Fundamental Forces in Physics of Numerical Relations

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According to the numerical-relational approach to physics proposed here, fundamental conservative forces such as gravity can be understood as a consequence of the logarithmic symmetry of fractal scalar fields of transcendental numerical attractors that arise in systems of coupled harmonic quantum oscillators.

Introduction

Modern physics attempts to explain every observed physical phenomenon by fundamental forces: gravitation, electromagnetism, the weak interaction, and the strong interaction. Each of the fundamental interactions can be described mathematically as a field. In the Standard Model [1] of fundamental interactions, matter consists of fermions, like electrons or protons, which carry fundamental properties called charges. They are thought to be field sources, which attract or repel each other by exchanging bosons. However, the origin of the charges and particles, and thus also the fields and forces is still poorly understood. So defining electric charge [2] as a fundamental property of matter that exhibits electrical attraction or repulsion in the presence of other electrically charged matter is essentially circular reasoning.

The explanation of observed physical phenomena by assuming the existence of elementary particles with charges that represent simply the physical properties required for interaction is a typical feature of the current paradigm. In this case, the question about the origin of the observed physical phenomena is only redirected, because also the question about the origin of the assumed particles and charges remains without answer. Basically, such relay-race-like explanation, in which the question is never answered but is passed like a stick from one model object to another, cannot satisfy the scientific mind in the long term.

Apropos, despite the appreciated success of the Standard Model in describing subatomic processes, the gravitational interaction defies this paradigm – already over more than 50 years. In my opinion, this circumstance indicates less the specificity of the gravitational interaction than the conceptual limitations of the paradigm.

In this context, the history of Newton's law of gravitation is quite revealing. In accordance with the historical legend, only 100 years after Newton, in 1797, Henry Cavendish came up with the idea to measure the mutual attraction of two bodies of known mass in an experiment with a sensitive rotating balance. Cavendish's measuring device is similar to the torsion balance that was invented by the geologist John Michell and used by Charles Augustin de Coulomb in 1785 to investigate electrostatic attraction and repulsion. Actually, until the second half of the 19th century, Newton's law of gravitation was described only in the form of proportionalities, no gravitational constant. In the explicit form that is used today, it was formulated 200 years after Newton in 1873 by Alfred Cornu and Jean-Baptist Baille, whose competence lay in the field of optics and electricity. Actually, they were inspired by Coulomb's law of electrostatic interaction, with the idea that gravitation must be something similar to electrostatic attraction, where the masses of the involved bodies act like the charges in Coulomb's law. In this way, Coulomb's law served as conceptional model of the current form of Newton's law of gravitation.

Electrostatic forces and gravitational forces actually share some fundamental properties: both are central, conservative, and obey an inverse-square law. Furthermore, the electrostatic and gravitational fields both act instantaneously.

In fact, it is well known that if a charged source moves at a constant velocity, the electric field experienced by a test particle points toward the source's instantaneous position rather than its retarded position.

Also in astronomical calculations of star and planetary movements, it is traditionally assumed that the effect of gravity occurs instantaneously. In fact, gravitation shows no aberration [3], such as the light of the stars. It is certainly true, although perhaps not widely enough appreciated, that observations are incompatible with gravitation having a light-speed propagation delay. Orbits in the solar system would shift substantially on a time scale on the order of a hundred years. By analyzing the motion of the Moon, Pierre Simon Laplace [4] concluded in 1805 that the speed of gravitation must be at least $7 \cdot 10^6$ times higher than 300.000 km/s. Using modern astronomical observations, Thomas Van Flandern [5] raised this limit to $2 \cdot 10^{10}\, c$.

The theoretical problem is that instantaneity contradicts the Standard Model, which considers fundamental interactions as mediated by force carrier particles limited by the speed of light in vacuum.

Actually, besides instantaneity, there is still a more serious problem: The hypothesis that G is a fundamental constant of physics is generally accepted, although it has not yet been experimentally confirmed [6]. In fact, Newton's law of gravitation cannot be verified in the scale of a planetary system, because the mass of a planet cannot be measured. By the way, the widely quoted claim that the orbit of the planet Neptune was discovered by calculation based on Newton's law of gravity is obviously false [7]. Apropos, Kepler's laws of planetary motion contain neither masses nor the G, and hence, they do not require Newton's law of gravitation for their derivation. Moreover, while Newton's theory of gravitation leads to inconsistencies already in the case of three interacting bodies, Kepler's laws of planetary motion do not have any N-body problem. However, despite perturbation models and parametric optimization, the stability of planetary systems is still a theoretical problem. In general, the stability of systems of a large number of coupled periodical processes is still a fundamental problem in physics [8].

