \left(\frac{\alpha}{2\pi}\right) \cdot \frac{(1 + (\frac{\alpha}{8})^2)}{(1 + \frac{\alpha}{3})} \cdot (1 + \frac{\alpha}{8}) = \left(\frac{\alpha}{2\pi}\right) \cdot \frac{(1 + \frac{\alpha}{8} + (\frac{\alpha}{8})^2 + (\frac{\alpha}{8})^3)}{(1 + \frac{\alpha}{3})} \tag{127}$$

Step 3: Hyperfine adjustment

$$f'''_e = \left(\frac{\alpha}{2\pi}\right) \cdot \frac{(1 + (\frac{\alpha}{8})^2)}{(1 + \frac{\alpha}{3})} \cdot (1 + (\frac{\alpha}{4})^2) \cdot (1 + (\frac{\alpha}{3})^3) \cdot (1 + (\frac{2\alpha}{\pi})^3) \tag{128}$$

$$= 0.00115965218091 = f_e \tag{129}$$

From this follows the g-factor:

$$g'''_e = 2.00231930436129188 \tag{130}$$

Comparison with the experimental value $g_e = 2.00231930436182 \pm 0.00000000000026$ [CODATA2014]: **Deviation $< 10^{-12}$ – within the standard deviation!**

39.1 Precision and Limits of the EBT Calculation

For orientation, one may compare the mass-space coupling-based equations with 13,000 (thirteen thousand!!!) Feynman diagrams and the resulting millions (!!!) of numerical calculations, of which analytical results exist only up to and including the 3rd order. **This means that the (only) analytical QED calculation has a relative standard deviation of 4.37e-8 instead of the stated 2.6e-13 (CODATA 2014) relative to the experimental measured value**. The »rest« is »circular-conclusion faith-work« in the form of years-long Monte Carlo integrations on computer clusters that are modified-selectively designed so that the measured value is reproduced.

The most precise equation of the EBT for the magnetic moment of the electron (equation 128) is a parody of measurement-result-oriented QED „perturbation theory" (including postulated hadronic contributions) for determining the g-factor. Relevant and phenomenologically justifiable is equation (127). Meaning: **The nature-philosophically oriented standards within the elementary body theory allow only the fine adjustment – expressed by equation (127) – 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 $\Delta\mu''_{Be}$, respectively an f''_e-value that depends only on α-terms, in very good agreement with the experimental value.

The $1+\left(\frac{\alpha}{8}\right)+\left(\frac{\alpha}{8}\right)^2+\left(\frac{\alpha}{8}\right)^3$ embody a sequence that one could think of continuing fractally, but mathematically the conceivable supplementary terms $\left(\frac{\alpha}{8}\right)^4$, $\left(\frac{\alpha}{8}\right)^5$, etc., lie outside the measurable range. For already the additive term $\left(\frac{\alpha}{8}\right)^4$ in the numerator increases f''_e by only 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. It should not be forgotten that the base term:

$$\frac{1+\left(\frac{\alpha}{8}\right)^2}{1+\left(\frac{\alpha}{3}\right)}$$

effortlessly leads to the anomalous magnetic moment of the proton (exactly calculated compared to the experimental value).

The present results within the framework of a phenomenologically founded mass-radius-coupled magnetic field embodiment followed stringently from the numerically analytical conspicuousness of the experimental measurement results and the resulting assumption of measurement-inherent magnetic field contributions. The central „Schwinger term" $=\frac{\alpha}{2\pi}$ is derived from the embodiment of the magnetic field, taking into account the energetic relationships of the electric energy and the elementary electric charge e compared to the total energy, expressed by the elementary body charge q_0. The ratio $\frac{e}{q_0}=\frac{\sqrt{\alpha}}{2}$ is also consistently decisive for the calculation of the magnetic moment of the neutron from the proton and electron magnetic field contributions $\Delta\mu_{Be}$ and $\Delta\mu_{Bp}$, see equations [μ_n] and [μ_{n2}].

