Equations with Oscillating Charge in Unitary Quantum Theory

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Abstract

There are considered in the paper so called equations with oscillating charge which are the important elements of Unitary Quantum Theory. There are described within bounds of this theory the behavior of micro-particle in many quantum problems as the passing or reflection of potential barriers, wells, the tunnel effect, the particle scattering etc. and are observed some interesting quantum phenomena not corresponding to standard Quantum Mechanics There is constructed the mathematical model of Coulomb barrier's overcoming, which shows the practical possibility of the cold nuclear fusion although the standard Quantum Mechanics denies such possibility.

Keywords: Unitary quantum theory, Equations with oscillating charge, Potential step, Barrier, Well, Tunnel effect, Particle scattering, Overcoming of Coulomb barrier

1. The constructive way to the equations with oscillating charge

The equations named "Equations with oscillating charge" are the important elements of our Unitary Quantum Theory (UQT). There are two forms (non-autonomous and autonomous) of these equations. For the first time, the non-autonomous equation was simply postulated in 1994 (L.G.Sapogin, 1994), where this equation was used for description of cold nuclear fusion process due to mutual deuteron interaction. This equation has the following form

$$m\frac{d^2\mathbf{r}}{dt^2} = -2Q\,\mathrm{grad}U(\mathbf{r})\cos^2\left(\frac{mt}{2\hbar}\left(\frac{d\mathbf{r}}{dt}\right)^2 - \frac{m\mathbf{r}}{\hbar}\frac{d\mathbf{r}}{dt} + \varphi_0\right), \tag{1.1}$$

where m is the mass, $\mathbf{r}$ is the radius vector, $U(\mathbf{r})$ is the external potential, φ_0 is the important parameter called "initial phase" and Q is charge of particle.

The heuristic premises to the equation (1.1) were following. It was obtained (Sapogin L.G., Boichenko V.A., 1988, 1991) the solution of the simplified scalar integro-differential equation of UQT that resulted in a periodically appearing and vanishing wave packet (identified with a particle). The integral of bilinear of such wave-packet over the whole volume turned out to be equal to the value of the dimensionless elementary electric charge with the precision up to 0.3% (Sapogin L.G., Boichenko V.A., 1988, 1991). It was easy to associate such wave-packet with simple space electric charge oscillation that has a double charge amplitude, i.e. with an oscillating point charge described by a general Newton equation but taking into consideration the changes of points characteristics within process of movement. In the essence, it is simply the next step in material point's motion theory. It is not a new idea for ordinary mechanics. There are well known equations of I.Mestchersky for the motion of variable mass bodies and K.E.Tsiolkovsky equations for the rockets motion.

The constructive way from the Schroedinger equation to our equation (1.1) was published (L.G.Sapogin, 1994, 1996) a lit bit later (see also L.G.Sapogin, Yu.A.Ryabov, V.A.Boichenko, 2005, 2008). It has been not strict deduction but, so to say, some "deriving".

Let us notice at the same moment that quantum mechanics is the more general science than classical mechanics. As it approaches the limit quantum mechanics results in classical mechanics. However, that fact had not prevented Erwin Schroedinger to obtain his famous equation from relations obtained within Newton mechanics. E.Schroedinger himself (and many other researchers) considered it not as rigorous deduction but a peculiar illustration because it is impossible to derive this equation strictly from classical mechanics, and this equation was, in fact, postulated. Quite similarly, our equation with oscillating charge does not correspond strictly to the Schroedinger equation. Our "deriving" of equation (1.1) from Schroedinger equation is following. Let us do it for one-dimensional case, since 3-dimensional generalization is too complicated. The complete Schroedinger equation with potential $U(x)$ is following:

$$\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\Psi(x,t)+i\hbar\frac{\partial}{dt}\Psi(x,t)=U(x)\Psi(x,t) \tag{1.2}$$

We will seek the solution of this equation in non-traditional form:

$$\Psi(x,t)=\cos(kx)\int\exp(itg(\varphi))dt, \tag{1.3}$$

where

$$\varphi=\frac{mt}{2\hbar}\left(\frac{dx(t)}{dt}\right)^2-\frac{mx(t)}{\hbar}\frac{dx(t)}{dt}+\varphi_0 \tag{1.4}$$

The x(t) function is some function of time and is not connected in any way with independent variable x in equation (1.2). By substituting (1.3) in (1.2) we get:

$$i\hbar^2k^2\int\exp(itg(\varphi))dt+2imU(x)\int\exp(itg(\varphi))dt+2\hbar m\exp(itg(\varphi))=0 \tag{1.5}$$

For the very small kinetic energies the following relation always holds true:

$$\hbar^2k^2<<2mU(x).$$

Then we may neglect the first integral in (1.5). Differentiating the remnant part in time and reducing general exponential factor we obtain:

$$2U(x)\cos^2(\varphi)+2mt\frac{dx(t)}{dt}\frac{d^2x(t)}{dt^2}-m\left(\frac{dx(t)}{dt}\right)^2-2mx(t)\frac{d^2x(t)}{dt^2}=0 \tag{1.6}$$

If we use the relation

$$x(t)\approx t\frac{dx(t)}{dt},$$

that may be considered true for short time-intervals, then in equation (1.6) items 2 and 4 are canceled and we obtain:

$$U(x)\cos^2(\varphi)=\frac{m}{2}\left(\frac{dx(t)}{dt}\right)^2 \tag{1.7}$$

In the equation (1.7) left side is oscillating potential energy, right is kinetic energy. Unfortunately, we do not observe mutual transformation of kinetic energy into potential one and back (as it is in classical mechanics of different conservative systems). It seems that potential energy oscillate because the whole packet appears and disappears together with the charge. At the other side, kinetic energy apparently is connected with Fourier harmonic components of moving packet that results in appearance and disappearance of mass due to dispersion in the process of moving. Then we shall assume that independent variable *x* should be replaced by *x(t)* in the potential; we have no other simple ideas. In that case we get the following relation:

$$U(x(t))\cos^2(\varphi)=\frac{m}{2}\left(\frac{dx(t)}{dt}\right)^2. \tag{1.8}$$

This relation is well known in the analytical mechanics if $\varphi=const$. Then we obtain after differentiation right and left parts (1.8) in respect to t following another relation

$$m\frac{d^2x(t)}{dt^2}=\frac{dU\ (x(t))}{dx}\cos^2\varphi \tag{1.9}$$

which coincides essentially with our equation (1.1) in one-dimension case (the sign minus or plus corresponds to the attractive or to the repulsive potential, the multiplier 2 is needed for correct transition to equation of classical mechanics because the averaged in φ charge will be two times smaller). In 3-dimensional case we obtain the same result. Notice, equation (1.9) is non-autonomous according to expression (1.4) for φ. If we neglect the member proportional to time t in the expression of φ (i.e. if we neglect possible fast oscillations of $\cos(\varphi)$) then we obtain our autonomous equations with oscillation charge that may be written as follows:

$$m\frac{d^2\mathbf{r}}{dt^2}=-Q\,\mathrm{grad}\,U(\mathbf{r})\cos^2\left(-\frac{m\mathbf{r}}{\hbar}\frac{d\mathbf{r}}{dt}+\varphi_0\right) \tag{1.10}$$

Of course, this method of "deriving" will not delight anybody, but it differs a little

from accepted cancellation of divergences in quantum field theory, when infinities being subtracted one from the other are canceled. Certainly, our equations with oscillating charge (1.1), (1.10) are rather crude approximations. Our main task, however, was to show there exists certain correspondence between our equations and the Schroedinger equation. Viz., we have obtained some relations which link together the coordinates, the charge of particles (identified with a wave packet), the potential and these relations correspond approximately (may be very approximately) to those which are described by the Schroedinger equation which do not pretends in own turn to full adequacy in respect to real processes. The question what relations are nearer to real physical micro-world requires many further researches and experiments.

It is quite understandable that equation with oscillating charge cannot strictly describe interference processes since according to it moving particle should have bifurcation's states (particle should physically divide). That is why using of our equations is apparently limited to the cases of small energies and to the cases when there is evidently no interference or strong diffraction. In other words, to the cases when the wave packet is being reflected or dispersed as a whole.

The meaning of solutions obtained from our and from the Schroedinger equations is quite different. The last allow to calculate or to estimate only the probability of particle's location or other particle's characteristics at given place or at given moment of time. The notion of trajectory of particle's motion is missing. Our equations are in essence some generalized variants of Newton's equations describing material point's (particle's) motions. Their difference from usual Newton's equations consists in following: there are taken into account the changes of particle's properties during the movement. There are well known examples of such equations in usual mechanics. Viz., the equations of Mestshersky for the bodies with variable mass, the equations of Tsiolkovsky for the rockets motion. Using solutions of our equations for different initial phase φ_0 we acquire the possibility to construct different theoretical trajectories of particles (identified with wave packets), to analyze the properties of these trajectories, to describe (certainly, approximately) the behavior of particles wave packets in terms of images and movements.

But there are some parallels between our equations and the Schroedinger equation. The first is following. The parameter φ_0 contained in our equation takes part of so called "hidden" parameter and the values of this parameter for one or other wave packet are not controllable theoretically. So, the results obtained by using our equations have strictly speaking probabilistic character as in the case of using the Schroedunger equation. But such property of our result follows from mathematical formalism of our theory. The other very interesting parallel is following. It is known due to experiments that in the case of charged particle movement in plane condenser with the constant tension to be applied the classical accelerated motion $x=at^2$ appears. Our non-autonomous equation with oscillating charge possess exactly such analytical solution. The Shroedinger equation has physically similar solution also. Viz., let potential in Schroedinger equation be equal $U(x)=rx$. Then complete Schroedinger equation is as follows:

$$\frac{\hbar^2}{2m}\frac{\partial^2\Psi(x,t)}{\partial x^2}-rx\Psi+i\hbar\frac{\partial\Psi(x,t)}{\partial t}=0 \tag{1.11}$$

We will seek the solution in rather unusual form:

$$\Psi(x,t)=b\exp\left(i\frac{ma^2t^3}{2\hbar}-i\frac{matx}{\hbar}\right) \tag{1.12}$$

By substituting (1.12) in (1.11) we get:

$$-2ma^2t^2 + (ma - r)x = 0.$$

This relation will be fulfilled if

$$x = \frac{2ma^2}{ma - r}t^2. \tag{1.13}$$

This result confuse untrained reader, because in equation (1.11) x and t are independent from each other variables. Such idealization is inherent and convenient in mathematics, but the real situation is slightly others: during motion the truly independent variable is time only. Generally speaking, coordinate is dependent variable and at given velocity is connected with time by means of the relation (1.13). If we impose in (1.11) the requirement $r \to 0$ (potential vanishes), then absolutely strange particular solution appears where the particle is able to move with constant acceleration and to generate energy no of an unknowns where origin (!!!) Of course, it is out of understanding how such initial conditions could be created. That effect remains valid even if we put $r \to 0$ directly in equation (1.13). From the standard physics point of view the motion of quantum particle within the field of constant potential never differs from the motion in empty space free from any field, because, as a rule, potential is determined up to arbitrary constant (well known calibration) and that constant may be always selected so as potential would be equal zero. Such solution of the equation (1.11) for wave function with increasing frequency (energy) has been discovered independent from us by Dr. Bill Page - USA (particular report) in the form of combinations of Airy functions. The same solutions can be obtained for Dirac equation. Curious, but we have similar situation in classical electrodynamics. If during acceleration of a charge one takes into account force acting on a charge itself, then the braking due to radiation arises. In different works this effect is called in different way: "bremsstrahlung", Lorenz frictional force or Plank's radiant friction. That force is proportional to third derivative of coordinate x relative to time and was experimentally proved many years ago. If we write the equations of motion for the charge moving in space free from external fields impact and if the only force acting on the charge is the "Plank radiant friction", then we would obtain following equation:

$$m\frac{d^2x}{dt^2} = \frac{2e^2}{3c^3}\frac{d^3x}{dt^3}$$

It is evident that equation in addition to trivial and natural particular solution $v=\frac{dx}{dt}$=Const has general solution where particle acceleration is equal

$$a = \frac{d^2x}{dt^2} = C_1 \exp(\frac{3mc^3t}{2e^2}),$$

i.e. is not only unequal to zero, but more over it unrestrictedly exponentially increases in time for no reason whatever!!! For example, L.Landau and E.Lifshits in their classical work "Theory of the field" wrote apropos of this: "*A question may arise how electrodynamics satisfying energy conservation law is able to give rise to such an absurd result in accordance to which a particle was able to unrestrictedly increase its energy. The background of that trouble is, actually, in infinite electromagnetic "eigen mass" of elementary particles. If we write in equations of motion finite charge mass, then we, in essence, arrogate to it formally an infinite, formally, negative "eigen mass" of not electro-magnetic origin that together with electro-magnetic mass should result in finite mass of particle. But as far as subtraction of one infinity from another is not mathematically correct, that leads to troubles as described above".* We are going to tell about such astonishing solutions, where excess energy appears in further sections of our paper.

