

Real inertons against hypothetical gravitons. Experimental proof of the existence of inertons*

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Abstract

Previously, one of the authors has suggested [*Phys. Essays* **6**, 554 (1993); **10**, 407 (1997); xxx.lanl.gov quant-ph/9906091] a mechanism of the particle motion within the framework of a vacuum regarded as an original cellular medium, i.e. quantum aether. The existence of special elementary excitations of the aether medium – inertons – around the particle has been the main peculiarity of that mechanism. The present paper treats the impact of inertons on the collective behaviour of atoms in a solid. It is shown that inertons should contribute to the effective potential of interaction of atoms in the crystal lattice. The possibility of separating this inerton contribution from the value of the atom vibration amplitude is analysed. The experiment which assumes the presence of the hypothetical inerton field is performed. The expected changes in the structure of the test specimens caused by this field are in fact convincingly fixed in micrographs.

Key words: space, matter waves, inerton field, condensed matter, lattice vibrations, morphological structure

PACS: 03.75.-b Matter waves – 43.25.+y Nonlinear acoustic – 14.80.-j Other particles (including hypothetical)

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1 Introduction

Gravitational waves of the general theory of relativity are presumed to be real carriers of the gravitational interaction. The waves came out, based on the belief that the matter was highly rarefied, Bergmann [1]: space between distant massive points was perceived to be empty and hence a moving massive point did not interact with a vacuum. It is assumed that gravitational waves are quantized and that quanta of the gravitational field – gravitons – are massless particles (see, e.g. Weinberg [2]). However, it is important to keep in remember that Einstein [3] derived the solutions for gravitational waves in 1918 and those solutions were resting on the pure classical consideration. Quantum mechanics was constructed later in the mid-1920s. It introduced such a notion as the matter waves which are described by the ψ -wave function. And just these waves as we know are of primary importance in determining the behaviour of matter at the scale comparable with the de Broglie wavelength λ of the quantum system studied. On the atom size at which the means of quantum mechanics operates the ψ -wave function is considered as the probabilistic characteristic of the quantum system. The Schrödinger nonrelativistic formalism and the Dirac relativistic one were developed just for the description of steady-states of the electron in an atom in which the de Broglie wavelength λ defines the length of stationary orbit of the corresponding electron. In the range lesser λ the behaviour and construction of the matter waves have not practically been investigated, de Broglie [4].

Turning back to the gravitation we should note that it has never taken into account the presence of the matter waves. In this connection one can raise the question whether the hypothesis of the theory of gravitation about the existence of a macroscopic quantization of space is correct. Probably it is quite reasonable to assume that the theory is based on an essential methodological mistake. Evidently, the main error was made when gravitational waves deduced in the framework of phenomenological theory were quantized in a scale much exceeded the de Broglie wavelength. In other words, the large-scale quantization was thrown on space without any investigation whether such a requantization could exist on the background of reliably established quantization in the microworld. Therefore, in this case one faces a conflict between the general theory of relativity and quantum mechanics. Other significance aspects of the conflict have been discussed in literature as well (see, e.g. Stapp [5]). Moreover, the background of general relativity itself can be reconsidered from new standpoints, Kar [6] (see also Logunov and Metvirishvili [7]).

Modern theories of gravitation try to reach quantum foundations starting from the macroscopic background. However, we can attempt to construct the gravitation phenomenon beginning with quantum mechanics. In fact, one can suppose that the matter waves which are associated with structural blocks (electrons, nuclei, atoms, *etc.*) of an object overlap and form the whole matter field surrounding the object. It is apparent that a solution of this difficult problem will be possible only in the case when we clear up the substructure of matter waves.

Currently several new views on the nature of a vacuum substance have been introduced in quantum physics. Among them one can point out mathematical approaches by Hoyle [8] on the origin of matter, by Kohler [9] on point particles as defects in solid continuum, and Bounias and Bonaly [10,11] who consider the matter as deformations of space and in particular, could find relativistic principles (the Lorentz constriction) and investigate the gravity and quantum properties in the framework of the topology and the set theory. There are also works which consider the vacuum as a special kind of crystal, Fomin [12],

as a "liquid crystal" model, Aspden [13], as a zero point energy field, Haisch *et al.* [14], as an electromagnetic energy density, Vegt [15], as an inelastic Planck aether, Winterberg [16] and as a degenerate electron-positron plasma that dominates the aether, Rothwarf [17]. Winterberg's Planck aether consists of positive and negative Planck masses, which interact locally through contact-type delta function potentials. It is interesting that these potentials are neither electromagnetic nor gravitational. That does Winterberg provide an in-depth analysis has shown that in microcosmos a new type of physical interaction could quite exist.