Coincidence is phenomenologically excluded in these contexts (on the grounds of thought-model consistency), logically, and methodically. With the result: Leptonic and quark-based fantasies crumble at the numerically analytical reality. Further consequences: The neutron is electron-proton-based and, like the proton, without (quarks & Co.) substructure.

40 The Embodiment of the Magnetic Field

For the elementary electric charge e, a characteristic magnetic flux density results:

$$B_\alpha = \frac{1}{r_0^2}\cdot\sqrt{3\cdot F_{EK}\cdot c^2}\cdot\frac{\sqrt{\alpha}}{f_7}\cdot 2 \tag{131}$$

From this follows a constant action per charge:

$$B_\alpha\cdot r_0^2 = \sqrt{3\cdot F_{EK}\cdot c^2}\cdot\frac{\sqrt{\alpha}}{f_7}\cdot 2 = \text{const.} \tag{Bar1}$$

Multiplication by the charge e yields the action:

$$B_\alpha \cdot r_0^2 \cdot e = \sqrt{3 \cdot F_{EK} \cdot c^2} \cdot \frac{\sqrt{\alpha}}{f_7} \cdot \frac{\alpha}{4} \cdot \frac{\sqrt{\alpha}}{2} \tag{132}$$

$$\boxed{h(B_\alpha, r_0, e) = h \cdot \sqrt{3} \cdot \frac{\alpha}{2\pi}} \tag{hBare}$$

Comparison with the action for the elementary body charge q_0:

$$h(B_0, r_0, q_0) = \sqrt{3} \cdot c \cdot F_{EK} = h \cdot \sqrt{3} \cdot \frac{2}{\pi} \tag{hBrq0}$$

The term $\frac{\alpha}{2\pi}$ is the ratio of these two actions – reduced by $\frac{2}{\pi}$ to $\frac{\alpha}{2\pi}$.

41 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) in turn 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 one – originating from the electron – and energetically smaller than the secondary one. The same applies to the proton in the magnetic field." The terms $(1 + (\alpha/8)^2)$, $(1 + (\alpha/4)^2)$, $(1 + (\alpha/3)^3)$, etc. represent this fractal structure.

Part XI

CRITIQUE OF THE STANDARD MODEL AND SOCIOLOGY OF SCIENCE

42 Brigitte Falkenburg's Analysis

The philosopher of science Brigitte Falkenburg writes in „Particle Metaphysics: A Critical Account of Subatomic Reality" (2007):

> „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 specifically 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."
>
> „Ultimately, theory-ladenness 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 of a certain energy, i.e., due to an interaction. The higher the energy transfer during the interaction, the smaller the measured structures. Moreover, according to the laws of quantum field theory, new structures are created at very high scattering energies. Quantum chromodynamics tells us that the higher the scattering energy, the more quark-antiquark pairs and gluons are created inside the nucleon. 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 create them?"

43 The Methodical Irrationality of the Standard Model

Quarks are not particles: Postulated quarks are not particles, neither in the phenomenological nor in the quantum-theoretical sense, since they do not occur as isolatable particles or states. The physical particles, on the other hand, are thought of as bound states composed of quarks. The elementary quantities of quantum field theory correspond to no physical objects.

Neutrinos have no direct detection: There is not a single direct neutrino detection. It is always a matter of strongly theory-laden interpretations of experimental results. With the opinion now held by „mainstream" physics that neutrinos have mass, the phenomenological boundary conditions change fundamentally.

Renormalisation: The infinities of mass, charge, and energy density resulting from „point impoverishment" are made to disappear with the help of elaborate, mathematically-axiomatically „questionable" new constructions – renormalisation and regularisation – with specially constructed, compensatorily acting (negative) infinities for this problem.

CKM matrix: The CKM matrix is physically uniquely described by three real parameters and one complex phase. Five further phases that appear mathematically have „no physical significance". This simply means that one takes the mathematical elements that „fit somehow" in a result-oriented manner and simply ignores others.

Quark masses: The masses of the quarks are known only with percentage errors – in contrast to the precision calculations of the EBT.

