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Non-Local Theory of Lighting Balls and Some Mysterious Catastrophes

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Abstract

The theory of lighting balls is constructed in the frame of non-local physics. The lighting balls (or plasmoids) have the character of the stable quantum objects in the self consistent electric field. Particularly these effects can be considered as explanation of the existence of the stable plasmoids, lightning balls and atoms with the separated electronic shell and the positive kernel. The delivered theory demonstrates the great possibilities of the generalized quantum hydrodynamics in investigation of the quantum solitons. The theory leads to solitons as typical formations in the generalized quantum hydrodynamics. The self-consistent theory of plasmoids cannot be constructed in the frame of local physics. The developed theory is applied for explanation of Tunguska event, Gagarin catastrophe and catastrophes of flights MH 370 and AirAsia QZ8501.

Keywords

Quantum Hydrodynamics, Theory of Plasmoids, Atom Structure, Gagarine Catastrophe, MH 370 Catastrophe, AirAsia Flight QZ8501 Catastrophe

1. Introduction

In the latter part of 20th century two very important results were obtained:

1) The Irish physicist John Stewart Bell (1928 – 1990) was to show (Bell's theorems [1]) that all local statistical theories of dissipative processes are wrong in principal.

2) The Russian physicist Boris V. Alexeev [2 - 5] was to show that the derivation of the kinetic equation for the one-particle-distribution-function from the BBGKY equations (*prior* to introducing any approximation destined to break the Bogolyubov chain) leads to additional terms of the non-local origin, generally of the same order of magnitude, appear in the Boltzmann equation (BE). Then the passage to the BE means the neglect of non-local effects. These additional terms cannot be omitted even in the limit cases of kinetic theory, therefore BE is only a plausible equation.

It could be anticipated that we will obtain small corrections to the existing results. But in reality we are in front of the tremendous catastrophe in modern theoretical physics. Several extremely significant problems challenge modern fundamental physics, which can be titled as "Non-solved problems of the fundamental physics" or more precisely – of *local physical kinetics* of dissipative processes, namely:

1) Kinetic theory of entropy and the problem of the initial perturbation;

2) Strict theory of turbulence;

3) Quantum non-relativistic and relativistic hydrodynamics, theory of charges separation in the atom structure;

4) Theory of ball lightning;

5) Theory of dark matter;

6) Theory of dark energy, Hubble expansion of the Universe;

7) The destiny of anti-matter after the Big Bang.

8) A unified theory of dissipative structures – from atom structure to cosmology.

Appearance of these old and new problems (including the problems 5 and 6 in the list) means that we have reached the revolutionary situation not only in physics but in natural philosophy on the whole. Practically we are in front of the new challenge since Newton's *Mathematical Principles of Natural Philosophy* was first published in 1687.

The origin of difficulties consists in the total Oversimplification following from the principles of local physics and reflects the general shortcomings of the local kinetic transport theory. The main mistake of local physical kinetics can be indicated as follows:

The physically infinitely small volume is an *open* thermodynamic system *for any division of macroscopic system by a set of physically small volumes* (PhSV). However, the Boltzmann equation (BE) fully ignores non-local effects and contains only the local collision integral J^B. The non-local effects are insignificant only in equilibrium systems, where the kinetic approach changes to methods of statistical mechanics. This is what the difficulties of classical Boltzmann physical kinetics arise from.

The rigorous approach to derivation of kinetic equation relative to one-particle DF f (KE_f) is based on employing the hierarchy of Bogoliubov equations. Generally speaking, the structure of KE_f is as follows

$$\frac{Df}{Dt} = J^B + J^{nl}, \tag{1.1}$$

where J^{nl} is the non-local integral term.

An approximation for the second collision integral is suggested by me in *generalized* Boltzmann physical kinetics,

$$J^{nl} = \frac{D}{Dt}\left(\tau \frac{Df}{Dt}\right), \tag{1.2}$$

τ is non-local parameter (coinciding in a gas with the relaxation time τ_r proportional to the mean time τ_{mt} *between* collisions of particles); τ_{mt} is related in a hydrodynamic approximation with dynamical viscosity μ and pressure p,

$$\tau_{mt} p = \Pi \mu, \tag{1.3}$$

where the factor Π is defined by the model of collision of particles; for neutral hard-sphere gas, Π =0.8. Obviously in "the simplest version" τ_{mt} can be used in (1.2) instead of τ; it leads only to variety of Π -parameter in (1.3).

All of the known methods of deriving kinetic equation relative to one-particle DF f lead to the approximation (1.2), including the method of many scales, the method of correlation functions, and the iteration method.

We are faced in fact with the "price – quality" problem familiar from economics. That is, what price - in terms of the increased complexity of the kinetic equation - are we ready to pay for the improved quality of the theory? An answer to this question is possible only through experience with practical problems.

Extremely important:

1 Approximation $J^{nl} = \frac{D}{Dt}\left(\tau \frac{Df}{Dt}\right)$ delivers local approximation of non-local collision integrals.

2 Approximation $J^{nl} = \frac{D}{Dt}\left(\tau \frac{Df}{Dt}\right)$ return us to two level description (level of hydrodynamic processes + level of transport processes between collisions).

