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Imagination and real quantization

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Abstract
The paper shows that the use of mathematical imaginaries, complex numbers, and even more so quaternions in the Quantum Theory to increase the dimension of solutions of one-dimensional equations is, in principle, incorrect. As a result, Einstein's condition was violated: SOME equations of Classical Physics can be rewritten in operator form. The use of correct multidimensional models makes it possible, using the example of the Harmonic Oscillator, to obtain the Planck-Einstein Quantization for da Broglie waves.

Keywords: Harmonic oscillator, multidimensional models, particle dualism, wave resonance, quanta

Introduction
Many basic models were originally built on the basis of rather rough experiments. But, because they were canonized, it took considerable effort to conduct their experimental re-verification and theoretical refinement [1, 2, 3, 4].
But when the Quantum Theory was formed, another misfortune happened. After Newton, Physics and Mathematics parted ways. At the same time, both the watchmaker Peltier [5] and unfinished mathematicians who were able to solve one equation were ranked as physicists.
Heaviside's restoration of the connection between Physics and Mathematics raised Physics to a new level and enriched Mathematics with new directions. At the same time, it can be said that it was formed as an independent branch of the science of Mathematics. But, while Heaviside himself (who, by the way, was never considered a scientist, although his Math physics was used from Maxwell to Dirac), Mathematics was used for strictly defined specific physical parameters, numerous developers were in a hurry to simply calculate something new, not really caring about the logical connection of their calculations with the Physical Reality.
For such abstract calculations, very vague interpretations of the results obtained arose, often hastily farfetched to Reality, i.e. without Understanding both the Principles of Mathematics and the Principles of Physics. At the same time, Science, having broken into sects of “believers” (schools), departed from the True Scientific Priorities (Goals) and from the True Scientific Methodological Principles [6]. And the artisans of Science, the builders of the "Tower of Babel" of Science, ceased to understand each other. And it is quite natural that the role of understanding in Science was leveled.
To some extent, understanding has been replaced by confidence that Mathematics, as it gives the value of a number on a curve at any point on it, will itself give the correct answer to all questions of Physics. But "correctness" - correspondence to real processes of the curve itself is determined by the model used. And if the model is not built on INVARIATE parameters, then it is natural that the empirical regularity allows approximation only in a limited area. And if there are an infinite number of points on the curve and approximation, albeit roughly, but also works outside the model applicability area, then the introduction of a new dimension initially makes it “otherworldly” in relation to the usual four physical dimensions.
In this regard, it is not accidental that the imaginary unit introduced by Mathematics into the very name of the complex number was reflected in the IMMISSION of all Theoretical Physics, both in the Quantum Theory and in the Theory of Relativity. And the hastily obtained complex solutions of the one-dimensional Schrödinger equation are simply confirmation of this [7]. The artificial interpretation of the Schrodinger wave function, despite the objections of Einstein and Heisenberg, only legitimized (canonized) their imaginary. An intuitive attempt to give a physical meaning to two-dimensional wave functions was made in [8].
And as was strictly shown in [9], two-dimensional wave functions are simply resonances in the plane of the cross section of the constant energy of the energy paraboloid of a two-dimensional harmonic oscillator.

Whereas even in the classical description of the wave, the imaginary can physically correspond to different parameters of the wave, both to a change in the phase of a plane wave during its linear propagation, and to a rotation of the phase of the circular polarization of the wave. Strictly mathematically, such a description should correspond not to simple complex numbers, but to quaternions with several orthogonal imaginary units, but without understanding that the imaginary in this case simply reflects orthogonality, a simplified complex description should be perceived only as a section of a functional space of a higher dimension.

The resulting CONFUSION was only aggravated by the fact that the imaginary was attributed to the decay of time, which led to the "imaginary" of TIME itself in the Theory of Relativity [10]. But we will not go into more detail here. Let's just summarize and generalize the PRINCIPLES of Real QUANTIZATION, to which we have summed up all the previous analysis.

Real Quantization

Real (without imaginaries) Quantization of oscillations of a two-dimensional harmonic oscillator, as shown in [9], corresponds to resonant de Broglie waves in an orbit formed by a section of the oscillator energy paraboloid by a plane of constant energy (Fig. 1).

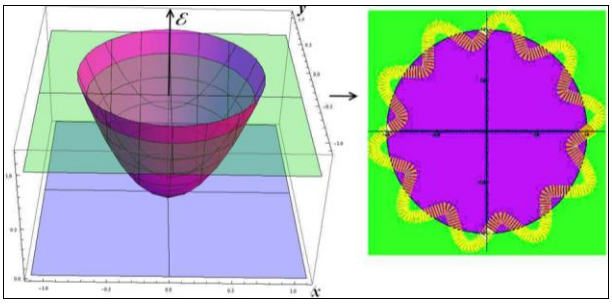

Fig 1: Following from the Law of Conservation of Energy Quantization (on the right) by resonant waves of a flat orbit of the Harmonic Oscillator (on the left - top view)