Previously one of the authors studied [18-20] the motion of a canonical particle in a vacuum regarded as a cellular elastic space. In this approach space is superdensely packed with structural units, or cells – superparticles – which are found in a degenerate state and whose size is of the order of 10^{-28} cm (all kinds of interactions come together at this scale, as required by the grand unification of interactions). It was conceived that a moving particle was interacting with superparticles of the space net and as a consequence elementary excitations called "inertons" were knocked out of the particle. These excitations are virtual, since each emitted inerton is again absorbed by the particle. So a moving particle is constantly surrounded by a cloud of oscillating inertons and this oscillating nature of the motion is also applied to the particle. It has been found that this kind of motion is characterised by the two basic quantum mechanical relations: $E = h\nu$ and $p_0 = h/\lambda$ where p_0 is the initial momentum of the particle and ν and λ are respectively the frequency and amplitude of spatial oscillations of the particle (to put in differently, these are peculiar submicroscopic overdeterminations of the de Broglie wavelength λ and the frequency ν .) As is well known, de Broglie [21], the availability of these two relations enables the wave ψ -function to be introduced which in its turn results in the Schrödinger wave equation. The relationship between the parameters of the particle and the cloud of inertons has the form [18]

$$v_0/\lambda = c/\Lambda. \quad (1)$$

where v_0 is the initial velocity of the particle, c is the initial velocity of inertons (speed of light) and Λ/π is the enveloping amplitude of the inerton cloud which oscillates in the neighbourhood of the particle. Consequently, the particle's inerton cloud is extended on a distance of λ along the particle path and restricted by the size $2\Lambda/\pi$ in the transversal directions. Such motion of the particle studied from the submicroscopic deterministic view-point is easily result in the Schrödinger and Dirac formalism at the atom range [18-20].

It is known that a behaviour of each element of a solid such as the electron or a more composite system (nucleus, atom) is characterised by its own de Broglie wavelength λ and own wave ψ -function. Based on our concept of space we can consider any solid as being built into the space net. In this case one can suggest that it is this inner substance, that exerts control over electrons and atoms in solids, in the same way as space governs a free moving elementary particle [18,19]. The quantity λ of the composite system clearly characterises the coherent motion of all strong-coupling elementary particles of which the system is composed. Therefore, inerton clouds of separate particles merge into a common inerton cloud of the moving system and then relation (1) can be applied to this system as well. The application of the wave ψ -function to the description of the whole composite system should mean that any moving atom/nucleus is shrouded in an inerton cloud much as a free moving elementary particle.

It has been recently demonstrated by the author [22] that clouds of inertons enclosing

electrons reveal themselves in a great number of experiments. Thus based on our results [18-20,22] we can say that the wave ψ -function of any quantum system, from a particle to a solid, is "filled" by a huge number of very light inertons. This means that one may speculate that inertons could be emanated from the ψ -function, that is, from the system's inerton cloud and, because of this, they could be fixed by the instrument. The nature of inertons is not directly associated with the electromagnetism or gravitation. The inertons are more likely to belong to the nature of matter, that is to the space net as it follows from our concept (and the same possibility lies in the Winterberg's aether model [16] as well). Moreover one can infer that just these elementary excitations of space may successfully substitute for hypothetical gravitons of the general theory of relativity (recall that the latter are derived from a pure classical consideration, see e.g. Refs. [1,2]).

The goal of the present work is to study the impact of inertons on the collective behaviour of atoms in a solid. The problem is regarded both theoretically and experimentally. In the first part of the work we show how inerton clouds of separate atoms, which are overlapped in a solid, form a system of entirely cooperated inertons that is interpreted as a field of the matter waves of the body studied. A contribution of inertons to the atoms vibration is considered in the framework of a modified standard model of the harmonic interaction of atoms in the crystal lattice. In the second part of the work an experiment which concerns the possibility of an inerton field to act upon the test specimen is carried out. The microstructure of the reference and test specimens is investigated using the electron microscope. The corresponding micrographs appear in the affixed figures.

