Review of some projects connected with of fundamental laws of physics

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A B S T R A C T

Recognising the space environment (neo-ether) as a new corporeal entity provides the humankind with an inexhaustible source for conceptual innovations in many domains. Instantaneous transmission of the information and energy to anywhere in The Solar System, gravity control, generating unlimited amounts of electrical energy at subatomic level, fundamentally new electric motors, the power reactors on the basis of cold nuclear fusion (CNF). Formal science had not recognised new physical phenomena; nevertheless, many of those projects have been already in a stage of their technological implementation.

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INTRODUCTION

In 2013, the American edition, *The Unsolved Problems in Special and General Relativity,* published results of astronomic observations made by Chinese scientists concerning motion of planets within the Solar System. In their papers, member of the Academy of Sciences Hua Di, professors Juhani Fu, Guo-Hua et al., in total 21 authors from the Public Republic of China and professors L.Sapogin and Florentin Smarandache, proved a complete failure of SRT and GRT by A. Einstein. As a result, they demanded to revise research results and conclusions on the space environment (ether) in the Universe (1).

A conclusive evidence for existence of the space ether is so-called "relic" thermal radiation identified in 1965 by A. Penzias and R. Wilson. The radiation has an average temperature of 2.7 degrees Kelvin. A. Efimov and A. Shpitalnaya in their paper called *On Motion of Solar System Relative to Background Radiation in Universe* (2) write that referring to background radiation as a relic one is "totally incompetent, it is more correct to identify it with neo-ether."

Astronomical observations (3) related to an assessment of the Solar System motion speed in the universe, have enabled to state that three-degree micro radiation (10GHz - 33 GHz) is not involved in this motion. Later, professionals from the NASA, B. Kori, D. Wilkinson, J. Smith et al., made corrections to initially recognised isotropic distribution of radiation in the universe (4). With the help of COsmic Background Explorer (COBE) they found available little deviations from homogeneous distribution (5). Experiments show that background radiation anisotropy arises due to motion of The Solar System relative to this radiation. A total speed of The Solar System relative to neo-ether is ~ 380 km/s directed with about 90 degree towards an ecliptic plane to the north. (2)

Remaining within SRT and GRT by A. Einstein, it is impossible to explain revealed radiation anisotropy. For a cause for thermal radiation of background neo-ether one should search in physical nature of the space environment. If we assume that a structure of neo-ether includes virtual pairs of related charges, i.e. electrons and positrons, making dipoles, then with its physical features such an electrical environment, with its polarization would look like dipoles of dielectrics.

A thermal effect revealed by A. Penzias and R. Wilson one may explained in terms of Unitary Quantum Theory by L. Sapogin (6) and Fundamentals of the Theory of Ether by A.Rykov (7). In case of deformation of bound charges dipoles – polarization of the space environment may generate spherically asymmetric potential trap holes. When electrons enter such traps, we observe an implemented solution to UQT differential equations, called *" maternity home*."

According to him, following a series of oscillations at a potential hole, the electron intakes energy enough to leave out of the trap. Moving in one direction, spontaneously per se, electrons generate constant electric current able to warm the environment up (6).

The deformation of bound charges in the ether has a universal nature for electromagnetism, electrostatics and gravity. A difference is in direction of polarization relative to the direction of interaction – longitudinal for electrostatics and gravity, cross for electromagnetism. The electric field is original in all other fields, including magnetic, gravitational and nuclear interactions are secondary (7).

The space environment (neo-ether) available in the universe provides the science with an inexhaustible source for conceptual innovations. Instantaneous transmission of the information and energy to anywhere in The Solar System, gravity control, generating unlimited amounts of electrical energy at subatomic level, fundamentally new electric motors, the power reactors on the basis of cold nuclear fusion (CNF). Nevertheless, many of those projects have been already in a stage of their technological implementation.

The most well-known among them is *The Global System to Transmit Energy Wirelessly* project (7), in part implemented by N. Tesla in 1908 in his laboratory on Long Island near New York.

