Calculation of the rest masses of elementary particles using polynomials with the base π

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ABSTRACT

By restricting k to rational numbers, the Schrödinger wave equation $\Psi = Ae^{-i/\hbar(Et+pr)} = Ae^{-i\pi k}$ can be converted into a polynomial with the base π. Ultimately, this leads to the action S for each object:

$$S_{Object} = (2\pi)^4 E_t + (2\pi)^3 E_r i^t + (2\pi)^2 E_\varphi i^{t-1} + (2\pi) E_\theta i^{t-2} \; t \in \mathbb{Z} \; (2)$$

If 2 objects and an observer have a common center of gravity, the energies can be related and calculated using a single polynomial. The integer quantum numbers E_t, E_r, E_φ and E_θ ensure cohesion and lead to the four fundamental natural forces. Our worldview, with 3 isotropic dimensions x, y and z and rotations with 2π, must be distinguished from this. The polynomials are transformed by simple operators (addition) for parity, time and charge. The 3 spatial

dimensions result from regularly recurring parity operators. Numerous calculations are given for the orbits in the solar system and for the masses of the elementary particles, e.g.:

$m_{neutron}/m_e = (2\pi)^4 + (2\pi)^3 + (2\pi)^2 - (2\pi)^1 - (2\pi)^0 - (2\pi)^{-1} + 2(2\pi)^{-2} + 2(2\pi)^{-4} - 2(2\pi)^{-6} + 6(2\pi)^{-8} = 1838.6836611$

The charge operator for all particles is:

$\widehat{C} = -\pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9} - \pi^{-12}$

Together with the neutron mass, the result for the proton is:

$m_{proton} = m_{neutron} + \widehat{C}m_e = 1836.15267363\ m_e$

The probabilities for the correct representation of the neutron and proton mass have been calculated and are greater than 0.99997. The muon and tauon masses can be calculated in the same way. For an observer and two objects, from the torque and angular momentum alone, a common constant of h, G, and c can be derived, giving a ratio of meters and seconds:

$$hGc^5s^8/m^{10}\sqrt{\pi^4 - \pi^2 - 1/\pi - 1/\pi^3} = 1.00000$$

Fine structure constant:

$$1/\alpha = \pi^4 + \pi^3 + \pi^2 - 1 - \pi^{-1} + \pi^{-2} - \pi^{-3} + \pi^{-7} - \pi^{-9} - 2\pi^{-10} - 2\pi^{-11} - 2\pi^{-12} = 137.035999107$$

The Sonnensystem can be calculated in the same way. For example for Mercury with relative error = 1.002.

$$r_{Periapsis} = 696342km\sqrt{32\pi^5 - 0 * 16\pi^4 + 8\pi^3 + 4\pi^2 + 0 * \pi + 1} = 69916199$$

$$r_{Apoapsis} = 696342\sqrt{16\pi^5 - 8\pi^4 + 8\pi^3 + 2pi^2 - 1\pi + 1} = 46114001km$$

Keywords

Proton mass, neutron mass, muon, tauon, fine-structure constant, quantum mechanics, unified of quantum mechanics and general relativity, planetary system

INTRODUCTION

In 1958 von C. F. von Weizsäcker presented his quantum theory of the original alternatives. [1] It was an attempt to derive quantum theory as a fundamental theory of nature from epistemological postulates. Since then, numerous experiments on Bell nonlocality [2] have shown the violation of the inequality for entangled particle pairs, thereby confirming the predictions of quantum mechanics [3, 4, 5, 6]. The causal fermion systems introduced by Felix Finster [7, 8, 9, 10, 11] overcame the limitations of physical objects of space and time in favor of the underlying elementary particles. However, the unification of the 4 natural forces was not yet achieved. Robert B. Laughlin disputes the fundamental possibility that a theory could explain complex issues such as emergence and self-organization.[12,13]. This article shows for the first time how the rest masses of the elementary particles, the natural constants c, h, G and α and the expansion of the planetary system can be derived solely from ratios.

1.1 Solution of the Schrödinger equation as polynomial

For the Schrödinger wave equation $\Psi = Ae^{-i/\hbar(Et+mrdr/dt)} = Ae^{-i(wt+r/\lambda)} = Ae^{-i\pi k}$ the number space of the exponent k is not clearly defined. If one assumes the rational numbers $k \in \mathbb{Q}$ for the exponent and follows this approach, the energy results as a polynomial with the base 2π and the integer parameters time, radius, φ and θ and requires no additional normalization.

$$E_{Object} = (2\pi)^3 E_r i^t + (2\pi)^2 E_\varphi i^{t-1} + (2\pi) E_\theta i^{t-2} \quad E_r, E_\varphi, E_\theta \in \mathbb{Z} \ (1)$$

Radius, φ and θ are of the same kind. I.e. the radius itself can be an arc of a circle. For the 4-dimensional time, the action S results for the duration of one revolution:

$$S_{Object} = (2\pi)^4 E_t + (2\pi)^3 E_r i^t + (2\pi)^2 E_\varphi i^{t-1} + (2\pi) E_\theta i^{t-2} \ t \in \mathbb{Z} \ (2)$$

The first consequence is that there must be a single type of particle that makes up all elementary particles and can be assumed to be the electron. Our idea of a 3-dimensional space complements the natural numbers to real and transcendental numbers.