2. Passage of potential step

Overcoming the potential step is one of the simplest problems of Quantum Mechanics, especially in the case of a right-angle step. The standard quantum theory affirms following: if the kinetic energy of a particle is less than the potential energy of the barrier, then this particle is always reflected. At the same, there is always within standard quantum mechanics the probability of detecting this particle at some distance on the other side of the barrier (i.e. located on the top of the step) and that probability decreases exponentially with distance tending to zero. In other words, there is always some probability that the particle dives at first deep into barrier and later returns. But the mentioned process is not well understood from the physical point of view. *One may ask what*

causes the particle to return if it is located already on the horizontal top of the barrier? Nothing is affecting the particle; nothing prevents it from advance with constant speed. The reason and logic seem to be violated. Our theory (UQT) removes such question. Consider the behavior of a particle described by our equation with oscillating charge. The numerical mathematical simulation of a right-angle potential is rather complicated. More over there is no such a real potential in the microcosm. So let us investigate that problem in more real case (Woods-Sacson modified potential):

$$U(x)=\frac{U_0}{1+exp\left(-\frac{x}{a}\right)},$$

where $U_0>0$, $a>0$ (Fig.2.1). Our autonomous equation with oscillating charge are following (if $a = 1$):

$$m\frac{d^2x}{dt^2}+\frac{2U_0exp(-x)}{(1+exp(-x))^2}cos^2\left(m\frac{dx}{dt}x+\varphi_0\right) \tag{2.1}$$

in autonomous case and

$$m\frac{d^2x}{dt^2}+\frac{2U_0exp(-x)}{(1+exp(-x))^2}cos^2\left(\frac{m}{2}\left(\frac{dx}{dt}\right)^2t-m\frac{dx}{dt}x+\varphi_0\right). \tag{2.2}$$

in non-autonomous case. The attempts to construct analytical solutions of these equations (including the cases of potentials like *arctan(x)* or *th(x)*) were not successful, and we used numerical integration for various initial data and initial phases. We calculated the trajectories (*x* as the function of time *t*) for more, than 10 000 particles. Some trajectories are shown in Fig.2.2. The trajectory 1 corresponds to straight reflection. The trajectory 2 can be explained as follows: the particle does not overcome the barrier but penetrates inside, some time moves within barrier, and returns later. The trajectory 3 shows that the particle penetrates into the barrier after the same interval of time as the particles 1 and 2, but thereafter moves away with very low speed and a vanishing charge. It is not the particle now but miserable remainders. From UQT wave packet point of view the particle is nearly absolutely spread throughout the cosmos, becomes a mathematical phantom.

We calculated also the number (the percentage) of all particles passing the barrier with respect to initial velocity. There was derived also the distribution curves for velocities and charges of passed particle. The calculations have revealed also the following features. Viz., at first, there is quite narrow interval of initial phase φ_0 values which allows a particle to penetrate the high barrier. With the increase of barrier height that interval is narrowing around $\frac{\pi}{2}$. At second, if the particle overcomes the barrier it comes away with very low speed and a vanishing small charge with the distance away and becomes a phantom (see the curve 3 in Fig.2.2).

We have obtained also the results of mathematical modeling of particle passing over potential barrier of following form:

$$U(x)=\frac{U_0\left(arctg(x)+\frac{\pi}{2}\right)}{\pi}$$

One-dimensional non-autonomous equation for the motion of the particle with mass *m* and charge *Q* is following:

$$m\frac{d^2x}{dt^2}+\frac{2QU_0}{(1+x^2)\pi}cos^2\left(\frac{mt}{2\hbar}\left(\frac{dx}{dt}\right)^2-\frac{m}{\hbar}\frac{dx}{dt}x(t)+\varphi_0\right)=0$$

The plot of numerical solution of that equation for starting values: $Q=\frac{\pi}{2}$, $\varphi_0=1.55$, $x_0=10$, $U_0=3/2$, $\dot{x}_0=1.3$, $\hbar=m=1$ is shown in Fig.2.3. One can see typical horizontal steps at the left part of particles' velocity curve. There are seen the intervals, where the charge becomes vanishing small, no forces affects the particle, and it mechanically moves with nearly constant velocity. When the charge increases, the particle brakes and so on. That is why the oscillations of velocity can be seen. While approaching to the barrier the oscillating charge of particle abruptly decreases and the particle penetrates the barrier. Just after the barrier its velocity and its

oscillating charge continue to decrease (exponentially) and further the particle may even disappear or becomes a phantom. In other words, according to our model, the particles do not turn back, as usual quantum mechanic theory explains, but become a phantom and less detectable with moving away form the barrier.

However we did not detected the above-barrier reflection, well known within standard quantum mechanic. If the particle's energy is more than barrier potential then it always passes the barrier.

3. Tunneling effects.

We have considered in sect. 2 the case of the potential step. Here we will consider the general case of one-dimensional barrier. The simplest type of one-dimensional barrier is shown at fig. 3.2, where datum line is potential energy in function of *x* axis coordinate. The point x_0, where the potential energy is at its maximum U_0, divides the whole interval $(-\infty,\infty)$ in two domains, $(-\infty,x_0)$ and (x_0,∞), where $U<U_0$ always. Total particle energy *E* equals the sum of it kinetic and potential energies

$$E=\frac{p^2}{2m}+U(x),$$

where *m* and *p* are the particle mass and impulse, respectively. We get for the momentum *p* following relation

$$p=\pm\sqrt{2m(E-U(x))},$$

where the sign must be chosen in accordance with the direction of particle motion. If *p>0*, then the particle will approach the barrier from left to the right or if *p<0* then in the opposite direction. Let us examine the particle moving from left to the right with total energy $E<U_0$. Then at some point x_1 it potential energy will be $U(x_1)=E$, momentum will equal zero and, consequently, the particle will be stopped. The whole particle energy will be transformed in potential, and at pivot point x_1 particle will start moving in opposite direction, unable to penetrate into the second area. Consequently, such potential energy fields (Fig.3.1) are known as barriers as they prevent passage of a particle with $E<U_0$ in classical mechanics. The barrier is always transparent in case $E<U_0$.

The Quantum Mechanics adds a new element to the picture. At $E>U_0$ some particles may be reflected from the barrier and at $E<U_0$ some particles can still pass the barrier. The effect is paradoxical for reasons other as well. If particle with $E<U_0$, gets inside the barrier, it should have following classical mechanics negative kinetic energy or imaginary momentum. However, that is the paradox of classical mechanics. Within quantum mechanics, the particle spends nearly no energy in overcoming the potential barrier; it seems to "tunnel" under the barrier. The details of exactly how the particle does this are unknown. The standard quantum mechanical "explanation" is that the particle' behavior follows a wave probability and there exist the probability that the particle may be partially reflected and partially pass. That resulted in the appearance of probabilities of particle tunneling or reflecting. We are not going to show solutions of Schroedinger equation for tunnel effect you can find them in any quantum mechanics course, we will only write the approximated result for a barrier with the height U_0 and width *a*. Viz., probability of passing *P* is proportional to the following exponential function:

$$P\approx\exp\left(-\frac{2}{\hbar}a\sqrt{2m(U_0-E)}\right) \tag{3.1}$$

Such approximate dependence remains for many types of barriers, although exact analytical solutions usually do not exist, but (there are) various opinions. One can see that contrary to the classical mechanics at $E<U_0$ probability of barrier passage still exist. We should also note that in all events wave function amplitude in potential barrier area between points *x=0* and *x=a* is extremely small. Tunnel effect is significant when the power of the exponent in (3.1) close to unity.

$$\left(\frac{2}{\hbar}a\sqrt{2m(U_0-E)}\right)\approx 1 \tag{3.2}$$

Suppose we observed a particle $E<U_0$ from inside the potential barrier, as particles penetrate it in accordance with (3.2). Then to detecting the particle inside the barrier should accurately fix its coordinates with the accuracy $\Delta x<a$. But in this case a mistake in calculating momentum is inevitable

$$\Delta p^2>\frac{\hbar^2}{a^2}.$$

Replacing the value a from (3.2) will yield

$$\frac{\Delta p^2}{2m} > 2(U_0 - E)$$

In other words, measuring particle kinetic energy inside the barrier macro-device has an associate error that is twice the energy needed to escape the barrier. So, Nature preserves her building and tunneling secrets.

However, it is possible to make the situation clearer if using our equations with oscillating charge. When the particle approaches the barrier (particle energy is less than the barrier potential) while in a phase when its charge amplitude is very small, the barrier's repellent power is also small, and the particle is able to pass over such barrier. Fig.3.1 illustrates the event. That phenomenon is unknown for standard quantum mechanics because according to it the phase of wave function does not play any essential role.

Examine passage of potential barrier in form of the Gaussian hat by the particle. Both autonomous and non-autonomous variants have been analyzed. One-dimensional potential and corresponding motion equation are following:

$$U(x) = U_0 \exp\left(-\frac{x^2}{\sigma^2}\right)$$

$$m\frac{d^2x}{dt^2} - \frac{4U_0}{\sigma^2}Qx\exp\left(-\frac{x^2}{\sigma^2}\right)\cos^2(\varphi) = 0 \tag{3.3}$$

where

$$\varphi = \frac{mt}{2\hbar}\left(\frac{dx}{dt}\right)^2 - \frac{mx}{\hbar}\frac{dx}{dt} + \varphi_0$$

for the non-autonomous case,

$$\varphi = -\frac{mx}{\hbar}\frac{dx}{dt} + \varphi_0$$

for the autonomous case.

Both equations were solved numerically at $m = Q = \hbar = 1, U_0 = 0.5$. The number of the particles passing the barrier was calculated (equivalent to the probability of barrier tunneling) depending on barrier width for randomly, uniformly distributed values of the initial phase within the interval $\varphi_0 = 0 \div \pi$ and fixed velocity. In Fig.3.3 we can clearly see that the periodicity of tunneling probability depending on barrier width. Barrier back wall reflection is an astonishing feature of nonlinear motion equations, because by intuitive form the particles' motion in monotone potential point of view the appearance of such an effect is incomprehensible. It seems as though a nonlinear equation "remembering" what potential the particle had been moving against some time ago and "foreseeing" what will be in future.

Then we considered the dependence of tunneled particle's number on its initial velocities and initial phases uniformly distributed the interval $0 \div \pi$ for the same initial parameters. Plots in Fig.3.4 are perfectly approximated by exponential functions of velocity corresponding with high precision to (3.1) or (3.4). That means that H.Heiger-J.Nuttall experimental law connecting the α-disintegration constant with the velocity of emitted α-particle disintegration may be theoretically derived from the evolved approach.

Since the barrier transparency index is described by exponential function, it is possible to create theory about the nature of α-decay. According to it, when tunneling is an extremely small probability (10^{-15} or less) that probability should sharply depends on the energy. Thus, changing the particle's velocity approaching the barrier by a factor of four changes the probability of tunneling by 23 orders. We can now see that taking into account nuclear decay law (K.N.Mukhin,1974) we will have an exponent with the other exponent as index that result in such strong dependence (H.Heiger-J.Nuttall law). For a long time, the nature of alpha-decay was a mystery. Lord William Thomson Kelvin was the first to assume that particles emitted by radioisotope behave as if boiling inside "potential" crater. Statistically form time-to-time one of the particles receives enough energy to overcome the barrier, which is above the average energy of the particles inside. As it leaves, the particle is accelerated by

potential field of the barrier, giving it even more energy. But E.Rutherford in his classical experiment disproved that view. During experiments uranium nuclei were bombarded by $13\cdot10^{-6}$ erg alpha-particles from a thorium source. Alpha-particles propagation strongly depended on Coulomb law and according to the Rutherford evaluations nuclear forces "came into play" at distances less then *Rnucl*=$3\cdot10^{-12}$ centimeter. It is clear that alpha particles are in the potential hole of uranium nucleus, which dimensions are at least less than *Rnucl.* But the uranium itself is radio-active and emits alpha particles with the energy $6.6\cdot10^{-6}$ erg, so according to Kelvin's model, $13\cdot10^{-6}$ erg should be enough to overcome the Coulomb barrier and result in α - capture by the uranium nuclei. Thus the *experiment* results in strange dilemma: *either the Coulomb forces act differently upon incident and emitted alpha particles, or conservation of energy and momentum is entirely absent from these nuclear interactions.* From our point of view that problem does not exist at all because the energy gained by the alpha- particle depends on its initial phase, as illustrated in Fig.3.5.