2 Inerton contribution to crystal atoms vibration

Atoms in solids vibrate with respect to the equilibrium positions. Let us evaluate the velocity of the atoms passing through the equilibrium position, based on the equality of kinetic and thermal energy

$$Mv_0^2/2 \approx k_B T. \quad (2)$$

At the room temperature, assuming, e.g., for the atomic mass $M = 30M_p$, where $M_p = 1.67 \times 10^{-27}$ kg is the mass of proton at rest, we find from (2) the value of the velocity: $v_0 \simeq 4 \times 10^2$ m/s. The respective de Broglie wavelength is $\lambda = h/Mv_0 \simeq 3.3 \times 10^{-11}$ m. According to our concept any motion of atoms in space should be accompanied by the motion of inertons. Hence, substituting the atoms' values v_0 and λ into expression (1) we obtain for the amplitude of inerton cloud of an atom: $\Lambda \simeq 2.4 \times 10^{-5}$ m, that essentially exceeds the lattice constant $g_0 \simeq 4 \times 10^{-10}$ m. Thus, hypothetical inerton clouds of atoms noticeably overlap in a solid and it is obvious that this overlap should make a definite contribution to the collective behaviour of atoms. Let us study this problem in the context of the standard model of the harmonic interaction of atoms in the crystal lattice.

We will proceed from the Lagrangian

$$L = \frac{M}{2} \sum_{l\alpha} \dot{\xi}_{l\alpha}^2 - \frac{1}{2} \sum_{\vec{l}\alpha, \vec{n}\beta} V_{\alpha\beta}(\vec{l} - \vec{n}) \xi_{\vec{l}\alpha} \xi_{\vec{n}\beta}$$

$$- \sqrt{Mm} \sum'_{\vec{l}_\alpha, \vec{n}_\beta} \xi_{\vec{l}_\alpha} \tau_{\alpha\beta}^{-1} (\vec{l} - \vec{n}) \dot{\chi}_{\vec{n}_\beta} + \frac{m}{2} \sum_{\vec{l}_\alpha} \dot{\chi}_{\vec{l}_\alpha}^2. \quad (3)$$

Here the first two terms describe the vibrations of the sites in a three-dimensional lattice (see, e.g. Davydov [23]) and the last two terms, which we have additionally introduced, describe the interaction of the atoms with inertons and the kinetic energy of inertons. $\xi_{\vec{l}_\alpha}$ ($\alpha = 1, 2, 3$) are three components of atom displacement from the lattice site whose equilibrium position is determined by the lattice vector \vec{l} ; $\dot{\xi}_{\vec{l}_\alpha}$ are three components of the velocity of this atom; $V_{\alpha\beta}(\vec{l} - \vec{n})$ are the components of the elasticity tensor of the crystal lattice. Let m be characteristic mass of the inerton cloud and, if $\chi_{\vec{l}_\alpha}$ ($\alpha = 1, 2, 3$) are three components of the position of the inerton cloud for the atom determined by the lattice vector \vec{l} , then $\dot{\chi}_{\vec{l}_\alpha}$ are three components of the velocity of this inerton cloud. $\tau_{\alpha\beta}^{-1}(\vec{l} - \vec{n})$ are components (generally they might be tensor quantities) of the rate of collisions between the inerton cloud of the atom determined by the lattice vector \vec{n} and with the atom whose equilibrium position is determined by the vector \vec{l} . The prime at the sum symbol means that terms with coinciding indices \vec{l} and \vec{n} are not taken into account in summation.

In a standard way, we carry out canonical transformations in (3) with respect to collective variables, both for atoms ($A_{\vec{k}} = (A_{-\vec{k}})^*$) and for inerton clouds ($a_{\vec{k}} = (a_{-\vec{k}})^*$):

$$\xi_{\vec{l}_\alpha} = \frac{1}{\sqrt{NM}} \sum_{\vec{k}} e_\alpha A_{\vec{k}} e^{i\vec{k}\vec{l}}, \quad (4)$$

$$\chi_{\vec{l}_\alpha} = \frac{1}{\sqrt{Nm}} \sum_{\vec{k}} e_\alpha a_{\vec{k}} e^{i\vec{k}\vec{l}} \quad (5)$$

where $e_\alpha \equiv e_\alpha(\vec{k})$ are components of the polarisation vector and N is the number of atoms in the crystal. On rearrangement, the Lagrangian (3) takes the form

