2π c meter day = (Diameter of Earth)^2 Incidence or fundamental truth?

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ABSTRACT

$r = \sqrt{(\pi/2 \text{ c meter day})} = 6378626$ m corresponds to the equatorial Earth radius of 63781,37 km (GSM 80) with a difference of only 489 m. The only assumption for this is that nature is made up of rational numbers, while our conception of space and time is shaped by revolutions. This leads to a single type of particle around the geodesic line. $\Psi = Ae^{-i/\hbar(Et+pr)}$ can be converted into a polynomial with the base 2π. For each object, there is a polynomial for the action:

$$E = E_t(2pi)^d + E_r(2pi)^{d-1} + E_\varphi(2pi)^{d-2} + E_\theta(2pi)^{d-3} \; d, E_r, E_\varphi, E_\theta \in \mathbb{Z}$$

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_r, E_φ, E_θ and d provide cohesion and result in the four fundamental interactions. 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

Numerous experiments for the Bell nonlocality [1] have shown the violation of the inequality for entangled particle pairs and thus confirmed the predictions of quantum mechanics [2, 3, 4, 5]. Quantum mechanics and quantum field theory (QFT) [6, 7, 8] draw on ideas from Newton's theory of gravitation and relativity on 4-dimensional space and forces. Since Newton, every body has been assigned a mass in kg and a center of gravity. Almost all mathematical physics is based on this concept, with calculations based on gravity. The gravitational constant has the units $m^3/kg/s^2$. This alone shows that gravity only leads to finally observable measurements in m after several steps. The mass with units of kg is not a directly observable quantity. Newton's law of gravitation, similar the GR, does not give any indication of the diameters and orbits of celestial bodies.

As early as 1958, von C. F. von Weizsäcker proposed his quantum theory of the original alternatives. [9] It was an attempt to derive quantum theory as a fundamental theory of nature from epistemological postulates. Robert B. Laughlin disputes the fundamental possibility that a theory could explain complex issues such as emergence and self-organization [10,11]. The causal fermion systems introduced by Felix Finster [12,13,14,15,16] overcame the limitation of physical objects of space and time in favor of the underlying elementary particles. Therefore, it is a fundamental concept that all space-time structures (geometry, topology, fields, wave functions, etc.) are encoded in linear operators on a Hilbert space [17,18]. More precisely, each space time corresponds to an operator. This article examines to what extent meaningful results from polynomials with the base 2π are possible, even without the principle of action and Euler-Lagrange equations.

1.1 Representation of quantum mechanics as a one-dimensional system

Quantum numbers are the most compact information for a system. In contrast, our conception of the world is one with 3 isotropic dimensions x, y and z. A comparison of x, y and z is physically very problematic. Each ruler is rotated for comparison and subjected to the Coriolis force. In the following, polar coordinates are used and are also converted into Archimedean spirals. If one calls r the large radius, xy the small radius and z the deviation, there are only ratios $r/z = n/(m + spin) \quad r/xy = n/l \quad n > l > 0 \quad n > |(m + spin)|$. Therefore r, xy and z cannot be the same. 2π is just the appropriate conversion factor from radius r to circumference and orbital period according to our view of the world. Quantum mechanics is built on a linear space. In nature, however, there is not a single straight line in the universe. The radius around a center is also not a straight line. This means that mathematics with a linear space is not effective for the simplest possible description of nature.

Starting from the center, there is a clear order according to the sizes $r > xy > z$. This corresponds to Heisenberg's uncertainty principle. Schrödinger's wave theory is based on $\Psi = Ae^{-i/\hbar(Et+mrdr/dt)} = Ae^{-i(wt+r/\lambda)} = Ae^{-i\pi k}$ with

$k \in \mathbb{Q}$ (1). The more particles N there are in a system, the finer the resolution ω and λ with the spatial coordinate r and the time t.

$$r_{Orbit,\varphi.\theta} = (2\pi)^{-iwt}(2\pi)^{Nr/\lambda} = i^{-wt}(2\pi)^{Nr/\lambda} \ (2)$$

Vectors can be treated as polynomials. The polynomial is the combination of the 3 dimensions of an object into one dimension.

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

In this formula, the coefficients $(2\pi)^d$ take on the role of ladder operators.
The most important point is that E_r is not distinguished from E_φ and E_θ. E_r can also contain a factor $(2\pi)^d$ with arbitrary d. That is, the radius itself is curved. This results in the connection to the GR. All objects rotate in circles. For the 4-dimensional time, the action S results for the duration of one revolution:

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

1.2. Interactions between objects

Every physical calculation needs at least 2 objects $O_1(N_1)$ and $O_2(N_2)$ and an observer $O_B(N_B)$. The ratio N_1/N_{total} to N_2/N_{total} is relevant for the radii R_{Orbit}, r_1 and r_2. Ignoring $O_B(N_B)$, the idea of the universe is a continuum. This also means that 3 further parameters c, h, and G are required for 3 dimensions and lead to discrepancies between the micro- and macrocosm. In principle, physical laws result from relationships such as torque.

$$N_B/r_B = N_1/r_1 = N_2/r_2 \ (5)$$

The simplest relationships are Kepler's laws $(T_1/T_2)^2 = (a_1/a_2)^3$. They result from our conception of three spatial dimensions and time. The center of gravity is given by

$$M_{(1,2,pot)} = N_1(r_1) + N_2(r_2) + N_B(r_B) = 0 \ (6)$$

Using polynomials, the center of gravity for objects O_1, O_2 and O_B can be combined into a single formula. The centroid is the center of the polar coordinates. At least 2 x 3 terms $N_{B,1}$ and $N_{B,2}$ are assumed for the interaction of the observer with 2 objects.

