Development of Euler's ideas at the Moscow State Regional University

P I Vysikaylo and V V Belyaev
Moscow Region State University, Radio street 10A, Moscow, 105005, Russia

E-mail: filvys@yandex.ru

Abstract. In honor of the 250th anniversary of Euler's discovery of three libration points in Russia in 1767 in the area of two rotating gravitational attractors in 2017 an International Interdisciplinary Conference “Euler Readings MRSU 2017” was held in Moscow Region State University (MRSU). The Conference demonstrated that the Euler's ideas continue to remain relevant at the present time. This paper summarizes the main achievements on the basis of Leonard Euler's ideas presented at the Conference.

1. Introduction. Leonard Euler discovery of the libration points

In 2017, international scientific community celebrates 250 anniversary of one of the most important discoveries made in Russia by the famous Swiss scientist Leonard Euler in 1767. The discovery of three linear libration points by Euler (the nonlocal interaction of various potentials - two gravitational and centrifugal) is still relevant and is used in many sciences about the Space, in the theory of gas-discharge phenomena, nanotechnologies, and other theoretical and technical sciences. This is due to the analogy of the long-range interaction of Coulomb, gravitational, centrifugal and even social potentials, such as language that comprises history, habits, customs and even the spirit of peoples acting synergistically (together) and thereby forming a joint civilization or opposing each other, which results in the destruction of the states that vacillate between them.

The fact that a libration point (oscillations of the third body between the attractors) should be between two gravitationally interacting spatially separated bodies (attractors) - \( L_1 \) (Figure 1), where the forces of attraction of the third body to these two gravitational attractors (equalizers) are equal to each other was supposed by Newton, who discovered the law of universal gravitation. Euler was the first to show that the libration point \( L_1 \), with the centrifugal potential taken into account, multiplies by three points - \( L_1, L_2 \) and \( L_3 \) (\( L_1 \) is reflected behind these bodies rotating relative to each other and results in the formation of two more linear libration points \( L_2 \) and \( L_3 \) behind them). Thus Euler transformed for the first time the Newton point to the Euler line (Figure 1). Therefore he took into account the nonlocality (the highest derivative with respect to the coordinates) - in the momentum transfer equation (the term in Euler's equation - \( \nabla V \)) as well as showed us methods how to solve and generalize many problems, including for describing social phenomena between two or more global social attractors.

Five years later, Lagrange emerged into the plane of rotation of the gravitating system of two bodies (the Sun and Jupiter) and the third small body and opened the triangular libration points \( L_4 \) and \( L_5 \) in front and behind Jupiter. In contrast to the Euler points these two points, proved to be absolutely Lyapunov stable with respect to weak perturbations. Then in 1904, astronomers discovered in these
libration points a system of asteroids ahead of and behind Jupiter, moving in unison along the orbit of Jupiter. After that all the points of libration and cumulation, including those discovered by Euler, were illegally called the Lagrange’s points.

The escape into the 3D space from the plane of rotation of double stellar systems was carried out by MRSU employees. Earlier, some of the specific tasks for calculating centrifugal potentials have been solved by Academician E I Zababakhin in analyzing the destruction of unlimited cumulation of cumulative jets or converging rotating liquid metal shells [1] and Academician L A Artsimovich in describing the reflection of charged particles in the mirror cells [2]. All these 3D tasks were summarized in the works of the MRSU employees. This resulted in the discovery of 3D structural turbulence at the libration points and quasi-Cooper bicyclones. Such cyclones enhance the rotation of each other, although rotating in opposite directions in a single system [3] like electrons in the Cooper pair. Neither Kolmogorov, nor Obukhov, nor other researchers of turbulence could guess on the structural turbulence. They did not take into account the centrifugal potentials that describe the energy-mass-impulse flows convergent or cumulative to the center. They believed that viscosity erases turbulent vortices and rotation. Further in 2009, the MRSU employee discovered not only the libration points between two positively charged structures, but also lines and even the libration planes for electrons in the region of positively charged structures, which allowed explaining the causes of the Faraday dark space, strata and a number of phenomena during the ingoing and destruction of meteoroids into the electronegative atmosphere of the Earth. However, do not forget that it all started with the work by Euler, in which he first took into account the influence of the centrifugal potential on the structure of energy-mass impulsive flows of small bodies in the region of two rotating gravitational attractors. Therefore the 250th anniversary of this event was celebrated in MRSU on November 22-24, 2017 by the International Interdisciplinary Conference "Euler Readings - MRSU 2017" [4]. Anyone who is interested in the problems of natural sciences, technology, as well as social phenomena and music could participate in the conference.