For a linear mechanical oscillator, taking into account the balance of the mass inertia force and the spring force

$$F_m = a \cdot m, \qquad F_k = k \cdot x \tag{1}$$

We have an equation for the harmonic displacement of the mass and its resonant frequency

$$m\frac{d^2x}{dt^2} + \kappa \cdot x = 0 \Rightarrow \frac{d^2x}{dt^2} = -\Omega^2 x \Rightarrow \Omega = \sqrt{\frac{\kappa}{m}} \Rightarrow x = A\mathrm{Cos}(\Omega t) \tag{2}$$

And when taking into account the energy balance for the displacement velocity of a mechanical linear oscillator

$$E_U = \frac{m(x'[t])^2}{2}, \quad E_T = \frac{k(x[t])^2}{2} \quad (x'[t])^2 + \Omega^2(x[t])^2 = \frac{2E_n^\Sigma}{m}, \quad x'[0] = 0 \tag{3}$$

then for the resonant frequency we have, in principle, a similar expression

$$\Omega = \sqrt{\frac{\kappa}{m}}, \text{ a } \quad x = \frac{1}{\Omega}\sqrt{\frac{2E_n^\Sigma}{m}}\mathrm{Cos}[t\Omega] \tag{4}$$

For a two-dimensional oscillator, the stationary motion of a particle along an orbit in the classical case is determined by the equality of the force of attraction to the center of the orbit and the centrifugal force, which uniquely corresponds to the equality of the kinetic and potential energy of the particle in orbit:

$$F_m = \frac{mv_L^2}{r}, \quad F_k = k_r \cdot r \quad \Rightarrow \frac{mv_L^2}{r} = k_r \cdot r \quad \Rightarrow \frac{mv_L^2}{2} = \frac{k_r \cdot r^2}{2} \tag{4.1}$$

Equilibrium, i.e. stationary, in principle, undamped - resonant rotation we now have at a frequency determined by a similar expression

$$v_L = \sqrt{\frac{k_r}{m}} \cdot r \Rightarrow T = \frac{2\pi r}{\sqrt{\frac{k_r}{m}} \cdot r} \Rightarrow \Omega_r = \sqrt{\frac{k_r}{m}} \tag{5}$$

If we take into account that the particle is a wave packet [11], then the first quantum level corresponds to the maximum de Broglie wavelength on the orbit, equal to the length of the orbit (Möbius strip for a circle, in the simplest case - Fig. 2), and the subsequent ones correspond to the wavelengths multiple of the circumference

$$\lambda_1^O = 2\pi R_1^O, \quad \lambda_n^O = \frac{2\pi R_1^O}{n} \tag{6}$$

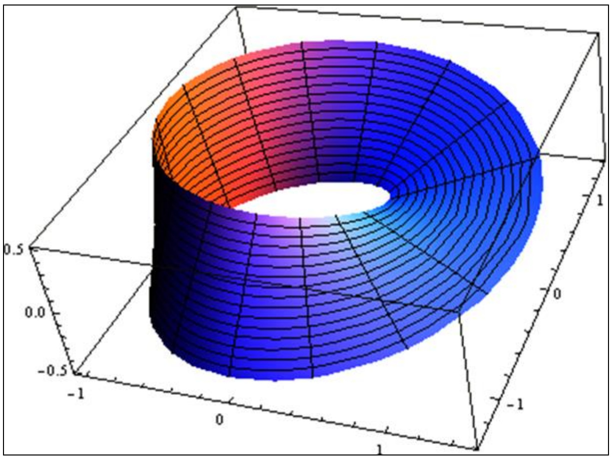

Fig 2: Image of the maximum wave on a resonant orbit in a paraboloid section

These wavelengths (6) correspond to the Planck frequencies and quanta of kinetic energy

$$\varepsilon_1^O = \hbar\omega_1^O = 2\pi\frac{\hbar}{T} = 2\pi\frac{\hbar}{\lambda_1^O/c} = \frac{\hbar c}{R_1^O}, \quad \varepsilon_n^O = \hbar\omega_n^O = n \cdot \frac{\hbar c}{R_1^O} \tag{7}$$

Thus, according to [9], one can obtain the relationship between the quantum of a two-dimensional harmonic oscillator and its resonant frequency:

$$\varepsilon_1^O = \hbar\omega_1^O = \frac{1}{2}\sqrt[3]{m(\pi\hbar c\Omega_r)^2} \tag{8}$$

Formally, this formula is similar to Kepler's 3rd law (classical, corrected and simplified for a circular orbit), but it allows movement only along the first orbit, the radius of which can only change with a change in mass

$$\frac{R_1^3}{R_2^3} = \frac{T_1^2(M + m_1)}{T_2^2(M + m_2)} \simeq \frac{T_1^2}{T_2^2} \tag{9}$$

The functional similarity of formulas 8 and 9 is very likely not accidental. But we will not analyze their physical analogy here in more detail. We will not delve into the analogy with surface tension, which, in principle, allows, according to [12, 13], to relate the minimum values of the wave frequency and the radius of the resonant orbit with the relationship between the surface tension of the cylinder and the rigidity of waves in orbit with the orbital rigidity coefficient and pressure inside her.

$$\Delta p = \frac{\sigma}{R_1} \quad (10).$$

Omitting the analysis of the connections noted above, let's immediately proceed to the consideration of a harmonic oscillator in a 4-dimensional E-x-y-z space. Sections - surfaces of constant energy, corresponding to the quanta of motion, in contrast to the depicted sections-planes in Fig. 1, will be spheres nested into each other (Fig. 3, on the right), the squares of the radii of which determine the amount of energy that is preserved when the particle moves along the sphere.