1.2. Photon

The photon corresponds to two directly neighboring particles, i.e. electron and positron. It's unobservable. The energy of the photon contains φ for the frequency and θ for the polarization as parameters. In general, bosons are objects with even particle numbers and fermions with odd particle numbers.

$$spin1 = spin\tfrac{1}{2} + spin\tfrac{1}{2} \qquad E_{ges} = E_{electron} + E_{positron}$$
$$N_e = 1 \ \ E_e > 0 \ \ E_{e,r} = 1 \qquad N_{e^+} = 1 \ \ E_{e^+} < 0 \ \ E_{e^+,r} = -1$$
$$E_e = 1 + (2\pi)^{-1} E_{e,\varphi} - (2\pi)^{-2} E_{e,\theta} \qquad E_p = -1 + (2\pi)^{-1} E_{e^+,\varphi} - (2\pi)^{-2} E_{e^+,\theta}$$

$$N_{photon} = N_\gamma = 2$$
$$E_\gamma = (2\pi)^{-1}E_\varphi - (2\pi)^{-2}E_\theta \qquad (3)$$
$$N_{boson} = 2k \qquad N_{fermion} = 2k+1 \qquad k \in \mathbb{Z}$$

The interaction between 2 entangled and thus immediately adjacent photons results solely from angular momentum. This applies to all entangled objects. Bosons are made up of an even number of particles and fermions are made up of an odd number.

1.3. Matter - Observation - Antimatter

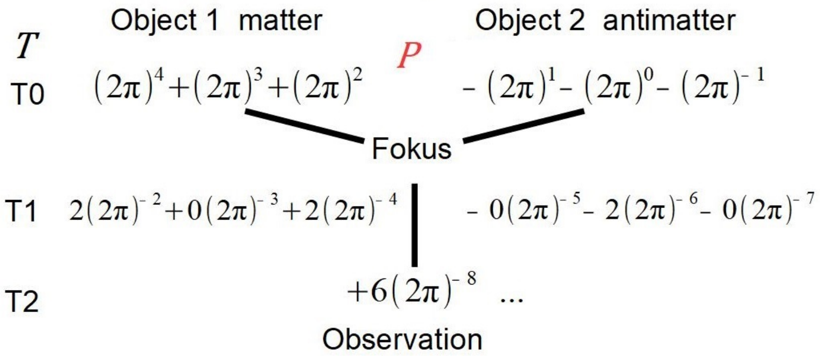
The observation is the third object in a system and is the geometric mean of the two three-polynomials of object 1 and object 2. Quantum mechanically this corresponds to a triple cross product calculation, together with the corresponding ladder operators. The tensor product of time and this three-fold polynomial gives the action, with the lowest possible energy content for the entire system.

$$E_{Object,1} = (2\pi)^4 E_{r,1} + (2\pi)^3 E_{\varphi,1} + (2\pi)^2 E_{\theta,1} \qquad E_{r,1}, E_{\varphi,1}, E_{\theta,1} \in N \quad (4)$$
$$E_{Object,2} = (2\pi)^1 E_{r,2} + (2\pi)^0 E_{\varphi,2} + (2\pi)^{-1} E_{\theta,2} \qquad E_{r,2}, E_{\varphi,2}, E_{\theta,2} \in Z \quad (5)$$
$$E_{Object,3,r,\varphi,\theta} = E_{r,3} + E_{\varphi,3} + E_{\theta,3} > 0 \qquad \text{minimal energie (Euler-Lagrange)}$$
$$E_{r,3} = (E_{\varphi,1}E_{\theta,2} - E_{\varphi,2}E_{\theta,1})(2\pi)^{-2} \qquad \text{cross product}$$
$$E_{\varphi,3} = (E_{r,1}E_{\theta,2} - E_{\varphi,2}E_{\theta,1})(2\pi)^{-4} \qquad \text{commutator}$$
$$E_{\theta,3} = -(E_{\varphi,1}E_{r,2} - E_{\varphi,2}E_{r,1})(2\pi)^{-6} \qquad \text{ladder operator}$$

$$S_{t,r,\varphi,\theta} = E_{r,3}E_t(2\pi)^{-6} + E_{\varphi,3}E_t(2\pi)^{-4} + E_{\theta,3}E_t(2\pi)^{-2} \qquad \text{tensor produkt} \quad (6)$$
$$S_{observation} = \sqrt{E_{object}E_{antiobject}} / \pi \qquad \text{normalization} \quad (7)$$