$$L = \frac{1}{2} \sum_{\vec{k}\alpha} e_\alpha \dot{A}_{\vec{k}} e_\alpha \dot{A}_{-\vec{k}} - \frac{1}{2} \sum_{\vec{k}\alpha\beta} \tilde{V}_{\alpha\beta}(\vec{k}) e_\alpha A_{\vec{k}} e_\beta A_{-\vec{k}} - \sum_{\vec{k}\alpha\beta} \tilde{\tau}_{\alpha\beta}^{-1} e_\alpha A_{\vec{k}} e_\beta \dot{a}_{-\vec{k}} + \frac{1}{2} \sum_{\vec{k}\alpha} e_\alpha \dot{a}_{\vec{k}} e_\alpha \dot{a}_{-\vec{k}} \quad (6)$$

where real elements of force matrices are

$$\tilde{V}_{\alpha\beta}(\vec{k}) = \frac{1}{M} \sum_{\vec{l}} V_{\alpha\beta}(\vec{l}) e^{i\vec{k}\vec{l}}, \quad (7)$$

$$\tilde{\tau}_{\alpha\beta}^{-1}(\vec{k}) = \sum_{\vec{l}} \tau_{\alpha\beta}^{-1}(\vec{l}) e^{i\vec{k}\vec{l}}. \quad (8)$$

Euler-Lagrange equations

$$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{Q}_s} \right) - \frac{\partial L}{\partial Q_s} = 0$$

for the variables $Q_1 = e_\alpha A_{\vec{k}}$ and $Q_2 = e_\alpha a_{\vec{k}}$ are respectively

$$e_\alpha \ddot{A}_{-\vec{k}} + \sum_{\beta} [\tilde{V}_{\alpha\beta}(\vec{k}) e_\beta A_{-\vec{k}} + \tilde{\tau}_{\alpha\beta}^{-1}(\vec{k}) e_\beta \dot{a}_{\vec{k}}] = 0; \quad (9)$$

$$e_\beta \ddot{a}_{-\vec{k}} - \sum_\alpha e_\alpha \tilde{\tau}_{\alpha\beta}^{-1}(\vec{k}) \dot{A}_{\vec{k}} = 0. \quad (10)$$

Differentiating Eq. (9) with respect to time and replace $(-\vec{k})$ for \vec{k} we obtain

$$e_\alpha \ddot{A}_{\vec{k}} + \sum_\beta [\tilde{V}_{\alpha\beta}(\vec{k}) e_\beta \dot{A}_{\vec{k}} + \tilde{\tau}_{\alpha\beta}^{-1}(\vec{k}) e_\beta \ddot{a}_{-\vec{k}}] = 0. \quad (11)$$

Substituting $e_\beta \ddot{a}_{-\vec{k}}$ from Eq. (10) into Eq. (11), we gain the equation for $A_{\vec{k}}$ which after integration over t changes to

$$e_\alpha \ddot{A}_{\vec{k}} + \sum_\beta W_{\alpha\beta}(\vec{k}) e_\beta A_{\vec{k}} = C \quad (12)$$

here C is the integration constant and the force matrix

$$W_{\alpha\beta}(\vec{k}) = \tilde{V}_{\alpha\beta}(\vec{k}) + \tilde{\tau}_{\alpha\beta}^{-1} \sum_{\alpha'} \tilde{\tau}_{\alpha'\beta}^{-1}(\vec{k}) \frac{e_{\alpha'}}{e_\beta}. \quad (13)$$

Eq. (12) has the form of a standard equation for collective variables of the crystal lattice and it determines three frequencies $\Omega_s(\vec{k})$ ($s = 1, 2, 3$), that is, three branches of acoustic vibrations: one longitudinal branch (along \vec{k}) and two transverse ones (normal to \vec{k}). The equation for the frequencies $\Omega_s(\vec{k})$ has the form

$$|\Omega_s^2(\vec{k}) - W_{\alpha\beta}(\vec{k})| = 0. \quad (14)$$

But in our case, as seen from (13) the force matrix $W(\vec{k})$ comprises in addition to the elastic (electromagnetic nature) component $\tilde{V}(\vec{k})$ also the inerton component caused by overlapping the inerton cloud of each atom with the adjacent atoms and proportional to $(\tau^{-1})^2$.

