Dedicated to the blessed memory of my teachers:
A.I. Filatov, S.P. Kurdyumov, V.A. Zhuravlyov.

Forceps and scalpel for nanotechnologies

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The main obstacle in the way of nanotechnologies is the lack of selective "scalpel and forceps", the instruments to operate with particles of size less than 10^{-9} meters, particularly with molecules and atoms.

Nanotechnologies were referred to for the first time in a well-known Richard Feynman's speech at the annual meeting of American Physical Society in California Institute of Technology (Caltech), 1959, "There's Plenty of Room at the Bottom". Feynman suggested power moving single atoms and assembling macroobjects with the help of adequate-sized robots. It would allow making these objects many times cheaper. It was only needed to give such nanorobots the requisite amount of molecules and energy and write a suitable assembly program.

The studies to develop this adequate-sized robot - "scalpel and forceps" for nanotechnologies - have been in progress for a long time indeed and have their own respectable history. It is due to the fact, that the problem keeps arising while various applied problems in physics, biology, medicine and technology are being solved. These problems may concern the study of the way cells, organisms and particles move, attempts to hold them fixed and manipulate them with regard to their characteristics - size, ranging from micro- to macro-, charge, mechanical, electric, and magnetic moments in inhomogeneous fields.

The solutions of problems like these involve other serious mathematical and physical problems even in the first approximation.

The main mathematical problem is the absence of general vibration theory and small parameter for nonlinear systems. As a rule, the pendulum with vibrating suspension center was regarded as a "simple" model system with vibrational amplitude as a small parameter. Given approximation gave rise to numerous difficulties in the process of physical and mathematical (analogous, digital, hybrid) simulation of nonlinear dynamics in the sphere of resonance, such as "strange" singularities, attractors and chaos. Finally the authors of found solutions concluded that dynamical stability was impossible in zones of parametric resonance.

The main physical problem is that in a particle weighting region without any field sources (electrical, magnetic or gravitational) only saddle points exist. According to this, in statics and for the saddle points, the particle will be pulled in the weighting region in one direction and out in the other. The problem of stability was considered long ago by Gilbert (1600) and Earnshaw (1842). They discovered unstable equilibrium (static magnetic configuration). In accordance with Earnshaw theorem, stable particle confinement is just impossible in statics.

But what is impossible in statics, may be quite possible in dynamics (in variable fields or while particles move in inhomogeneous fields). In particular, Brownback showed that unstable equilibrium in statics may become stable in dynamics provided that there is a diamagnetic body in the system. Many theoretical and empirical researches have proved that dynamical stability of various physical systems is possible (levitron tasks, atomic traps, Kapitza's and Chelomey's pendulums etc.) outside the zones of parametric resonance. In 1989 N.F. Ramsey, W. Paul and H. Demelt won the Nobel Prize for nonresonant confinement of charged particles in electromagnetic atomic traps without feedback. Later on similar studies on confinement of living systems were carried out on the basis of intravital study of cell dynamics

in inhomogeneous electromagnetic fields (1994). By the estimates of foreign experts, this discovery meant a breakthrough in the sphere of fundamental physics, biophysics and nanotechnologies.

0 Bombay, XIV c. A. Stephenson, 1908 P.L. Kapitza, 1951 V.N. Chelomey, 1956

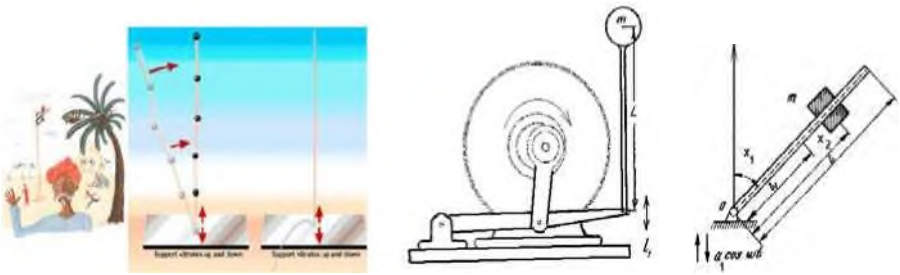
For the first time the possibility to manipulate molecules with the help of resonant electromagnetic field was demonstrated theoretically and experimentally by P.N. Lebedev the century before last [2]. In 1890 he brought forward a single program of "nanoworks" on resonant influence of fields on molecules and atoms.

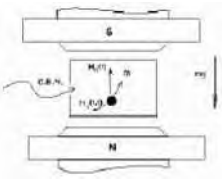
In 1974 A.I. Filatov and V.G. Shironosov provided both theoretical and experimental evidence for resonant confinement of particles (ferromagnetics) in inhomogeneous electromagnetic fields without external feedback

Later on in 1990 Scientific Research Center "IKAR" was organized in Izhevsk and by the decree of USSR Committee for Science and Technology (№ 508, April, 9, 1991) means [3] were granted to finance the project on nanotechnologies - "New technologies on the basis of selective spatial confinement of bodies (from elementary to macro ones) without external feedback in inhomogeneous fields" as the priority direction of science and technology progress.