2. Main Sections of the International Interdisciplinary Conference “Euler Readings MRSU 2017”

On the first day of the conference, many topical interdisciplinary problems were discussed:

- Research of structures and fields in the Space and application of this knowledge in practice;
- Turbulence and structural turbulence in potential wells. Transport processes in inhomogeneous media and in media with potential wells;
- Structures in continuous media and their properties. Cumulative-dissipative structures in plasma (linear and pulsating lightning, cathode spots, strates, electric cords, electric tails behind meteoroids, plasmoids, etc.), solid bodies (excitons, exciton molecules and superlattices), liquids (gutters, etc.), gases (tornadoes, cyclones, etc.) and their properties. Vortex structures (cyclones, bi-cyclones, tornadoes, electric tails behind meteoroids, etc.);
- Shock and detonation waves and their cumulative and dissipative properties and transformation;
- Ambipolar drift and diffusion transport processes and inhomogeneous structures in plasma;
- Methods of generalized mathematical description of analogs in various phenomena (including gravitational, electromagnetic, nuclear, acoustic and quantum phenomena);
- Alloyed crystals (excitons, exciton molecules, superlattices) and their properties;
- Development of the Euler's ideas for describing phenomena and structures in nanochemistry;
- Application of the Euler's ideas in the development of social sciences about social structures and their interaction.

Many MRSU staff members from different MRSU faculties and departments as well as many specialists from numerous Russian and international institutions took an active part in the discussion of these subjects.

Numerical and analytical solutions of problems and modeling of the processes accompanying similar phenomena in such different environments involve the use of generalized mathematical transposition methods (GMTM) or generalized transposition methods (GTM) of knowledge and
mathematical models from areas well studied in the field of knowledge, currently insufficiently studied. This implies the further development of the foundations of cognitive sciences (interdisciplinary scientific direction, which forms the theory of artificial intelligence), allowing obtaining new knowledge in the fields of natural sciences on the basis of the analogues learned. In this respect, as shown by the Interdisciplinary International Conference "Euler Readings - MRSU 2017", the Euler's discoveries are still relevant and are used as a scientific foundation in many sciences about the Space, fullerenes, etc., can be used to explain phenomena in the electron-hole plasma, waves of spatial recharge of traps, and other theoretical and technical sciences. Relying on the Euler's work and methods of transferring mathematical models, one can acquire new knowledge in completely different sciences and apply them in technologies from femto- to macrocosm.

The talks were presented in a few sections. The program included many leading scientists of Russia: Academician Son E.E., Corresponding Member of the Russian Academy of Sciences D V Bisikalo, Academician S T Surzhikov, Academician A S Bugaev et al.

3. Review of the Conference Talks

In the introductory lecture of the conference "Euler Readings - MRSU 2017" Prof. P I Vysikaylo paid special attention to the problem of studying not only the gravitating systems investigated by Euler and Lagrange, but also systems with violation of neutrality. As was shown for the first time by MRSU employees besides of the libration points, discovered by Euler and Lagrange, there are libration points between the structures with the same charge sign. Properties of such structures have already been described. It is shown that in these points between positively charged structures there is the cumulation of the electric potentials of electrons, their energy and fluxes. As a result, the Faraday dark spaces are formed in the region of the libration point between the positively charged cathode spot and the positive plasma column. Consideration of a weak violation of the neutrality of structures and cumulative processes due to a violation of neutrality makes it possible to explain the stratification of discharges in gases, the Pekarik effect (the opposite direction of the group and phase velocities of perturbation propagation in a plasma with current), the reverse motion of a cathode spot in a transverse magnetic field, the constant solar wind, the electric wind, the formation and Coulomb levitation (ascent) of cylindrical columns of water or alcohol above their surface.

The investigation of the solar wind is conducted by graduate and post graduate MRSU students under supervision of MRSU Professor D.Sc. Vysikaylo P.I. A report "On electrohydrodynamic action of the corona discharge on a liquid" was presented by professor of the Moscow State University Bychkov V.L. The structurization and properties of droplets of liquids is studied under the guidance of Honorary Professor of Moscow State University and Honored Scientist of the Russian Federation Kuzmin R.N. The points of libration between positively charged crystals of phosphors and the role of physical doping of phosphor materials by nanostructures from allotropic forms of carbon were reported by Ms. Kovaliev A.I. from St.-Petersburg Technology Institute (graduate student of Professor Sychev M.M.).

