NEWTON'S POTENTIAL 1/*r* AS A MANIFESTATION OF THE SPACE DEFORMATION GENERATED BY QUANTUM MECHANICAL LAWS

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1. INTRODUCTION, OR HOW SPACE GENERATES MATTER AND PHYSICS LAWS

Indeterminism is a very important starting point of modern quantum theories. All quantum theories starting from quantum mechanics are constructed in the phase space. They do not consider particles as spatial objects, instead quantum theories deal with wave ψ -functions, laws of fundamental symmetries, and abstract mathematical constructions. In recent author's paper [1] the major conceptual difficulties of conventional quantum theory have been analysed. The difficulties are in fact very severe and that is why significant improvements and the deepest conceptual basis have been proposed.

The staring point was Louis de Broglie's ideas [2] who was searching for the double solution theory, which would describe quantum mechanics in the real space as opposed to the conventional description based on the probabilistic formalism developed in the phase space. In his approach, the main attention was paid to the circumstance that a moving particle was guided by a real wave, i.e. a wave that moved in the real space and appeared owing to the interaction of the particle with a subquantum medium. Dirac [3] in his work *Is there an aether?* noted that quantum mechanics rejected all the objections, which the relativity early posed to the aether. A deep insight into the concept of quantum aether and the derivation of quantum mechanics from a Planck aether model has recently been carried out by Winterberg [4].

Thus when we consider the real space in which physical processes occur we make assumption that the organisation of matter on the microscopic, i.e. atomic level has to reproduce the sub microscopic space ordering. Then the crystal lattice one can treat as a reflection of the arrangement of the real space, which is set on scale ~ 10^{-28} cm. This size is in accord with the scale on which all three so-called fundamental physical interactions (electromagnetic, weak and strong) coincide. Besides, in high energy physics theorists deal with an abstract 'superparticle' whose different states are electron, muon, quark, etc. That is why a simple logical deduction suggests by itself: the physical space at the said range has a peculiarity and we may associate it with presence of structural blocks, i.e. balls (or elementary cells, or superparticles), which are densely packed and hence form the degenerate state of the real space. Then one may expect that a theory of the physical space densely packed with those balls will be able to overcome many difficulties, which are insuperable hindrances in formal theories of both quantum gravity and high energy physics. In such a manner a submicroscopic theory being based on the structure of fine-grained space will be able to widely expand our knowledge about the origin of matter, the foundations of quantum mechanics, the foundations of quantum gravity, and the foundation of quantum electricity.

In our concept we indeed have introduced such a subquantum medium considering it as a degenerate tesselattice whose elements are same cells; a detailed mathematical theory of the space based on topology, set theory and fractal geometry has recently been constructed by Bounias and myself [5]. In these and other works (see review articles [6,7]) we have shown how space generates matter and physics laws. Our space is a typical substrate (one might call it an aether), which shares discrete and continual properties. In what way can we distinguish a particle from all other superparticles of the space? A particle is considered as a local deformation of the tesselattice, i.e. a particle is created from a cell (superparticle) whose volume has altered from that of surrounding degenerate cells and hence this implies the generation of a massive entity. A stable local deformation is called an actual particle and a local deformation that is unstable in the sate of rest is called a field particle, or more exactly, a quasi-particle (excitation) of the real space.

The study of the motion of a particle in such a densely packed space brings about quantum mechanics [8-10] in which the moving particle is accompanied by a cloud of spatial excitations called 'inertons,' which appear due to the interaction of the particle with superparticles of the space. Such an approach automatically eliminates the notion 'particle-wave' – the major conceptual difficulty of conventional quantum mechanics. Thus instead of a vague wave-particle we obtain a particle and a cloud of inertons that accompanies it. Furthermore, it should particularly be emphasised that nowadays we face complete forgetfulness of the fact that the probabilistic formalism strongly suffers from long-range action. By conventional quantum mechanics, as was mentioned by Ehrenfest [11], particles can interact simultaneously even if they are spaced at any quantity of kilometres. The introduction of inertons fully resolves this problem: they appear as carriers of potential interactions. The range of spreading of the particle's inerton cloud is restricted by amplitude $L = l\, c/u$ where l is the de Broglie wavelength, c and u are velocities of the motion of inertons (the speed of light) and the particle, respectively.

Thus inertons are carriers of inert properties of the particle and yet they represent a substructure of the particle's matter waves. Hence the probabilistic indeterminism is replaced for the entire determinism. The inerton cloud is a hidden subsystem of a sort and the particle exchanges the momentum and the energy with its inerton cloud. The kinetics of a particle in the real space – the parameters L and l can be treated as the free path lengths for the particle and its inerton cloud respectively – can ridely result in orthodox quantum mechanics. In fact, transitions to the Schroedinger and Dirac formalisms, which are constructed in the phase space, have been carried out in respective refs. [8,9] and [10]. The problem of spin has successfully been solved in work [9]: The notion of spin reflects two possible own pulsations of the particle in the real space, which are exhibited by two so-called spin-1/2 projections in the phase space. An integer-valued spin is the property of a composite quantum system.

The existence of inertons has been verified experimentally [12-14]. Since the amplitude of inerton cloud L can much exceed the lattice constant, inertons are able to manifest themselves on the macroscopic scale and we have demonstrated this fact in the experiment described in ref. [12] (see also ref. [15]). Therefore, the quantum mechanical force whose carriers are inertons makes itself evident in the macroscopic range. My colleagues and I have just elaborated a device that measures the inerton radiation of the Earth (in particular, the device might be available for the quantum curriculum).