In particular, there is no way to derive the current configuration of the solar system from Kepler's laws of planetary motion, and certainly not from Newton's law of universal gravitation, because there are infinitely many pairs of orbital periods and distances that fulfill Kepler's laws. Newer models of modified Newtonian dynamics have not changed this situation. Einstein's field equations do not reduce the theoretical variety of possible orbits, but increases it even more. General relativity does not provide solutions of the mentioned problems, because in the normal case of weak gravity and low velocities, Einstein's field equations obey the correspondence principle and reduce to Newton's law of gravitation.

Perhaps the concept of gravitation itself requires a revision. Obviously, it is not about details, but an important part of the hole is missing.

In previous publications [9, 10] I have applied a numeric-relational approach to the analysis of the ratios of the orbital and rotational periods of the planets and planetoids of the solar system and thousands of exoplanets [7], which led me to the hypothesis that the *avoidance* of orbital and rotational resonances by approximation of transcendental ratios is a basic forming factor and stabilizer of planetary systems [11].

In this article, I indent to show that this numeric-relational approach leads to a new understanding of gravitation based on fractal scalar fields of transcendental numerical attractors.

Theoretical Approach

It is well known [12] that orbital resonance can destabilize a planetary system. However, resonance is often confused with synchronization that occurs when coupled oscillators lock to a common period or phase. Once they are synchronized, they behave as one large oscillator. In either case, the frequencies of the coupled periodical processes coincide, or are related by a ratio of small integers like 1:2 or 2:3. However, only if the frequency of synchronization coincides with the *natural* frequency of an oscillator involved, resonance amplification occurs and can destabilize the system. For instance, asteroids cannot maintain orbits that are unstable because of their resonance with Jupiter [13]. These orbits form the Kirkwood gaps that are areas in the asteroid belt where asteroids are absent. In a similar way, resonances with the orbital motion of Saturn's inner moons give rise to gaps in the rings of Saturn.

In contrast to these cases, the 1:2:4 orbital synchronization of the moons Io, Europa and Ganymede does not destabilize the Jupiter system. There are many moons in the solar system that approximate orbital synchronization, for example, Enceladus-Dione = 1:2, Titan-Hyperion = 3:4, Phobos-Deimos = 1:4. Cases of extrasolar planets close to orbital synchronization are also fairly common. For instance, the 6 known exoplanets (b, c, d, e, f, g) of HD110067 approximate 54:36:24:16:12:9 synchronization ratios [14].

By the way, most known exoplanetary systems are similar in scale to the lunar system of Jupiter, because the predominantly used transit photometry method can detect only planets with short enough orbital periods in the range of days. This circumstance can create the impression that in their majority, exoplanetary systems are very small, and our solar system is quite exotic. Indeed, in contrast to moon systems and small exoplanetary systems, the planets of our solar system avoid orbital synchronization and resonances by approximation of transcendental ratios [10] of orbital periods.

Synchronization requires irreversibility, as is the case of dissipative, self-excited non-conservative oscillators, whose energy is not a conserved quantity. Their oscillations converge towards certain attractors, which are independent of initial values and are determined by a dynamic balance of energy supply and dissipation [15]. Even a weak coupling is enough to accelerate or slow down the oscillation phase. Therefore, even small periodic stimuli are able to adjust oscillations and frequencies, and oscillators can adjust their periods through weak interaction. Hence, synchronization can occur even with any weak interaction.

Coupled oscillators with slightly different frequencies exhibit a transition to equal period oscillations once the coupling strength exceeds a critical value that is proportional to the frequency difference. However, for frequency differences larger than some threshold, phase locking is not possible [16]. If the frequencies do not almost match, higher-order synchronization is possible, in which the oscillators lock into a rational frequency ratio. Simple cases with small integers usually occur. For example, oscillations can synchronize by exciting them with double or half frequency. As a rule, a larger excitation force or stronger coupling is required for higher-order synchronization.

The physical reason of synchronization is sharing energy between the oscillators according to Hamilton's principle in order to minimize the energy dissipation of the system. Synchronization requires feedback and self-regulation and can, in a sense, be viewed as a type of intelligent behavior.