As shown by the MRSU staff, the number of the libration points between atoms determines their valence in molecules and crystals. Besides, the libration points as well as libration lines and even libration surfaces for electrons arise in charged plasma structures [4]. The Debye' radius is not a panacea for all physics. And the application of the approach, where the Debye radius is the main characteristic size of all problems, is very limited. Myths and false conjectures should be verified by experiments, not by learned mantras.

The generalization of the above discoveries and studies allowed the MRSU staff to formulate a method of the generalized mathematical transposition, consisting in the adequate transfer of the mathematical models and methods of scientific description of phenomena from areas well studied and verified by numerous experiments in the field of natural sciences that have so far not been studied well enough with wrong conclusions refuted by experiments. To-date, the staff of MRSU have obtained solutions of the system of Euler and Poisson equations in perturbation theory, which made it possible to study in the plasma three types of ambipolar diffusions (Schottky, Poisson and Euler) and compare...
their relative contribution under varying conditions. Thus, inertia and violation of neutrality results in new types of diffusion of a quasineutral (but not absolutely neutral) plasma. On the basis of experiments with fullerenes, all hypotheses and provisions on the partial restriction of the de Broglie hypothesis in quantum mechanics are attributed to erroneous conclusions.

Professor of the Peoples’ Friendship University of Russia (RUDN University) N V Samsonenko spoke on current problems of quantum mechanics. He was a scientific trainee in the de Broglie group in 1980-1981. So he was informed firsthand by the founder of quantum mechanics and his disciples. In his report "The Choice of Dynamic Variables and the Interpretation of Quantum Mechanics" jointly with co-authors Ndahayo Fidel (Department of Physics of the Rwanda University, Butare, Rwanda), Usman Manga Adam (Department of Physics, Abdu Moumouni University, Niamey, Niger), he noted that due to the specific features of physical laws in the microregions of our space-time and unusual mathematical apparatus, quantum mechanics occupies a special place among the physical sciences about the nature. To date, it is considered the most proven and most successful theory in the history of science, but there is still no consensus in understanding its deep meaning. Despite the fact that with its help we are able to calculate the values of many physical quantities with high accuracy a saying by R. Feynman is valid: "I think I can safely say that nobody understands quantum mechanics" [Feynman, Richard (1965). The Character of Physical Law. Modern Library]. N V Samsonenko has finished his report: "It's funny that all the experimenters with whom the author met in Russia and abroad spontaneously stand on de Broglie-Bohm positions, despite the official teaching in all universities of the world of the Copenhagen interpretation of quantum mechanics."

Professor P I Vysikaylo has made a single remark to the fundamental talk of N V Samsonenko. In his interpretation of the first axiom of quantum mechanics, there is a general mistake made by all the classics of quantum mechanics that there exists a wave function that completely describes (in the quantum sense) a physical system and its square is the probability density \( \psi^2 \). In fact, in the framework of any interpretation of quantum mechanics, it is necessary to take into account the geometric normalization coefficient \( \omega(r) = 2k\pi r |\psi|^2 \) for spherical and cylindrical symmetric quantum resonators in the probability density \( \omega(r) \). Here \( k \) is equal to 2 for spherical symmetry and \( k = 1 \) for the cylindrical symmetry of the quantum resonators. Such consideration rehabilitates the solutions of the Helmholtz equation, ejected by the requirement that Dirac's psi function is to be limited (he ejected the so-called \( \cos(kr)/r \) waves with its own energy spectrum – \( E_{n=1/2} \) from classical quantum mechanics). Such waves are named also as the fundamental tone. They are observed in conventional acoustics. They describe such phenomena as sonoluminescence and cavitation). The calculation of cos-waves \( (E_{n=1/2}) \) in hollow quantum resonators (for example, in fullerenes and standing hollow excitons of large radius) made it possible to explain the experimentally observed Raman spectra of doped crystals, establish the foundations of cumulative quantum mechanics, increase significantly the possible spectra \( (E_{n=1/2} \) and \( E_n \) of standing large-radius excitons and at least to eliminate the contradiction of the de Broglie hypothesis with Schrödinger's quantum mechanics that was truncated by Dirac's erroneous requirement about the boundedness of the psi-function everywhere. Unlimited cumulation of the waves was taken into account in acoustics, however, it was not considered in quantum mechanics owing to Dirac's requirement.