1.4. Neutron

The neutron's mass is the easiest to calculate because it is uncharged. The terms of matter and antimatter are separated by parity operators. How the series is put together can be illustrated using a hall of mirrors. All objects are made of the same particles. As an observer, we see an object through 3 dimensions in three ways. Depending on the viewing angle, the focus is different. The further away the viewer is from the object, the lower the resolution. A mapping from focus can be understood as a time operator T. The intensity is the same for the image planes T0, T1 and T2, up to the constant factors $(2\pi)^{-2}$,$(2\pi)^{-4}$, $(2\pi)^{-6}$ and $(2\pi)^{-8}$ and corresponds to a Fourier transform.

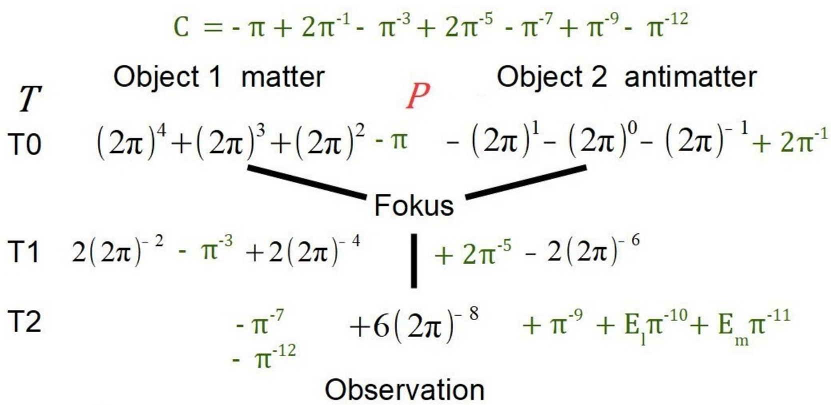


$$m_{neutron}/m_e = (2\pi)^4 + (2\pi)^3 + (2\pi)^2 - (2\pi)^1 - (2\pi)^0 - (2\pi)^{-1} + 2(2\pi)^{-2} + 2(2\pi)^{-4} - 2(2\pi)^{-6} + 6(2\pi)^{-8} = 1838.6836611 \qquad (8)$$

theory : $1838.6836611 m_e$ *measured* : $1838.68366173(89) m_e$ [14]

1.5. Proton

For the mass difference between proton and neutron, terms with the base plus and minus π are to be assumed and result in an alternating series. The third charges of the quarks result from the ratios of π and 2π, each with plus or minus. And since the quarks only exist in the hall of mirrors, they do not exist as free particles either. The negative terms of C are on the left for matter, the positive ones on the right for antimatter. In the case of the neutron, there are several factors with 0 at T1 and T2. The loading operator fills up exactly these places with powers of π. The 2 terms π^{-10} and π^{-11} are placeholders for valence electrons. The calculated proton mass corresponds exactly to the measured value.



$$m_{proton}/m_e = (2\pi)^4+(2\pi)^3+(2\pi)^2-(2\pi)^1-(2\pi)^0-(2\pi)^{-1}+2(2\pi)^{-2}+2(2\pi)^{-4}-2(2\pi)^{-6}+6(2\pi)^{-8}+(-\pi+2\pi^{-1}-\pi^{-3}+2\pi^{-5}-\pi^{-7}+\pi^{-9}-\pi^{-12}) = 1836.15267363 \tag{9}$$

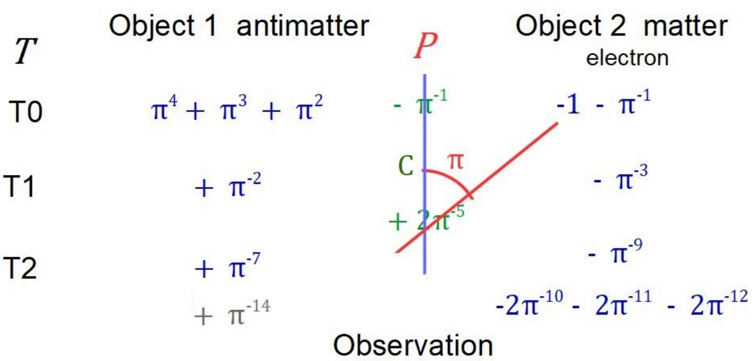
$theory : 1836.15267363 m_e$ $\qquad$ $measured : 1836.15267343(11) m_e$ [14]