3 The generalized transport theory is not too complicated in applications.

One can draw an analogy with the Bhatnagar–Gross–Krook (BGK) approximation for local integral J^B,

$$J^B = \frac{f^{(0)} - f}{\tau_r}, \tag{1.4}$$

(in the simplest case $\tau_r \sim \tau$) the popularity of which in the case of Boltzmann collision integral is explained by the colossal simplification attained when using this approximation. The order of magnitude of the ratio between the second and first terms of the right-hand part of Eq. (1.1) is Kn^2, at high values of Knudsen number, these terms come to be of the same order. It would seem that, at low values of Knudsen number corresponding to hydrodynamic description, the contribution by the second term of the right-hand part of Eq. (1.1) could be ignored.

However, this is not the case. Upon transition to hydrodynamic approximation (following the multiplication of the kinetic equation by invariants collision and subsequent integration with respect to velocities), the Boltzmann integral part goes to zero, and the second term of the right-hand part of Eq. (1.1) *does not go to zero* after this integration and produces a contribution of the same order in the case of generalized Navier–Stokes description.

From the mathematical standpoint, disregarding the term containing a small parameter with higher derivative is impermissible. From the physical standpoint, the arising additional terms proportional to viscosity correspond to Kolmogorov small-scale turbulence; the fluctuations are tabulated [3 – 5]. It turns out that the integral term J^{nl} is important from the standpoint of the theory of transport processes at both low and high values of Knudsen number.

Note the treatment of the generalized Boltzmann equation (GBE) from the standpoint of fluctuation theory,

$$Df^a / Dt = J^B, \tag{1.5}$$

$$f^a = f - \tau\, Df / Dt \tag{1.6}$$

Equations (1.5) and (1.6) have a correct free-molecule limit. Therefore, $\tau\, Df/Dt$ is a fluctuation of distribution function, and the notation (1.5) disregarding (1.6) renders the BE open. From the standpoint of fluctuation theory, Boltzmann employed the simplest closing procedure

$$f^a = f. \tag{1.7}$$

Fluctuation effects occur in any open thermodynamic system bounded by a control surface transparent to particles. Obviously the mentioned non-local effects can be discussed from viewpoint of breaking of the Bell's inequalities because in the non-local theory the measurement (realized in PhSV_1) has influence on the measurement realized in the adjoining space-time point in PhSV_2 and verse versa.

The equation (GBE) reads

$$\frac{Df}{Dt} = J^B + \frac{D}{Dt}\left(\tau \frac{Df}{Dt}\right). \quad (1.8)$$

Here τ is nonlocal parameter, in the simplest case it is the mean time *between* collisions (for plasma τ is mean time between close collisions), for plasma in D/Dt should be introduced the self consistent force F. For a multi species reacting gas, the generalized Boltzmann equation can be rewritten as

$$\frac{Df_\alpha}{Dt} - \frac{D}{Dt}\left(\tau_\alpha \frac{Df_\alpha}{Dt}\right) = J_\alpha^{B,el} + J_\alpha^{B,r}, \quad (1.9)$$

where f_α is distribution function for a particle of the α th kind, τ_α is nonlocal parameter for α species (in the simplest case τ_α is mean free time for a particle of the α th kind), and $J_\alpha^{B,el}, J_\alpha^{B,r}$ are the Boltzmann collision integrals for elastic and inelastic collisions, respectively. GBE was derived in the theory of liquids, in this case τ is connected with the time of the particle residence in the Frenkel cell. The important methodical question how classical conservation laws fit into the GBE picture are considered in [3 - 5].

Now several remarks of principal significance:

1. All fluctuations are found from the strict kinetic considerations and tabulated [3 - 5]. The appearing additional terms in generalized hydrodynamic equations (GHE) are due to viscosity and they correspond to the small-scale Kolmogorov turbulence. The neglect of formally small terms is equivalent, in particular, to dropping the (small-scale) Kolmogorov turbulence from consideration and is the origin of all principal difficulties in usual turbulent theory.

2. Fluctuations on the wall are equal to zero, from the physical point of view this fact corresponds to laminar sub-layer. Mathematically it leads to additional boundary conditions for GHE.

3. It would appear that in continuum mechanics the idea of discreteness can be abandoned altogether and the medium under study be considered as a continuum in the literal sense of the word. Such an approach is of course possible and indeed leads to Euler equations in hydrodynamics. But when the viscosity and thermal conductivity effects are to be included, a totally different situation arises. As is well known, the dynamical viscosity is proportional to the mean time τ between the particle collisions, and a continuum medium in the Euler model with $\tau = 0$ implies that neither viscosity nor thermal conductivity is possible.

4. Many GHE applications were realized for calculation of turbulent flows with the good coincidence with the bench-mark experiments. GHE are working with good accuracy even in the theory of sound propagation in the rarefied gases where all moment equations based on the classical BE lead to unsatisfactory results.