$$M_{1,2,pot} = N_1(r_1(2\pi)^3 + xy_1(2\pi)^2 + z_1(2\pi)^1) + N_2(r_2(2\pi)^0 + xy_2(2\pi)^{-1} + z_2(2\pi)^{-2}) + N_{B,1}(r_B(2\pi)^{-3} + xy_B 2\pi^{-4} + z_B 2\pi^{-5}) + N_{B,2}(r_B(2\pi)^{-6} + xy_B(2\pi)^{-7} + z_B(2\pi)^{-8} = 0 \ (7)$$

According to classical mechanics, the center of gravity is $M = 0$. According to quantum mechanics, the energy can only be calculated if the 3 objects with the smallest center of gravity interact. This corresponds to gravitation and is thus quantized in gravitons G

$$N_1/N_B(r_1/r_B + xy_1/xy_B + z_1/z_B) + N_2/N_B(r_2/r_B + xy_2/xy_B + z_2/z_B) = \sum_{i=3}^{n=-15} a_i \pi^i \in \mathbb{Z} \ (8)$$

with (5)

$$(r_1^2/r_B^2 + xy_1^2/xy_B^2 + z_1^2/z_B^2) + (r_2^2/r_B^2 + xy_2^2/xy_B^2 + z_2^2/z_B^2) = \sum_{i=3}^{n=-15} a_i\pi^i$$
$$E_{1,2} = (r_1 v_{1,r} + xy_1 v_{1,xy} + z_1 v_{1,z})c + (r_2 v_{2,r} + xy_2 v_{1,xy} + z_2 v_{1,z})c =$$
$$c^2\sqrt{\sum_{i=3}^{n=-15} a_i\pi^i}$$

Adding time as the 4th dimension results in i = 4

$$G^2 = \sum_{i=4}^{n=-15} a_i\pi^i \ (9) \ E_{1,2} = E_1 + E_2 + Gc^2 \ (10)$$

Since π is a transcendental number, the coefficients a_i should be integers. The summands $a_i\pi^i$ in G are the connections to other members of a larger system. Interactions are thus represented with polynomials with base π. 2π is simply a tool to distinguish between inside and outside. Nature works digitally. For our understanding of space, the base is 2π, one complete revolution. The barrier between an object and another object is a circle. Either the object is inside or outside, matter or antimatter, before or after time. Exactly on the circle, the energy is zero. Regardless of how epicycles are built from circles, the barrier remains. It does not matter whether the physics consists of 3 or 11 spatial dimensions; the length of the polynomials is man-made, from our idea of a 3-dimensional space. It does not need a human observer. O_B can be understood as the center between O_1 and O_2, as the center of gravity and focus between two real images.

1.3. Elektron, Antielektron, Photon, Speed of Light

A photon can be thought of as a pair of an electron and an antielectron. The term antielectron was chosen to distinguish it from a free positron. In nature, these are two immediately adjacent particles. They cannot be separated and observed except by emission or absorption or by pairing with a 3rd object. The pairing shows the consequence of the decay and results in an electron moving towards the center and an antielectron moving in the opposite direction. A photon has the properties of an electron paired with an antielectron.

$$spin1 = spin\tfrac{1}{2} + spin\tfrac{1}{2} \qquad E_{ges} = E_{electron} + E_{antielectron}$$
$$N_{electron} = -N_{antielectron} = 1 \qquad E_{electron} > 0 \qquad E_{antielectron} < 0.$$

The minimum energies, i.e. rest masses, result in:

$$E_{e-} = E_r + (2\pi)E_\varphi + (2\pi)^2 E_\theta = 1 + (2\pi)^{-1}E_\varphi + (2\pi)^{-2}E_\theta$$
$$E_{e+} = -1 + (2\pi)^{-1}E_\varphi + (2\pi)^{-2}E_\theta$$
$$E_{photon} = E_{e-} + E_{e+} = (2\pi)^{-1}E_\varphi + (2\pi)^{-2}E_\theta \ (11)$$

E_φ describes the frequency f, and describes E_θ the polarization.

Calculating c requires the number of particles in photon $N_r = 2$ compared to an observer, appropriately with N_{Eerth} N_r in d = 1. The interior of the earth is irrelevant according to Gauss' integral theorem. The relative speed of the electrons in the photon compared to the electrons on the surface of a macroscopic object results from the angular momentum $L_{e,photon} + L_{e+,photon} = L_{e,makro}$ and applies independently to the 3 dimensions. For a thought experiment, a beam of light is emitted along the surface of the earth. Both electrons describe a spiral around the geodesic line at $2pic$. Orthograde to N_r and $N_r + 1$ and at angle α, is the closest possible integer. $\triangle(\alpha) = 2N_r + 1 = (N_{r+1})^2 - N_r^2 = 1/(2\pi c)$ An orbital period corresponds to $2N_r = 1day$. The ratios are equal: $OP = 2N_r/day = 2\pi c/(2N_r + 1)$ With the unit meter for c and N_r we obtain:

$$r^2/day/meter\ 2/\pi = c \quad r = \sqrt{\pi/2 \text{ c meter day}} = 6378626\ m \ (12)$$