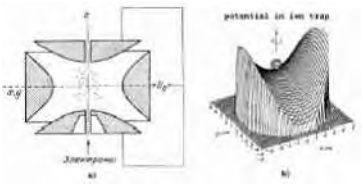
Main working data (in the sphere of resonant influence of the fields on non-linear physical and biological systems, 1974 - 2008, Fig. 1-3) [3]:

1. In 1974 for the first time the possibility to confine bodies and particles (from elementary to macro ones) with the help of resonance was demonstrated both theoretically and experimentally in inhomogeneous fields without external feedback. In 1988 the method was developed, which allowed finding analytically and with necessary degree of accuracy the areas of dynamical unstable states stability in complex nonlinear multicomponent systems of physical nature in resonant and non-resonant conditions.
2. The "$1\backslash R^3$ " problem was solved. It was proved that resonant microclusters (RM) as stable resonant states of motion may originate in the system of two or more oscillating dipoles at the expense of non-linear parametric resonance and RM supercoherent emission (SE) (http://www.ikar.udm.ru/sb22.htm).
3. The phenomenon of non-contact activation of liquids (NAL) was discovered experimentally at non-diaphragm electrolysis (1999), chemical and biochemical reactions, sustaining the fact of RM existence (http://www.ikar.udm.ru/mis-rt.htm).
4. Methods to detect and visualize the cluster liquid structure were developed on the basis of the following methods: SHF-spectroscopy (2002), spectrophotometry (2004) and Doppler US tomography (2007).
5. Method and devices to obtain new condensed structured environments (liquids and solid bodies) were developed on the basis of non-contact activation of liquids (patents RU 2316374, 2299859)
6. New high-performance resonance methods of treatment and prevention on the basis of NAL were suggested (http://www.ikar.udm.ru/pr-1.htm, http://www.ikar.udm.ru/sb43-3.htm).
7. New non-contact express-diagnosing methods to detect blood poisoning, contamination of liquids and register physical, chemical and biochemical processes in water solutions were suggested (2006). A multipurpose diagnostic complex "IKAR-Test" and sensors for NAL were developed (patent applications RU 2007127132, 2007127133).
8. Installations for non-contact activation of liquids were developed and introduced into mass production after winning prestigious international awards in Switzerland and Brussels (http://www.ikar.udm.ru/avk_com.htm).





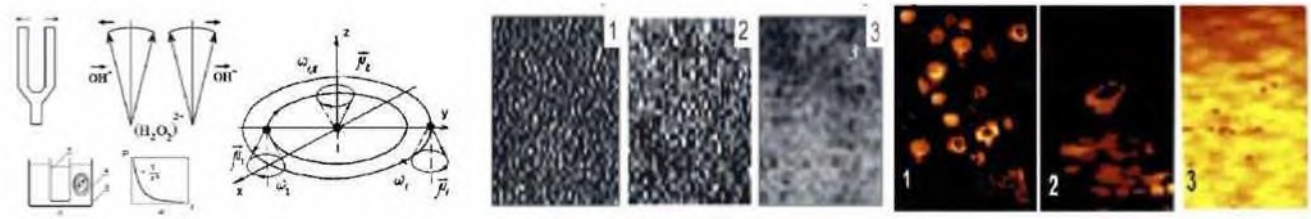
A.I. Filatov,
V.G. Shironosov, 1974



N.F. Ramsey, W. Paul,
H. Demelt, 1989

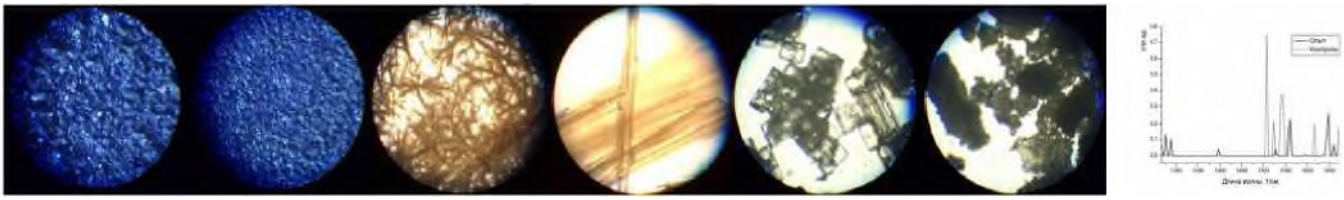
V.G. Shironosov, 1987

Fig.1. Particle traps



RM (1984) 10-100 цш (2004) 5-100 mm (2007)

Fig.2. Resonant clusters: theory; visualization of cluster liquid structure on the basis of laser interference methods (10-100 цт) and Doppler US tomography (5-100 mm).



Metal (control\activated) Na_2CO_3(control\activated) NaCl(control\activated) Wax (control\activated)

Fig.3. Obtaining new solid matters on the basis of non-contact activation of liquids (RU 2316374).

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Translated by Kseniya Chernysheva

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