In 1927, in paper *The World System* (8), N. Tesla wrote, "A fundamental distinction between now applied translational system and the system, I hope I would introduce, is that currently a transmitter emits energy in all directions, whereas within the system drafted by me to any place on the earth it only transmits the force field, while energy as such travels following a certain predetermined route."

A striking fact is that energy mainly travels along a curve, i.e. follows the shortest way between two dots on the earth's surface and reaches a receiver without any dispersion. A wireless transmitter

generates longitudinal waves in the near-Earth electric environment. Its behaviour looks like that of sound waves in the air, except for the fact that huge elasticity and extremely low density of the medium (ether) makes their speed greater than that of the light. Average surface speed is about 471,200 km/sec. At that, distribution of currents along the earth's surface more looks like the moon's shadow gliding across the globe."

One can capture the law on energy transmitted wirelessly from a picture by N. Tesla (figure 1). In an explaining text, N. Tesla wrote, "When a transmitter is working, two effects may be achieved, i.e. electromagnetic waves pass through the air, while current passes through the Earth. The former are distributed with the speed of light and a loss of their energy is irreparable in a circuit. The latter keeps flowing with a changing speed depending on the cosecant of an angle, which makes a radius drawn from any arbitrary point on the axis of wave symmetry. At the beginning, the speed is infinitely high, but it has been gradually decreasing until passes through a quarter circle and become equals to the light speed. From that moment, it is increasing again to become infinitely high at the opposite side. Instead of transmitting sound vibrations to a remote wall, I sent electrical oscillations deeply into the earth, and instead of the wall, I got an answer from the Earth. Instead of echo, I got a standing electric wave reflected from the far depths."
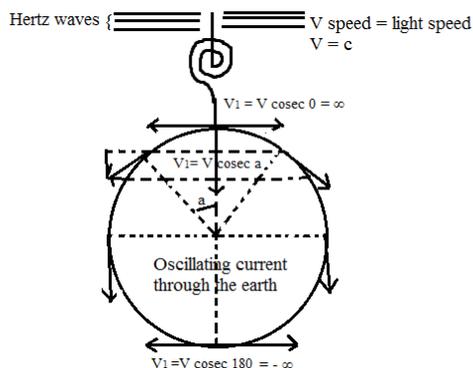

Figure 1N

Tesla failed to complete this project due to lack of funding. The Earth has an electric charge, which, because of the Coulomb repulsion, tends to a spherical surface of the planet. The electrification process of the near-Earth environment that behaves like

the incompressible fluid looks like according to an expression by N. Tesla a yield state. At that, the energy is primarily transmitted along the curve - the shortest way between a source and a receiver on the Earth's surface. Distribution of currents of the "electric fluid" on the Earth's surface one describe analytically with the theory of the stationary, two-dimensional, ideal incompressible fluid on the Riemann surface.

See Appendix A.

History of another project for wireless data transmission to any point of The Solar System began in the60-ies of the 20th centuryand referred to namesof N.Kozyrev, G.Shipovand and A.Akimov. N.A. Kozyrev in time of his astronomical observations of the star Procyon using a telescope, equipped with a special signalling sensor, found unknown radiation. Herewith the telescope was not focused on a place, which was seemingly emitting visible light, but the place where the star was actually located at that time, taking into account the light speed of light and a direction and speed of the star motion star.

A propagation velocity of unknown radiation was significantly higher than the light speed (a signal reaches the earth almost instantly). N. Kozyrev recognised the time as a radiation source, as in math aspect he concluded that in the star all the forces were balanced to such an extent that there was just nowhere for power to come from (9).

However, in the late 60-ies, young scientists A. Akimov and G. Shipov reproducing N. Kozyrev's experiments concluded that it was not the time as a source of mysterious radiation, but massless inertia vortices, which they called torsion radiation. A nature of inertia vortices formation has been still unclear, but having accepted the hypothesis of cosmic ether, we can assume that a reason for vortices formation is outrage of the space environment. In his paper (10), G. Shipov writes. "Torsion radiation looks like massless vortices of inertia, which as their only physical feature have a spin.