By this means we have inferred in ref. [10] that the gravitation is a pure dynamic phenomenon and that the gravitational radius of a moving particle is restricted by the amplitude of particle’s inerton cloud that oscillates in the vicinity of the particle along the whole particle path. In other words, in the space beyond the range L there is no any information about the particle. This signifies that inertons should also be recognised as actual carriers of the gravitational interaction (and hence gravitons of general relativity derived in the framework of the phenomenological approach, which neglected the existence of the matter waves, do not exist in nature at all).

2. REASONS FOR GRAVITY

We have to note that similarly to condensed matter physics the submicroscopic concept constructed supposes the making a deformation coat around a particle. The coat differs from the degenerate space in that its superparticles possess mass. The coat has been called [10] the space crystallite and its vibrating behaviour been investigated in some detail. The size of the crystallite is identified with the Compton wavelength $l_{\rm Com}$. According to the definition [8,9], the induction of mass means that the volume of a superparticle changes from its volume in the degenerate space. In other words, if we set that a superparticle constricts with deformation, the mass will be defined as the ratio of superparticle’s initial and final volumes. When a particle moves, the crystallite travels together with it. However superparticles themselves are motionless: the crystallite state migrates by a relay mechanism.

Detailed theoretical consideration of the motion of a canonical particle has shown [8-10] that owing to the interaction with superparticles the particle looses its kinetic energy on the section $l/2$ of the particle path (l is the de Broglie wavelength). The lost energy is spent on the creation of inertons. On the next section $l/2$ the particle absorbing inertons acquires the initial velocity v and so on. Thus inertons indeed form a substructure of the matter waves.

De Broglie [16] considered the behaviour of the particle mass and concluded that the corpuscle dynamics was the basis for the wave mechanics, namely, he obtained and studied the equations of motion of a massive point reasoning from the typical Lagrangian

$$L = -m_0 c^2\, (1 - {\rm v}^2/c^2)^{-1/2}$$

He could show that the dynamics of the particle should be characterised by the variation of its proper mass.

Unifying de Broglie's dynamics of the behaviour of the particle mass [16] with the submicroscopic quantum mechanics stated above, we arrive at the following physical pattern of the gravitation phenomenon [17]. The detailed study of the processes of emission of inertons from a moving particle and then their absorption by the particle points to the fact that the proper mass of the particle oscillates between values $m_0c^2(1- v^2/c^2)^{-1/2}$ and m_0. In other words, the particle's inert mass periodically break-up along the whole particle path; the periodical reduction of the mass occurs within the section l . In the geometrical language this means that the particle volume (i.e. a local deformation of the space) periodically changes between the maximal and minimal values, respectively. An oscillating part of the mass, Dm (or an oscillating part of the particle volume DV), is not transformed into a complex variable. This is an actual deformation of the space, which is emitted and then absorbed in the form of elementary excitations, namely, inertons.

When we consider inertons in quantum mechanics, we are interested in their kinetic energy and momentum. However, when we treat inertons as carriers of a local deformation of the space tesselattice, we have to focus on that peculiarity, which inertons having kinetic energy and momentum transfer. What do inertons carry? Evidently, they transfer bits of the local deformation. That is, inertons remove volume DV (or Dm) from a point of the particle location and atomise this deformation in the space around the particle. This induces the field of deformation of the space surrounding the particle. In paper [17] the said dynamics has been studied in the framework of a specific Lagrangian and it has been shown that inertons scatter from the particle as a standing spherical wave. This wave is reflected from the elastic space tesselattice and come back to the particle. A spherical wave is specified by the law $1/r$ and this implies that the particle's inertons carry the space deformation (or in other words, the gravitational potential) $1/r$ from the particle to the space. The origin of such a potential is stipulated by friction of the moving particle, i.e. its interaction with coming superparticles of the space.

In the case of a classical object, inerton clouds of its entities overlap and form a total deformation field around the object, i.e. the gravitational field. The velocity of inertons may even exceed the speed of light. The very fast oscillation of the inerton cloud creates illusion of a static character of the gravitational field. Nonetheless, Newton's gravitational potential $1/r$ is dynamic. We are able to estimate how far from the object its gravitational potential spreads. For instance, for a solid ball whose volume is only 1 cm^3, simple calculations yield [17] the radius about 300 light years. In paper [18] the mass of inertons emitted by objects whose velocity is small in comparison with *c* has been evaluated; it has been found that the mass varies in a wide spectral range, from 10^{-70} to 10^{-45} kg (much as the photon frequency varies from zero to the frequency of high-level g -photon).

3. CONCLUSION

The research conducted allows the interpretation of the gravitation phenomenon, i.e. the attraction, as a contraction of the space tesselattice between material objects. This is the first interpretation of Newton's gravitational law $1/r$ that is based on the detailed theory of the constitution of the real space and principles of motion of matter. Topology, set theory, and fractal geometry have been used to prove the necessity of the existence of the empty set, which allows the topological spaces result in a 'physical universe.' The empty hyperset has ensured a formal structure that enables the correlation with a degenerate cell (or ball, or superparticle) of space and supports conditions for the existence of a universe.

The theory briefly ascribed herein represents a fruitful collection of views by H. A. Lorentz and L. de Broglie who firmly believed in the necessity of the detailed description of physical phenomena, the viewpoint by P. A. M. Dirac on the necessity of a new (and strict) mathematical basis for the fundamental physical ideas and the revival of an ancient aether, dramatically new physical concepts based on profound analogies with the behaviour of matter in condensed matter physics and an advance mathematical approach to the problem of constitution of the real space.

The theory of gravitation described above can successfully be applied to experiments in the realm of gravitational physics, all the same on the microscopic or macroscopic scales.

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