Dependence on barrier width σ is not so simple. Let's cite exact values of barrier transparency index *D* obtained in standard quantum mechanics for the rectangular barrier of width *a:*

if

$$E > U_0 \text{ and } k = \sqrt{E - U_0}$$

$$D = \frac{4E(E - U_0)}{4E(E - U_0) + U_0^2 \sin^2(ka)} \tag{3.4}$$

if

$$E < U_0 \text{ and } \gamma = \sqrt{U_0 - E}$$

$$D = \frac{4E(U_0 - E)}{4E(U_0 - E) + U_0^2 \operatorname{sh}^2(\gamma a)} \tag{3.5}$$

The expression (3.4) describes periodicity of the energy-tunneling index (sine function in denominator). That phenomenon is called over-barrier reflecting, but we have not found any over-barrier reflecting at $E > U_0$ in the process of mathematical modeling. Vice versa, the expression (3.5) shows monotonous dependence of transparence index on the energy (hyperbolic sine function in denominator); at the same time as our mathematical modeling shows oscillations (see Fig.3.3). That amazing result encourages, because from the Schroedinger wave equation point of view even now it is impossible to understand the reason of transparent index monotonous dependence on the barrier width *a* for $E < U_0$, when some periodicity is expected, and at the other side transparency index should become constant and equal to 1 at $E > U_0$, but it starts oscillating. We have analyzed many trajectories of particles corresponding to the autonomous and to the non-autonomous equation (3.3) for different values of initial data and of the parameters. As it were expected, the behavior of particle depends to a very considerable extent on the values of the initial phase φ_0. The particle' velocities after passing or reflecting were smaller, greater (in the series of cases even much greater) or nearly equal to those of incident particles. Some of such trajectories are shown in Fig. 3.5 -3.7 corresponding to the solutions of autonomous equation and following input data:

$$x_0 = -10, \dot{x}_0 = 0.48, U_0 = 4, \sigma = m = \hbar = Q = 1$$

and following initial phases: $\varphi_0 = 1.55735$ (Fig.3.5), $\varphi_0 = 1.55736$, (Fig.3.6), $\varphi_0 = 2$ (Fig.3.7). These trajectories illustrate very interesting behavior of particles. The both particles start at the point x_0= - 10 relatively far from the barrier. The potential $U(x_0)$ at this point is equal 4 exp(-100) i.e. nothing and the initial kinetic energy of particle $^1/_2\,\dot{x}^2$ exceeds $U(x_0)$ to a considerable extent. The both particles reach the left barrier's border and penetrate into barrier quickly enough but with much decreasing velocity and averaged energy. The coordinate and the velocity of the first particle are at $t \approx 25$ $x \sim -1.352, \dot{x} \approx$ 0.0 312, the kinetic energy $E \approx$ 0.00049, the potential $U \approx 0.64$. So, the particle is located at this moment inside of potential bell. The data for the second particle at this moment are nearly the same: $x \approx$ -1.352, $\dot{x} \approx 0.0312$. The both particles move very slowly to the barrier's middle *x*=0. But the first doesn't reach the barrier's middle. It reaches the minimum distance 0.00074 to the middle and then begins to move backwards with increasing velocity. The

particle is pushed out by barrier backwards. The particle returns at $t \approx 260$ to its initial place but with much greater absolute value of velocity $\dot{x} \approx -1.82$ and much greater averaged kinetic energy. (The particle's charge oscillate during particle's movement owing to multiplier $cos^2(-x\dot{x} + \varphi_0)$. The value of this multiplier oscillate from 0 to 1 during particle' movement at $t>260$ and the averaged charge and the averaged energy of particle are equal Q=1, E=$^1/_2\,\dot{x}^2$ correspondingly). The trajectory of the second particle is quite different after $t \approx 25$. Although the values of the initial phases φ_0 in equation 3.3 for both particles differ one from another very little φ_0 =1.55735 and φ_0 =1.55736, but the second particle experienced just a bit lesser repulsion. The particle didn't come to a stop and overcomes the barrier's middle x=0 at $t \approx 187$ with very small positive velocity $\dot{x} \approx 0.00012$.

The barrier begins after this moment to push the particle out to the right, i.e. forwards and besides imparts to the particle additional velocity. The particle reaches at $t \approx 301$ the right barrier's border at the point $x \approx 1.22$ with velocity $\dot{x} \approx 1.344$ and reaches at $t \approx 306$ the distance $\boldsymbol{x}$=10 with the velocity $\dot{x} \approx 1.82$. So, the both particles were pushed out the barrier (the first backwards and the second forwards) with much greater velocity (nearly 4 times greater) and averaged kinetic energy (nearly 16 times greater). The third particle (Fig.3.7) starts with the same initial data but possessing other initial phase (φ_0 =2.0) and reaches the barrier's border and penetrates into barrier quickly enough. The coordinate and the velocity at t=17 are $x \approx -2.04$, $\dot{x} \approx 0.177$ and the kinetic energy is less than the potential energy. But after $t > 18$ the particle begins to return and at t=81 is near the initial point x=-10 but possessing lesser velocity $\dot{x} \approx -0.124$ than initial velocity $\dot{x}$=0.48. So, the particle reflected from the barrier with considerable loss of velocity and kinetic energy. These examples illustrate the fact for single processes, described with the oscillating charge equation the conservation laws do not exist and they apparently appear after averaging over all initial phases. But the conservation law for the ensemble is rather complicated question, as far as the impulse sum before and after interactions do not equal exactly each other but depend on potential (different small - 1%). In the case of one or other potentials the impulse sum value is different and that question is still open.

All calculations show there exists an initial phase interval about $^{\pi}/_2$, where the high barrier is permeable even for particles with small energies. Here we have nearly the same problem as with the step barrier. Even the particles possessing very small energy and having the initial phase near $^{\pi}/_2$ are able to pass (tunnel) the extremely high barrier, but do it too long because they, so to say, snail inside the barrier. The charge is too small, the same is the acting on particle force and the motion with low velocity near to inertial motion may continue during very long period. It is quite natural to call that effect "snail". That fact was surely confirmed by numerous experiments (for example, J.Kasagi, H.Yamasagi, T.Ohtsuki, H.Yuki, 1996) and in other different articles.

4. Conservation Laws and Unitary Quantum Theory. *Perpetuum mobile* and modern Science.

Inventors and swindlers of every stripe and range many years tried to construct or even to design *perpetuum mobile*, i.e. imaginary mechanism able to work without outside energy supply. Peter the First (Russian Emperor Peter Great) had even established Russian Academy of Science for such researches (see V.L. Keerpechev, "Talks about mechanics", Gostechisdat, 1951, page 289), but today persons from modern Russian Academy of Science do not like to recollect that circumstance. At the other side French Immortals have decided in 1775 to consider no projects of *perpetuum mobile*, and it seems they have not been mistaken jet. However one mistake is known: Daniel Bernoulli was awarded a prize by French Academy for mathematical proof that a boat with engine and screw propeller would never have faster speed than sailing ship! Magnificent successes of classical thermodynamics have strengthened Humanity confidence in Divine Infallibility of Conservation Laws. Today it is considered nearly indecent to call in question these laws.

First of all let us clarify the origin of conservation laws in classical mechanics. Nearly each textbook contains a statement that Energy Conservation Law (ECL) results from homogeneity of time, Momentum Conservation Law results from homogeneity of space, and Angular Momentum Conservation Law – from isotropy of space. And so many people are impressed that Laws themselves result from space-time properties that nowadays are no doubt a relativistic conception. But for example angular momentum is not a relativistic conception already. Therefore such restricted approach is not totally correct; Newton's second law of motion or relativistic dynamics equation and concept of system closeness should be attracted. More over the requested space- time properties themselves are usually wrongly being interpreted. For example, it is assumed that time homogeneity means simple equivalence among all moments of time and homogeneity and isotropy of space means equivalence of all its points and absence of preferential direction in space (all directions are equal) correspondingly.

But these statements are *sensu stricto* wrong. For example, within many mechanical systems the Earth center direction and horizontal direction differ in principle (for example, pendulum clock located in horizontal plane

will not work at all). We can say the same about the body being at the top of the hill, it is able to roll dawn independently, but according to classical mechanics it never climbs by itself. And for a person, being young or old, these moments of time are not equal at all. Hereinafter we would like to explain in what way all that should be understand.

Time homogeneity implies that, *if at any two moments of time in two similar closed systems somebody runs two similar experiments, their results would not differ.*

Space homogeneity and isotropy means that *if closed system is moved from one part of the space to another or oriented in other way, nothing would be changed.*

Derivation of energy and momentum conservation laws from Newton equation is quite simple in idea. Viz., let us write down the main equation of dynamics in form of

$$\mathbf{F} = \frac{d\mathbf{P}}{dt} \tag{4.1}$$

For closed system **F**=0 (there are no external forces) and the equation possess the integral

$$\mathbf{P=Const}$$

expressing the momentum conservation law.

Now let's write the main equation of dynamics in the form:

$$\mathbf{F} = m\mathbf{a} = m\frac{d\mathbf{v}}{dt}$$

and scalar-wise multiply it by v

$$\mathbf{F}\cdot\mathbf{v} = m\frac{d\mathbf{v}}{dt}\mathbf{v} = \sum_{i=1}^{3} m\frac{dv_i}{dt}v_i = \sum_{i=1}^{3} m\frac{d}{dt}\left(\tfrac{1}{2}v_i^2\right) = \frac{d}{dt}\left(\frac{mv^2}{2}\right)$$

where v is a modulus of velocity vector **v**. For the closed system **F**=0 it exists the integral

$$\frac{mv^2}{2} = \text{Const}$$

expressing one of the forms of energy conservation law.

Using the definition of the angular momentum for the particle, i.e.

$$\mathbf{L} = [\mathbf{r}\times\mathbf{P}]$$

and differentiating it both parts by t, we obtain

$$\frac{d\mathbf{L}}{dt} = \left[\frac{d\mathbf{r}}{dt}\times\mathbf{P}\right] + \left[\mathbf{r}\times\frac{d\mathbf{P}}{dt}\right]$$

As the momentum vector is parallel to velocity vector, the first bracket is equal to zero. And basing on the equation (3.2.1) and on definition of central force, as one not creating a momentum, we get

$$\left[\mathbf{r}\times\frac{d\mathbf{P}}{dt}\right] = 0$$

and

$$\mathbf{L=Const}.$$

In the case of central force within unclosed system angular momentum remains constant in value and direction.

The energy and momentum conservation laws can be easily obtained within relativistic dynamics from relativistic relation between energy and momentum

$$E^2 = P^2c^2 + m^2c^4$$

The term m^2c^4 is an invariant, i.e. it is similar within all reference frames. In other words it is a some kind of constant. This relation can be written in rather different form

$$E^2 - P^2c^2 = Const$$

To satisfy that relation one should admit that

$$E=Const \quad \text{and} \quad P=Const$$

And that is nothing else than energy and momentum conservation laws.

But strictly speaking there is in relativistic mechanics there is a law of conservation of four-momentum vector P^{μ}, but we are not going to stop at these details.