A direction of vortex rotation determines its charge. Herewith having the same name charges attract each other, while unlike repel". Based on theoretical constructs by member of Academy of Science G. Shipov, Professor A. Akimov in the 90-ies of the 20th century developed torsion transmitting devices that presented fantastic opportunities in communications. Receiving and transmitting equipment was ready to get patents; including producing a prototype, but a lack of funding prevented the project completion. (11)

The third project refers to generation of electric power at a subatomic level. An author of the project is a group of enthusiasts headed by Professor at Moscow State Automobile and Road Technical University L. Sapogin and astronaut pilot V. Dzhanibekov.

In his interview in 2012, L. professor Sapogin said: "The issue is a fundamentally new way to produce electrical power. Since Faraday time people have been generating electric current moving a conductor within a magnetic field. Our system does not include the magnetic field at all. We have almost completed building of a new installation. It is based on implemented quantum solutions called *The Maternity*, mentioned in paper *Which physics prohibits perpetuum mobile*?" Within UCT, both appearing and disappearing substance (energy) is possible, and we can apply it. We need to select processes that release excess energy, while standard quantum mechanics cannot tell us how to do it. At the same time, UCT has such potential. We are perhaps achieving the time when a scientific theory, followed by engineering thought, would make it possible to obtain "free" power on installations based on features of the subatomic level in substance structure."(6).

The fourth project is associated with farther of new electrodynamics, "Siberian Maxwell" G. V. Nikolaev (12). In September 1991, at *the 2nd International Conference on Space, Time and Gravitation* in Saint Petersburg, Nikolaev reported opening a new kind of the magnetic field, and new theory of electromagnetism, as well as presented a unique electromotor of his own design. Austrian physicist Stefan Marinov announced his interest in Nikolaev's papers. He reproduced some G. Nikolaev experiments and built his paradoxical electromotor, functioning against laws of electrodynamics.

Stefan Marinov also published a monograph, a main theme of which was new theory by G. Nikolaev and a principle of operation for the electromotor that he called *SIBERIAN COLIA*. In his papers, Nikolaev presented himself as a follower to Maxwell theory, but the theory based on a corporeal medium, in which bias currents play a leading role. The most important achievement of the new theory was discovery of new scalar magnetic field $H\parallel$ = - divA, supplementing the vector magnetic field $H\perp$ = rotA.

G.Nikolaev, using the single-valued magnitude of physical property of vector potential A and moving charge e, at (v « c) (12)

$$A = \frac{ev}{cr} \quad (1)$$

ascertained existence of two types of magnetic fields in the space around it:

$$\text{vector field } H\perp = \text{rotA} \quad (2)$$
$$\text{scalar field } H\parallel = -\text{divA} \quad (3)$$

To eliminate certain difficulties in determining power of magnetic interaction W between moving charges through their magnetic fields $H^\perp$ and $H\|$ associated with making interaction formal of the vector and scalar fields between each other, G. Nikolaev suggested a move from two types of magnetic fields to one complete vector field Hn :

$$Hc = |H^\perp|ro + |H\|| xo \qquad (4)$$

The known transverse Lorentz force presents far from a complete picture of properties that the magnetic field has. When we take into account all properties of the magnetic field, we also immediately discover an available longitudinal magnetic interaction force, which considerably differs from the known Lorentz force. (12)

Under the new theory of electrodynamics, many phenomena have found their explanations the results of Aronov-Bohm experiments, for which, going from transverse Lorentz forces, there has been no correct explanation found.

A physical nature of rotation of *engine* axis, fixed on two bearings, with current (AC or DC) flowing through external bearing rings (see Fig. 2), G. Nikolaev explained as follows: "In this experiment, with a constant angular velocity of rotating axis on bearings, dimensions of a circuit and hence its L inductance do not change and a dependence for the circuit energy

$$WL = \frac{Lj^2}{2} \qquad (5)$$

from which we can found the force influencing the axis

$$F = \frac{dWL}{dx} = -\frac{j^2}{2}\frac{dL}{dx} \qquad (6)$$

turns out to be essentially unacceptable.