5. The non-local kinetic effects listed above will always be relevant to a kinetic theory using one particle description – including, in particular, applications to liquids or plasmas, where self-consistent forces with appropriately cut-off radius of their action are introduced to expand the capability of GBE. The application of the above principles also leads to the modification of the system of the Maxwell electro-dynamic equations (ME). In the general case, the parameter τ is the non-locality parameter; in quantum hydrodynamics, its magnitude is correlated with the "time-energy" uncertainty relation [5 -7].

The following conclusion of principal significance can be done from the previous consideration:

1 Madelung's quantum hydrodynamics is equivalent to the Schrödinger equation (SE) and leads to the description of the quantum particle evolution in the form of Euler equation and continuity equation. Quantum Euler equation contains additional potential of non-local origin which can be written for example in the Bohm form. SE is consequence of the Liouville equation as result of the *local* approximation of *non-local* equations.

2 Generalized Boltzmann physical kinetics leads to the strict approximation of non-local effects in space and time and *in the local limit* leads to parameter τ, which on the quantum level corresponds to the uncertainty principle "time-energy".

3 Generalized hydrodynamic equations (GHE) lead to SE as a deep particular case of the generalized Boltzmann physical kinetics and therefore of non-local hydrodynamics.

The main goals of investigations realized in the paper consist in answer two questions:

A) Is it possible to construct the self-consistent non-local theory of lighting balls?

B) Is it possible to apply the developed theory to explanation of some mysterious catastrophes of the last two centuries?

Both questions have the positive answers.

2. The Stationary Single Spherical Plasmoid

Ball lightning is an atmospheric electrical phenomenon. The properties of a "typical" ball lightning are associated with:

1. Thunderstorms, but lasts considerably longer than the split-second flash of a lightning bolt.

2. Shapes that vary between spheres, ovals, tear-drops, rods, or disks.

3. Its capability to change form, split into fragments and penetrate through chinks.

4. Peculiar character of its movement (absence of convection, movement against the wind, floating along conductors).

5. The lifetime of each event is from 1 second to over a minute with the brightness remaining fairly constant during that time.

6. Quiet dying or destruction with explosion.

7. Absence of heat emission, and burns at close contact.

8. Its ability to penetrate through obstacles (glasses, nets) with or without damaging them.

9. The presence or absence of noise and odour, accompanying its appearance.

Ball lightning is often erroneously identified as St. Elmo's fire. St. Elmo's fire is named after St. Erasmus, the patron saint of sailors. The phenomenon sometimes appeared on ships at sea during thunderstorms. St. Elmo's light is a weather phenomenon in which luminous plasma is created by a coronal discharge from a sharp or pointed object in a strong electric field in the atmosphere.

Given the wide range of physical conditions under which events have been reported in nature (including unknown flying object, UFO, like foo-fighters), it is quite likely that ball lightning is not a single phenomenon but a collection of physical phenomena that gives rise to similar observables [8 – 11]. Over the last century, there have been numerous attempts to produce an atmospheric ball lightning. The first reproducible experimental production of ball-lightning-like phenomena is attributed to Nicola Tesla at the Colorado Springs laboratory in 1899−1900, [12]. In January 1900, Tesla noted that "the phenomenon of the 'fireball' is produced by the sudden heating, to high incandescence, of a mass of air or other gas as the case may be, by the passage of a powerful discharge."

As you see "the ball lightning" is not aptly called. More preferable name is plasmoid. The word *plasmoid* was coined in 1956 by Winston H. Bostick to mean a "plasma-magnetic entity". Hereafter we intend to use "plasmoid" in the extended sense for an object with the separated positive and negative charges – it does not matter whether the magnetic field is existing or not.

Plasmoid phenomenon has attracted the attention of researchers for more than two hundred years. Considerable number of papers is published in this area including monographs and review articles. Many efforts have been made for theoretical explanation generation, structure and long lifetime of ball lightning. A number of models for the ball lightning have been developed. But all theoretical models have the same character features – they are developed in the frame of the local physics. Further is shown that local models have no chance for success.

Moreover, the creation of the plasmoid theory means also the creation of theory of the atom structure with the simultaneous description of the electronic shell and the positive nucleus. Let us consider in the frame of the non-local hydrodynamic description the charge system placed in a space domain. The character linear size of the object will be defined as result of the self-consistent solution of the generalized hydrodynamic equations (GHE). The internal species energy and the possible influence magnetic field here are not interesting for us. Moreover we suppose that this single charged object has the spherical symmetry. For the case under consideration we have (see [3 - 7]):

- continuity equation for species α :

$$\frac{\partial}{\partial t}\left\{\rho_\alpha-\tau_\alpha\left[\frac{\partial\rho_\alpha}{\partial t}+\frac{1}{r^2}\frac{\partial\left(r^2\rho_\alpha v_{0r}\right)}{\partial r}\right]\right\}+$$
$$\frac{1}{r^2}\frac{\partial}{\partial r}\left\{r^2\left\{\rho_\alpha v_{0r}-\tau_\alpha\left[\frac{\partial}{\partial t}\left(\rho_\alpha v_{0r}\right)\right.\right.\right.$$
$$\left.\left.\left.+\frac{1}{r^2}\frac{\partial\left(r^2\rho_\alpha v_{0r}^2\right)}{\partial r}+n_\alpha q_\alpha\frac{\partial\psi}{\partial r}\right]\right\}\right\}-\frac{1}{r^2}\frac{\partial}{\partial r}\left(\tau_\alpha r^2\frac{\partial p_\alpha}{\partial r}\right)=R_\alpha\,, \quad (2.1)$$