The radius at the equator is 63781.37 m (GSM 80), with a difference of 489 m. This simple calculation from astronomy is to be distinguished from the standard c from atomic physics. It is a matter of opinion which parameters are defined as constants and whether the representation is linear or logarithmic. This includes the twin paradox. In an atom, the relative velocity of the electrons is corrected by the fine structure constant. c is quantized exactly like the number of particles. In nature, all circles are approximated by secants. An estimate of the equatorial and polar earth radii of 6356750 m and 6378135 m results from different c if N_r are the same in all dimensions. For the 2 x 3 dimensions, the difference between the radii is 2π in each case. With the polynomial $\triangle\ r = (2\pi)^3 + (2\pi)^2 + (2\pi)^1 + 1 + (2\pi)^{-1} + (2\pi)^{-2}$ the correction factor results in a relative error of $(6378135/6356750 - 1) \triangle\ r = 0.9924$.

$$\text{Equatorial, polar earth radii: } 6378135\ m(1 - 1/\triangle\ r) = 6356513\ m$$
$$\text{Difference of 237 m (13)}$$

In nature, 2 entangled photons are immediately adjacent. The interaction 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.

1.4. Frequency of objects in quantum mechanics with polynomials

For a complete revolution of an object, the time with the three polar coordinates adds up to action. $S_{Object} = (2\pi)^4 E_t + (2\pi)^3 E_r + (2\pi)^2 E_\varphi + (2\pi) E_\theta$. The direction of propagation in the longitudinal direction is given by the ratio E_r/E_θ. The properties of a photon can only be determined in relation to a third body. The frequency of E_φ, which is usually assigned to an elementary particle, is the frequency of recoil after emission or absorption and depends on the detector, observer and ultimately the mass/particle numbers of the earth. The interaction

$E_W = \pi^d c = hf$ can be included in the square root of

$$G/c^2 = \sqrt{\sum_{i=4}^{n=-15} a_i \pi^i} \quad (14)$$

The first 8 terms refer to the first order of the two objects.

$$\pi^4 E_t + \pi^3 E_{1,r} + \pi^2 E_{1,\varphi} + \pi E_{1,\theta} + \ E_{2,t} + \pi^{-1} E_{2,r} + \pi^{-2} E_{2,\varphi} + \pi^{-3} E_{1,\theta}$$

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 t, r, φ and θ one of the two objects has the value 0. This results in the minimal action

$$G/c^2 = \sqrt{\pi^4 - \pi^2 - \pi^{-1} - \pi^{-3}} \; (15)$$

2.1. Gravitational constant

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

$$hGc^5s^8/m^{10}\sqrt{\pi^4 - \pi^2 - \pi^{-1} - \pi^{-3}} = 0.999991 \quad hGc^3s^8/m^{10}G = 1 \; (16)$$

h, G and c form a unit and are defined by this formula. The units of meters and seconds must appear in this formula. Three objects can be used as standard units of measure if at least two measures are specified: orbital period, diameter, and/or particle count. The value of G is only known up to the fifth digit. In this respect, the result can be assumed to be 1. h and c are already exactly defined. The only parameter left to be determined by measurement is G. The only forces holding the world together are the natural numbers, which appear as centrifugal and centripetal forces. The only parameter that is not directly observable is the mass in kg! Kg are displayed with a digital or analog, so in m. Mass is not observable. Two objects with 3 dimensions need 3^2 parameters plus the total number of particles and 10 equations. The GR with 16 equations, only 10 of which are independent, is redundant. This also means that the GR should be fully formulatable without the gravitational constant but with the particle numbers N.

2.2. H0 and the gravitational constant

The 3-dimensional volume of a single electron is $V_e = \pi^2 c^3$.

$$G_{Universe}/V_e = hGc^5s^8/m^{10}\sqrt{\pi^4 - \pi^2 - 1/\pi - 1/\pi^3} \; /\pi^2/c^3 = hGc^2s^5/m^7\sqrt{1 - 1/\pi^2 ....}$$

$G_{Universe}/V_e \; 2c$ should be the orthogonal component of the speed of light c, i.e., the expansion of the universe H0. The factor of 2 is understandable, especially since the photon consists of an electron and an anti-electron.

$$hGc^3 2\sqrt{1 - 2/\pi^2} \; s^5/m^8 = 2.1310^{-18}/s \; (17) \text{ Measurement: } H0 = 2.1910^{-18}/s$$

All interactions and thus emergence could be the result of the expansion of the universe.

2.3. Orbital periods in the planetary system

Ratios of radii and orbits are polynomials with base 2π. The ratios between orbital periods correspond to the natural ratios without π. After 3 rotations in 3 dimensions, a ratio of 8 between neighboring objects results. At least 3 objects are required. In the inertial system, from the center of gravity, the orbital times are divided between the rotation around the center and the orbital period of the orbit, giving the factor $\frac{1}{2}$:

For the time being, the following are speculative:
Op. for the lunar orbit: $1/2(8^2 - 8^1 - 1) = 27.5d$ Measured: 27.322 d (18)
Op. for the Venus orbit: $1/2(8^3 - 8^2 + 0 * 8 + 1) = 224.5d$ Me: 224.70 d (19)
Op. for the Earth orbit: $1/2(8^3 + (4-1)(8^2 + 8 + 1)) = 365.5$ Me: 365.25 d (20)
Op. for Mercury's orbit relative to the Sun's rotation of 25.38 d:
$25.38d1/2(8 - 1 - 1/2/8) = 88.04$ Measured: 87.969 d (21)

2.4. Reflections on the planetary system sun - earth – moon

For the 3 spatial dimensions, $2^3 = 8$ is the natural ratio of rotations or orbital periods. The considerations are particularly interesting for the system sun, Earth and the bound moon. Earth and the moon have the largest possible stable ratio of the radii of 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.