An analysis of functioning for devices of such type shows that driving forces in them are not potential transverse Lorentz forces applied to radial rotation currents of an anchor, but longitudinal reaction forces applied to currents in supplying rails. "(12).

It should be clarified that in case of symmetric current input (figure 2.A), an engine axis starts spinning in any direction after the first push. In case of asymmetric current input (figure 2.B), the axis starts spinning without the prior push. This clarification is crucial, if we extend the *railgun* experiment to a global scale and if as an engine we consider the Globe, on a surface of which a negative electric charge $Q = 5,16 \cdot 10^{14}$ coulomb is concentrated, while along an outer sphere such currents go, which generate a magnetic field of 50 a/m, while the immovable space aether plays a role of bearings. Axial rotation of the Earth would depend on the same longitudinal forces, as in the *railgun* experiment.

Asymmetry for the Globe is achieved with running away magnetic and geographic poles in the space, eliminating a need for the first push.
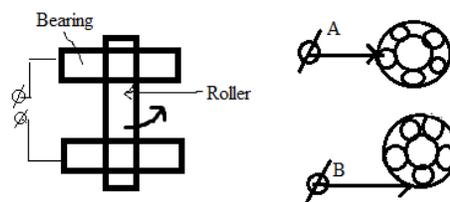

Figure 2

The fifth project is a DC generator, which has been successfully operating for about 30 years as a perpetuum mobile, i.e. it produces energy from the vacuum. In Switzerland, the device is called *Testatik Machine M/L Converter* of the *Methernitha religions group*.

Swiss physicist Paul Baumann is an inventor of this "gratuitous" energy source. Externally, the device looks like an electrostatic machine with Leyden jars. It has two acrylic disks with 36 narrow sectors, made of thin aluminium. The machine is manually driven by rotating disks in different directions. A rotation speed is 50 to 70 rpm. Having been firstly driven, disks spontaneously rotate. At that, we achieve DC voltage of about 300 to 350 V with the 30A current.

The installation was made in four variants with a power of 0.1, 0.3, 3 and 10 kW. Mechanical energy spent to rotate disks is only about 100 mW, hundreds of thousand times less than generated electric energy is. A motor and a generator in the device are combined together. The largest installation for 10 kW has a diameter of plastic disks of more than 2 m, while the smallest - 0.2 m. The machine with 3kW has a weigh of about 20 kg. Such a system is noiseless, compact and clean in an environment safety aspect.

The installation with 10 kW operates today in a town of Linden near Bern and belongs to a religious commune. A principle of machine operation has not been still entirely clear even to the inventor himself. To clarify this, the commune gave as a present a 100 W power installation to Stefan Marinov. In 1989, Professor S. Marinov published his book *The Thorny Path of Truth* that is a documentary evidence for broken conservation laws.

Later, getting familiar with papers by G. Nikolaev, S. Marinov suggested that in his invention Paul Baumann had implemented theoretical objectives of new electrodynamics. A generator operates on a principle of separated charges between two metal spheres insulated from the earth and each other. At the same time, rotation of disks after the first push and separation of charges in the inter-disk space filled with the neo-ether, occur under an influence of the same longitudinal forces that rotate a rotor of the SIBERIAN COLIA engine and provide bias currents when charging a flat-topped generator. The circulation theorem, under which efforts to replace charges would be equal to the energy released when the electric current flows through, after charges have been separated, is not true for single electric charges. Professor L.Sapogin proved this in the UQT (6).

Active contribution of environment appears in cosmology in the maintenance of constant energy thickness under the accelerated extension of the universe. V.Rubakov, a member of the Russian Academy of Sciences, writes in his paper "Energy is as clear as mud": "There is no law of conservation of energy in cosmology. The universe expands, but energy thickness is constant. Volume increases and the energy in that volume increases, too. Where does it come from? Vacuum energy is constant and it is the major characteristic." (13).