- momentum equation for mixture

$$\frac{\partial}{\partial t}\left\{\rho v_{0r}-\sum_\alpha\tau_\alpha\left[\frac{\partial}{\partial t}\left(\rho_\alpha v_{0r}\right)+\frac{1}{r^2}\frac{\partial\left(r^2\rho_\alpha v_{0r}^2\right)}{\partial r}+\frac{\partial p_\alpha}{\partial r}+n_\alpha q_\alpha\frac{\partial\psi}{\partial r}\right]\right\}$$
$$+\frac{\partial\psi}{\partial r}\sum_\alpha\left[n_\alpha q_\alpha-\tau_\alpha\left(q_\alpha\frac{\partial n_\alpha}{\partial t}+\frac{1}{r^2}q_\alpha\frac{\partial\left(r^2 n_\alpha v_{0r}\right)}{\partial r}\right)\right]$$
$$+\frac{1}{r^2}\frac{\partial}{\partial r}\left\{r^2\left\{\rho v_{0r}^2-\sum_\alpha\tau_\alpha\left[\frac{\partial}{\partial t}\left(\rho_\alpha v_{0r}^2\right)+\frac{1}{r^2}\frac{\partial\left(r^2\rho_\alpha v_{0r}^3\right)}{\partial r}+2q_\alpha n_\alpha\frac{\partial\psi}{\partial r}v_{0r}\right]\right\}\right\}$$
$$+\frac{\partial p}{\partial r}-\frac{\partial}{\partial t}\sum_\alpha\left(\tau_\alpha\frac{\partial p_\alpha}{\partial r}\right)-2\frac{\partial}{\partial r}\sum_\alpha\left(\frac{\tau_\alpha}{r^2}\frac{\partial\left(r^2 p_\alpha v_{0r}\right)}{\partial r}\right)-$$
$$\frac{1}{r^2}\sum_\alpha\frac{\partial}{\partial r}\left(\tau_\alpha r^2\frac{\partial\left(p_\alpha v_{0r}\right)}{\partial r}\right)=0\,. \quad (2.2)$$

- energy equation for species α

$$\frac{\partial}{\partial t}\left\{\frac{1}{2}\rho_\alpha v_{0r}^2+\frac{3}{2}p_\alpha-\tau_\alpha\left[\frac{\partial}{\partial t}\left(\frac{1}{2}\rho_\alpha v_{0r}^2+\frac{3}{2}p_\alpha\right)+\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 v_{0r}\left(\frac{1}{2}\rho_\alpha v_{0r}^2+\frac{5}{2}p_\alpha\right)\right)\right.\right.$$
$$\left.\left.+q_\alpha n_\alpha\frac{\partial\psi}{\partial r}v_{0r}\right]\right\}+\frac{1}{r^2}\frac{\partial}{\partial r}\left\{r^2\left\{\left(\frac{1}{2}\rho_\alpha v_{0r}^2+\frac{5}{2}p_\alpha\right)v_{0r}-\tau_\alpha\left[\frac{\partial}{\partial t}\left(\left(\frac{1}{2}\rho_\alpha v_{0r}^2+\frac{5}{2}p_\alpha\right)v_{0r}\right)\right.\right.\right.$$
$$\left.\left.\left.+\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\left(\frac{1}{2}\rho_\alpha v_{0r}^2+\frac{7}{2}p_\alpha\right)v_{0r}^2\right)+q_\alpha n_\alpha\frac{\partial\psi}{\partial r}v_{0r}^2+\frac{\partial\psi}{\partial r}\left(\frac{1}{2}n_\alpha q_\alpha v_{0r}^2+\frac{3}{2}\frac{n_\alpha q_\alpha}{\rho_\alpha}p_\alpha\right)\right]\right\}\right\}$$
$$+\left\{q_\alpha n_\alpha\frac{\partial\psi}{\partial r}v_{0r}-\tau_\alpha\left[\frac{q_\alpha n_\alpha}{\rho_\alpha}\frac{\partial\psi}{\partial r}\left(\frac{\partial}{\partial t}\left(\rho_\alpha v_{0r}\right)+\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\rho_\alpha v_{0r}^2\right)+\frac{\partial p_\alpha}{\partial r}+q_\alpha n_\alpha\frac{\partial\psi}{\partial r}\right)\right]\right\}$$
$$-\frac{1}{r^2}\frac{\partial}{\partial r}\left(\tau_\alpha r^2\frac{\partial}{\partial r}\left(\frac{1}{2}p_\alpha v_{0r}^2+\frac{5}{2}\frac{p_\alpha^2}{\rho_\alpha}\right)\right)-\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\tau_\alpha p_\alpha\frac{q_\alpha n_\alpha}{\rho_\alpha}\frac{\partial\psi}{\partial r}\right)=\int\left(\frac{m_\alpha v_\alpha^2}{2}+\varepsilon_\alpha\right)J_\alpha^{st,el}d\mathbf{v}_\alpha+\int\left(\frac{m_\alpha v_\alpha^2}{2}+\varepsilon_\alpha\right)J_\alpha^{st,inel}d\mathbf{v}_\alpha\,. \quad (2.3)$$