This unique relationship between the sun, earth and the first moon in the planetary system explains why the moon fits pretty much exactly into the sun during a solar eclipse. The distances between all bodies can also be the result of the expansion of the entire universe $H0 = 2.1910^{-18}/s$.

$$d/dt\ distance(Moon) = 38.2\ mm/384400\ km/year = 3.1510^{-18}/s$$
$$(1 - 1/pi)3.15\ 10^{-18}/s \approx H0$$

2.5. Calculations of the orbits in the solar system

The calculations are based on the ratios between the radius of the object and the orbit and thus the inverse square law. A static image is sufficient to calculate peri- and apoapsis. In terms of ladder operators, the objects can be constructed iteratively

$$E_{n,n-1} = (2\pi)^5 E_{r,n} + (2\pi)^4 E_{\varphi,n} + (2\pi)^3 E_{\theta,n} + (2\pi)^2 E_{n,n-1} + 2\pi E_{\varphi,n-1} + E_{\theta,n-1}$$
$$r_{Apo/Periapsis} = r_{sun}\sqrt{E}\ .\ \text{The normalization is } r_{sun} = 696342\ km\ (23)$$

The focus is between n and n-1. Half-integer or whole-integer quantum numbers are thus allowed for E.
For **Mercury** with n = 1, this results in the following equation:

Periapsis:	$E_r = 1$	$E_\varphi = 0$	$E_\theta = 1$	$E_{r,s} = 1$	$E_{\varphi,s} = 0$	$E_{r,\theta} = 1$
Apoapsis:	$E_r = \frac{1}{2}$	$E_\varphi = -\frac{1}{2}$	$E_\theta = 1$	$E_{r,s} = \frac{1}{2}$	$E_{\varphi,s} = -\frac{1}{2}$	$E_{r,s} = 1$
	$\Delta E = -\frac{1}{2}$	$\Delta E = -\frac{1}{2}$	$\Delta E = 0$	$\Delta E = -\frac{1}{2}$	$\Delta E = -\frac{1}{2}$	$\Delta E = 0$

Periapsis
$r_{Orbit} = 696342\ km\sqrt{32\pi^5 - 0 * 16\pi^4 + 8\pi^3 + 4\pi^2 + 0 * \pi + 1} = 69916199\ km$
(24) Measured: 69.81 10^6 km Relative error = 1.0015
Apoapsis
$r_{Orbit} = 696342 km\sqrt{32/2\pi^5 - 16/2\pi^4 + 8\pi^3 + 4/2pi^2 - 2/2\pi + 1} =$
$46114001 km$
(25) Measured: $0.3075 AU = 46.002\ 10^6\ km$ Relative error = 1.0024

For **Venus** n = 2, Sun/Mercury is the center. Thus the quantum numbers are integers.

Periapsis:	$E_r = 2$	$E_\varphi = 3$	$E_\theta = 1$	$E_{r,s} = 0$	$E_{\varphi,s} = 0$	$E_{r,s} = 1$
Apoapsis:	$E_r = 2$	$E_\varphi = 3$	$E_\theta = -2$	$E_{r,s} = 0$	$E_{\varphi,s} = 0$	$E_{\theta,s} = -2$
	$\Delta E = 0$	$\Delta E = 0$	$\Delta E = 3$	$\Delta E = 0$	$\Delta E = 0$	$\Delta E = 3$

Apoapsis: $r_{Orbit} = 109,0167\ 10^6\ km$ Messure: 108,908 km (26)
Periapsis: $r_{Orbit} = 107,3446\ 10^6\ km$ Messure: 107,412 km (27)

$$r_{Merkur}/r_{Venus} = 2448.57/6123.80 = 2.50096$$
$$(6123.80 - 2448.57)/2448.57) = 3/2 = E_\varphi/E_r \quad E_\theta = 1 \quad (28)$$

This shows that Merkur and Venus are themselves quantum numbers and inversely related in area to radius. This the explanation for Kopernikus Mysterium Cosmographicum (1596) [23, 24].

2.6. Approximately calculated for the entire solar system

The energies or radii can be approximately calculated with 4 parameters n,l,m, and s.

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

$$E_{n,l,m,s} = R^2_{sun}\pi^3/2(4\pi^2 3^n 2^l + 4\pi^2 3^m 2^{s/2} + (1 + 2\pi + 4\pi^2))\ (29)$$

E_{total} is a multiple of $\pi^3/2$ and is divided into 3 objects. All energies are multiples of $4\pi^2$. $1 + 2\pi + 4\pi^2$ correspond to 3 layers within an object. They are 3 focal points and thus 3 centers of gravity. The definition of the surface results from the coincidence of the body when it rotates. Thus, there is no exact limit for the surface. The energies $E_{n,l,m,s}$ can be inserted in a single line of a program. Everything else is only necessary for our contemplation of the world. There are 4 loops for the 4 parameters n, l, m and s. n, l and m depend on E_r E_φ E_θ. s describes the large moons. The following table therefore also contains values of $\frac{1}{2}$ or $\frac{1}{4}$; n, l and m are not directly comparable with the quantum numbers in QM. Each run requires a unit of time. Apoapsis and periapsis result. These are the limit values of two different quantum combinations (n,l,m,s). Kepler's laws are used for graphics, with 2 orthogonal circles for apoapsis and periapsis, i.e., an ellipse. Another circle gives the deviation. The advantage of the solar system over atoms or elementary particles is that the orbits can be directly observed.