Avoiding resonance is another type of intelligent behavior of real systems of coupled oscillators. The physical reason is lasting stability as strategy of survival. Already in 1799, Laplace [17] concluded that the solar system can be stable under periodic perturbations only if the ratios between the orbital parameters approximate irrational numbers. Irrational frequency ratios allow to avoid resonances [18, 19]. Resonance can be viewed as a special case of synchronization when the common oscillation frequency matches the natural frequency of an oscillator involved. The natural frequency can be defined as the rate at which a conservative free harmonic oscillator tends to oscillate with minimal excitation. In a certain range, this frequency does not depend on the excitation energy, but is determined by the physical properties of the oscillator, by its mass, size, atomic structure etc.

From the arithmetic point of view, coupled oscillators can avoid resonance by maintaining frequencies that are in irrational ratios to their natural frequencies. However, algebraic irrational numbers, being real roots of algebraic equations, can be converted to rational numbers by multiplication. Therefore, only frequency ratios that approximate transcendental numbers can prevent resonance in systems of coupled harmonic oscillators and sustain their stability [9].

Among all transcendental numbers, Euler's number $e = 2.71828\ldots$ is unique, because the real exponential function is its own derivative. For rational exponents, the natural exponential function is always transcendental [20]. This is why Euler's number and its rational powers allow avoiding mutual parametric resonance between any coupled harmonic periodic processes including their derivatives.

Integer and rational powers of Euler's number form a fractal scalar field of transcendental attractors – the *Euler field*, as I have shown in [10]:

$$\mathcal{E} = e^{\mathcal{F}}$$

The Euler field $\mathcal{E}$ is a k-dimentional projection of its fundamental fractal $\mathcal{F}$ that is given by finite canonical continued fractions of integer attractors $n_0, n_1, n_2, \ldots, n_k$:

$$\mathcal{F} = \langle n_0; n_1, n_2, \ldots, n_k \rangle = n_0 + \cfrac{1}{n_1 + \cfrac{1}{n_2 + \cdots + \cfrac{1}{n_k}}}$$

Figure 1 shows the first and the second layer of $\mathcal{F}$ in comparison. As we can see, reciprocal integers $\pm 1/2, \pm 1/3, \pm 1/4, \ldots$ are the attractor points of the fractal. In these points, the attractor distribution density reaches local maxima. Integer logarithms $0, \pm 1, \pm 2, \ldots$ define the main attractors having the widest ranges. Half logarithms $\pm 1/2$ form smaller attractor ranges, third logarithms $\pm 1/3$ form the next smaller attractor ranges and so forth.

Fig. 1: Two layers $k = 1$ (above) and $k = 2$ (below) of the fundamental fractal $\mathcal{F}$ in the range $-1 \leqslant \mathcal{F} \leqslant 1$.

These attractors are islands of stability in the sense that they define the frequency ratios which allow to avoid destabilizing parametric resonance in systems of coupled harmonic oscillators. For instance, two coupled harmonic periodical processes A and B with the angular frequencies ω_A and ω_B can avoid parametric resonance, if they obey the condition:

$$\ln(\omega_A / \omega_B) = \mathcal{F}$$

In other words, coupled harmonic oscillators can avoid mutual parametric resonance, if the ratios of their natural frequencies approximate attractors of the Euler field. In the case of harmonic *quantum* oscillators [21], the same is valid for the ratio of their natural wavelengths $\lambda = c/\omega$, and energies $E = \hbar\omega$, where c is the speed of light in vacuum, and $\hbar$ is the Planck constant.

The spatial projection of the Euler field $\mathcal{E}$ of coupled harmonic quantum oscillators is a fractal set of embedded spherical equipotential surfaces. The logarithmic scalar potential difference $\Delta\mathcal{F}$ of sequent equipotential surfaces:

$$\Delta\mathcal{F} = \langle n_0; n_1, \ldots, n_k \rangle - \langle n_0; n_1, \ldots, n_k + 1 \rangle$$

defines a gradient [7] always directed to the center of the attractor n_{k-1} of the next higher level that finally creates the effect of an existing field source (charge) at the center of the Euler field. However, the Euler field is of pure arithmetic origin, and there is no particular physical mechanism required as field source.