Here q_α - charge of the α -component particle, p_α - static pressure for α -component, $\mathbf{v}_0$ - hydrodynamic velocity for mixture, ψ is electric potential, ε_α - internal energy of a particle of α -species, τ_α - non-local parameter. Suppose also that the stationary physical system is in rest; it means

$$v_{0r} = 0\,,\ \partial/\partial t \equiv 0\,. \tag{2.4}$$

The main problem from the mathematical point of view – is it possible to find the soliton kind solution from equations (2.1) – (2.3) as result of the Cauchy problem consideration? This question has the positive answer.

3. Results of the Mathematical Modeling of the Rest Solitons

Let us write down equations (2.1) – (2.3) using the conditions (2.4). By the conditions (2.4) Poisson equation can be written in the usual form

$$\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial\psi}{\partial r}\right) = -4\pi e\left[n_i - n_e\right]. \tag{3.1}$$

Continuity equation for species α :

$$\frac{\partial p_\alpha}{\partial r} + n_\alpha q_\alpha \frac{\partial\psi}{\partial r} = 0\,. \tag{3.2}$$

Momentum equation for mixture:

$$\sum_\alpha \left\{\frac{\partial\psi}{\partial r} n_\alpha q_\alpha + \frac{\partial p_\alpha}{\partial r}\right\} = 0\,. \tag{3.3}$$

This equation can be satisfied identically by the condition (3.2). Using (3.3) we find from the energy equation

$$\begin{aligned} &-\frac{5}{2}\frac{1}{r^2}\frac{\partial}{\partial r}\left[\tau_\alpha r^2 \frac{n_\alpha q_\alpha}{\rho_\alpha} p_\alpha \frac{\partial\psi}{\partial r}\right] \\ &-\tau_\alpha \frac{q_\alpha n_\alpha}{\rho_\alpha}\frac{\partial\psi}{\partial r}\left(\frac{\partial p_\alpha}{\partial r} + q_\alpha n_\alpha \frac{\partial\psi}{\partial r}\right) \\ &-\frac{5}{2}\frac{1}{r^2}\frac{\partial}{\partial r}\left(\tau_\alpha r^2 \frac{\partial}{\partial r}\left(\frac{p_\alpha{}^2}{\rho_\alpha}\right)\right) \\ &= \int\left(\frac{m_\alpha v_\alpha^2}{2} + \varepsilon_\alpha\right) J_\alpha^{st,el} d\mathbf{v}_\alpha + \int\left(\frac{m_\alpha v_\alpha^2}{2} + \varepsilon_\alpha\right) J_\alpha^{st,inel} d\mathbf{v}_\alpha\,; \end{aligned} \tag{3.4}$$

taking into account (3.2) we have

$$-\frac{5}{2}\frac{1}{r^2}\frac{\partial}{\partial r}\left[\tau_\alpha r^2\left(\frac{n_\alpha q_\alpha}{\rho_\alpha} p_\alpha \frac{\partial\psi}{\partial r} + \frac{\partial}{\partial r}\left(\frac{p_\alpha{}^2}{\rho_\alpha}\right)\right)\right] = \int\left(\frac{m_\alpha v_\alpha^2}{2} + \varepsilon_\alpha\right) J_\alpha^{st,el} d\mathbf{v}_\alpha + \int\left(\frac{m_\alpha v_\alpha^2}{2} + \varepsilon_\alpha\right) J_\alpha^{st,inel} d\mathbf{v}_\alpha$$

and after the repeated (3.2) application we reach the equation

$$-\frac{1}{r^2}\frac{5}{2}\frac{\partial}{\partial r}\left[r^2 \tau_\alpha p_\alpha \frac{\partial}{\partial r}\left(\frac{p_\alpha}{\rho_\alpha}\right)\right] = \int\left(\frac{m_\alpha v_\alpha^2}{2} + \varepsilon_\alpha\right) J_\alpha^{st,el} d\mathbf{v}_\alpha + \int\left(\frac{m_\alpha v_\alpha^2}{2} + \varepsilon_\alpha\right) J_\alpha^{st,inel} d\mathbf{v}_\alpha\,, \tag{3.5}$$

where index $\alpha = e^-, i^+$ corresponds to the negative and positive species. Local collision integrals of the right hand side of equation (3.5) can be written in the relaxation form.

$$\frac{1}{r^2}\frac{5}{2}\frac{\partial}{\partial r}\left[r^2 \tau_i p_i \frac{\partial}{\partial r}\left(\frac{p_i}{\rho_i}\right)\right] = \frac{p_i - p_e}{\tau_{ei}}\,, \tag{3.6}$$

$$\frac{1}{r^2}\frac{5}{2}\frac{\partial}{\partial r}\left[r^2 \tau_e p_e \frac{\partial}{\partial r}\left(\frac{p_e}{\rho_e}\right)\right] = \frac{p_e - p_i}{\tau_{ei}}\,. \tag{3.7}$$