It seems likely that in a crystal under ordinary conditions the correction $(\tau^{-1})^2$ to the elastic matrix $V(\vec{k})$ is small. But given a sufficiently intensive external source of inertons, this correction can substantially increase and then the inerton component can show up explicitly. Indeed, given an external inerton source, Eq. (10) is replaced by the generalised equation

$$e_\beta \ddot{a}_{-\vec{k}} - \sum_\alpha e_\alpha \tilde{\tau}_{\alpha\beta}^{-1}(\vec{k}) \dot{A}_{\vec{k}} = f_{\vec{k}\beta} \cos(\omega_{\vec{k}} t). \quad (15)$$

With the permanently acting source, when the external force $f_{\vec{k}} > \tilde{\tau}^{-1} \dot{A}_{\vec{k}}$, the equation

$$e_\beta \ddot{a}_{-\vec{k}} \simeq f_{\vec{k}\beta} \cos(\omega_{\vec{k}} t) \quad (16)$$

follows from (15). Integrating (16) over t and then substituting $e_\beta \dot{a}_{-\vec{k}}$ from (16) into (9), we obtain the equation

$$e_\alpha \ddot{A}_{\vec{k}} + \sum_\beta \tilde{V}_{\alpha\beta}(\vec{k}) e_\beta A_{\vec{k}} = \sum_\beta \frac{\tilde{\tau}_{\alpha\beta}^{-1}(\vec{k})}{\omega_{\vec{k}}} f_{\vec{k}} \sin(\omega_{\vec{k}} t). \quad (17)$$

At a sufficiently large value of the permanent disturbance, e.g. along the projection e_1 , it is easy to find from (17) the amplitude $A_{k_1}^{(0)}$ of collective vibrations of atoms:

$$A_{k_1}^{(0)} = f_{k_1} \frac{\tilde{\tau}_{11}^{-1}/\omega_{\vec{k}}}{\Omega^2(\vec{k}) - \omega_{\vec{k}}^2} \quad (18)$$

and, therefore, the amplitude of individual atom vibration

$$\xi_{n_1} = \frac{1}{\sqrt{NM}} \sum_{k_1} A_{k_1}^{(0)} e^{ik_1 n_1} \quad (19)$$

(as is generally known, the consideration of friction η enables the limitedness and constant sign of amplitude $A_{k_1}^{(0)}$ in (18)). Thus, it is easily seen from (19) and (18) that given disturbing force $f_{\vec{k}}$ of the applied inerton field, the amplitude of atom vibrations in the crystal should increase, especially at resonance.

3 Source of inertons

A condensed medium and, in particular, our planet itself could be considered as a source of inertons. Moreover, two types of stationary inerton flows can be set off in the terrestrial globe; their availability being associated with the motion of the Earth: 1) the orbital motion around the Sun with the velocity $v_{01} \simeq 30$ km/s and 2) the proper rotation; with this motion the velocity changes from $v_{02} = 0$ in the centre of the Earth to $v_{02} = 2\pi R_{\text{Earth}}/24$ hour $\simeq 462$ m/s in the equator surface.

Actually, the motion of atoms of the Earth considered to be an ideal globe moving as a single unit apparently does not differ in principle from the motion of a free particle [18-20]. Structural bonds, which keep atoms in the globe, lead to the coherence of their motion. If we assume that the mean mass of atoms of the Earth is $M = 30M_p$, then the de Broglie wavelength for the two types of the motion will be $\lambda_1 = h/Mv_{01} \approx 4 \times 10^{-13}$ m and $\lambda_2 = h/Mv_{02} \approx 1.5 \times 10^{-11}$ m respectively. Substituting the values $\lambda_{1(2)}$ and $v_{01(02)}$ into formula (1), we acquire the amplitudes of inerton clouds of the moving atoms of the terrestrial globe: $\Lambda_1 \approx 8 \times 10^{-9}$ m and $\Lambda_2 \approx 4 \times 10^{-5}$ m. In both cases the overlap of inerton clouds is substantial ($\Lambda_1/g_0 \sim 10$ and $\Lambda_2/g_0 \sim 10^4$), but due to inequality $\Lambda_2 \gg \Lambda_1$ the degree of coherence between atoms is greater along the velocity vector \vec{v}_{02} (i.e., along the West-East line) than along the orbital velocity vector \vec{v}_{01} .

Deviations from coherence in the motion of atoms caused by thermal fluctuations and various mechanical, physical and chemical processes produce excitation of the atoms and as a result generation of acoustic waves takes place. As a consequence corresponding excitation of inertons (inerton waves) accompanying the acoustic waves will appear as well. We may expect that owing to the inequality $\Lambda_2 \gg \Lambda_1$ the generated inerton waves will have a maximum intensity along the West-East line. The velocity of the generated inerton wave propagation may be equal to (or even exceed) the speed of light.