Since the frequency ratio $x = \omega_A / \omega_B$ is always a real number, the first derivative of $\ln x$ equals the reciprocal of its argument:

$$\frac{d}{dx} \ln x = \frac{1}{x}$$

Therefore, the larger the frequency ratio $x = \omega_A / \omega_B$, the slower the velocity of its change. Consequently, the velocity of change of the frequency ratio x increases always in the direction to an attractor of the Euler field $\mathcal{E}$. In this way, the logarithmic symmetry of the Euler field causes an acceleration of the frequency ratio x in the direction to the center of the field. In fact, the 2^{nd} derivative of $\ln x$ equals the negative reciprocal square of its argument:

$$\frac{d^2}{dx^2} \ln x = -\frac{1}{x^2}$$

If we substitute $x = E_A / E_B$ we can realize that the energy of the coupled quantum oscillators increases in the direction to an attractor of the Euler field. Therefore, the physical reason of the accelerated free fall of coupled quantum oscillators to the center of the Euler field is to gain energy from the field.

Now we can recapitulate the behavior of coupled harmonic quantum oscillators caused by the Euler field: In order to reach collective stability, coupled harmonic quantum oscillators adjust the ratios of their frequencies in a way that they approximate numerical attractors of the Euler field. Then, by approximating an attractor, the quantum oscillators experience a frequency blueshift that allows them to gain energy from the field. In this way, the numerical Euler field turns out to be an energy source, and fundamental interactions like gravity or electromagnetism could turn out to be physical effects caused by numerical attractors.

In their famous experiment of 1959, Robert Pound and Glen Rebka [22] verified the gravitational frequency shift. Sending gamma rays over a vertical distance of $\Delta h = 22.56$ m, they measured a blueshift of $\Delta f/f = 2.46 \cdot 10^{-15}$ that corresponds precisely with Earth's surface gravity 9.81 m/s^2.

$$\frac{\Delta f}{f} = g\,\frac{\Delta h}{c^2}$$

However, because of the fractal logarithmic hyperbolic metric of the Euler field $\mathcal{E}$, every equipotential surface is an attractor where potential differences decrease and processes can gain stability. While integer logarithms $\mathcal{F}$ define main equipotential surfaces at $k = 0$, rational logarithms define equipotential surfaces at deeper layers $k > 0$. Therefore, one can expect that gravity does decrease parabolically fractal with the distance to an attractor of the Euler field. The closer to an attractor, the more evident this effect of fractal inhomogeneity of the gravity field becomes. The strongest inhomogeneities are expected near the main attractor in the center of the field.

In fact, Stacey, Tuck, Holding, Maher and Morris [23, 24] reported anomalous measures of the gravity acceleration in deep mines and boreholes. In [25] Frank Stacey writes that "geophysical measurements indicate a 1% difference between values at 10 cm and 1 km (depth); if confirmed, this observation will open up a new range of physics."

In [26] was shown that the Euler field reproduces the 2D profile of the Earth's interior confirmed by seismic exploration. Also the stratification layers in planetary atmospheres correspond with equipotential surfaces of the Euler field [27].

Exemplary Applications

Compared to the majority of known particles, electron and proton are exceptionally stable quantum oscillators. Indeed, their life-spans top everything that is measurable, exceeding 10^{28} years [28]. This is why normal matter is formed by nucleons and electrons. For this reason, in a previous publication [11] I introduced a model of matter as fractal chain system of oscillating protons and electrons.

In order to be bound in atoms, the proton and the electron must avoid mutual resonance. This is why the proton-to-electron frequency ratio approximates an integer power of Euler's number and its square root:

$$\ln\left(\frac{\tau_e}{\tau_p}\right) = \ln\left(\frac{1.28809 \cdot 10^{-21}\,\text{s}}{7.01515 \cdot 10^{-25}\,\text{s}}\right) \simeq 7 + \frac{1}{2} = \mathcal{E}\langle 7; 2\rangle$$

$\tau_e = \lambda_e/c = 1.28809 \cdot 10^{-21}$ s is the angular oscillation period of the electron, λ_e is the Compton wavelength of the electron, c is the speed of light in vacuum, and $\tau_p = 7.01515 \cdot 10^{-25}$ s is the angular oscillation period of the proton. In order to avoid proton and electron resonance, also planetary systems have to obey the Euler field. In [10] I have shown that Venus' distance from Sun approximates the main equipotential surface $\mathcal{E}\langle 54\rangle$ of the Euler field of the *electron* that equals the 54^{th} power of Euler's number multiplied by the Compton wavelength of the electron λ_e. The aphelion 0.728213 AU = $1.08939 \cdot 10^{11}$ m delivers the upper approximation of $\mathcal{E}\langle 54\rangle$:

$$\ln\left(\frac{A(Venus)}{\lambda_e}\right) = \ln\left(\frac{1.08939 \cdot 10^{11}\,\text{m}}{3.86159 \cdot 10^{-13}\,\text{m}}\right) = 54.00$$