Table 1: Radii of orbits of planetary systems obtained with the formula
$r_{orbit} = 696342km\sqrt{\pi^3/2(4\pi^2 3^n 2^l + 4\pi^2 3^m 2^{s/2} + (1 + 2\pi + 4\pi^2))}$ (30)

Object	radius	error	apoapsis	error	periapsis	error	quantum	numbers
							n l m s	n l m s
Mercury	2448.57	0.004	46.2	0.00	69.3	-0.01	1 0 1 0	1 2 1 0
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
Asteroids			293.5	-0.02	510.4	0.00	2 5 0 0	3 5 2 1
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

The specified planetary radii are not corrected by moons. The orbital and rotation period are shown together. The values are extracted from the radii and therefore do not have to exactly conform to Newton's laws.

Example Mercury n = 1: l = 0: m = 1: s = 0
$Apoapsis = 696342\sqrt{(\pi^3/2(4\pi^2 3^1 2^0) + 4\pi^2 3^1 2^{0/2} + (1 + 2\pi + (2\pi)^2)}$
Apoapsis = 46175339
n = 1: l = 2: m = 2: s = 0
$Periapsis = 696342\sqrt{(pi^3/2(4\pi^2 3^1 2^2 + 4pi^2 3^1 2^{0/2} + (1 + 2pi + (2pi)^2)}$
Periapsis = 69304544

3.1. Rest masses of particles

The rest masses of elementary particles can be expressed as polynomials. The action is S_{Object}. $S_{Object} = (2\pi)^4 E_t + (2\pi)^3 E_r + (2\pi)^2 E_\varphi + (2\pi) E_\theta$ (4) In the term $(2\pi)^4 E_t$ is t the absolute time. Composite particles are sums of two polynomials, each with the quantum numbers E_r E_φ and E_θ.

For stable particles, the coefficient $E_r = 1$ for matter or -1 for antimatter. E_φ describes the angular momentum, and E_θ describes the spin. The energy of all elementary particles is related to the electron. $E_e = 1$ $E_{e+} = -1$. Similar to QM, operators can be applied to polynomials. They are simple operators without a vector space. I.e., after E_r, E_φ and E_θ, there is a parity change: $\widehat{P}: f(E_r, E_\varphi, E_\theta) \longmapsto f(-E_r, -E_\varphi, -E_\theta)$

3.2. Calculation of the mass of a neutron

The simplest calculation involves the neutron since it is uncharged. It starts with 2 polynomials for 2 objects:

$$E_{n,1} = (2\pi)^4 + (2\pi)^3 + (2\pi)^2 \text{ and the antiparticle}$$
$$E_{n,2} = -(2\pi)^1 - (2\pi)^0 - (2\pi)^{-1}.$$

$$E_n = (2\pi)^4 + (2\pi)^3 + (2\pi)^2 + \widehat{P}((2\pi)^1 + (2\pi)^0 + (2\pi)^{-1}) + E_W = 1838.79090228 + E_W \quad (12)$$

The binding energy is the lowest possible quantum energy of the observer and is gravity. In the case of neutral elementary particles, the decimal places result from bases of $1/(2\pi)$. How the series is composed can be illustrated by a hall of mirrors. All objects are composed of the same particles. As an observer, we see an object through 3 dimensions in three ways. Depending on the point of view, the focus is different. The further away the observer is from the object, the smaller the resolution. As with interferences, terms with $\pm 2/(2\pi)^n$ or $0/(2\pi)^n$ result. A mapping from the focal point can be understood as a time operator $\widehat{T}$. The intensity is the same for each image plane T0, T1 and T2. They illustrate a Fourier transform. The terms are again separated with parity operators. Fig. 1 clearly shows the meaning of the operators.

$$m_{neutron} = (2\pi)^4 + (2\pi)^3 + (2\pi)^2 - (2\pi)^1 - (2\pi)^0 - (2\pi)^{-1} + 2(2\pi)^{-2} + 2(2\pi)^{-4} + 2(2\pi)^{-6} + 6(2\pi)^{-8} m_e = 1838.6836611\ m_e \quad (13)$$

$$Theory: 1838.68366115\ m_e \quad Measurement: 1838.68366173(89)\ m_e \text{ [19]}$$