In accordance with the classical mechanics, the energy conservation law signifies that energy of closed system remains constant, hence, if at the moment t=0 the energy of such system is denoted by E_0, and at the moment t is denoted by E_t, then

$$E_0 = E_t .$$

In accordance with standard quantum theory, the energy conservation law is laid down in the same way. Within that theory we have the same integrals of motion as in classical mechanics. Some value L would be an integral of motion if

$$\frac{d\hat{L}}{dt} = \frac{\partial \hat{L}}{\partial t} + \left[\hat{H}, \hat{L}\right] = 0 \tag{4.2}$$

$[\hat{H}, \hat{L}]$ is determined by commutator of operator $\hat{L}$ and of Hamilton's operator $\hat{H}$, so any quantity L, being not evidently dependent on time will been an integral of motion if its operator commutes with $\hat{H}$. When quantity L is not evidently dependent of time, then the first terms in (4.2) vanishes. As remainder we have

$$\frac{d\hat{L}}{dt} = \left[\hat{H}, \hat{L}\right], \tag{4.3}$$

and, as we know, the quantum Poisson bracket vanishes for the integrals of motion being not evidently dependent on time. Thus,

$$\frac{d}{dt}(L) = 0 .$$

In any good work dealing with quantum theory it was shown that probability w to observe at any moment t any value of such motion integral L, does not depend on time either. We will denote below such integrals of motion L_n. As far operators L and H commuted they had common eigen-functions that were functions of stationary states. We should note that the last were obtained from solution of Schroedinger equation without time (not containing t) which is derived from full Schroedinger equation if

$$\Psi(\mathbf{r}, t) = \Psi_0(\mathbf{r}) exp\left(i\frac{E}{t}\right)$$

i.e. if this equation has the periodic solutions. The solutions of Schroedinger equation not containing t satisfy conservation laws, which are, in fact, dictated by condition of total time-independence. The expansions of such solutions in eigen-functions' have the form

$$\hat{L}\Psi_n = L_n \Psi_n ,$$

$$\hat{H}\Psi_n = E_n \Psi_n ,$$

where

$$\Psi(x,t) = \sum_n c_n \Psi_n(x) exp\left(-i\frac{E_n}{\hbar}t\right) = \sum_n c_n(t)\Psi_n(x) , \tag{4.4}$$

$$c_n(t) = c_n exp\left(-i\frac{E_n}{\hbar}t\right) = c_n(0) exp\left(-i\frac{E_n}{\hbar}t\right) .$$

As (4.4) is eigen-functions' expansion of the operator L_n ., the probability does not depend on time, i.e.

$$w(L_n, t) = |c_n(t)|^2 = |c_n(0)|^2 = Const$$

We should note once more that it is the probability to observe some given value that is time-independent, while, the value itself is occasional in each individual case. As far the energy is an integral of motion and probability *w(E,t)* to find out at the moment *t* energy value to be equal to *E* is time-independent, then:

$$\frac{dw(E,t))}{dt} = 0$$

Quantum energy conservation law in the above mentioned form assume the possibility of energy determination at the current moment of time not taking into account its uncontrolled changes due to influence of the process of measurement itself. That situation did not raise any doubts within classical mechanics. But according to quantum theory the energy can be measured without disturbance of its value only up to

$$\Delta E \geq \frac{\hbar}{\tau},$$

where τ- is the duration of measuring process. Formally, there are no troubles for energy conservation law, as the energy is the integral of motion and we have arbitrary large time interval to accomplish long measuring. For example, let measure within time τ, then leave the system alone for the time *T*, and then measure the energy once again. The energy conservation law in standard quantum mechanics states that the result of the second measuring will coincide to

$$\Delta E \approx \frac{\hbar}{\tau}$$

with the results of the first measurement. But even according to standard quantum theory all this is not totally logical, because really existing vacuum fluctuations may meddle and they are able to change the result. Here we have evident violation of conservation law due to vacuum fluctuations, although the integrals of motion exist (contrary to UQT). *The standard quantum theory carefully avoids the question of conservation laws for single events at small energies. Usually that question either does not being discussed at all, or there are said some words that quantum theory does not describe single events at all.* But these words are wrong, because the standard quantum theory describes, in fact, single events, but is able to foreseen only the probability of that or other result. It is evident that at that case there are no conservation laws for single events at all. These laws appear only after averaging over a large ensemble of events. As the matter of fact it can be easily shown that classical mechanics is obtained from quantum one after summation over a large number of particles. And for a quite large mass the length of de Broglie wave becomes many times less than body dimensions, and then we cannot talk about any quantum-wave characteristics any more.

It is well known that local laws of energy and momentum conservation for the individual quantum processes are valid within all experiments at high energies only. We cannot say so in the cases of law energies at least due to uncertainty relation and stochastic nature of all predictions in quantum theory. The idea of global but not local energy conservation law is invisibly presenting in quantum mechanics and in any case is not new. From the physical viewpoint it just means that in stationary solutions with fixed discrete energies (standard quantum mechanics) the velocity of a particle reflected from the wall is equal to the velocity of an incident particle. If the particle energy decreases at each reflection, then that case corresponds to solution type “crematorium” and if increases – to “maternity home” solution. The scenarios under which events will be developed depend on the initial phase of the wave function and particle energy.

In the strict Unitary Quantum Theory and in the theory of quantum measuring un-removable vacuum fluctuations part a great role. It is quite clear these fluctuations being totally unforeseen and non-invariant with respect to space and time translations. In other words, within UQT there are no habitual space-time properties. Now space-time is heterogeneous and non-isotropic. For example, if the experiment is replaced in any other point of the space or repeated at other time, then in the point where the particle’s parameters were examining and particle is interacting with macro-device, another value of vacuum fluctuations would appear (differing from the previous one) that would give another result. Of course that is true for small energies and individual events (particles) only.

The Unitary Quantum Theory is much more destructive with regard to the notion of Closed System. For single events at small energies that notion is inapplicable at all because at any moment of time and in any place where the particle is located (for example, within potential hole) vacuum fluctuation may be abruptly changed. It may occur thanks to various causes; either due to the nature of vacuum fluctuations, or due to the tunneling effect of other random particle.

Sometimes it is stated that energy conservation laws follow from E.Noether theorem, although those results have been contained in the works of D.Gilbert and F.Klein: *For any physical system, the motion equations of which can be obtained from variational principle, every one-parameter continuous transformation, that is keeping the variation functional invariant, corresponds only one differential law of conservation and then there exists explicitly conserved quantity.* However, it can be easily seen that vacuum fluctuations being imposed on varying functional (Lagrangian) does not remain constant (in any case it seems so today) under parametrical transformations. That consideration does not work too without ensemble averaging either.

In other words, all requirements that lead to classical laws of conservation are absent now. It is hard to expect that the entire laws of conservation will remain valid in that situation for the single particles at small energies. But nowadays it seems that classical laws of energy, momentum and angular momentum conservation for the single quantum objects do not work at small energies due to the periodic appearance and disappearance of particles. All direct experimental checks of the conservation laws were carried out in the cases of great energies but in the cases of small energies for single particles probability results can be obtained only. In that case it is indecently even to recollect the idea of conservation law.

And now a bit of Philosophy for reader. Local Energy Conservation Law (ECL) for individual processes results from the Newton equations for closed systems. It is naive to think that its local formulation will remain constant forever. And it would be a gross error to transfer ECL without alterations from Newton mechanics to quantum processes inside microcosm.

Definitely speaking references to the first law of thermodynamics are baseless because it is a postulate. For example, in his letter to one inventor the famous Russian mathematician N.N.Lousin wrote: *"first law of thermodynamics was a product of unsuccessful attempts of the humanity to create perpetuum mobile and frankly speaking did not follow from anything"*.

Today we can say with more belief that no resourceful machines within the network of Newton mechanics are able to realize perpetuum mobile, and the decree of French Academy, accepted in 1755 to consider no projects of perpetuum mobile is still valid. We should add that is apparently true for all projects based on Newton mechanics only.

It is characteristic of the understanding the position ECL in modern physics that this low is bringing down, especially in theory, to the rank of second-order conclusion from the equations of motion. Some physicists reduce ECL to the statement of the first law of thermodynamics, others as for example (D.I.Blochintsev "On the Energy Conservation Law", In: "Works on the methodological problems of physics", p.51, 1993, Print of Moscow State University in Russian) consider that *"it is quite possible with further development of new theory ECL form will be transformed"*. As F.Engels wrote in his "Natural dialectics": *"no one of physicists does not, in particular, consider ECL as everlasting and absolute law of the nature, as a law of spontaneous transformation of substance motion forms and quantitative permanency of that motion at its transformations."* Many of them are thinking in another manner as, for example, M.P.Bronshtein. He wrote in his work "Substance structure": *"ECL is one of the basic laws of Newton mechanics. And nevertheless Newton had not attributed to that law rather general character that law had in reality. The reason of that Newton mistaken point of view at ECL was quite interesting"*. Now it is understandable that in the light of the above mentioned such point of view was not wrong at all. And we should remind that Newton had foreseen in his "theory of bout" many things even quantum mechanics.

At the other side, the founders of quantum mechanics perfectly understood that the conservation law for the single quantum processes at small energies did not exist at all. So, the first thought that understanding of ECL on a par with the second law of thermodynamics, as statistical law, being correct on average and not applicable to the individual processes with small energies, appeared as despair and went back to Erwin Schroedinger first and then to N.Bohr, Kramers, Sleter and G.Gamov. In 1923 Bohr, Kramers and Sleter in despair tried to construct the theory according to which in the process of dispersion energy and momentum conservation laws were satisfied statistically on the average during long time intervals but were inapplicable to the elementary acts. Leo Landau even called that as *"Bohr perfect idea"*.

According to that theory, the process of dispersion should be continuous, but Compton electrons are emitted in a random way. The authors assumed both processes of wave dispersion and Compton electrons dispersion were not connected with each other (?). The main idea was to lay a bridge between quantum theory of the atom and classical emission theory. There were introduced specially so called "virtual" oscillators which generate in accordance with classical theory waves (non quantum one) enable to induce the transition from the state with lower energy to the state with higher energy. These waves did not carry the energy, but power necessary for atom transition from lower to the higher state was generated within the atom itself. Along with that the inverse process of the atom transition from excited state to the lower one could take place, but the energy was not taken away by waves but should disappear inside the atom. In other words, the increase of one atom energy was not connected with energy decrease in another one. Authors considered that these processes compensated each other on average only and that compensation was the better the more events are participated. Energy conservation law has statistical character according to that interpretation, and there is no law of conservation for single events, but they appear in processes involving large number of particles, i.e. at transition to Newton mechanics. But then it should be acknowledged that in the case of Compton effect the changes of motion direction of the light quantum and its energy to be appeared in the result of collision were happening apart from the changes of electron's state. The unfoundedness of such an approach was lately experimentally proved by Bote and Geiger. To say the truth, the authors abandoned that point of view later; moreover at that time this idea did not follow from quantum theory equations. And to get out of the tight spot it was declared that quantum mechanics did not describe single events at all. Thus the most striking paradox was removed by a simple prohibition just to think about it! But genius idea that laws of conservation are not valid for individual processes and appear in quantum mechanics after statistical averaging does not become less genius even if those for whom it "has come to mind" rejected it. May be, this idea was a little premature and should have a somewhat different shape.

Contrary to that Unitary Quantum Theory describes single particles. And the alteration of their behavior is determined not only by initial values of its position and velocity but also by initial phase of the wave function (of the wave packet). Then for the single particle local conservation laws do not exist at all. And that is quite another question how to measure the initial phase or any other parameters of a single particle.

Let us examine the following virtual experiment. For more simplicity let use in our reasoning some quantum ball-particle. If classical ball is running to the wall (for simplicity assume it as perpendicular), the velocity of the reflected ball would be equal to its initial velocity (we neglect friction and consider the ball and the walls as totally resilient). In the case of quantum ball the velocity of the reflected ball in various experiments with similar initial circumstances will have the whole spectrum of values: there will be balls reflected with the velocity higher than initial, equal to it and lower then initial. And all these will be described by means of quantum mechanics within uncertainty relation.

Let us ask what would be if we place a second wall parallel to the first one in such a way the ball at each reflection increased its velocity? *Then we would get the growth of the ball energy without any efforts from our side.* The aim of future constructors of such systems of XXI century would be the necessity to create such initial conditions for the great number of particles forming the object, that is realized the sole solution "maternity home" and is suppressed as far as possible the other solution.

It is evident from the above-mentioned that at competent exploitation of the Unitary Quantum Theory ideas the principle prohibition for perpetuum mobile does not exist. Formally as it was shown above that prohibition does not exist even in standard quantum mechanics (there is no laws of conversation for single processes with small energies), and to get energy the particles should be selected in some way (grouping together all random processes with excess energy). But the standard quantum mechanics refuse to describe single events and is not able to advise the way for grouping. As it seems today, the Unitary Quantum Theory gives us such an opportunity. However, by efforts of scientific groups, interested in their own stability because of simple instinct of self-preservation the great idea of free energy generation was distorted to such a degree everybody who starts to talk about it is taken for mad. The modern experimental physics have examined the correctness of conservation laws for huge energies in single cases and for large macro-object when ensemble averaging is used, but the area of small energies is terra incognita. From the philosophical point of view any categorical prohibitions like impossibility of perpetuum mobile creation are absolutely unacceptable. If everybody will be convinced of that forever, then the laws of conservation and prohibitions for perpetuum mobile would remain unshakable for all civilizations while humanity lives. Of course, Conservation Laws funeral can continue very long. By the way, we are not going to do that, and may be our paper only clears a little the place for further grave, and sumptuous funeral with proper honors will be done by future generations. On the other side, undoubtedly, these laws will never become a thing of the past and of course will be constantly used but at the

beginning there will be small areas of science and engineering where these laws application will be evidently insufficient.