Non-local parameter τ_{ei} of the interaction of the positive and negative particles is written as

$$\tau_{ei}^{-1} = \tau_e^{-1} + \tau_i^{-1}\,. \tag{3.8}$$

In this case τ_{ei} is the relaxation time in the process of the particle interaction of different species. The relation (3.8) is in keeping with the Heisenberg principle of uncertainty. No reason to discuss τ_e , τ_i , τ_{ei} separately because in the following all these parameters will be introduced in equations as a combination. Further the dependent variables $q_i = en_i$, $q_e = en_e$ are used, (instead of introduced before q_α as the particle charges), where e is the absolute value of the electron charge, n_i, n_e are the numerical densities of the positive and negative species. Transform equations (3.1), (3.2), (3.6), (3.7) to the dimensionless forms using the sign tilde for the dimensionless values, the scales ρ_0, ψ_0, r_0, $p_0 = q_0\psi_0$ are used.

$$A\frac{\partial}{\partial\tilde r}\left(\tilde r^2 \frac{\partial\tilde\psi}{\partial\tilde r}\right) = \tilde r^2\left(\tilde q_e - \tilde q_i\right), \tag{3.9}$$

$$\frac{5}{2}\frac{e}{m_i}\tau_i\tau_{ei}\frac{\psi_0}{r_0^2}\frac{\partial}{\partial\tilde r}\left[\tilde r^2 \tilde p_i \frac{\partial}{\partial\tilde r}\left(\frac{\tilde p_i}{\tilde q_i}\right)\right] = \tilde r^2\left(\tilde p_i - \tilde p_e\right) \tag{3.10}$$

$$\frac{5}{2}\frac{e}{m_e}\tau_e\tau_{ei}\frac{\psi_0}{r_0^2}\frac{\partial}{\partial\tilde r}\left[\tilde r^2 \tilde p_e \frac{\partial}{\partial\tilde r}\left(\frac{\tilde p_e}{\tilde q_e}\right)\right] = \tilde r^2\left(\tilde p_e - \tilde p_i\right), \tag{3.11}$$

$$\frac{\partial\tilde p_i}{\partial\tilde r} + \tilde q_i \frac{\partial\tilde\psi}{\partial\tilde r} = 0\,, \tag{3.12}$$

$$\frac{\partial\tilde p_e}{\partial\tilde r} - \tilde q_e \frac{\partial\tilde\psi}{\partial\tilde r} = 0\,, \tag{3.13}$$

where the factor

$$A = \psi_0 \big/ \left(4\pi r_0^2 q_0 \right). \tag{3.14}$$

is used. Introduce the definition of non-local Reynolds number

$$\mathrm{Re}_i = LV_i / \nu_i , \tag{3.15}$$

where the linear size $L = r_0$, the character velocity $V_i = r_0 / \tau_i$ and the kinematic viscosity has the following definition

$$\nu_i = \frac{5}{2}\frac{e}{m_i}\psi_0\tau_{ei} = \frac{5}{2}\frac{e}{m_i}\tau_{ei}\frac{p_0}{q_0} = \frac{5}{2}\frac{e}{m_i}\tau_{ei}\frac{p_0}{en_0} = \frac{5}{2}\tau_{ei}\frac{p_0}{m_i n_0} . \tag{3.16}$$

In this case

$$\frac{1}{\mathrm{Re}_i} = \frac{5}{2}\frac{e}{m_i}\tau_i\tau_{ei}\frac{\psi_0}{r_0^2} . \tag{3.17}$$

Analogically

$$\nu_e = \frac{5}{2}\tau_{ei}\frac{p_0}{m_e n_0} , \tag{3.18}$$

$$\frac{1}{\mathrm{Re}_e} = \frac{5}{2}\frac{e}{m_e}\tau_e\tau_{ei}\frac{\psi_0}{r_0^2} . \tag{3.19}$$

Equations (3.10), (3.11) takes the form

$$\frac{1}{\mathrm{Re}_i}\frac{\partial}{\partial\tilde{r}}\left[\tilde{r}^2\tilde{p}_i\frac{\partial}{\partial\tilde{r}}\left(\frac{\tilde{p}_i}{\tilde{q}_i}\right)\right] = \tilde{r}^2\left(\tilde{p}_i - \tilde{p}_e\right), \tag{3.20}$$

$$\frac{1}{\mathrm{Re}_e}\frac{\partial}{\partial\tilde{r}}\left[\tilde{r}^2\tilde{p}_e\frac{\partial}{\partial\tilde{r}}\left(\frac{\tilde{p}_e}{\tilde{q}_e}\right)\right] = \tilde{r}^2\left(\tilde{p}_e - \tilde{p}_i\right). \tag{3.21}$$