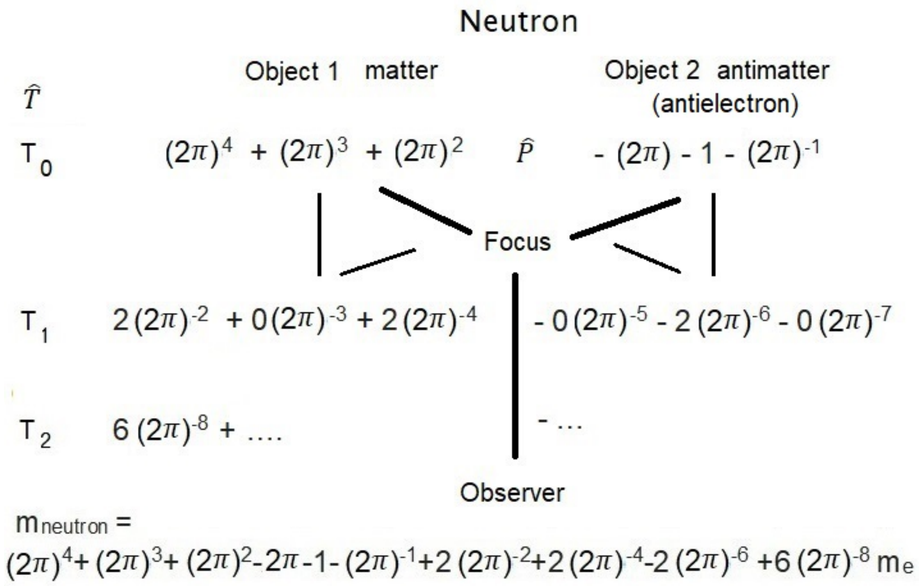

Figure 1: Mass of the neutron as a polynomial. Parity operator $\widehat{P}$ between two objects and time operator $\widehat{T}$

3.3. Calculation of the proton mass

The neutron mass consists of polynomials with base 2π. Solely from considerations of symmetry, terms with the base $\pm\pi$ are to be assumed. The mass difference between protons and neutrons ($m_{proton-neutron} = -2.5309883 m_e$) can easily be determined from an alternating series:

$$m_{proton-neutron}/(-\pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9} - \pi^{-12})m_e < 1 + 3 \times 10^{-7}$$

With the theoretically calculated neutron mass, the proton mass is:

$$m_{proton} = (2\pi)^4 + (2\pi)^3 + (2\pi)^2 - (2\pi)^1 - (2\pi)^0 - (2\pi)^{-1} + 2(2\pi)^{-2} + 2(2\pi)^{-4} + 2(2\pi)^{-6} + 6(2\pi)^{-8} + (-\pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9} - \pi^{-12})m_e = 1836.15267363 m_e \quad (14)$$

Only in the 6th term of the polynomial for the charge does an irregularity of the coefficients with a transition to a quadratic term appear. The odd exponents from the loading operator fill in the zeros in the terms T1 and T2. The difference between the polynomials of protons and neutrons can be understood as the charge operator $\widehat{C}$.

$$\widehat{C} = -\pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9} - \pi^{-12} \quad (15)$$

$$Theory : 1836.15267363 m_e \quad Measurement : 1836.15267343(11) m_e \ [19]$$

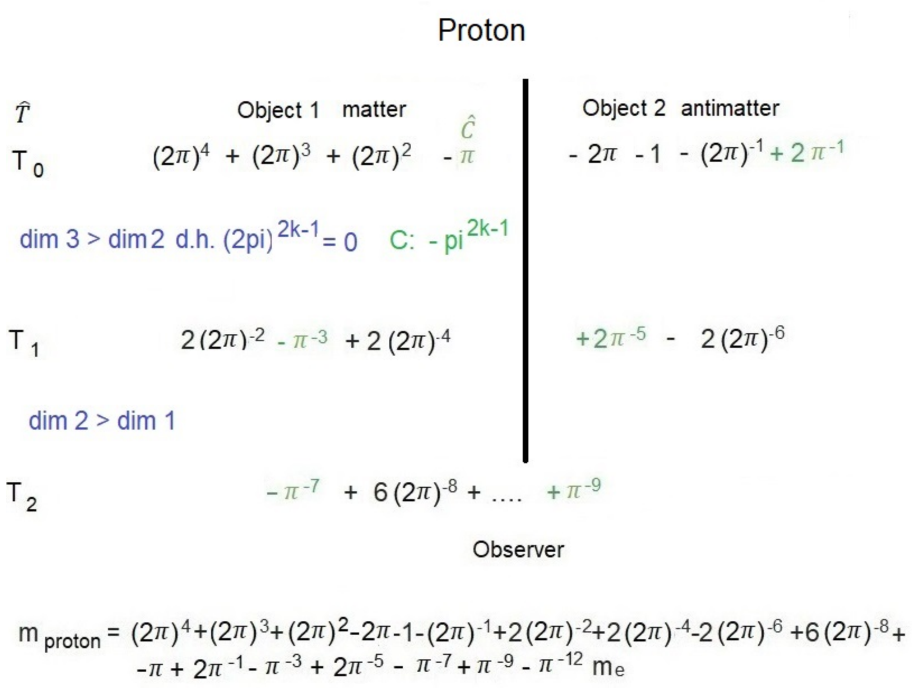

Figure 2: Proton mass as a polynomial with parity, time and charge overators $\widehat{P}$, $\widehat{T}$, $\widehat{C}$.

3.4. 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. The polynomial coincidentally of 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, as well as the proton, greater than 0.99997.