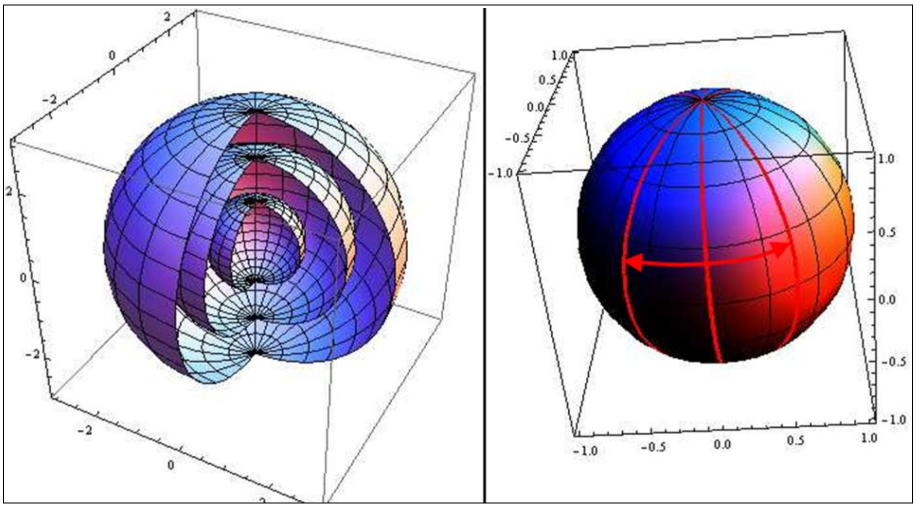

Fig 3: Isoenergetic spheres (on the right) and an orbit oscillating on the sphere around the axis of rotation (on the right, red lines)

As shown in Fig. 3, in the case of 3-dimensional quantization, in addition to the oscillations of a circular orbit described in [9], which are synchronous with resonant rotation along the orbit, leading to an elliptical orbit, synchronous rotations of the orbit around its axis are also possible, also leading to an increase in the total quantum of energy. But additionally, with 3-dimensional quantization, it is possible for a particle to pass through a sphere in such a way that the complete phase coincidence of the wave corresponding to the particle occurs after several turns (Fig. 4).

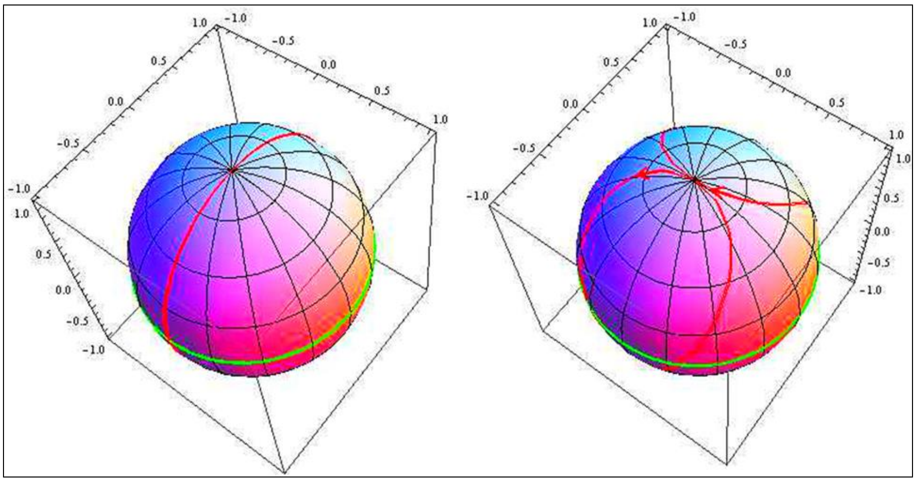

Fig 4: One-turn orbits on the sphere of constant energy and the transformation of one of them (red) into an orbit in which the complete coincidence of the phase of the wave at the pole will occur after two turns

Thus, the length of the resonant wave on the sphere can be equal to several lengths of the sphere circumference, i.e. the resonant frequency can be several times lower than the minimum frequency of 2-dimensional quantization, defined by formula 8. And these low overtones are not associated with damping, as in an anharmonic oscillator [9], they strictly correspond to the propagation of a wave over a sphere of constant energy.

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