From (3.20), (3.21) follow

$$\frac{1}{\mathrm{Re}_i}\frac{\partial}{\partial\tilde{r}}\left[\tilde{r}^2\tilde{p}_i\frac{\partial}{\partial\tilde{r}}\left(\frac{\tilde{p}_i}{\tilde{q}_i}\right)\right] + \frac{1}{\mathrm{Re}_e}\frac{\partial}{\partial\tilde{r}}\left[\tilde{r}^2\tilde{p}_e\frac{\partial}{\partial\tilde{r}}\left(\frac{\tilde{p}_e}{\tilde{q}_e}\right)\right] = 0 . \tag{3.22}$$

One integration can be realized with taking into account that constant of integration is equal to zero.

$$\frac{\mathrm{Re}_e}{\mathrm{Re}_i}\tilde{p}_i\frac{\partial}{\partial\tilde{r}}\left(\frac{\tilde{p}_i}{\tilde{q}_i}\right) + \tilde{p}_e\frac{\partial}{\partial\tilde{r}}\left(\frac{\tilde{p}_e}{\tilde{q}_e}\right) = 0 . \tag{3.23}$$

Using (3.12), (3.13), transform (3.23)

$$\frac{\partial\tilde{\psi}}{\partial\tilde{r}}\left(\tilde{p}_e - \frac{\mathrm{Re}_e}{\mathrm{Re}_i}\tilde{p}_i\right) = \left(\frac{\tilde{p}_i}{\tilde{q}_i}\right)^2\frac{\partial\tilde{q}_i}{\partial\tilde{r}} + \left(\frac{\tilde{p}_e}{\tilde{q}_e}\right)^2\frac{\partial\tilde{q}_e}{\partial\tilde{r}} , \tag{3.24}$$

and

$$\frac{\mathrm{Re}_e}{\mathrm{Re}_i} = \frac{\tau_i / m_i}{\tau_e / m_e} . \tag{3.25}$$

Relations (3.24), (3.25) are useful in particular for the qualitative analysis of the calculation results.

Some conclusions from the developed theory:

1. The basic system of equations (3.9) – (3.13) contain the similarity criteria Re_i , Re_e and A , defining the interrelation of the scales of the electrostatic and hydrostatic origin.

2. Non-local description is of the principal significance. Really, from equations (3.9) – (3.13) follow *only trivial* solutions of the equilibrium plasma if the non-locality parameters τ_i , τ_e turn into zero, namely $\tilde{p}_i = \tilde{p}_e$, $\tilde{q}_i = \tilde{q}_e$, $\tilde{\psi} = const$.

3. Therefore the plasmoid theory (Ball lighting theory) can be constructed *only* in the frame of non-local physics.

4. The criteria variations Re_i , Re_e , A , Cauchy conditions and the possible chemical composition lead to the tremendous class of the possible solutions.

Take into account the formulated remarks and demonstrate the character features of the numerical solutions. The following figures reflect the results of calculations realized with the help of the Maple program. The notations on figures are used: r - $\tilde{q}_i$ (dimensionless charge for the positive particles); s - $\tilde{q}_e$ (absolute dimensionless charge for the negative particles); p - pressure $\tilde{p}_i$; q - pressure $\tilde{p}_e$ and v – self-consistent potential $\tilde{\psi}$. Explanations placed under all following figures, Maple program contains Maple's notations – for example the expression $D(\mathrm{v})(0) = 0$ means in usual notations $\frac{\partial\tilde{\psi}}{\partial\tilde{r}}(0) = 0$, independent variable t responds to $\tilde{r}$.

We investigate the problem of the principal significance – is it possible to obtain the soliton solution after perturbations defined the Cauchy conditions? With this aim introduce the Cauchy perturbations (VARIANT 1):

p(0)=0.9, q(0)=1, v(0)=1, r(0)=1, s(0)=1, D(p)(0)=0, D(q)(0)=0, D(v)(0)=0, D(r)(0)=0, D(s)(0)=0; $A = \mathrm{Re}_e = \mathrm{Re}_i = 1$.

Figures 1 – 3 reflect the calculation results for VARIANT 1.

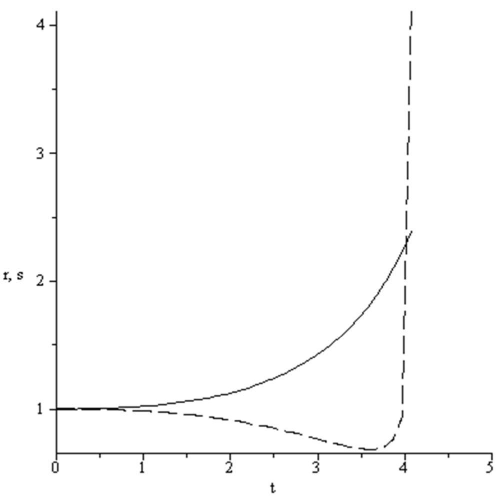


Fig. 1. *r- $\tilde{q}_i(\tilde{r})$ and s - $\tilde{q}_e(\tilde{r})$, VARIANT 1. (s – dashed line)*