After the creation of cumulative quantum mechanics, unlimited cumulation of the psi function was possible in hollow quantum cavities. Only the inclusion of the fundamentals of cumulative quantum mechanics allows us to conclude that the de Broglie hypothesis "quantum particles behave like waves" completely corresponds to all the wave phenomena discovered in conventional acoustics. Thus, the main achievements of the quantum mechanics for describing the behavior of the quantum particles in the quantum resonators are reduced to the de Broglie hypothesis that the quantum particles behave like waves and all the mathematical models and solutions obtained for the waves are carried completely by the description of the behavior of the quantum particles.

MRSU Professor, Doctor of Sciences in Physics and Mathematics (Department of General Physics of the MRSU) E V Gevorkyan detailed on the history of the creation of Euler's calculus of variations. It was firstly published in an Euler's work in 1744 and was described in detail in the book "Elements
of the Calculus of Variations” in 1766. The Euler's calculus of variations became the foundation of not only mathematics but also theoretical physics. The paper discussed the application of Euler's variational methods in modern condensed-state physics and, in particular, in the theory of the liquid-crystal state.

Professor M Y Ivanov, Chief Researcher of the P I Baranov Central Institute of Aviation Motors (CIAM) told about the integrals of the Euler equations and solitons in the hydrodynamic plasma model.

Professor A V Gerasimov in a joint report with A P Kirpichnikov, F R Sabirova (Kazan National Research Technological University) spoke about the geometrical location of the points of separation of the regions of direct and return currents in the channels in the presence of heating zones restricted in their longitudinal coordinate. Such surfaces can be attributed as the surfaces of the Euler's libration, as the Co-Chairman of the Conference P I Vysikaylo noted.

Of particular interest was the report of Professor V V Cherniy on the nature of the origin of the rings of Saturn: possible superconductivity of ice particles of rings. Here, new mechanisms of ring formation were proposed and verified.

Professor of the Institute of Space Researches (ISR) of RAS N S Erokhin presented a study of wave propagation in inhomogeneous media. The research is in co-authorship with Academician of the Russian Academy of Sciences, Chairman of the Scientific Council of the Russian Academy of Sciences on Nonlinear Dynamics V E Zakharov and ISR RAS staff N N Zolnikova, L A Mikhailovskaya). N S Erokhin talked about the reflectionless propagation of the electromagnetic waves through the plasma with small-scale structures of large amplitudes with varying relative permittivity.

A PhD and Associate Professor V N Ilyin presented a talk on environmental problems in Russia and the Moscow region. Once again he convincingly showed that the basis of cumulative processes in social phenomena are the processes of timely purification of sewage and separate utilization of garbage. His team has original developments and sufficient experience to solve these problems effectively.

The application of the method of generalized transposition allowed the conference to analyze the behavior of the United States in relation to the Russian Federation, the European Union (Germany), and China. Here the Euler's ideas about points and areas of libration (oscillations, throwing, etc.) between two social attractors have not been applied yet. Indeed, if one looks at the big Eurasia, taking into account China, India, Indonesia, Japan, then the calm synergetic development of this region will undoubtedly result in reduction of the role for the United States and its satellites. Here, the United States beat out weak links (Ukraine, Russia, Near East) with small expenses ($ 5 billion) and flood Europe with refugees from the destroyed countries. So areas of the libration are purposefully created in Ukraine, as well as problems in Russia, Germany.

A separate important event was the performance of the great-great-granddaughter Euler in the 9th generation - Hecker Nadezhda Feodorovna. She told about the descendants of Euler from his daughters in the book about the descendants of Euler and more in detail focused on the works of his father and uncle professors and famous scientists of Russia.

Undoubtedly adornment of the interdisciplinary conference was the speeches of the staff and students of the Yu A Shaporin Music School and the A Shnитke Moscow State Institute of Music. Their speeches occurred between scientific reports. A number of musical performances were listened to at the conference.

4. Conclusion
Despite the old anniversary - 250 years, the Euler's ideas do not become obsolete they continue to develop, bringing new results. In this case, the theory itself is practically not modified. The article is concluded with the words by Lagrange: "If you love math, then read the work of Euler", they are relevant at the moment. The full record of the conference "Euler Readings - MRSU 2017" can be viewed in youtube [4].
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