The truth should be accepted irrespective of the source it came from. That is why it would be useful to cite a quotation of "Natural Dialectics" of F.Engels: *"But when Solar System will finish its circle of life and suffer the fate of everything finite, when it will become a victim of the death, what will be later? Thus we realize that the heat radiated in world space should have the possibility in any way to be determined in future, to transform in other motion form where it will be able to be accumulated again and begin functioning. But in that case the main obstacle preventing the reverse transformation of dead suns into red-hot nebula will drop away".*

The question whether the conservation laws exist in global form (we have already proved that it is not local) remains open. Nothing except human mentality inertia is leading to that. That inertia is based on Newton laws that have been already exchanged for the Quantum ones. Thinking inertia leads to the situations when in the cases of motion equations solving an excess energy appeared the question where it has come from arise. Of course, if the particle (for example, photon) is falling down at half-transmitting mirror and is divided into two parts, then due to vacuum fluctuations superposition could be detected by photo multiplier tube full two photons. In this case there is fixed the excess of the energy, as if, obtained from vacuum: two photons instead of one (see, Sapogin 2010, 2011). In other case, the photon divided at the mirror in two parts can be not detected at all and its energy is, as escaping into vacuum. Once we have absorbed energy from vacuum, at the other time and in other act we have returned the same quantity. And so one might think, and probably such process takes place in reality. But if we examine solutions of the equation with oscillating charge, then the laws of energy and momentum conservation do not work in principle. Vacuum fluctuations have nothing to do with it. And the question where could energy appear from is based on the inertia of our thinking and as a matter of fact is an atavism, dictated by the Newton mechanics.

It is interesting that even in logical definition of the energy there is a bomb. If the energy is something that can neither arise nor disappear and is just always transforming from one form into another the single value that obeys these conditions is null. We are far from the thought that energy does not exist at all. But the problem if its existence is being solved in various philosophical systems in different ways, but it seems the most correct approach is mathematical: an object exists if it is free from contradictions. But energy was not lucky, and thanks to that approach it should be null.

And many cosmologists would like have to do with theories, which assume there are in Universe localities where the energy is coming into being and also other localities where the energy annihilates. For example, British astronomer Fred Hoyle has developed the theory of Universe where it takes the place the continuous creation of matter. He wrote: *"... Different atoms constituting the matter do not exist at some given moment of time and then after instant they exist already. I must admit this idea may look as strange… But all our ideas about creation are strange. According to previous theories the whole quantity of matter in Universe was coming into being just as whole and all process of creation looks as super-gigantic instant explosion. As for me, such idea seems much stranger, than idea of continuous creation…"* F.Hoyle, La nature de l'Universe, 1952.

The official astronomical science does not accept the ideas of F.Hoyle and of some other astronomers (H.Bondi, T.Gold, P.Jordan) about continuous creation of matter in Universe because the Conservation Laws are considered as infallible. But from the viewpoint of our UQT these ideas are quite not strange.

5. Passage of Potential Wells

In this section we will consider only one-dimensional problems. In classical mechanics the problem of rolling a particle into a finite-depth well is very simple from the physical point of view. Classical solutions of motion equations in the case of a potential well with symmetrical sides correspond to situation when a particle always rolls into the well and then leaves it at the same initial velocity. Moreover, in classical mechanics it is impossible to roll a particle into a well with symmetric sides in such a way that it remains there. If not for friction this would be true.

There are allowed in the mechanics of a particle described by the equation with an oscillating charge solution with very different properties, i.e. allowed very different possible modes of particle's behavior which greatly depend on the value of initial phase in corresponding equations. There are very interesting from the standpoint of our UQT following modes of particle's behavior.

(1) A particle can roll into the well and roll out (after certain period of oscillations ore without oscillations) with higher (even much higher) velocity and energy than initial velocity and energy. We call the corresponding solutions as "Maternity home solutions" because the well takes in such case the part of Maternity home, where

are restored in essence to life new particles. The existence of such solutions seem to explain theoretically multiple experiments (Y.S.Potapov, 1993,1998, A.Samgin, A.Baraboshkin et al., 1994, A.Samgin, 1995, T.Mizuno, M.Enio, T.Akimoto, K.Azumi, 1994, A.Patterson, 1996, C.Tinsley, 1995, J.Griggs, 1994, M.Huffman, 1995 and other).

(2) A particle can roll out (after or without oscillations) or can remain to oscillate inside the well with much decreasing velocity and energy tending to zero. The corresponding solutions we call as "Crematorium solutions". Such particles turn out into "phantom" and wave packets representing such particles are spread over the Universe.

(3) A particle can also preserve stationary oscillations with constant amplitude of classical type inside the well.

The plots below (Fig.5.1 - Fig.5.5) illustrate these modes of particle's behavior. These plots are obtained after numerical integration of the autonomous equation

$$m\frac{d^2x}{dt^2}+\frac{4U_0Qx\cos^2\left(mx\frac{dx}{dt}+\varphi_0\right)\sinh\left(x^2\right)}{\cosh^2\left(x^2\right)}=0 \tag{5.1}$$

in the case of the potential well in the shape of hyperbolic secant

$$U(x)=-U_0\,\mathrm{sech}\left(x^2\right) \tag{5.2}$$

where m,Q,φ_0 are mass, charge and initial phase of a particle respectively.

Numerical solutions in all six cases were obtained under following values of m,Q,U_0 and initial data:

$$U_0=1;\ m=1;\ Q=1;\quad x_0=-0.5;\ \dot{x}_0=1/20\,.$$

The trajectories on Fig.5.3, Fig.5.4 represent the "Maternity solutions". Velocity of particles after they rolled out the well are at t=50 $\dot{x}\approx$ 0.9, i.e. almost 20 times greater than initial $\dot{x}=$ 1/20. The trajectory on Fig.5.1 represents also the "Maternity solution" although the increase of velocity is not so essential: $\dot{x}\approx$ 0.094 at t=100 only nearly two times greater than $\dot{x}(0)$. The trajectories on Fig.5.2, 5.6 represent the "Crematorium solutions". The first particle leaves the well and moves away with monotonously decreasing velocity and spread out over all Universe. The second particle oscillate inside the well with slowly decreasing and tending to zero velocity.

6. Scattering of particle on Coulomb potential

While studying the particles scattering at Coulomb potential we use the following scheme of the motion. The particle is moving towards the central nuclear with the charge of the same sign (so that repulsion but not attraction arises), and we assume that repulsion force obeys the Coulomb law. The autonomous equations with oscillating charge of the motion on the coordinate plane *XY* are following:

$$\ddot{x}=2q\frac{x}{r^3}\cos^2(-x\dot{x}-y\dot{y}+\varphi),\ \ddot{y}=2q\frac{y}{r^3}\cos^2(-x\dot{x}-y\dot{y}+\varphi), \tag{6.1}$$

where $r=(x^2+y^2)^{1/2}$, φ is the initial phase, q is the constant part of charges.. Let be initial data following:

$$x(0)=x_0,\dot{x}(0)=0,y(0)=b,\dot{y}(0)=-v_o, \tag{6.2}$$

in other words at the initial moment the particle is at distance *b* (so called "sighting" distance) away from the axis *OX*, initial velocity equals to v_o, directed to the central nuclear in parallel to the axis *OX*.

The particle moves along a trajectory of hyperbolic type. It is going away to infinity approaching asymptotically to some straight line at some angle of θ in respect to axis *OX*. That angle θ is called *scattering angle* and it determines angular deviation from the initial direction of the particle motion.

According to the classical Kepler problem the particle moves along the hyperbola in accordance with the equations:

$$\ddot{x}=\mu\frac{x}{r^3},\ddot{y}=\mu\frac{y}{r^3}. \tag{6.3}$$

The particle is at the initial moment, within ideal model, at infinitely far distance $x_0=\infty$. The well-known formula of E.Rutherford for scattering angle θ resulting from the equations of celestial mechanics is following:

$$\mathrm{ctg}\frac{\theta}{2} = \frac{bv_0^2}{\mu}. \tag{6.4}$$

At fixed sighting distance b the angle θ decreases if velocity v_0 increase and tends to zero if v_0 tends to infinity. At fixed velocity v_0 the angle θ increases with decrease of b and tends to 180^0 if $b \to 0$.

In our modeling calculations (numerical integration of equations (6.1)) we have set values $q = 1$, $x_0 = 100$ and carried out calculations for the range of values b, v_0 and phase φ. We intended to study the dependence of the angle θ on the sighting distance and initial velocity v_0 and to compare the results with the dependence described by Rutherford formula and by experimental data. In the result we have got table data and plots for dependence of angle θ on phase φ at different b and v_0, also for dependence of θ on velocity v_0 at different b and phase φ and so on. These data and plots allows to conclude the dependence θ on velocity v_0 at constant b being close, on the whole, to the relation described by formula (6.4) provided values of phase φ are near to the middle of the intervals (0,π/2), (π/2, 0). But at the phase values near to zero (on the right) and near to π (on the left) the angle θ has on values the bigger in comparison with those to be obtained in accordance with the formula (6.4), the closer the phase to zero and to π relatively. As an example we cite the table of values θ_0, computed by formula (6.4), and values θ at $b = 0.01$, v_0=16, 20, 24, 28, 32, 36, 40, 44, $\varphi = 0$, (7/32)π, (24/32)π, (30/32) π obtained by our numerical integration:

v_0	θ_1	θ_2	θ_3	θ_4	θ_0
16	66.60	42.93	39.49	66.80	42.67
20	46.01	29.05	25.26	45.87	28.07
24	32.86	20.78	17.44	32.57	19.70
28	24.34	15.53	12.77	23.99	14.31
32	18.54	12.01	09.77	18.24	11.16
36	14.51	09.55	07.73	14.24	08.82
40	11.60	07.75	06.29	11.37	07.15
44	09.45	06.42	05.21	09.25	05.91

Of course these are preliminary data that may be specified later after detailed analysis. If comparing the experimental data with those to be obtained by Rutherford formula, then it is well known that there is some discrepancy in data of scattering for very small and very big angles. Our calculations indicate that this deviation is eliminated by our model. Thus *our model explains with more details the experimental data for the Coulomb potential deviation than Rutherford formula did.*

Draw our attention at one interesting circumstance revealed after numerical integration of initial equations. We mean the change of particle velocity after it filed past the central nucleus. According to numerical data*, particles after going far away from central nucleus do not retain the velocity equal to initial velocity* v_0, *but are moving faster or slower then* v_0 (that does not exist in Kepler classical problem owing to energy integral existence). But it is more essential that on the average the square velocity of outgoing particles is more than square initial velocity, and besides this exceeding the more essential the less sighting distance b. For example, at $b = 0.005$, $v_0 = 6$ the square velocity of the outgoing particles equals to 46.68, and at $b = 0.025$ equals to 38.42 and so on. These values signify that outgoing particles have on the average greater kinetic energy in comparison with initial kinetic energy.

7. The Cold Nuclear Fusion and Nuclear Transmutations

The wide discussion about phenomenon called the cold nuclear fusion, i.e. the nuclear synthesis at low temperature has began after remarkable experiments carried out by M.Fleishman and S.Pons in the March of 1989 (M.Fleischman, S.Pons,1989). Notice, one of the authors of this paper (prof. L.Sapogin) has predicted theoretically already in 1983 (L.G.Sapogin, 1983) the possibility of such nuclear reactions at small energies. Without going into well-known details we can say: the phenomenon of the cold nuclear fusion really exists and no one physicist can explain it clearly within the classical mechanics or within the standard quantum mechanics. The series of various mechanisms which explain this intriguing phenomenon is offered but it is hard to believe them because of the following reasons.