The perihelion 0.718440 AU = $1.07477 \cdot 10^{11}$ m delivers the lower approximation:

$$\ln\left(\frac{P(Venus)}{\lambda_e}\right) = \ln\left(\frac{1.07477 \cdot 10^{11}\,\text{m}}{3.86159 \cdot 10^{-13}\,\text{m}}\right) = 53.98$$

This means that Venus' orbit derives from the Euler field of the electron. In other words, Venus' orbit is of subatomic origin. This is not a random coincidence. Jupiter's distance from Sun approximates the main equipotential surface $\mathcal{E}\langle 56\rangle$ of the Euler field of the electron. The aphelion 5.45492 AU = $8.160444 \cdot 10^{11}$ m delivers the upper approximation of $\mathcal{E}\langle 56\rangle$:

$$\ln\left(\frac{A(Jupiter)}{\lambda_e}\right) = 56.01$$

The perihelion 4.95029 AU = $7.405528 \cdot 10^{11}$ m delivers the lower approximation:

$$\ln\left(\frac{P(Jupiter)}{\lambda_e}\right) = 55.91$$

This fact suggests that quantumness is conserved in macroscopic scales up to planetary systems. Indeed, in [29] the quantumness of macroscopic large masses was verified, in particular, the mass-independent irreducible quantumness of harmonic oscillator systems.

Also Jupiter's orbital period 4332.59 days derives from the Euler field of the electron. In fact, it equals the 66^{th} power of Euler's number multiplied by the oscillation period $2\pi \cdot \tau_e$ of the electron:

$$\ln\left(\frac{T(Jupiter)}{2\pi \cdot \tau_e}\right) = \ln\left(\frac{4332.59 \cdot 86400\,\text{s}}{2\pi \cdot 1.28809 \cdot 10^{-21}\,\text{s}}\right) = 66.00$$

The same is valid for the orbital period 686.98 days (1.88 years) of the planet Mars that equals the 66^{th} power of Euler's number multiplied by the *angular* oscillation period τ_e of the electron:

$$\ln\left(\frac{T(Mars)}{\tau_e}\right) = \ln\left(\frac{686.98 \cdot 86400\,\text{s}}{1.28809 \cdot 10^{-21}\,\text{s}}\right) = 66.00$$

Consequently, the ratio of the orbital periods of Jupiter and Mars equals 2π:

$$T(Jupiter) = 2\pi \cdot T(Mars)$$

This transcendental ratio allows Mars to avoid parametric orbital resonance with Jupiter and evidences that Jupiter and Mars are not planets of different systems, but bound together in the same conservative system (the solar system).

In [10] I introduced the Archimedes field $\mathcal{A} = \pi^{\mathcal{F}}$ and have shown how it connects orbital periods with rotational periods. Stable orbital speeds [30] derive from the speed of light divided by integer and reciprocal integer powers of e or π. This circumstance drastically reduces the diversity of preferred orbits, orbital periods, and speeds, increasing the likelihood of matches in different planetary or lunar systems. Furthermore, it indicates a transcendental duality of Euler- and Archimedes-orbits in the solar system.

In the Jupiter lunar system, we can observe both strategies of stabilization, avoidance of resonance and synchronization. The orbital period of the Galilean moon Io approximates the attractor $\mathcal{E}\langle 60\rangle$ of the *Euler* field of the *electron*:

$$\ln\left(\frac{T(Io)}{\tau_e}\right) = \ln\left(\frac{1.7691378 \cdot 86400\,\mathrm{s}}{1.28809 \cdot 10^{-21}\,\mathrm{s}}\right) = 60.03$$

Simultaneously, it approximates also the attractor $\mathcal{E}\langle 59\rangle$ of the *Archimedes* field of the *proton*:

$$\mathrm{lp}\left(\frac{T(Io)}{\tau_p}\right) = \mathrm{lp}\left(\frac{1.7691378 \cdot 86400\,\mathrm{s}}{7.01515 \cdot 10^{-25}\,\mathrm{s}}\right) = 59.01$$