The quantity of degrading stellar systems which is registered by N.Kozyrev and abnormally small from the point of view of the present- day science (9) and the motion of Mercury's perihelion (14) can illustrate the active contribution of cosmic environment to the universe evolution.

From the modern science point as energy source of Universe this of Ptrpetuum mobile. Active influence of ether on the system can assume different shapes. Thus, under ultra-deep penetration of particles moving with acceleration into the target body, anomalous release of energy by a factor of hundreds exceeding the kinetic energy of particles at the moment of impact was observed in N.Kozyrev experiments on the absolutely non-elastic collision of two bodies (completely irreversible process) and in later A.Venik and S.Usherenko experiments, and here the

total mass of the system varied (9,15,16). Similar effect was observed on the firing of the target using electron injector in the experiments connected with the investigations of secondary electron emission in spherical condensers and the Evacuated Tube. Research has been underway of the generation and properties of electron clusters, which appear on pointed cathodes with large currents

of autoelectronic emission. The first research in this sphere was started by Kenneth Shoulders. These researchers discovered two extremely interesting facts:
1. Electron current is generated by sufficiently stable electron clusters,
2. These clusters acquire during acceleration an energy, which exceeds by 30 and more times the value possible when the charge passes the used potential difference.

These phenomena (especially the second one) are absolutely incomprehensible from the point of view of the ordinary physics.

UQT and FTE assume even the possibility many times experimentally studied both by Nicola Tesla and Canadian physicians Correa, who have even patented the system, generating electric current by taking the energy, as they thought, from vacuum fluctuations (17).

All these experiments were repeated in the Lavochkin NPO (18) the gas speed increase effect the exit from a narrow slot leads to simultaneous increase of both terms in equation that jet engine thrust:

$$F = G (u - V A = \pi r^2) + (P - p) S, \qquad (7)$$

Where G is the mass gas outflow speed, V is the aircraft speed, P is the absolute pressure on nozzle section, p is the atmospheric pressure, S is the nozzle cross-section, F is the nozzle thrust. In this equation u and V are regarded as measured in relation to the Earth, and value (u-V) is thus the gas speed relative to the nozzle. If the nozzle thrust is divided by its cross-section of the narrow internal channel, the resulting value will have pressure dimensions. It can be called "effective pressure". It is surprising, but measurements show that it exceeds the pressure in the receiver (the input) by 2-4 times, which is equivalent to a molecular speed increase, since pressure is composed of the blows of different molecules, and the more the molecular speed the

greater the pressure. The measurements showed that the role of the small value of the slot width is not to reduce consumption, but mainly to make the flow laminar, in which case only the effect of greater gas speed at the end of the slot than at the beginning of it is observed. It follows from numerous experiments that the kinetic energy of the flowing out gas exceeds bu twice and more the energy spent for air compression. In other words, the gas molecular speed at the nozzle (slot) output exceeds the input molecular speed at the beginning of the slot by 2-4 times. This incomprehensible effect contrary the modern gas dynamics and leads to a considerable growth of excess pressure.

The astonishing experimental results of A.Samgin and A.Baraboshkin should be added (Russia) (19) and of T.Mizuno (Japan) (20). They have used, apparently independently one from each other, some special proton-conductive ceramics that is able to generate the thermal energy thousands time more than energy consumption if current runs through it. In some experiments of T.Mizuno that value exceeded 70000.

These effects can be easily explained from the viewpoint of the Fundamentals of Theory of Ether. Polarization of environment and deformation of the structural elements of ether (dipoles) occurs on the acceleration and deceleration of particles. In fact, the body fallen on the target imparts energy composed of the energy of particle and energy released from ether to itself and to the target.

The structure of cosmic environment determines the inertia of bodies as the resistance of electric dipoles (their polarization) to any acceleration. Obtain a known electric Coulomb force, while instead of the inertia force the electric force F:

$$F = -m_{in} \cdot \alpha = qE \qquad m_{in} = \frac{qR}{a} \qquad (8)$$

will appear, a source of which is induced voltage E preventing accelerated motion of the charge. This eliminates a need in the equivalence gravity and inertia principle as a way to interpret the inertia in the General Relativity.