1.6. **Estimate that the polynomials of neutron and proton mass are not accidentally correct.**

In the neutron mass polynomial $(2\pi)^4 + (2\pi)^3 + (2\pi)^2 - (2\pi)^1 - (2\pi)^0 - (2\pi)^{-1} + 2(2\pi)^{-2} + 2(2pi)^{-4} - 2(2\pi)^{-6} + 6(2\pi)^{-8}$ is the smallest ratio between consecutive terms π. With 10 terms, the representation of 1838.683661 can be reduced by the factor $\pi^9 = 29809$ with the base π. That the polynomial coincidentally the neutron mass is $29809/1838683661 < 0.00002$. For the charge operator $\widehat{C} = (-\pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9} - \pi^{-12})$ is the smallest ratio only $\pi^2/2$. The ratio for this is $(\pi^2/2)^6/1838683661 < 0.00001$. This is the probability for the correct representation of the neutron, like the proton, greater than 0.99997.

1.7. Electron

The electron is described by the polynomial of α. The electron is now on the right as matter. 1 is the unit of an electron and $-1/\pi$ its spin. Striking is the symmetry with the symmetry axis between matter and antimatter and between the three-polynomials top left and bottom right. $\pi^4 + \pi^3 + \pi^2$ is antimatter and is not visible to us. They are placeholders for binding to a proton and at the bottom right for the next electron. The series probably infinite. The last term π^{-14} is speculative for now. Thus α is in the measuring range.

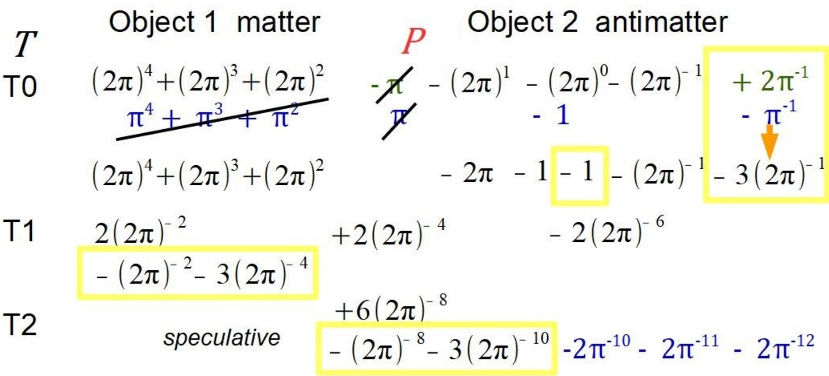


$$1/\alpha = \pi^4+\pi^3+\pi^2-1-\pi^{-1}+\pi^{-2}-\pi^{-3}+\pi^{-7}-\pi^{-9}-2\pi^{-10}-2\pi^{-11}-2\pi^{-12}-\pi^{-14} \tag{10}$$

$theory : 137.035999216 m_e$ $\qquad$ $measured : 137.035999206(11) m_e$ [14]

1.8. Hydrogen atom

In the case of the hydrogen atom, the electron binds to the proton. The three-fold polynomial of the electron vanishes. The terms at $1/\pi$ are interesting. They describe the spins. Without interaction the sum was $2/\pi$ with interaction it is $-3/(2\pi)$. With the rules described above, the mass of the hydrogen atom results in the measured value. The mass of the hydrogen atom itself is only known in 5 digits.



$$m_H/m_e = (2\pi)^4 + (2\pi)^3 + (2\pi)^2 - (2\pi)^1 - 2 - (2\pi)^{-1} - 3(2\pi)^{-1} + 2(2\pi)^{-2} + 2(2\pi)^{-4} - 2(2\pi)^{-6} + 6(2\pi)^{-8} - (2\pi)^{-2} - 3(2\pi)^{-3} - (2\pi)^{-8} - 3(2\pi)^{-9} \qquad (11)$$

$theory: 1837,179 m_e$ $\qquad$ $measured: 1837.180 m_e$ $\qquad$ $(1,00784\text{–}1,00811)u$ [14]

1.9. Atom: Rydberg energy

The Rydberg energy should be found from the geometric mean of the energy of the hydrogen atom and the energy of the observation. The square root is divided with the smallest possible denominator, i.e. $1/\pi$ and is the normalization. The relative error for this simple calculation of the Rydberg energy is about 3 parts per thousand.