The curve of nuclear potential energy in the case of a charged particle interaction with a nucleus is plotted in Fig.6.0, here the right top part of the curve corresponds to the mutual Coulomb repulsion that nucleus and charged particle is xperienced. The repulsion potential is described by formula

$$U(r) = \frac{Zze^2}{r},$$

where Z is the nucleus charge, z is the charge of particle moving to the nucleus, e is the electron charge; r is the distance between given particle and nucleus. At $r=R$ the potential energy curve has a jump that can be explained by the appearance of the intensive nuclear attraction. Nowadays, we do not know any mathematical formula for the potential of the nuclear attraction. If the charged particle is able to overcome the potential barrier of the height

$$B_c = \frac{Zze^2}{R} \approx \frac{Zz}{\sqrt[3]{A}} MeV,$$

then further the particle falls into the region of nuclear forces of attraction and the nuclear reaction will proceed.

Let us consider the nuclear interaction if the charged particle possesses kinetic energy $T < B_c$. From the classical mechanics point of view there will no nuclear reaction at all in that case because reaching some distance $r < R$ to the Coulomb barrier top the particle will be turned back and reflected. Deuteron energy in ordinary electrolytic cell of Fleishman-Pons is near 0.025 eV, the height of Coulomb barrier in this case is $B_c = \frac{Zze^2}{\sqrt[3]{A}} = 0.8MeV$. It is naïve to discuss the question about overcoming the barrier with the height dozens of million times more than the kinetic energy from the classical mechanics point of view.

However, from quantum mechanics point of view there is tunneling effect and the probability of such tunneling, or potential barrier transparency D, is given by well-known formula:

$$D \approx \exp\left(-\frac{2}{\hbar} \int_{r_1}^{r_2} \sqrt{2\mu(U-T)}dr \right) \tag{7.1}$$

where $\mu = \frac{Mm}{M+m}$ is so called reduced mass, M is the nucleus mass, m is the particle mass. The lower limit of integration r_1 coincides with nucleus radius R, the upper limit r_2 corresponds to condition $T = \frac{Zze^2}{r_2}$. After integrating we will obtain

$$D = \exp(-2g\gamma)$$

where $g = \frac{R}{\lambda\!\!\!^{-}_{B_c}}$; $\gamma = \sqrt{\frac{B_c}{T}} \arccos\left(\sqrt{\frac{T}{B_c}}\right) - \sqrt{1-\frac{T}{B_c}}$, and value $\lambda_{B_c} = \frac{\hbar}{\sqrt{2mB_c}}$, is de Broglie wavelength, corresponding to the particle kinetic energy equal to the barrier height $T = B_c$. If $T << B_c$, then formula (9.1) can be easily transformed into the form

$$D = \exp\left(-\frac{2\pi R B_c}{\hbar v} \right) = \exp\left(-\frac{2\pi Zze^2}{\hbar v} \right) \tag{7.2}$$

where v is velocity. If we estimate the values g and γ for collision of two neutrons with such energy, then we obtain following:

$$g = \frac{R\sqrt{2mB_c}}{\hbar} = 1.9; \quad \gamma = \sqrt{\frac{B_c}{T}} \arccos\left(\sqrt{\frac{T}{B_c}}\right) - \sqrt{1-\frac{T}{B_c}} \approx 8883,$$

hence the probability of such a process equals to $\exp(-2 \cdot 1.9 \cdot 8883) \approx 10^{-7328}$(!) The cross-section of fusion reaction can be determined as multiplication nuclear cross-section and tunneling probability, i.e.

$$\sigma = \sigma_{nucl} D.$$

Moreover, if the deuteron sighting parameter does not equal zero, then the appearance of centrifugal potential

$$U = \frac{\hbar^2 l(l+1)}{2mr^2}$$

will lead for more reducing of interaction probability. The obtained values do not require the commentary. It is quite explainable that the official physical science has rejected every talk about the possibility of the cold nuclear fusion. The experiments of M.Fleishman and S.Pons were declared as some misunderstanding. For example, the most serious and responsible edition Encyclopedia Britannica 2001 could not even find a place for the cold nuclear fusion concept. Such official viewpoint can be understood only if one considers standard quantum mechanics as absolutely valid. In spite of all during last 21 years starting from the moment of experimental discovery of M.Fleyshman and S.Pons more than 30 International Conferences dealing with that subject were organized, there are a lot of books, Journals, and magazines discussing this problem, the number of articles written about it is near to dozen of thousand.

The cold nuclear fusion experimental data are extremely numerous and various, but we are going to dwell on the most important and fixed results. Thus at classical electrolysis study of the palladium cathode saturated with deuterium there is enormously great heat generation in heavy water: up to 3-kilowatt/ см3 or up to 200 megawatt-second in a small sample. There were also detected fusion products: tritium ($10^7 - 10^9$ t/sec), neutrons with the energy equal to 2.5 MeV (10-100n/sec), helium. The absence in the products of the reaction He^3 shows that heat does not the result from the reaction *d+p*. More over one can observe the emanation of charged particles (p, d, t, γ). We can study similar processes at gas discharge over palladium cathode, at change of phase in various crystals saturated with deuterium, at radiation treatment of deuterium mixture by strong sonic or ultrasonic flux, in cavitations micro-bubles in heavy water, in a tube with palladium powder saturated with deuterium under the pressure of 10-15 standard atmospheres and others. In some reactions, (for example at $d + t \to \alpha + p$) neutrons with the energy 14 MeV are absent; one can meet the same strange situation in other cases too. Thus the participation of nucleus Li^6, Li^7 in reactions with deuterium and protons, while the reaction

$$K^{39} + p \to Ca^{40}$$

was fixed even in biological objects. It was discovered long ago that nuclear transmutations are widespread (it is especially evident for plants and biological objects), but they are faintly connected with energy liberation. The examples of such reactions are:

$$Mn^{55} + p \to Fe^{56}$$

$$Al^{27} + p \to Si^{28}$$

$$P^{31} + p \to S^{32}$$

$$K^{39} + p \to Ca^{40}$$

In reactions of such a type very slow proton (its kinetic energy is equal practically to zero) is penetrating inside the nucleus by the above-mentioned way and stays there. ***There is no nuclear energy liberation, because the nucleus remains stable both before and after reaction.*** In accordance with classical nuclear physics, the nucleus, as usual, after a charged proton with great kinetic energy gets inside it, becomes unstable and breaks to pieces, and its fragments obtain bigger kinetic energy. The reactions of above-mentioned type were considered impossible at all at small energies and therefore were not studied in the classical nuclear physics. Apparently, ***that is absolutely new type of nuclear transmutations unacknowledged by modern nuclear science, but experimentally discovered sufficiently long ago.*** Today there are a lot of experimental data confirming the mass character of nuclear transmutation. Moreover there are many projects of nuclear waste neutralization that use this method. The journals "Infinite Energy", "New Energy", "Cold Fusion", "Fusion Facts" etc. and Internet is full of such projects. Of course, if the charge of a nucleus changes, then the electron shells of atom also will re-form, but the energy dealing with that process will be of few electron-volts order and cannot be compared with in any case with the energies of nuclear reactions that are from units till hundreds of billions electron-volts. By the way, experts in nucleonic got used to that range energies in nuclear reactions. Exactly that circumstance forces them it to reject *a priory* the presence of any nuclear processes in biology, because at such debris' energies dozens and hundreds of thousands of complex biological molecules will be destroyed.

Quite far ago Louis C. Kervran has published the book about nuclear transmutations in biology, and now nearly 20 years after it was reissued! Apparently for the first time numerous *experimental* data describing the above-mentioned phenomena were presented. The reaction of official science was also quite interesting. For example, the well-known physician Carl Sagan after having read the book about *experimental* results advised

Kervran *"to read an elementary course of nuclear physics!"* A little bit later Panos T. Pappas ("Electrically induced nuclear fusion in the living cell ", Journal of New Energy vol.3, #1, 1998) researched one of the nuclear reaction perfectly observed within biological cells, viz.

$$Na_{23}^{11} + O_{16}^{8} = K_{39}^{19}$$

The existence of $K - Na$ balance is well known in the classical biology for the long time. The ratio between quantities of *K* and *Na* ions is kept with a great accuracy in spite of presence of any *K* or *Na* ion in the food. Later in the work (M.Sue Benford, R.N. M.A. "Biological nuclear reactions: Empirical data describes unexplained SHC phenomena" Journal of New Energy vol.3, #4, 1999) that nuclear reaction was called "equation of life" and M.Sue Benford proved with direct physical methods the presence of such nuclear reactions in biological objects. To our regret there are too few researches of that problems in biology. We know about the existence of such groups in Japan (Komaki), India and Russia.

But the most intriguing fact in all these processes is the lack of fusion products that could explain the calorific effects. Thus, in some cases the number of fusion products (tritium, helium, neutrons, and quantum) should be million times more to give any explanation of the quantity of the heat evolved. So great energy liberation can be explained neither by chemical or nuclear reactions nor by changes of phase. The deeply studied interaction *d+d* proceeds along three channels:

$$D + D \text{ ---> } T(1.01) + p(3.03) \qquad \text{(1 channel)}$$

$$D + D \text{ ---> } He\ (0.82) + n(2.45) \qquad \text{(2 channel)}$$

$$D + D \text{ ---> } He + \gamma(5.5) \qquad \text{(3 channel)}$$

These reactions are exothermic. The third channel has very low probability. In the result of experiments it have been discovered that these reactions can take place at indefinitely small values of energies. In molecule of D_2 the equilibrium distance between atoms is 0.74A and according to standard quantum theory these two deuterons would be able to come into nuclear fusion by chance. But the value of the interaction is quite small and equals $\lambda_{D_2} = 10^{-64} c^{-1}$. There is an estimate well known in literature: the water of all seas and oceans contain 10^{43} deuterons and there would be only one fusion within 10^{14} years.

It is evident from the sated above that the main obstacle preventing *d+d* reaction is the presence of an extremely high Coulomb barrier. The UQT also gives such possibility. Solutions of UQT equations show that distance the deuterons could draw close depends strongly on our parameter "the initial phase "in corresponding equation with oscillating charge. We will give the concrete mathematical model constructed with the help of the equations with oscillating charge where a deuteron possessing small energy can approach the nucleus to a critical distance 10^{-12} cm or less.

Assume the stationary nucleus with the charge *q* is placed at the coordinate origin *x*=0 and a deuteron with the same charge *q* is placed at the initial moment *t*=0 at the point $x_0 < 0$ on the *x*-axis, and the deuteron velocity equals $\dot{x}_0 = v_0 > 0$. The units of mass, length and time are chosen if $m = 1, \hbar = 1, c = 1$ (m – deuteron mass, c – light velocity). Then charge *q* equals 0.085137266. Our units are connected (up to 4 significant figures) with the system (kg, m, s) as follows:

1 mass unit = $3.345 \cdot 10^{-27}$ kg,

1 length unit = $1.049 \cdot 10^{-16}$ m,

1 time unit = $3.502 \cdot 10^{-25}$ s.