τ_p is the angular oscillation period of the proton. We use the symbol "lp" for the logarithm to the base $\pi = 3.14159\ldots$

$$\mathrm{lp}(x) = \frac{\ln(x)}{\ln(\pi)}$$

The Galilean moons Europa and Ganymede are in 1:2:4 orbital synchronization with Io in order to save orbital kinetic energy. Callisto is not synchronized with the other Galilean moons, but avoids *proton* resonance by approximation of the attractor $\mathcal{E}\langle 68\rangle$ of the *Euler* field:

$$\ln\left(\frac{T(Callisto)}{2\pi \cdot \tau_p}\right) = \ln\left(\frac{16.689 \cdot 86400\,\mathrm{s}}{2\pi \cdot 7.01515 \cdot 10^{-25}\,\mathrm{s}}\right) = 67.96$$

and the attractor $\mathcal{E}\langle 61\rangle$ of the *Archimedes* field of the *proton*:

$$\mathrm{lp}\left(\frac{T(Callisto)}{\tau_p}\right) = \mathrm{lp}\left(\frac{16.689 \cdot 86400\,\mathrm{s}}{7.01515 \cdot 10^{-25}\,\mathrm{s}}\right) = 60.97$$

Obviously, in order to reach the centers of these attractors, Callisto still has to extend its orbital period by half a day. This prediction is consistent with alternative approaches [31].

However, not only Euler's number $e = 2.71828\ldots$ and Archimedes' number $\pi = 3.14159\ldots$ define fractal scalar fields of their integer and rational powers, but in general, every prime, irrational and transcendental number does it. While the fundamental fractal $\mathcal{F}$ is always the same distribution of rational logarithms, the structure of the corresponding fundamental field changes with the logarithmic base. Here it is important to notice that no fundamental field can be transformed in another by stretching, because $\log_a(x) - \log_b(x)$ is a nonlinear function of x. In this way, every prime, irrational or transcendental number generates a unique fundamental field of its own integer and rational powers that causes physical effects which are typical for that number. Figure 2 shows the Euler field and the Archimedes field in comparison.

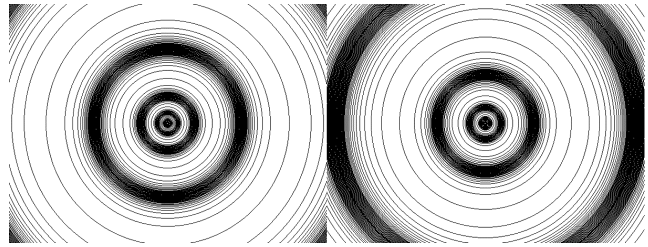

Fig. 2: The 2D projection of the first layer ($k = 1$) of equipotential surfaces of the Euler Field $\mathcal{E} = e^{\mathcal{F}}$ (left), and the Archimedes Field $\mathcal{A} = \pi^{\mathcal{F}}$ (right). The fields are shown to the same scale.

Conclusion

According to our numeric-physical approach presented in this paper, numeric fields like $\mathcal{A}, \mathcal{E}$ are primary. When formed in systems of coupled harmonic quantum oscillators, they define numerical attractors that act as islands of stability and avoid destabilizing mutual resonances.

In order to reach collective stability, coupled harmonic quantum oscillators adjust the ratios of their frequencies in a way that they approximate transcendental attractors of the numeric fields.

Then, in order to gain more energy from the numeric field by approaching always more powerful attractors, the coupled harmonic quantum oscillators are forced to move in the direction of the center of the numeric field.

Since the fractal scalar fields of transcendental numerical attractors are logarithmically symmetric, locally this movement appears as accelerated free fall caused by a conservative central force that obeys an inverse-square law.

However, because of the fractal logarithmic hyperbolic metric of the numeric field, every equipotential surface is an attractor, so that the closer to an attractor, the more evident the effect of fractal inhomogeneity of the numeric field becomes. These inhomogeneities appear as local deviations from the inverse-square law of free fall. In this way, no additional (fifth) force or physical field is required to explain the observed violations [24] of Newton's gravity in depth.

We are aware that no physical principle can explain the origin of energy, because every physical process presupposes the existence of another physical process that serves as its energy source. This non ending chain of energy converters suggests that the imperishability of motion and interaction, and the inexhaustibility of energy must have a non-physical cause. On the one hand, our approach seems to draw on Pythagoras, but on the other hand, it is intended to encourage us to break the vicious circle of the current paradigm.

Within the presented here approach, fundamental physical forces are caused by numerical relations. This approach allows to derive physical effects from non-physical i.e. numerical relations. In particular, this approach leads us to the conclusion that motion and interaction, including energy as well as other constants of motion are caused by attractors of numeric fields. Perhaps a new relational paradigm could lead us to a deeper understanding of physics and help us overcome our current inability to invent new energy sources.

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