$$E_H = (2\pi)^4 + (2\pi)^3 + (2\pi)^2 - (2\pi)^1 - 2 - 4(2\pi)^{-1} + E_{observation}$$

$$E_o = 2(2\pi)^-2 + 2(2\pi)^{-4} - 2(2\pi)^{-6} + 6(2\pi)^{-8} \quad \text{fraction of the neutron}$$

$$-(2\pi)^{-2} - 3(2\pi)^{-1}(2\pi)^{-4} \quad \text{fraction of the electron}$$

$$-(2\pi)^{-8} - 3(2\pi)^{-9}$$

$$R_{y,theory}/m_e = sqrt E_H E_B/\pi = 13.644 \qquad (12)$$

$theory: R_y/m_e = 13,644$ $\qquad$ $measured: Ry = 13,6057$ $\qquad$ $rel.\ error: 0,0028$

1.10. Electron orbital: Rydberg energy

Rydberg energy is already obtained with the QFT from m_{proton}/m_e together with c, h and α. The QFT already works with series representations of α. But R_y should already result directly from polynomials.

The thoughts on this are speculative for the time being:

For the exact calculation of the Rydberg energy, it is crucial to shift the focus from the center of the atom to the electron orbital and thus to the ratio of Rydberg energy R_y to electron mass m_e. For the observation of R_y/m_e the ratio of $n_{photon} = 2$ to $+6(2\pi)^{-8} - (2\pi)^{-8} - 3(2\pi)^{-10}$ decisive. For an excited but still uncharged atom, $P(2\pi)$ should be correct. The relevant terms contain three 3-polynomials starting from $(2\pi)^{-6}$ to $(2\pi)^{-18}$. The calculation scheme should be similar to that of the neutron. The first polynomial refers to the positron in the proton. The second to the interaction between positron and valence electron and the third to the valence electron alone. The relative error is: 3 10^{-10}.

$$E_{valenze} = E_{N,p} + E_{p,e} + E_{e,v}$$

$E_{N,p} = (2\pi)^{-6} - (2\pi)^{-7} - (2\pi)^{-8}$ $E_{positron}$ in the proton

$E_{p,e} = 6(2\pi)^{-10} - 3(2\pi)^{-11} + 4(2\pi)^{-12}$ Interaction of $E_{positron}$ with $E_{valenze}$

$E_e = 3(2\pi)^{-14} + 3(2\pi)^{-16} + 3(2\pi)^{-18}$ $E_{valenze}$ of the valence elektron

$$R_y = 2m_e((2\pi)^{-6} - (2\pi)^{-7} - (2\pi)^{-8} + 6(2\pi)^{-10} - 3(2\pi)^{-11} + 4(2\pi)^{-12} + 3(2\pi)^{-14} + 3(2\pi)^{-16} + 3(2\pi)^{-18}) = 13.6056931271 \quad (13)$$

$R_y : 13.605693127m_e$ $measured : 13.605693122994(24)m_e$ [14]

1.11. Muon - Fermi's golden rool

The muon consists of two three-polynomials. As a charged particle, it contains the charge operator C.

$$E_{\mu,1} = (2\pi)^3 - (2\pi)^2 + (2\pi)^1 \qquad E_{\mu,2} = -(2\pi)^1 + (2\pi)^0 - (2\pi)^{-1}$$
$$C = -\pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9} - \pi^{-12}$$

$$\begin{aligned} m_\mu/m_e &= (2\pi)^3 - (2\pi)^2 + (2\pi)^1 - (2\pi)^1 + 1 - (2\pi)^{-1} \\ &-(2\pi)^{-1} + 2(2\pi)^{-2} - (2\pi)^{-3} - (2\pi)^{-4} - 2(2\pi)^{-5} + 4(2\pi)^{-8} \\ &-\pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9} - \pi^{-12} = 206.7682833 \end{aligned} \quad (14)$$

$theory : 206.7682833m_e$ $measured : 206.7682830(46)m_e$

The calculated mass corresponds to the measured value. The decay is caused by the terms $+2\pi - 2\pi = 0$. The first two terms correspond to a high-energy photon:

$$(2\pi)^3 - (2\pi)^2 = (2\pi)^4((2\pi)^{-1}E_\varphi - (2\pi)^{-2}E_\theta)/m_e = E_\gamma/m_e$$

$$E_\mu/m_e = (2\pi)^3 - (2\pi)^2 + 0 + 1 - (2\pi)^{-1} =$$
$$(2\pi)^4 E_\gamma/m_e + 1 - (2\pi)^{-1} =$$
$$E_\mu/m_e = E_\gamma/m_e + 1 - 3/2\pi^{-1} + 1/2\pi^{-1} \ (15)$$
$$\mu^- = e^- + \overline{\nu}_e + \nu_\mu$$

The mean lifetime of the muon is $2.19\ 10^{-6}s$. The term $+(2\pi)^1 - (2\pi)^1 = 0$ leads to the decay:

$\tau \approx day/\alpha^5 = 1.8\ 10^{-6}s$ (16). See Gravity (21) below.