The electron velocity corresponding to its energy of 1 *eV* equals $5.931 \cdot 10^{7}$ *cm/sec*. The deuteron velocity corresponding to such energy will be assumed to be 3680 times less, and in our units it will be $5.372 \cdot 10^{7}$ (if $c = 3 \cdot 10^{10}$ *cm/sec*). Then the deuteron movement towards the nucleus is described by the non-autonomous equation

$$\ddot{x} = -\frac{2q^2}{x^2}\cos^2\left(\frac{1}{2}(t + t_*)\dot{x}^2 + x\dot{x} + \varphi_0\right), \tag{7.3}$$

where the parameter t_* is defined under the condition that the argument of cosine equals φ_0 for $t = 0, x = x_0, \dot{x} = \dot{x}_0$. Thus $t_* = -(2x_0)/\dot{x}_0$), We are particularly interested in solutions of (7.3) under very

small deviation ε from the phase $\varphi_0 = \frac{\pi}{2} + \varepsilon$ (We did not obtained the needed solutions for other values of φ_0) and rewrite (7.3) in the following form :

$$\ddot{x} = - -\frac{a}{x^2}\sin^2\left(\frac{1}{2}(t + t_*)\dot{x}^2 + x\dot{x} + \varepsilon\right), \tag{7.4}$$

where $a = 2q^2 = 0.0144967$. Let the initial x_0 be equal -500000 of our length units (i.e. approximately $5\cdot 10^{-9}$ cm) and the initial deuteron velocity v_0 be equal to the velocity v_{00} corresponding to the deuteron energy of 1 eV or less. It turned out that the precision of numerical integration of this equation under such initial conditions and under values $|\varepsilon| = 10^{-15}$ and less is not sufficient and besides the interval of the integration must be very large. That is why this equation also had to be transformed by passing to "slow" time $\tau = |\varepsilon| t$ to the equation with respect to the variable $w = \left(\frac{dx}{d\tau}\right)^2$ as a function of x:

$$\frac{dw}{dx} = -\frac{2a}{x^2}\left\{\frac{1}{\varepsilon^2}\sin^2\left[|\varepsilon|\left(\frac{1}{2}(\tau + \tau_*)w + x\sqrt{w} \pm 1\right)\right]\right\}, \tag{7.5}$$

where $\tau_* = -(2x_0)/\sqrt{w(x_0)}$ and we retain +1 if $\varepsilon > 0$, and -1 if $\varepsilon < 0$. It must be added also the equation for τ as a function of x:

$$\frac{d\tau}{dx} = \frac{1}{\sqrt{w}}. \tag{7.6}$$

The velocity $\dot{x}(t)$ and $w(x)$ satisfy the relation

$$\dot{x}(t) = |\varepsilon|\sqrt{w(x)} \tag{7.7}$$

The system of equations (7.5, 7.6) is, so to say, a "model" system describing fairly accurately (from viewpoint of quantities data) the deuteron movement under all values of $|\varepsilon|$ from 10^{-31} to 10^{-6}. The numerical integration of this system was carried out under different values of ε and under following initial conditions:

$$w(x_0) = 2.103, \tau(x_0) = 0, x_0 = -500000 . \tag{7.8}$$

The corresponding value of parameter t_* is equal 689573.18. The corresponding value of the initial velocity $\dot{x}_0$ of the deuteron is equal $1.450172|\varepsilon|$ according to (7.7). Such velocity is for $|\varepsilon| = 10^{-7}$ approximately 3.7 times less for given initial $w(x_0)$ than the velocity $v_{00} = 5.372\cdot 10^7 cm/s$ corresponding the deuteron's energy $1eV$.

It turned out that the numerical tables for values of w, τ obtained for different values of $\varepsilon < 0$ in the interval ($-10^{-31}, -10^{-6}$) don't differ essentially from each other. The following table is true up to three-four significant figures for τ and $\dot{x}/|\varepsilon| = \sqrt{w}$:

x	τ	$\dot{x}/\lvert\varepsilon\rvert$
-500 000	0	1.450
-50 000	$1.426\cdot 10^6$	0.0493
-500	$1.002\cdot 10^7$	0.000489
-200	$1.067\cdot 10^7$	0.000440
-100	$1.090\cdot 10^7$	0.000425
-80	$1.100\cdot 10^7$	0.000423.

If reducing the table values of x to centimeters, we obtain the following corresponding approximate values:

$$5\cdot 10^{-9}, 5\cdot 10^{-10}, 5\cdot 10^{-12}, 2\cdot 10^{-12}, 10^{-12}, 0.8\cdot 10^{-12}\ cm$$

The time interval ΔT, in which the deuteron reaches the critical distance $10^{-12} cm$ from the center is equal to $1.090 \cdot 10^7 / |\varepsilon|$ of our time units or $(1.090 \cdot 10^7 / |\varepsilon|) \cdot 3.502 \cdot 10^{-25}$ seconds. If nuclear forces are not taken into account then the deuteron may approach the distance less $10^{-12} cm$. We present here for illustration the table, where the initial deuteron velocities v_0 in velocities shares v_{00} and the corresponding time intervals ΔT (in seconds) for different values of ε are listed.

ε	$\frac{v_0}{v_{00}}$	ΔT (s)
-10^{-6}	2.7	$3.82 \cdot 10^{-12}$
-10^{-7}	0.27	$3.82 \cdot 10^{-11}$
-10^{-22}	$0.27 \cdot 10^{-15}$	$3.82 \cdot 10^{4}$ (≈ 10.6 hours)
-10^{-23}	$0.27 \cdot 10^{-16}$	$3.82 \cdot 10^{5}$ (≈ 106 hours).

Let us note that the given data change essentially under positive values of ε (10^{-6},10^{-7}, etc.) There is some asymmetry of solutions behavior under negative and positive values of ε. The calculations show the minimal distance $|x|_{\min}$ more than 500 of our lengths units even for relative big initial $w(x_0) = 10000$. Thus, if we limit ourselves to the condition that the deuteron energy is not over $(0.27)^2 eV$ at a distance of $5 \cdot 10^{-9}$ cm from the central nucleus, and the whole process of deuteron movement towards the nucleus does not exceeds approximately 10.5 hours, then the interval $(\frac{\pi}{2} - 10^{-7}, \frac{\pi}{2} - 10^{-22})$ is approximately the sought phase hole in the whole interval $(0, \pi)$ of phase change φ_0 in eq. (7.4).

If many deuterons with energy not more than $(0.27)^2 eV$ at the distance $5 \cdot 10^{-9} cm$ from the nucleus are equally distributed along their phases φ_0, the ratio of the length of this hole to π, equaling approximately $0.3 \cdot 10^{-7}$, is equal to the share (or the respective percentage of $0.3 \cdot 10^{-5}$) of deuterons overcoming the Coulomb barrier.

The above figures express at least the order of probability of the cold nuclear fusion occurrence, and this order is absolutely incompatible with the figures in the standard quantum mechanics mentioned above. Let us note once again that a one-dimensional problem was solved, and in case of an accurate analysis (not zero sighting distance will be taking into account) this probability will be lower. Let us also pay attention to the large time intervals ΔT calculated if $|\varepsilon|$ is very small. It explains well the effect (observed by many researchers) of continuation of cold fusion reactions even many hours after disconnection of the voltage in the electrolytic cells. This effect was named even *"life after death"*.

As for the analysis of the deuteron movement with the help of the autonomous equation, the calculations lead to initial velocities v_0, exceeding the above mentioned numbers, although the general motion picture is the same. But the autonomous equation is interesting, because in the area of those values $x, \dot{x}$, under which the product $x\dot{x}$ has a small modulo, it is possible to replace $\sin(x\dot{x})$ with $x\dot{x}$, and consider under ε =0 the following equation (describing the deuteron motion from initial point $x_0 > 0$ to the center)

$$\ddot{x} = a\frac{(x\dot{x})^2}{x^2} = a\dot{x}^2$$

This equation has a very simple analytical solution. Without giving very simple calculations, we will present the final formulas. Let the initial data be

$$x(0) = x_0 > 0, \qquad \dot{x}(0) = -v_0 < 0$$

Then

$$\dot{x}(t) = -\frac{v_0}{1 + av_0 t}, x(t) = x_0 - \frac{1}{a}\ln(1 + av_0 t)$$

It follows from these formulas that the velocity of a particle moving in accordance with the initial equation never turns to zero, and under

$$t = t_* = \frac{\exp(ax_0) - 1}{av_0}$$

$x(t_*) = 0$, i.e. the particle reaches the center of the nucleus, its velocity at this moment being

$$\dot{x}(t_*) = \frac{-v_0}{1 + av_0 t_*} = -v_0 \exp(-ax_0),$$

so that it passes through the nucleus and moves further!
For example, let a=0.0144967, $x_0 = 1000$ ($\approx 10^{-11}$cm), $\dot{x}(0) = 5.37 \cdot 10^{-10}$ (≈ 16cm/s).

Under such initial data, the product $x\dot{x} = -0.0000537$, so it is quite possible to replace $\sin(x\dot{x})$ with $x\dot{x}$. In this case,

$$t_* \approx 2.3 \cdot 10^7 \quad (\approx 8 \cdot 10^{-18} \text{ sec}),$$

$$\dot{x}(t_*) \approx -29.9 \cdot 10^{-17} (\approx 9 \cdot 10^{-6} \text{ cm/sec})$$

These figures fit well into the reasonable framework, so the autonomous model can also be of use for the movement analysis in the problem under review. The phenomenon of particle passage through the Coulomb potential accounts very well for the existence of pendulum orbits in the Bohr-Sommerfeld model, when in states *1s,2s,3s* etc. the electron passes through the nucleus. Such states in the strict theory and experiment have no angular momentum, so in the Bohr-Sommerfeld model they were discarded as absurd!? Now they have a right to exist. Further, the experimental data for angular distribution of non-elastic scattering by nuclear reactions (including reactions with heavy ions) reveal the big amplitude of the scattering forward. It is impossible to explain such effect by the formation of intermediate nuclei but it may be explained from the viewpoint of our UQT.

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References

Griggs J. (1994). Calorimetric study of excess heat production within the hydro sonic pump system using light water, *Fusion Source Book. International Symposium on Cold Fusion and Advanced Energy Sources,* Belarussian State University, Minsk, Belarus, May 24-26, p.248-253.

Huffman M.T. (1995). From a sea of water to a sea of energy, *Infinite Energy*, vol.1, No 1, p.38-45.

J.Kasagi, H.Yamazaki, N.Kasajima, T.Ohtsuki, H.Yuki. (1996). Bremsstrahlung in α-decay of ^{210}Po and $^{244}C_m$: Are α-particles emitting photons in tunneling? Preprint, October.

Mizuno T., Enio M., Akimoto T. and K.Azumi. (1994). Anamalous heat evolution from $SrCeO_3$-type proton conductors during absorption/desorption of deuterium in alternate electric field. *Proceedings of the 4th International Conference on Cold Fusion*, December 6-9, 1993, Hawaii, vol.2, p.14., EPRI, Palo Alto, USA,.

Mushin K.N. (1974). *Experimental Atomic Physics*. Vol.1, 2 (Moscow, Russia).

Patterson J.A. (1996). System for electrolysis, U.S. patent No 5,494,559,27 February.

Potapov Yu.S. (1995). Patent No 649 Instalatie pentru obtiinerea enerjiei electrice si-temice.Buletin Oficial de Proprietate Industriala, No12, p.18-19, Chisinau (in Moldavian).

Samgin A., Baraboshkin A. et al. (1994). The influence of conductivity on neutron generation process in proton conducting solid electrolytes. In: *Proceedings of the 4th International Conference on Cold Fusion.* Palo Alto, USA, v.3, p.51-57.

Samgin A. (1995). Cold fusion and anamalous effects in deuteron conductors during stationary high-temperature electrolysis. In: *Proceedings of the 5th International Conference on Cold Fusion*. April 9-13, Monte-Carlo, p.201.

Sapogin L.G. (1973). United Field and Quantum Mechanics, *System Researches (Physical Researches)* Acad. Science USSR, Vladivostok, 2, pp. 54-84, (Russian).

Sapogin L.G. (1983). *Technics for a young*, No.1, p.41, (Russian).

Sapogin L.G., Boichenko V.A. (1988). On the Solution of one Non-linear Equation, *Nuovo Cimento*, vol.102B, No 4, p.433. http://dx.doi.org/10.1007/BF02728514

Sapogin L.G., Boichenko V.A. (1991). On the Charge and Mass of Particles in Unitary Quantum Theory, *Nuovo Cimento*, vol. 104A, No 10, p. 1483. http://dx.doi.org/10.1007/BF02817431

Sapogin L.G. (1994). Deuteron Interaction in Unitary Quantum Theory, and On the Mechanisms of Cold Nuclear Fusion. In: *Proceedings of the Forth International Conference on Cold Fusion*, vol.4, Theory and Special Topics Papers TR-104188-V4, July, p.71-178, Hawaii.

Sapogin L.G. (1994). Deuterium Interaction in Unitary Quantum Theory, and On the Mechanisms of Cold Nuclear Fusion. In: *Fusion Source Book. International Symposium on Cold Nuclear Fusion and Advanced Energy Sources*, Belarussian State University, Minsk, May 24-26, p.91-98.

Sapogin L.G. (1994). Energy Generation Processes in Terms of the Schroedinger Equation, *Proccedings of the 2 Russian Conference CNFNT* (in Russian) p.18-24, Sochi, September 19-23.

Sapogin L.G. (1996). Cold Nuclear Fusion and Energy Generation Processes in Terms of the Schroedinger Equation, *Chinese Journal of Nuclear Physics* vol.19,#2, p.115-120.

Sapogin L.G. (1996). Cold Nuclear Fusion and Energy Generation Processes in Terms of Schroedinger Equation, *Infinite Energy* E.Mallove, editor, vol.1, No 5,6, p.75-76.

Sapogin L.G. (1996). Energy Generation Processes and Cold Nuclear Fusion in Terms of the Schroedinger Equation. In: *Proceedings of the Sixth International Conference on Cold Fusion, Progress in New Hydrogen Energy*, October 13-18, Japan, vol.2, p.595-600.