Under positive acceleration the elastic force of environment counteracts accelerated motion. Under negative acceleration (deceleration) the elastic force of environment arises, which counteracts velocity slowing down and which is directed to the continuation of uniform rectilinear motion of any body. Inertial forces of acceleration and deceleration are directed to the opposite directions. Such is the dynamics of 'target–particle' system. Being guided by the theory of electrical environment, A.Rykov performed the computation of energy released by environment on a dipole deformation (21). Formula for the determination of environment dipole deformation under the acceleration of any body and any mass will be given by:

$$\Delta r = \sqrt{\frac{\alpha}{4\pi E_o S}} \quad m, \qquad (9)$$

where α (m s^{-2}) is acceleration,

$$E = 0.7744 \left[cl^{-1} m^3 s^{-1} \right]$$

is specific surface electric intensity of environment,

$$S = 6.253387 \cdot 10^{43} \left[cl\ m^{-4} \right]$$

is environment polarization per unit area.

Energy of environment deformation is determined by the coefficient of electric elasticity and squared deformation

$$W = b (\Delta r)^2, \quad Joul \qquad (10)$$

where b = $1.155496 \cdot 10^{19}$ (kg/s²)   is coefficient of electric elasticity of environment dipoles.

Under positive acceleration, environment gets the energy of body moving with acceleration, which is influenced by outside forces. Under negative acceleration (deceleration) of body in the target, body gets the energy of environment, i.e. energy is released from environment. In fact, the body fallen on the target imparts energy composed of the kinetic energy of particle and energy released from environment to itself and to the target. The issue how one can move from the deformation of a dipole to the calculation of energy at macrolevel remains open.

The calculation of balance for the energy of incidence and deceleration of particles taking into account their interaction with environment is proposed in the works by A.V.Rykov.

$$w_\Delta = w_g - w_\alpha = \frac{b}{4\pi E_o S} (g + |\alpha|), \text{Joul} \qquad (11)$$

where g- is the gravitational constant.

The issue how one can move from the deformation of a dipole to the calculation of energy at macrocosm remains open. To do this, we introduce of "efficiency" of ether in the microscopic processes:

$$\frac{w_\alpha}{w_g} = \frac{|\alpha|}{g} = \text{«efficiency»} \qquad (12)$$

Since falling object will warm up much faster than that provider by the laws of classical physics, the "efficiency" of the ether in the macrocosm is easy to determine the experience of falling bodies in the calorimeter (21).

The designers create and put into production the power reactors for thermal energy production on the basis of up-to-date technologies of the effect of ultra-deep penetration of particles into the target without the recognition of new physical realities by the official science and without the complete disclosure of cosmic environment structure and energy transformation mechanism. Reactor should include particle accelerator, heat-producing element (target), and heat exchanger. Evaluation of minimal energy-release at a rate of ultra-deep penetration of particles into the target gives a size of order of 10^{10} J/kg and noticeable energy imbalance (10000 times) (22). Efficiency (output) of the proposed energy cycle of energy release from cosmic medium is very high and close to unity, as the expenditure of energy for the maintenance of energy-release process is much less than released energy. Optimal particle velocity and their size with powder and target material, one can gain maximal value of reactor efficiency. Reactor built according to the scheme developed by an Italian engineer Andrea Rossi and operating on nickel is currently the most promising source of energy. Energy-conversion efficiency of nickel fuel in the nuclear cycle is million than of gasoline.

A.Rykov (7) and V.Leonov (22) believe that the resultant additional energy is taken from the environment. The l.Sapogin and others authors of book (6) totally disagree with it and give another explanation to these experiments: " As was mentioned in the UQT, the absence of translation invariance of movement equations with an oscillating charge imply there are no energy and impulse conservation laws for them. In this case a particle in a narrow slot will periodically bump into the walls while moving. As a result of many bumps can accumulate extra energy. With certain geometry of the slot, the processes of particle energy reduction after many bumps can be suppressed. It slightly resembles the "maternity home" solution for the processes happening in a harmonic oscillator. It would be better if one experimentally tests the tunneling dependence on initial phase.