1.12. Tauon

A tauon consists of many particles, as seen from the numerous decay channels. Finally, any polynomial with base 2π could correspond to a particle. The more complex the polynomial is, the faster the particle decays. The first particle with the factor $(2\pi)^4$ is the proton. The tauon should therefore have the factor $2(2\pi)^4$ and thus indicates a particle that is composed of at least 3 objects.

$$E_{\tau,1} = 2(2\pi)^4 + 2(2\pi)^3 - 2(2\pi)^2 \qquad E_{\tau,2} = -(2\pi)^2 - (2\pi)^1 - 1$$
$$E_{\tau,3} = -2\pi - 1 - (2\pi)^{-1}$$

Along with the charge operator, the first estimate is:

$$m_\tau = 2(2\pi)^4 + 2(2\pi)^3 - 3(2\pi)^2 - 2(2\pi)^1 - 2 - (2\pi)^{-1} + (-\pi + 2\pi^{-1} - \pi^{-3})m_e =$$
$$3477.34 m_e \ (17)$$

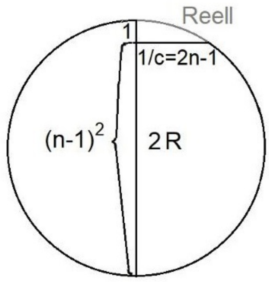
$theory : 3477.34 m_e$ $\qquad$ $measured : 3477.23 m_e$ [23]

1.13. Quarks, mesons, hadrons

According to the quark model, hadrons and mesons can be explained as the bonded state of 2 or 3 quarks and antiquarks. Quarts do not exist as free particles. The charge of the quarks is $\pm 1/3e$ or $\pm 2/3e$. The charge operator is $\widehat{C} = -\pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9}$ and can also be divided into 2×3 terms. The proton is distinguished by the parity operator, which occurs regularly. Electron and proton are the fundamental elementary particles.

2.1. n - Radius - Time - c

All interactions can be explained by the connection between the natural numbers. kg is meaningless. Everything moves. How fast the surface of a body moves relative to its radius is determined purely by the smallest possible ratio of its rational coordinates. With the fictitious details of the particle number of the radius, the rotation time is proportional to 1/c, which in turn can depend on α. With the units meter and day, the diameter of the earth follows to 63781,37 m a difference of 489 to the measured equatorial radius.



$$1/c(\alpha) \text{ is the smallest possible rational divisor.}$$

$$2\pi c(\alpha)\ meter\ \ orbital\,period = \sqrt{diameter} \qquad (18)$$

$$2\pi c\ \ meter\ \ day = (Earth's\ \ diameter)^2 \qquad (19)$$

The diameter of the earth is defined by the unknown but constant number of particles on earth. As long as there is a Michelson interferometer on the earth's surface, this device always supplies the same value for c.

2.2. Length - Time - Energy

All forces are explained by the cohesion of the natural numbers $\mathbb{N}$. The energies are the raw data from nature. Length, time and c are derived parameters. They are orthogonal to each other. A mass in kg does not define the radius of a celestial body. Rather, everything results from the geometric optics of the radii and orbits. The relationship between the equatorial and polar radius of the earth can also be derived.

$$\Delta r = 1/((2\pi)^3 + (2\pi)^2 + (2\pi)^1 + 1)$$

$$378135m(1 - \Delta r) = 6356513m \qquad \Delta r = 237m$$

The energy of every system in the universe is one-dimensional. The representation of space and time, linear or logarithmic, is arbitrary.

2.3. Gravity

A general consideration of the energies between two objects results in the smallest possible ratio of the energy of the third object in a system. If energy can no longer be released, whether by particles, electromagnetic waves or gravitational waves, a basic state has been reached in the overall system. Through interference or interaction between particles and antiparticles, the terms of the polynomial become 1, 0 or -1:

$$E_{1,t} = 1 \; E_{1,r} = 0 \; E_{1,\varphi} = -1 \; E_{1,\theta} = 0$$

$$E_{2,t} = 0 \; E_{2,r} = -1 \; E_{2,\varphi} = 0 \; E_{2,\theta} = -1$$

For each of the parameters E_t, E_r, E_φ and E_θ one of the two objects has the value 0. This results in the minimal action and corresponds to the graviton:

$$graviton = \sqrt{\pi^4 - \pi^2 - \pi^{-1} - \pi^{-3}} c^2 \qquad (20)$$

In product hG, there is no mass. For 3 dimensions, we obtain c^3. The minimum quantum energy G has unit c^2. This results in:

$$hGc^5 s^8/m^{10} \sqrt{\pi^4 - \pi^2 - \pi^{-1} - \pi^{-3}} = 0.999991 \approx hGc^3 s^8/m^{10} graviton = 1 \qquad (21)$$