4 Resonator

If inerton waves really exist, then we can try to amplify their intensity in a resonator and then to register the waves experimentally. Let us consider characteristics which a resonator of inerton waves of the Earth should possess. As mentioned above, we can separate out two types of inerton waves propagating in the terrestrial globe: 1) radial waves propagation along the diameter (in parallel and antiparallel with the orbital velocity

vector \vec{v}_{01} of the Earth) and 2) tangential waves propagation over the surface zone of the Earth along the equatorial West-East line (i.e., along or against the vector of the rotational velocity \vec{v}_{02} of the Earth on the equator). In the former case, the inerton wave front travels a distance $L_{\text{rad}} = 4R_{\text{Earth}}$ in the cyclic period and in the second case $L_{\text{tan}} = 2\pi R_{\text{Earth}}$. From these two expressions we obtain the relation

$$L_{\text{tan}}/L_{\text{rad}} = \pi/2. \quad (20)$$

Apparently, relation (20) also characterises the ratio between the wavelengths of the tangential and radial n th harmonics.

The time of passing of the mentioned distances by the front of an inerton wave is equal to $L_{\text{tan}}/c \approx 0.13$ s and $L_{\text{rad}}/c \approx 0.09$ s correspondingly where we take the speed of light c for the velocity of spreading of inerton waves. So, if the lifetime of acoustic waves which are excited in the directions L_{tan} and L_{rad} far exceeds these two magnitude, for instance by ten times, then inerton waves accompanying the acoustic waves can turn round and pass through the Earth the same number of times to the moment when the acoustic excitations are fully scattered or absorbed (and hence the inerton waves scattered too).

Let us assume that a material object is located in the globe surface far from its poles. The object has linear dimensions l_{tan} in the horizontal plane along the West-East line and l_{rad} in the vertical direction, that is radial one. Now, if the above dimensions satisfy relation (20), that is

$$l_{\text{tan}}/l_{\text{rad}} = \pi/2, \quad (21)$$

then this object can play the role of a resonator of inerton waves of the Earth since the object has a form similar to the Earth sphere (in the limit $l_{\text{tan}}, l_{\text{rad}} \ll R_{\text{Earth}}$). Such a resonator could amplify inerton waves, which have wavelength l_{tan} in the horizontal direction and l_{rad} in the vertical one and could also amplify their harmonics.

5 Experimental

Of course, it is by no means a simple problem to register the amplification of the amplitude of atom vibrations in the specimen in question placed into the resonator, the more so as we can say *a priori* nothing about the figure of merit of the resonator. However, a conclusion about the existence of inerton field can be made from the resulting integral effect.

The amplification of vibrations of the atoms of the test specimen in the resonator under the effect of the force of the inerton field can apparently be considered as an analogy of the effect of ultrasound or micro waves sound. This is evident from expression (13): the total force matrix of a crystal is formed by the two terms having the same rights. As is generally known (see, e.g. Yavorskii and Detlaf [24]), the effect of destroying and crushing various structures and polishing surfaces is characteristic of ultrasound. Thus, in our case, the experiment can be carried out to study the extent of changes in the non-uniformity surface of the specimen (its polish, finish or sharpening) which stayed in the resonator for some time.

The resonator was made of two identical rectangular plates of organic glass (transparent in the visible optical spectral band and with the dimensions of the plate 20×16.5 cm²

and the plate thickness 3 mm) which were sharpened and bonded together along one of the long sides. The angle of inclination of each of the plates with respect to the horizontal has made up 52° so that in the section perpendicular to the line of bonding of the plates, the resonator had the shape of a triangle. The dimensions of the base of the triangle $l_{\text{tan}} = 20$ cm and of the height $l_{\text{rad}} = 12.7$ cm satisfy relation (21). The resonator was placed on a polished wooden horizontal surface. No objects were found at a radial distance of about 70-cm from the resonator. The upper edge of the resonator (the line of the plates bonding) was oriented along the North-South line and, therefore, one plate faced the West and the other the East. A wooden support column 4.5 cm height, with the cross-section area 1×1 cm² was placed in the center of the resonator and the specimen being tested was put on the column.