But as it seems to us it would be more important for our critics as both cold nuclear fusion (CNF) and discovery of nuclear transmutations can not be apparently explained in any other way" (6).

Approaches and calculations are different in works bu A.Rykov and L.Sapogin , but the conclusion on the release of huge amount of excess energy under irreversible processes and the proposal of various innovation projects are common.

Let enumerate some of interesting directions in new power engineering:
1. Patterson fuel element (23).
2. Super- magnet, super- engines Tahahashi, Apsdent and converter V.Roshchin- S.Godin.
3. Electromotor "Siberian Colia" of G.Nikolaev (12) and Stefan Marinov.
4. Swiss device "Testatik Machine M/L Converter" of Paul Baumann.
5. Engines "Gravitsapa" of V.Leonov (22).
6. Helicopter of Yu.I.Volod'ko (18)
7. PAGD reactor of Canadian researches P&A Correa (17).
8. Reactor of Italian Andrea Rossi.
9. Engines working on water.
10. Griggs hyper-sound pump, heat- generators of Yu.S.Patapov (24) and Schaffer.
11. Cluster systems of Kenneth Shoulder and Hal Fox.
12. N- machines of Faraday, Bruce de Palma, Neumann, Searl, Tewari and others.
13. Cold nuclear fusion (CNF) and of nuclear transmutation of L.Sapogin (6).

Thus, availability of the space environment (neo-ether), new electrodynamics by G.Nikolaev, Fundamentals of the Theory of Ether by A.Rykov and Unitary Quantum Theory by L.Sapogin give theoretical justification for the existence of Perpetuum mobile.

The abovementioned list of projects can be continued, but the paper is not endless. Even the mentioned cases show that scientifically designed materialization of the space environment may provide us with a wide and varied choice of innovations. The matter depend on the science.

To conclude with, I would like to thank Professor L. G. Sapogin for his offer to write this paper and the exclusive content kindly provided by him.

Appendix A
Riemann Spaces and Modelling the Globe Electrisation Process

As interpreted by Helmholtz-Monastyrsky (25), the theory of analytic functions on the Riemann surface we can present as an issue of physics. We will show that the theory of the stationary two-dimensional ideal incompressible fluid on the surface entirely down to reduces to the theory of analytic functions.

Let us consider a stationary fluid flow u on the plane (x, y).The flow speed at each point has x-component P (x, y) and y-component Q (x, y).Through the cell with sides Δ x, Δy per a time unit the mass of liquid outflows (liquid density is constant and equals to I) :

$$\int_0^{\Delta y} \{P (x + \Delta x, y + h) - P (x, y + h\} \, d\, h + \tag{A.1}$$

$$+ \int_0^{\Delta x} \{Q (x + 1, y + \Delta y) - Q (x + 1, y\} \, d\, l$$

.

Approximating an arbitrary domain Ω with rectangles and applying the Green's formula, we obtain that the integral (A.1) is equal to :

$$\iint \left(\frac{dP}{dx} + \frac{dQ}{dy} \right) dxdy. \tag{A.2)}$$

Since the fluid is incompressible and nowhere appears and disappears in the Ω domain, it follows that the expression (A.2) is zero. The stronger statement is also reasonable, i.e. flow divergence u is zero:

$$\text{Div U} = \frac{d\,P}{dx} + \frac{dQ}{dy} = 0 \tag{A.3}$$

The flow circulation along the curve C is defined as the integral

$$\int_C Pdx + Qdy.$$

If this integral along any closed curve is zero, then the flow is called irrotational. For any single-bound domain, it follows that statement Pdx + Qdy is a complete differential of the function u (x, y).This function is harmonic.