3.5. Muon

The calculation is analogous to the neutron. Object 1 starts with $(2\pi)^3$, mixed with the antiparticle $(2\pi)^2$.

$$E_{muon,1} = (2\pi)^3 - (2\pi)^2 + (2\pi)^1 \quad E_{muon,2} = -(2\pi)^1 - (2\pi)^0 - (2\pi)^{-1}$$

The charge operator is used as a charged particle: $\widehat{C} = (-\pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9} - \pi^{-12})$ The first estimate is:

$$m_{muon} = (2\pi)^3 - (2\pi)^2 + (2\pi)^1 - (2\pi)^1 - 1 - (2\pi)^{-1} + (\pi - 2\pi^{-1} - \pi^{-3})m_e = 206.881 m_e$$

The mean lifetime of the muon is $2.19 10^{-6} s$. It is assumed that the term $+(2\pi)^1 - (2\pi)^1 = 0$ determines the decay. Experimentally, the muon mass can be calculated using a polynomial with base 2π and the charge operator:

$$m_{muon} = (2\pi)^3 - (2\pi)^2 + (2\pi)^1 - (2\pi)^1 + 1 - 2(2\pi)^{-1} + 2(2\pi)^{-2} - (2\pi)^{-3} - (2\pi)^{-4} - 2(2\pi)^{-5} + 4(2\pi)^{-8} - \pi + 2\pi^{-1} - \pi^{-3} + 2\pi^{-5} - \pi^{-7} + \pi^{-9} - \pi^{-12} m_e = 206.7682833 m_e \quad (16)$$

$$Theory: 206.7682833\ m_e \quad Measurement: 206.7682830(46)\ m_e\ [19]$$

In the polynomial $(2\pi)^d$ the smallest ratio between consecutive terms is π. With 11 terms, the representation of 206.7682833 can be reduced by the factor $\pi^{10} = 93648$ to reduce. That the polynomial happens to give the muon mass is $93648/206768283 < 0.0005$.

3.6. 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 indicate a particle that is composed of at least 3 objects.

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

Along with the charge operator, the first estimate is:

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

$$Theory : 3477.34m_e \quad Measurement : 3477.23m_e \text{ [19]}$$

3.8 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 actual fundamental elementary particles.

3.7. Fine-structure constant

α should also be a polynomial with base π and describe the ratio of two orbits O_1 with E_1 and O_2 relative to the core. The symmetry axis between the center of gravity of the atom and the observer is shifted by one unit π. Fig. 3 shows the new axis of symmetry between $-\pi^{-1}$ and $-\pi^{-5}$. The beginning of the polynomial $(2\pi)^3 + (2\pi)^2 + (2\pi)^1$ becomes $\pi^4 + \pi^3 + \pi^2$. For this purpose, the energy values can be extended to 3 further terms: $-2\pi^{-10} - 2\pi^{-11} - 2\pi^{-12}$. The fine structure constant can also be understood as the operator $\widehat{F}$ (Fig.4):

$$1/\alpha = \pi^4 + \pi^3 + \pi^2 - 1 - \pi^{-1} + \pi^{-2} - \pi^{-3} + \pi^{-7} - \pi^{-9} - 2\pi^{-10} - 2\pi^{-11} - 2\pi^{-12} = 137.035999107 \quad (18)$$

CONCLUSIONS

The approach to this theory is that physics should be explainable in purely mathematical terms. Nature is based on rational numbers. Energies are the raw data from nature with a single type of particle. Our idea of the world is that of a 4-dimensional space-time. It is characterized by rotations and generates polynomials with the base 2π from rational numbers. This gives a detailed description of the solar system and the rest masses of the elementary particles. The relationship between the units h, c, α, G on the one hand and meter and second on the other is shown. QM and GR are correct. Whether using matrices or polynomials, the results are the same. Important results can be expected for elementary particle physics, atomic theory and celestial mechanics, especially for muonic atoms as well as solar system. The polynomials based on the transcendent number π should also allow for complex situations such as emergence and self-organization.

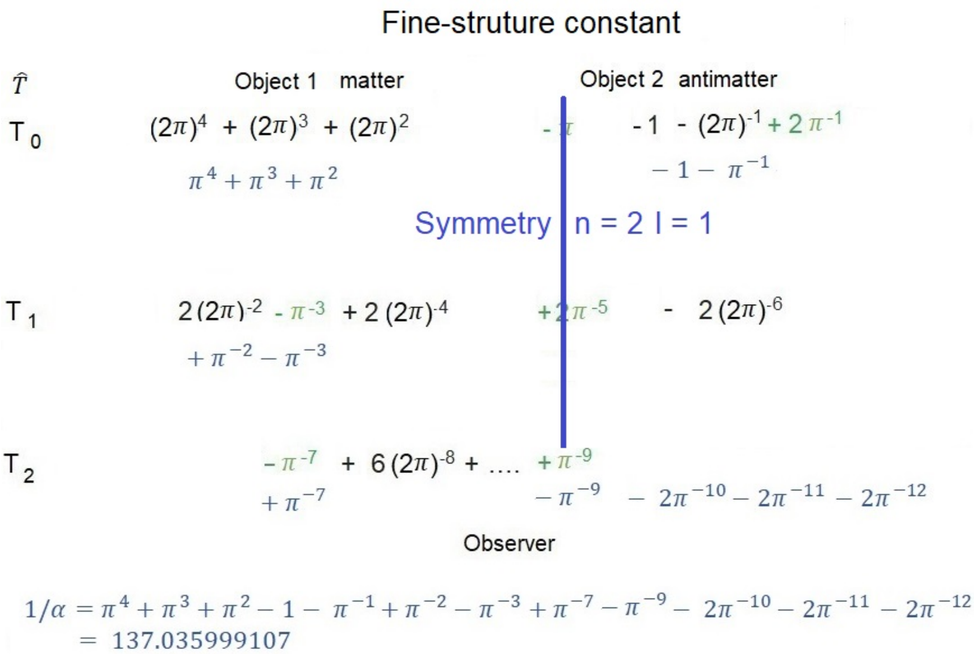

Figure 3: Fine-structure constant als Symmetrie bzw. Operator $\widehat{F}$

REFERENCES

[1] John Stewart Bell: On the Einstein Podolsky Rosen Paradox. In: Physics. Band 1, Nr. 3, 1964, S. 195–200 (cern.ch [PDF]).