Our investigation was related with the cutting edge (point) of a razor blade, but prior to putting it into resonator, a small reference specimen in area 15×7 mm² was cut out of the blade (the first dimension is the length of the cutting edge). The blade was put on the column in the resonator so that the axis of the blade was oriented along the North-South line. The main action on the blade on the part of inerton waves was expected in the plane of the blade along the West-East line (this action amounts to a peculiar sharpening of the cutting edge) and the less intensive action – along vertical direction. Razor blades produced by four different companies have been studied: "Shick" (the Netherlands), "BIC" (Hungary), "Sputnik" (Russia) and "Gillette" (the U.K.). Investigation of the structure of the cutting edge point of the reference specimen and of the specimen subjected to the hypothetical inerton field was carried out by scanning electron microscope JSM-35 (Japan) operated in secondary electron mode under 25 kV accelerated voltage. As for the blades of the first three companies the time of exposure of test specimens in the resonator varied from one to two weeks. Nevertheless no substantial distinction has been observed. In this connection the exposure time was increased up to 30 days.

Fragments of the cutting edge of a "Gillette" blade are presented for comparison in Fig. 1 (the reference and test specimens, micrographs *a* and *b*, respectively). The same for one more "Gillette" blade, Fig. 2 (the reference (*a*) and test (*b*) specimens). The Figs. 1 and 2 show that the fine structure well discernible on the reference specimen (Figs. 1*a* and 2*a*) is substantially smothered on the edge of the blade which has stayed in the resonator for a month (Figs. 1*b*, 2*b*). The morphologically more coarse structure is well preserved. (Note that pressure, temperature, humidity, etc. could not make any changes in the morphological structure of the test metal specimen separated from the reference one by 1.5 meters; the two specimens were found under the same atmospheric conditions.)

It can be seen that the established difference in the microstructure of the cutting edge of the razor blade confirms the qualitative treatment performed in Section 2 regarding the increase of the amplitude of atom vibrations under the external inerton field. In fact, it is central tenet of our concept that the influence of the acoustic or inerton field on any heterogeneity-crystallite of the specimen is not fundamentally different. There was no ultrasound in our experiment and therefore changes revealed in the fine structure of the specimens could arise only from the impact of Earth's inerton field. From the above reasoning it is clear that a macroscopic mechanism of these changes is identical to peculiarities of the absorption of sound in polycrystalline bodies, Landau and Lifshitz [25]. Thus, if the wavelength of the sound λ_{sound} is large as compared to the size d of individual crystallites, then each crystallite being in the field of this sound wave is



Figure 1: Micrographs of the cutting edge of the "Gillette" blade; top view of the edge [3000×]: *a* - reference specimen; *b* - test specimen.

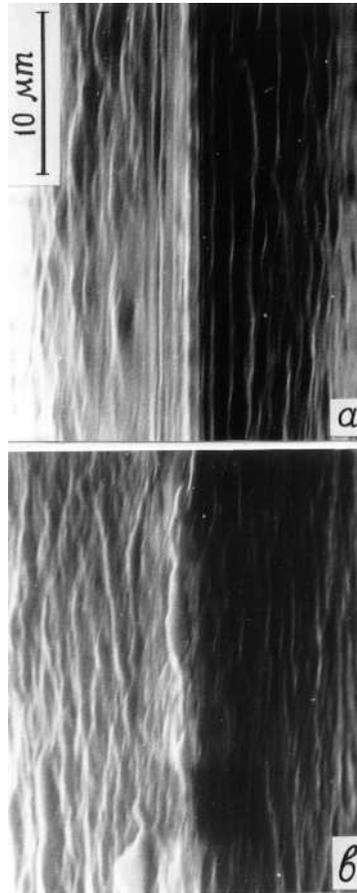


Figure 2: Micrographs of the cutting edge of one more "Gillette" blade [3000×]: *a* - reference specimen; *b* - test specimen.

subjected to an uniformly distributed pressure. However, the deformation arising in this case is nonhomogeneous due to anisotropy of the crystallites and boundary conditions on their contact surfaces. As can be seen from the Figs. 1 and 2, the typical size d of a crystallite in the blade is approximately $(0.1 - 1) \mu\text{m}$. The acoustic frequency is limited by the value $\nu_{\text{Debye}} \sim 10^{13}$ Hz and owing to our main supposition that acoustic waves generate inerton waves, we should ascribe this frequency also to the latter (see expressions (14) and (13)). Let us take the speed of light c for the velocity of spreading of an inerton wave. Then we can make an estimation of the lower length of the inerton waves excited in the Earth which propagate through the specimen and destroy its fine morphological structure: $c/\nu_{\text{Debye}} \approx 30 \mu\text{m}$. The upper value of inerton wavelength was obviously limited by the resonator dimensions – approximately 12 cm. So the wave length and frequency spectra of inerton field influenced the specimen in the resonator were restricted by the following uncertainties:

$$\begin{aligned} 30 \mu\text{m} < \lambda_{\text{iner}} < 12 \text{ cm}; \\ 2.5 \times 10^9 \text{ Hz} < \nu_{\text{iner}} < 10^{13} \text{ Hz}. \end{aligned}$$