Sapogin L.G., Ryabov Yu.A., Utchastkin V.I. (2003). *Unitary Quantum Theory and a New Energy Sources*. Ed. MADI, Moscow, (Russian).

Sapogin L.G., Ryabov Yu.A, Boichenko V.A. (2005). *Unitary Quantum Theory and a New Sources of Energy*, Archer Enterprises, Geneva, NY, USA

Sapogin L.G., Ryabov Yu. A. (2008). On the mass spectrum of elementary particles in Unitary Quantum Theory, *The Old and New Concepts of Physics*, Vol. 5, No 3.

Sapogin L.G., Ryabov Yu. A. (2010). New Theoretical Results about the Mass Spectrum of Elementary Particles, *Applied Physics Research*, vol. 2, No 1, p.86-98, May. www.ccsenet.org/apr

Sapogin L.G. (2010). About Unitary Quantum Theory, *Applied Physics Research*, vol. 2, No 2, p.114-140, November. www.ccsenet.org/apr

Sapogin L.G., Ryabov Yu. A. (2011). Unitary Quantum Theory and Catalytic Process Theory, *International Journal of Pure and Applied Sciences and Technolodgy*, vol. 3(2), pp 93-120.

Sapogin L.G., Ryabov Yu. A. (2011). About Unitary Quantum Theory and Catalytic Process Theory, *Elixir Applied Mathematics*, 34, p. 2412-2425, *www.elixirjournal.org*

Sapogin L.G.(2011). An Unitary Unified Quantum Field Theory, *Global Journal of Science Frontier Research*,vol.11, Issue 4,Version 1.0, July.

Tinsley C. (1995). Water fuel device conquers the marketplace! *Infinite Energy*, vol.1, No2, p.33-37.

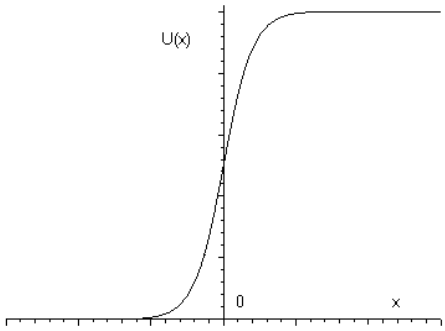

Figure 2.1. The step's potential U(x)

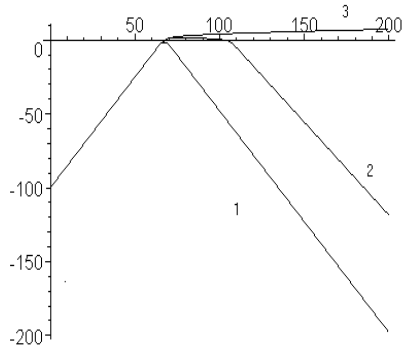

Figure 2.2. Reflection (1 and 2) and passage, (3) of particles with different values, of initial phase

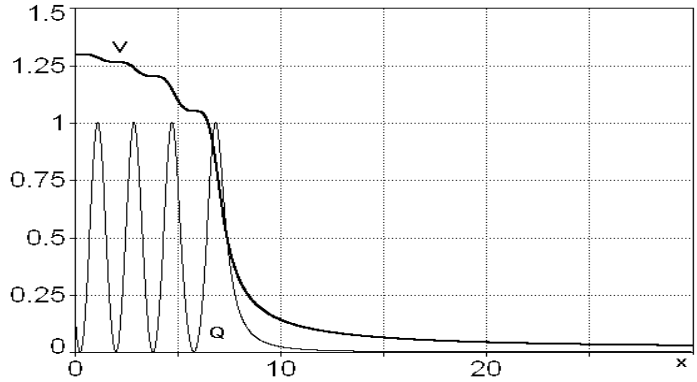

Figure 2.3. Dependence of particle's velocity and its charge on distance from barrier

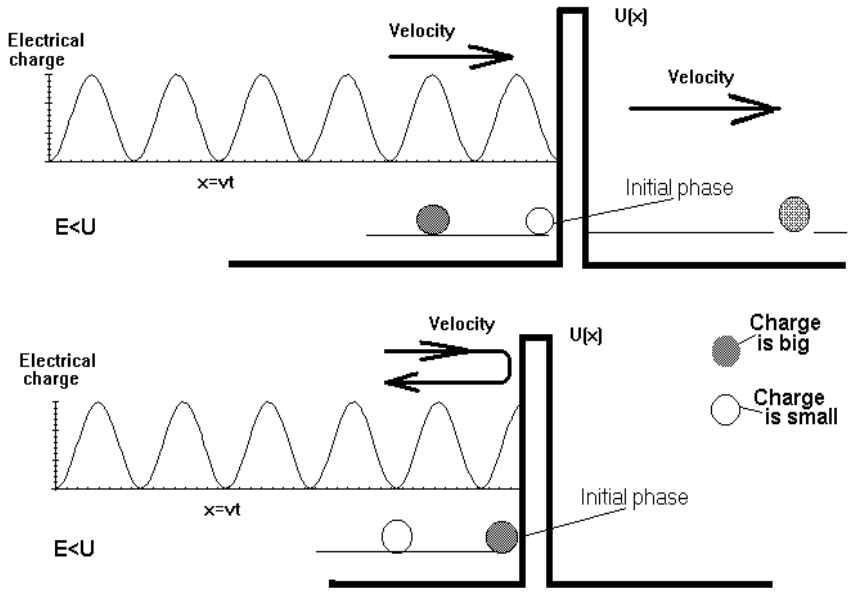

Figure 3.1. Visual picture of tunnel effect

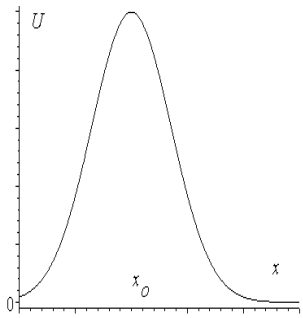

Figure 3.2. Potential barrier

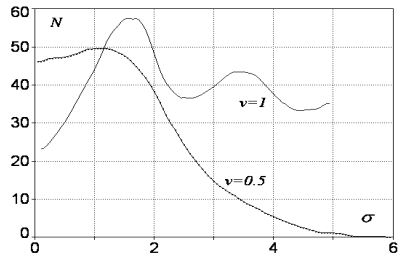

Figure 3.3. Dependence of particles number passed barrier on barrier width σ for different velocities

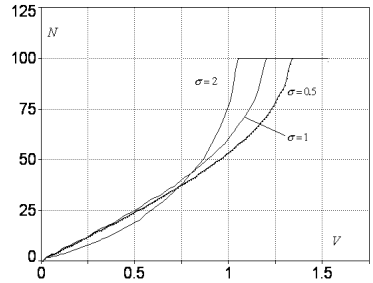

Figure 3.4. Dependence of barrier transparence on velocity for different barrier width

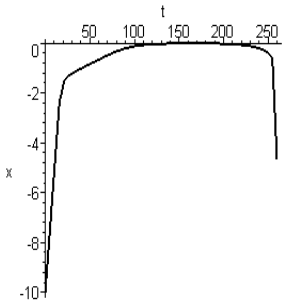

Figure 3.5. Reflection from barrier with increased velocity

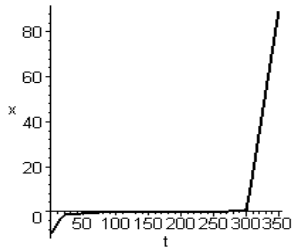

Figure 3.6. Passing of barrier with increased velocity

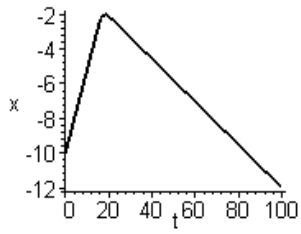

Figure 3.7. Reflection from barrier with loss of velocity

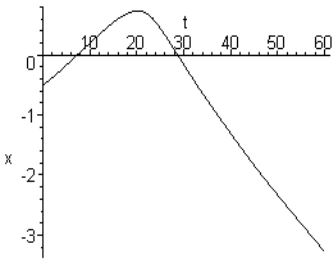

Figure 5.1. “Maternity home” solution

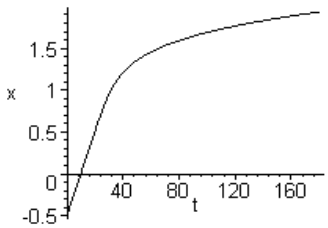

Figure 5.2. “Crematotrium” solution

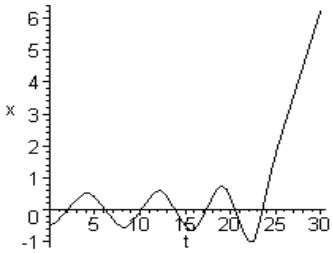

Figure 5.3. “Maternity home” solution

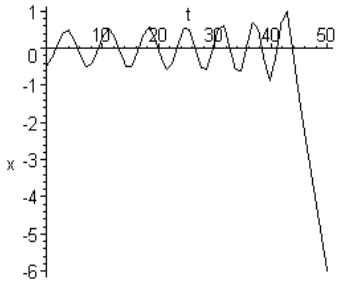

Figure 5.4. “Maternity home” solution

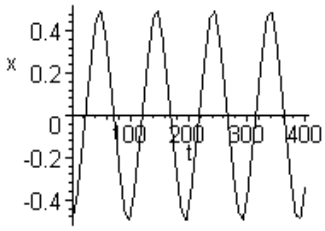

Figure 5.5. Classical solution

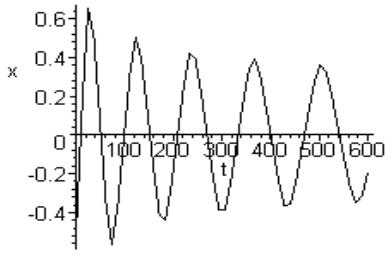

Figure 5.6. “Crematorium” solution

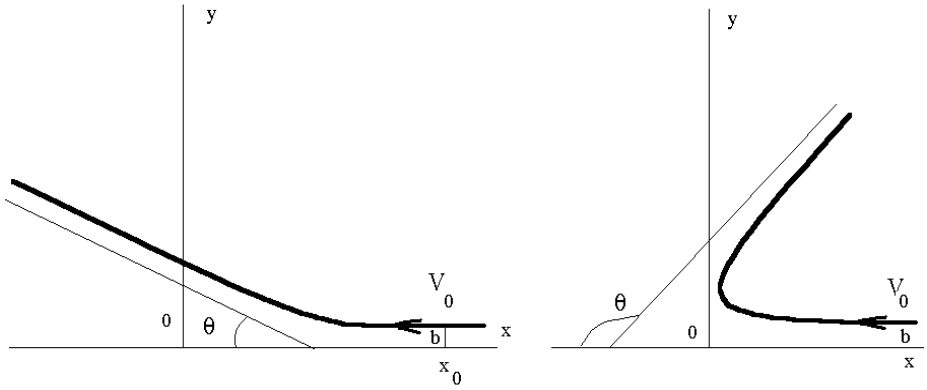

Figure 6.0

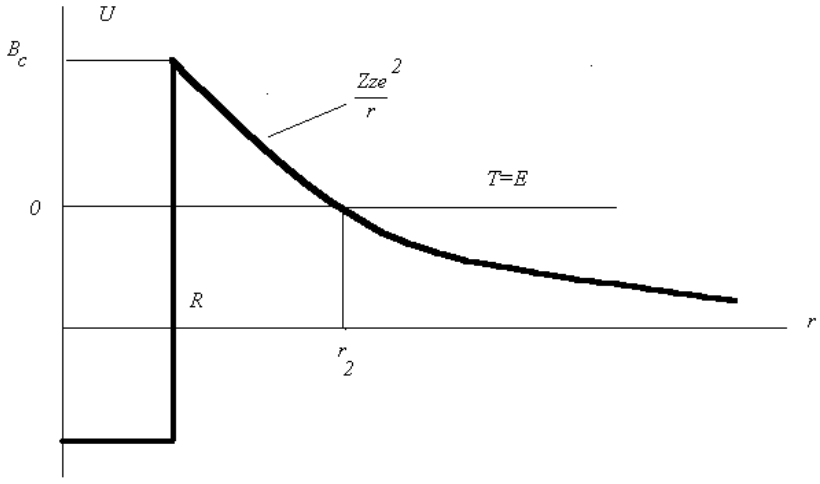

Figure 7.0. The potential corresponding to nuclear fusion