[2] B. Hensen, H. Bernien, R. Hanson et al.: Experimental loophole-free violation of a Bell inequality using entangled electron spins separated by 1.3km. In: Nature. Band 526, 2015, S. 682–686, arxiv:1508.05949.

[3] M. Giustina, M. A. M. Versteegh, A. Zeilinger et al.: Significant-Loophole-Free Test of Bell's Theorem with Entangled Photons. In: Phys. Rev. Lett. Band 115, 2015, S. 250401, arxiv:1511.03190.

[4] L. K. Shalm, E. Meyer-Scott, Sae Woo Nam et al.: Strong Loophole-Free Test of Local Realism. In: Phys. Rev. Lett. Band 115, 2015, S. 250402, arxiv:1511.03189.

[5] J. Li et al., "All-optical synchronization of remote optomechanical systems," Phys. Rev. Lett. 129, 063605 (2022).

[6] Steven Weinberg: The Quantum Theory of Fields. 3 Volumes, Cambridge University Press (1995, 2005).

[7] G. Dissertori, I. G. Knowles, and M. Schmelling, Quantum Chromodynamics – High Energy Experiments and Theory (Clarendon, Oxford, 2005).

[8] T. Fukuyama and T. Kikuchi, Grand Unified Theories – Current Status and Future Prospects (AIP Press, New York, Beijing, 2008).

[9] C. F. von Weizsäcker: Komplementarität und Logik. II. Die Quantentheorie der einfachen Alternative. Zeitschrift für Naturforschung 13a, 245–253, 1958.

[10] R. B. Laughlin and D. Pines, Proc. Natl. Acad. Sci. U. S. A. 97, 28 (2000).

[11] R. B. Laughlin, Abschied von der Weltformel: Die Neuerfindung der Physik (Piper, München, 2007).

[12] Finster, Felix (2006). The Principle of the Fermionic Projector. Providence, R.I: American Mathematical Society. ISBN 978-0-8218-3974-4. OCLC 61211466.Chapters 1-4Chapters 5-8Appendices

[13] Finster, Felix (2010). "Entanglement and second quantization in the framework of the fermionic projector". Journal of Physics A: Mathematical and Theoretical. 43 (39): 395302. arXiv:0911.0076. Bibcode:2010JPhA...43M5302F. doi:10.1088/1751-8113/43/39/395302. ISSN 1751-8113. S2CID 33980400.

[14] Finster, Felix (2010). "Causal variational principles on measure spaces". Journal für die reine und angewandte Mathematik. 2010 (646): 141 - 194. arXiv:0811.2666. doi:10.1515/crelle.2010.069. ISSN 0075-4102. S2CID 15462221.

[15] Finster, Felix (2014). "Perturbative quantum field theory in the framework of the fermionic projector". Journal of Mathematical Physics. 55 (4): 042301. arXiv:1310.4121. Bibcode:2014JMP....55d2301F. doi:10.1063/1.4871549. ISSN 0022-2488. S2CID 10515274.

[16] Finster, Felix (2016). The Continuum Limit of Causal Fermion Systems. Fundamental Theories of Physics. Vol. 186. Cham: Springer International Publishing. arXiv:1605.04742. doi:10.1007/978-3-319-42067-7. ISBN 978-3-319-42066-0. ISSN 0168-1222. S2CID 119123208.

[17] Finster, Felix; Grotz, Andreas; Schiefeneder, Daniela (2012). "Causal Fermion Systems: A Quantum Space-Time Emerging From an Action Principle". Quantum Field Theory and Gravity. Basel: Springer Basel. pp. 157–182. arXiv:1102.2585. doi:10.1007/978-3-0348-0043-3-9. ISBN 978-3-0348-0042-6. S2CID 39687703.

[18] Finster, Felix; Kleiner, Johannes (2016). "Noether-like theorems for causal variational principles". Calculus of Variations and Partial Differential Equations. 55 (2): 35. arXiv:1506.09076. doi:10.1007/s00526-016-0966-y. ISSN 0944-2669. S2CID 116964958.

[19] CODATA Task Group on Fundamental Constants: CODATA Recommended Values. National Institute of Standards and Technology, accessed

November 22, 2022 (English)

[20] Johannes Kepler ”Mysterium Cosmographicum” (1596). Original work by Johannes Kepler in https://mathematikalpha.de/mysterium-cosmographicum in Mathematics alpha, accessed January 24, 2023 (German)

[21] Barker, Peter; Goldstein, Bernard (2001). ”Theological Foundations of Kepler’s Astronomy,” Osiris. A Research Journal devoted to the History of Science and its Cultural Influences, Second Series (ISSN 0369-7827), Vol. 16, p. 88 - 113 (2001)

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Opinions and Statements

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