If the whole system is swung through 90° , i.e. the planes of the resonator and the cutting edge of the blade are oriented to the North and South, then no distinctions are observed between the fine structure of the test and the reference specimens after the blade has stayed in the resonator for 30 days (Fig. 3). This points to the fact that generation of the coherent inerton field of the Earth along the North-South direction is absent.

6 Concluding remarks

The present research unambiguous demonstrates that a vacuum should be considered in the form of a cellular elastic space. A submicroscopic analysis of the behaviour of objects in space performed in Refs. [18-20,22] and in this work has shown that any motion of objects is accompanied by elementary excitations of space called inertons. It is obvious that these quasi-particles should replace gravitons – hypothetical massless particles of the classical general theory of relativity. In fact, gravitons were deduced on the assumption that a moving massive object did not interact with the surrounding space (space was supposed to be empty); besides, gravitons did not occupy any place in quantum mechanics. By contrast, inertons fit naturally into quantum mechanics explaining physical processes, which are veiled from view by its formalism. Our data evidently display the existence of inertons in the system studied.

In such a manner inerton waves should be present in any system consisting of a large number of bound particles. These waves are excited and propagate in space and can influence material objects. In particular, our planet itself is an inerton generator and, evidently, the Earth inerton field may be considered as an alternative to the aether wind which, speaking the language of physicists of the nineteenth and early twentieth centuries, Born [26], the Earth might experience in its motion through the world aether.

Surprisingly, the mankind is familiar with the effect of influence of the Earth inerton waves over a long time. Egyptian pyramids are an glowing example. It is well-known (see, e.g. Schul and Pettit [27]) that Egyptian pyramids and their small models possess inexplicable properties: the pyramids provide the mummification of animal remains, depress germination of moistened grains, keep up the razor blades sharp, *etc.* The base of



Figure 3: Micrographs of the reference (*a*) and test (*b*) specimens ("Gillette" blade) [3000×] when the resonator planes and cutting edges of the blade are oriented to the North and South.

the pyramid is a square oriented with a high degree of accuracy to the directions of the world. The ratio between the side of the square a_{pyr} and the height h_{pyr} of the pyramid satisfies relation (21): $a_{\text{pyr}}/h_{\text{pyr}} = \pi/2$. This means that like our resonator, which has the shape of a partly open book, the Egyptian pyramid is a resonator for inerton waves generated by the Earth as well. By the way, the word *pyramid* means the "inside fire" in Ancient Greek, that is the word itself alludes to some inner properties of the pharaoh monument rather than points to the monument habit.

Review by Puthoff and Targ [28] describes experiments on transmission of mental information over a distance of hundreds kilometers by extrasensitive participants placed into a special metal room. The room shielded the participant-sender by two metal screens; hence the room was absolutely impenetrable for the electromagnetic field. Nevertheless the information transmitted via the perceptive channel from one participant to another was received successfully. However, it was pointed out in Ref. 28 that the transmission was efficient only along the West-East line; but it is just this direction that the intensity of inerton waves of the Earth is maximum. It is not ruled out that the inerton field as an informational field plays an important role in other phenomena of parapsychology (on parapsychology see, e.g. Dubrov and Pushkin [29], and Morgan and Morris [30]).

Of course the existence of inerton field should beyond any reasonable doubt be sustained by other pure physical experiments. Such candidates are in stock at present. Specifically, unusual effects of the multiphoton ionisation of atoms of gas or "effective photon", Panarella [31], caused by low energy photons provide a useful check on the availability of clouds of inertons enclosing electrons [22]. Other remarkable unusual physical effects revealed in the area of optical phenomena such as diffraction/diffractionless of a single photon, Panarella [32], photon as a particle-wave, Mizobuchi and Ohtake [33], and particle tunneling and superluminal photonic tunneling, Nimtz and Heitmann [34] can be easily understood from the submicroscopic view-point drawing inertons which should be an integral part of the systems studied and setups used by the researchers as well.

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