The value of G is only known up to the fifth digit. In this respect, the result can be assumed to be 1. All terms of E_t, E_r, E_φ and E_θ are of the same kind and give the GR for particle numbers.

h G describes the relationship between gravity and electromagnetic force. α describes the number of revolutions in the micro world, like c in the macro world. So after (16) times are in the same ratio as α^5 to c^5. For the mean lifetime of the muon $\tau = 2.19\ 10^{-6} s$ this means a conversion to $\approx day/\alpha^5 = 1.8\ 10^{-6} s$. See muon above.

2.4. General Theory of Relativity

The starting point of the theory are the rational numbers and this already includes the theory of relativity. Einstein's general theory of relativity was not yet completely relative, because the effect of the entire system is a continuous number and is shown in the unit kg. The ratio of the radii of the celestial bodies and their orbits was still speculative with the general theory of relativity.

For the 3 spatial dimensions, $2^3 = 8$ is the natural ratio of rotations to orbital periods. The sun, earth and the bound moon have the largest possible stable ratio of the radii of these celestial bodies. This results in the ratio of the diameters of the Earth/(Earth + moon):

$$R_{moon}/(R_{earth} + R_{moon}) = 2^3/(2\pi) = 4/\pi \ (22)$$

Calculated: $R_{moon} = 6356.75\ km\ (4/\pi - 1) = 1736.9$ km related to the pole diameter. Relative Error = 1.00011.

The distances between all bodies can also be the result of the expansion of the entire universe $H0 = 2.1910^{-18}/s$.

$$d/dt\ distance(Moon) = 38.2\ mm/384400\ km/year = 3.15\ 10^{-18}/s$$
$$(1 - 1/pi) 3.15\ 10^{-18}/s \approx H0$$

This also explains why the moon fits into the sun during a solar eclipse.

2.5. Orbital periods in the planetary system

The orbital times correspond to the natural conditions. The orbital times of the planets result iteratively from the focus, from the sun and Mercury. These calculations are always polynomials without π but in the same way. The factor $\frac{1}{2}$ gives the relative speed in each case. These calculations are also usually accurate to 1 per thousand.

Orbital period of Mercury relative to the Sun's rotation of 25.38 d:

$$25.38\,d \;\; 1/2(8-1-1/2/8)\,d = 88.04\,d \qquad \textit{measured}: \; 87.969\,d$$

Orbital period of Venus:

$$1/2(8^3-8^2+0*8+1)\,d = 224.5\,d \qquad \textit{measured}: \; 224.70\,d$$

Orbital period of the earth:

$$1/2(8^3+3(8^2+8+1))\,d = 365.5\,d \qquad \textit{measured}: \; 365.25\,d$$

Orbital period of the moon:

$$1/2(8^2-8^1-1)\,d = 27.5\,d \qquad \textit{measured}: \; 27.322\,d$$

2.6. Calculations of the orbits in the solar system

The solar system is an enlarged hydrogen atom. The advantage of the solar system is that apoapsis and periapsis are directly observable, while in the atom some energy levels are degenerate. But that doesn't mean that electron orbits don't exist. Apoapsis and periapsis can be determined using the same polynomials as in atomic physics. The focus of Mercury and the Sun is not discernible. However, it results from the geometric mean of the effect of the Sun and Mercury and results in a large difference between apoapsis and periapsis on Mercury's orbit. This center is the focus of Venus and hence the nearly circular orbit of Venus. A static image is sufficient to calculate the periapsis and apoapsis. With respect to ladder operators, the objects can be constructed iteratively. The errors are in the per thousand range.

$$E_{n,n-1}=(2\pi)^5 E_{r,n}+(2\pi)^4 E_{\varphi,n}+(2\pi)^3 E_{\theta,n}+(2\pi)^2 E_{r,n-1}+2\pi E_{\varphi,n-1}+E_{\theta,n-1}$$

$$r_{Sonne}=696342\,km \qquad \text{Sun – Fokus - Merkury} \qquad r_{(Apo/Periapsis)}=r_{Sonne}\sqrt{E_1}$$