The function U (x, y) is called the flow speed potential. Helmholtz introduced this concept. Curves U (x, y) = const are called equipotential lines. A tangent line to the equipotential line forms such an angle α with the axis x, that

$$\text{tg } \alpha = -\frac{d\,U}{dx} \bigg/ \frac{d\,U}{dy} \text{ , if only } \Delta U \neq 0.$$

The flow speed vector makes an angle β with the x axis,

$$\text{tg } \beta = \frac{d\,U}{dy} \bigg/ \frac{d\,U}{dx},$$

i.e. the flow goes orthogonally to equipotential lines in the direction of increasing U function.
As we remember, the harmonic function u (x, y) defines the function of

$$f(z) = u + i\upsilon$$

where υ is a conjugate to the harmonic function u, defined from Cauchy-Riemann equations (A.4) . Essentially, Cauchy solves the following problem, under which conditions for the complex function f (z) the integral ∫ f (z) dz in a closed loop ℓ is zero. However, he does not speak explicitly of the complex function, but applying pairs of real functions P(x, y) and Q (x, y), gets his main result: the integral ∫ f (z) dz does not depend on the integration path if such conditions are met:

$$\frac{dP}{dx} = \frac{dQ}{dy}; \frac{dP}{dy} = -dQ/dx \qquad (??.4)$$

This condition is a (A.4) - characteristic property of analyticity (holomorphicity) of function of a complex variable. In modern literature, the common name is the Cauchy-Riemann condition. The function f (z) people call the complex potential of the flow.
The tangent line to the curve υ = const makes an angle γ with the x axis and

$$\text{tg } \gamma = -\frac{dv}{dx} / \frac{dv}{dy} = \frac{du}{dy} / \frac{du}{dx} = \text{tg } \beta$$

i.e. the u flow goes along the curve υ = const. These curves people call streamlines.

The condition $\frac{d^2u}{dx^2} + \frac{d^2u}{dy^2} \neq 0$, equivalent to f '(z) ≠ 0,

indicates that streamlines are orthogonal to equipotential lines except at points where f' (z) = 0.
This physical analogy allows us to interpret any properties of analytic functions exceptionally clearly. For example, if the analytic function f (z) has at the point zo f' (zo) = 0, then curves u = const and υ = const do not cross at zo = xo + iyo at right angles. Such points are called stationary points, e.g. for the function

$$f(z) = a_0 + a_2 z^2$$

curves u = const and υ = const intersect at an angle π / 4.
With the same success, we can explore arbitrary features of analytic functions.

Consider the flow with the potential f (z), a derivative f '(z) of which is the rational function, i.e. has only pole specifics (z-zo)$^{-n}$. Then the function f (z) itself we can represent in the neighbourhood of a specific point in the form of
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$$f(z) = A \log(z - z_0) + A_1 (z - z_0)^{-1} + ... + \varphi(z) \qquad (A.5)$$

where φ(z) - function without specifics.

Features of flows defined with the function f (z) are made from specifics of streams made by individual components (A.5).

Let us consider an influence of the logarithmic term. Let us at first assume that A is a real number. Let us choose a circle of the radius r around the point zo:

$$z = z_0 + re^{i\varphi}$$ and assume that A log (z-zo) = u + iυ;

separating the real and imaginary parts, we obtain A log r = u, Aφ = υ.

Streamlines υ = const will be radii going from the point zo, while equipotential lines u = const - will be circles with a centre in zo.
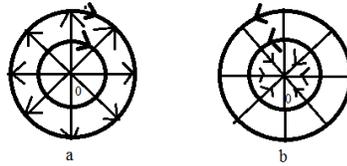

Figure A1

Thus, the point zo will be either the source (Fig. A.1) or a fluid outlet (Fig. A.1 a) or the fluid outlet (Fig. A.1b), depending on the operator A (the liquid will either outflow, or flow into the point z0). If A is a purely imaginary value, then we obtain the conjugate stream A = iB, u = - B φ, υ = log r. Circles will be streamlines. Such streams are called curls. Direction of motion (clockwise or counter clockwise) depends on the B operator.

We have obtained a great result. All features of the analytic function f (z) on the sphere we can describe in terms of the fluid flow with a defined number of sources, outlets, curls, etc.

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