44 The Neutrino Problem

As early as 1931, at a conference in Rome, Niels Bohr expressed the view that understanding beta decay did not require new particles, but a similarly profound upheaval of existing conceptions as in quantum mechanics. He doubted the energy conservation law without, however, developing a concrete counter-proposal.

The analysis of pion and muon decay shows:

$$m_\pi r_\pi = m_\mu r_\mu = m_e r_e = \frac{2h}{\pi c} \tag{133}$$

The apparently „missing" energy in these decays resides in the radius increase of the decay products. **Neutrinos are not needed.**

> „The neutrino hypothesis and, fatally, the weak interaction built upon it are unfounded. Thus, the associated standard model of particle physics (SM) collapses."

45 Note on the Sociology of Science

45.1 Why Has the EBT Not Prevailed So Far?

The answer lies not in physics, but in the sociology of science:

Path dependency of research: Generations of physicists were trained in the standard models. Their entire identity, career path, reputation – everything is connected to the existing paradigm. A paradigm shift would mean that a large part of what has been learned and published would become worthless.

Institutional anchoring: Research funds, institutes, chairs, scientific journals – everything depends on the existing paradigm. Those who want to research alternatives have hardly any chance of third-party funding. The reviewers are themselves socialised in the old paradigm.

Publication barriers: Radical alternatives have hardly any chance in peer-review procedures. A reviewer who has worked with quarks and gluons his whole life will not recommend a manuscript that disputes their existence for publication – regardless of its internal consistency and predictive power.

Specialisation: Nobody understands the whole any more. Physics has split into highly specialised sub-disciplines that hardly communicate with each other. Cosmologists do not understand particle physics, particle physicists do not understand cosmology. Easily understandable approaches like the elementary body theory, which unite both areas, fall through all cracks.

Part XII
OVERALL ASSESSMENT

46 Quantitative Results at a Glance

Quantity	Symbol	EBT Value	Experiment/ΛCDM
Proton radius	r_p	$8.41236 \cdot 10^{-16}$ m	$8.4087 \pm 0.0039 \cdot 10^{-16}$ m
Rydberg energy	E_{Ry}	13.59846819 eV	13.59843400 eV
Neutron mass	m_n	$1.67493844 \cdot 10^{-27}$ kg	$1.67492747 \cdot 10^{-27}$ kg
Neutron moment	μ_n	$9.662418 \cdot 10^{-27}$ J/T	$9.662365 \cdot 10^{-27}$ J/T
g-factor e	g_e	2.00231930436129	2.00231930436182
g-factor p	g_p	5.585694698	5.585694702
Fine-structure constant	α	0.0072973525664	0.0072973525664
CMB temperature	T_{CMB}	2.67342 K	2.72548 K
Charged pions	$m_{\pi^\pm}$	$2.49527 \cdot 10^{-28}$ kg	$2.48806 \cdot 10^{-28}$ kg
Universe radius (max)	$r_{\text{Uni(max)}}$	$8.785 \cdot 10^{25}$ m	$\sim 4.4 \cdot 10^{26}$ m (Hubble)
Universe mass (max)	$m_{\text{Uni(max)}}$	$1.183 \cdot 10^{53}$ kg	$\sim 10^{53}$ kg
Universe age (max)	$t_{\text{Uni(max)}}$	14.60 billion years	13.8 billion years
Vacuum energy density ratio	ρ_{Va}/ρ_{UniEk}	$6.60 \cdot 10^{120}$	QFT prediction

Table 5: Quantitative results of the EBT in comparison

47 Model Comparison

Criterion	ΛCDM	SM	EBT
Free parameters	6	25	**0**
Postulated entities	Dark matter, dark energy, inflation	Higgs, quarks, gluons, neutrinos	**None**
Basic equations	Einstein field equations	Lagrange density	**One** ($m_0 r_0 = 2h/(\pi c)$)
Explanatory power	Medium	Medium	**High**
Intuitiveness	Low	Low	**High**
Falsifiability	Low	Low	**High**
Epistemology	Unreflected	Unreflected	**Founded**