Merkury

$$r_{Periapsis}=696342\,km\sqrt{32\pi^5-0*16\pi^4+8\pi^3+4\pi^2+0*\pi+1}=69916199\,km$$

$$\textit{measure}: 69.81\;10^6\,km \qquad \textit{rel. error}=1.0015$$

$$r_{Apoapsis}=696342\,km\sqrt{32/2\pi^5-16/2\pi^4+8\pi^3+4/2\text{pi}^2-2/2\pi+1}=46114001\,km$$

$$\textit{measure}: 46.002\;10^6\,km \qquad \textit{rel. error}=1.0024$$

Venus

$$r_{Periapsis}=696342\,km\sqrt{2*32\pi^5+3*16\pi^4+8\pi^3+0*4\pi^2+0*\pi+1}=109016885\,km$$

$$\textit{measure}: 108{,}9088\;10^6\,km$$

$$r_{Apoapsis}=696342\,km\sqrt{2*32\pi^5+3*16\pi^4-2*8\pi^3+0*4\pi^2+0*\pi-2}=107342414\,km$$

$$\textit{measure}: 107{,}4128\;10^6\,km$$

$$r_{Merkur}/r_{Venus} = 2448.57/6123.80 = 2.50096$$
$$(6123.80 - 2448.57)/2448.57) = 3/2 \qquad (23)$$

This indicates that Mercury and Venus are themselves quantum numbers.

2.7. Approximately calculated for the entire solar system

The advantage of the solar system over atoms or elementary particles is that the orbits can be directly observed. Energies and radii can be approximated using quantum numbers n, l, m and s, and requires only a single line of a four-loop computer program. n and l describe the larger object, m and s the small object. The 4 large moons of Jupiter, for example, are largely determined by s, then with quarter parts.

$$E_{total} = R_{sun}^2 \pi^3/2(\text{planet} + \text{apo periapsis moon} + \text{sun})$$

$$E_{n,l,m,s} = R_{sun}^2 \pi^3/2(4\pi^2 3^n 2^l + 4\pi^2 3^m 2^{s/2} + (1 + 2\pi + 4\pi^2)) \qquad (24)$$

Inner planets

Object	Radius	rel. error	Apoapsis	rel. error	Periapsis	rel. error	quantum number	
							n l m s	n l m s
N = 1								
Merkury	2448.57	0.004	46.2	0.00	69.3	-0.01	1 0 1 0	1 2 1 0
N = 2								
Venus	6123.80	0.012	106.5	-0.01	110.9	0.02	2 2 0 0	2 2 1 0
Earth	6954	0.090	148.4	0.01	151.6	0.00	2 3 0 0	2 3 1 1
Moon	1737	0.094	0.3697	0.02	0.416	0.03	2 3 0 0	2 3 1 1
Mars	2356	-0.306	208.3	0.01	243.1	-0.02	2 4 0 0	2 4 3 2
Phobos	8.15	-0.272	0.00691	-0.26	0.00691	-0.26	2 4 0 1/2	2 4 1 0
Deimos	4.08	-0.332	0.01738	-0.26	0.01738	-0.26	2 4 1 1/2	2 4 2 0
N = 2 to 3								
Asteroids			293.5	-0.02	510.4	0.00	2 5 0 0	3 5 2 1

Outer planets n = 3 to n = 6

Object	Radius	rel. error	Apoapsis	rel. error	Periapsis	rel. error	quantum number	
							n l m s	n l m s
Jupiter	71617	0.002	739.7	0.00	810.8	-0.01	3 6 4 1	3 6 5 2
Jo			0.37512	-0.11				3 6 4 1/2
Europa			0.6192	-0.08				3 6 4 2/4
Ganymede			0.97469	-0.09				3 6 4 3/4
Callisto			1.68404	-0.11				3 6 4 4/4
Saturn	59505	-0.013	1394.2	0.03	1524.5	0.01	3 7 7 1	3 7 7 2
Uranus	25187	-0.015	2659.3	-0.03	2984.6	-0.01	4 8 7 1	4 8 8 1
Neptune	22354	-0.082	4402.3	-0.01	4517.6	-0.01	5 8 7 1	5 8 8 0
Pluto	3054	1.571	4402.3	-0.01	7485.6	0.01	5 8 7 1	6 8 7 0

CONCLUSION

Exact predictions for the masses of the elementary parts, the natural constants and the structure of the planetary system result solely from the assumption of rational numbers in the universe. The three spatial dimensions and time are a consequence of our notion of revolutions in space. This means that polynomials with the base pi or 2pi are the shortest possible representation of the natural constants. The main point of this paper is that it gives a pictorial idea of nature. A photon has a beginning and an end through immediately adjacent e^+ and e^-. Our idea of space fills this up with real or transcendent numbers. Polynomials are a 1 to 1 representation of quantum theory. The assumption of one focus in the GR is ultimately the reason for the incompatibility of QM and GR. Calculation of the proton radius of the muonic hydrogen atom should be a test for the correctness of this theory. If all properties of matter can really be described with a single polynomial, this could lead to new approaches to calculations, e.g. for the transition temperature of superconductors.

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Opinions and Statements

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