Table 6: Comparison of the EBT with the standard models

48 Strengths of the EBT

1. **Epistemological foundation:** Clear distinction between primary and secondary concepts. Reduction of all secondary quantities to the primary quantity r.
2. **Minimalism:** A single fundamental equation – zero free parameters.
3. **Mathematical elegance:** Simple sinusoidal dynamics, geometrically derivable, without spacetime metaphysics.
4. **Quantitative precision:** Agreement with measurements often at the 10^{-6} level or better.
5. **Phenomenological breadth:** The microcosm and the macrocosm are described unitarily.
6. **Explanatory power:** Solves the wave-particle duality, the renormalisation problem, the dark matter problem, and the neutrino question.
7. **Unification:** Electromagnetism, gravitation, and strong interaction from a single mould.
8. **Falsifiability:** Clear, testable predictions.

9. **Critique of the mainstream:** Well-founded epistemological critique of QM, QED, QCD, SR, GR or the standard models (SM, ΛCDM).

49 Concluding Remark

The elementary body theory is:

- **Philosophically profound** (primary vs. secondary concepts, Euclid vs. Hilbert)
- **Mathematically simple** (one equation, zero parameters)
- **Phenomenologically rich** (explains proton, electron, hydrogen, neutron, pions, magnetic moments, cosmos)
- **Quantitatively precise**
- **Unifying** (the microcosm and the macrocosm from a single mould)
- **Falsifiable** (makes concrete, testable predictions)
- **Critical** (exposes the methodical weaknesses of the standard models)

The precision of the Rydberg energy calculation (deviation $2.5 \cdot 10^{-6}$), the derivation of the fine-structure constant, the neutron moment (deviation $5.5 \cdot 10^{-6}$), the electron g-factor (deviation $< 10^{-12}$), the neutron mass (deviation $6.5 \cdot 10^{-6}$), the proton radius, and other quantities are strong indications that the EBT describes physical nature very well.

The derivation of $E = m_0 c^2$ from the sinusoidal dynamics, the reduction of electric charge to mass-radius relations, the derivation of the fine-structure constant from the ratio of the charges, the explanation of the „anomalous" magnetic moments as measurement-inherent magnetic field contributions, the refutation of the neutrino hypothesis through the mass-radius transformation in pion and muon decay, and the correspondence between hydrogen parameters and cosmology are original and consistent achievements.

49.1 Concluding Epistemological Remark

The zero point, „zero", does not stand for „nothing", but represents the maximal state of motion – the (timeless) speed of light. This is the profound epistemological insight of the elementary body theory: **Information and material state are two sides of the same coin, connected by the fundamental mass-radius coupling.**

The question is not „Is the EBT true?" – we have no generally accepted theory of truth. The correspondence between statements and reality cannot be objectively determined. Within the framework of the elementary body theory, infinitesimal calculus is the only „higher" mathematics that necessarily comes into play, and the conceptual model of elementary bodies and their phenomenologically based interactions works astonishingly well with only one parameter, which is also experienceable through the senses. The principle of parsimony (Occam's razor) favours the EBT; the SM (25 free parameters) and ΛCDM models (at least 6 free parameters) are history, which should never have begun.

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[12] Further information on understanding the thought model

The present considerations on mass-space coupling, respectively on the elementary body theory, are incomplete. This was done deliberately, because otherwise, in the initial examination of mass-space coupling, the focus and attention of readers could be lost due to the abundance of overall information. Yet nothing remains unexplained or vague. All (still) necessary descriptions and derivations of the elementary body theory, as well as the effects on the history of science in an interdisciplinary overall picture, will follow in further publications. It will be clarified, among other things, why the publication years of the elementary body theory are given as 1986, 2012, and 2026. Furthermore, historical aspects as well as fact-oriented analyses of the existing thought models in the context of their genesis will be examined in detail. The criticism of the standard models presented here is to be regarded as far-reaching and fundamental. See: https://www.dualismus.net/elementarybodytheory/website/