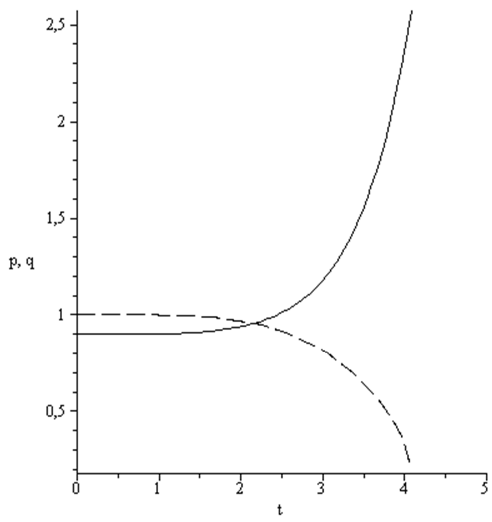


Fig. 2. *p-* $\tilde{p}_i(\tilde{r})$ *and q -* $\tilde{p}_e(\tilde{r})$*, VARIANT 1. (q – dashed line)*

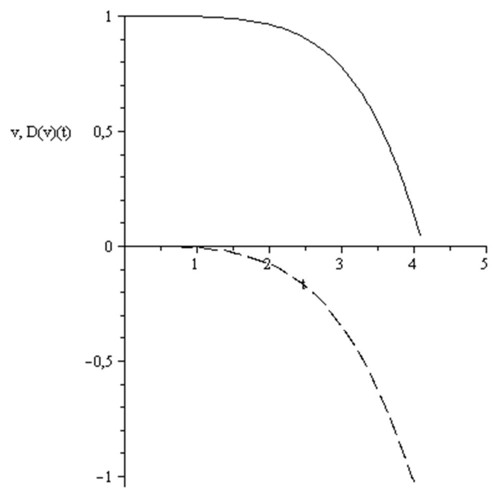


Fig. 3. *v-* $\tilde{\psi}(\tilde{r})$ *and D(v)(t) -* $\frac{\partial\tilde{\psi}}{\partial\tilde{r}}(\tilde{r})$*, VARIANT 1. (D(v)(t) – dashed line)*

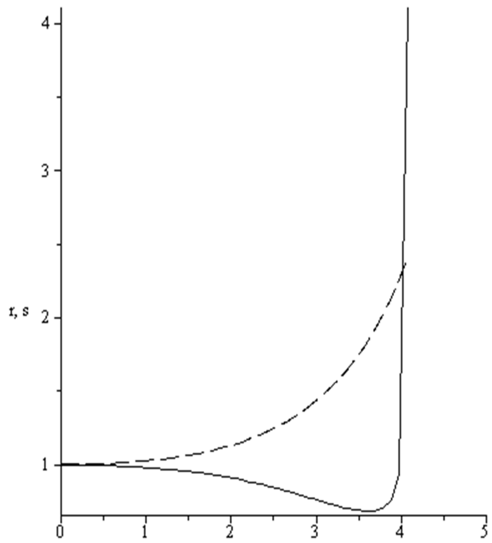


Fig. 4. *r-* $\tilde{q}_i(\tilde{r})$ *and s -* $\tilde{q}_e(\tilde{r})$*, VARIANT 2. (s – dashed line)*

Figures 4, 5 correspond to the Cauchy perturbations (VARIANT 2):

p(0)=1, q(0)=0.9, v(0)=1, r(0)=1, s(0)=1, D(p)(0)=0, D(q)(0)=0, D(v)(0)=0, D(r)(0)=0, D(s)(0)=0; $A = \mathrm{Re}_e = \mathrm{Re}_i = 1$.

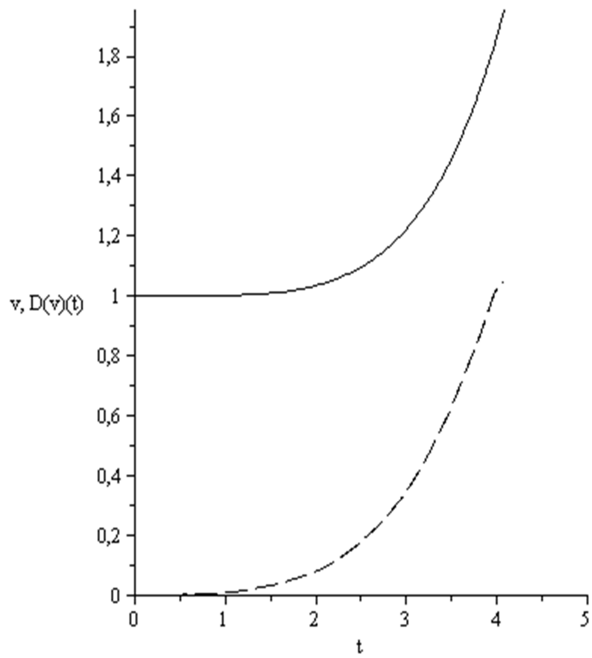


Fig. 5. *v-* $\tilde{\psi}(\tilde{r})$ *and D(v)(t) -* $\frac{\partial\tilde{\psi}}{\partial\tilde{r}}(\tilde{r})$*, (D(v)(t) – dashed line) VARIANT 2.*

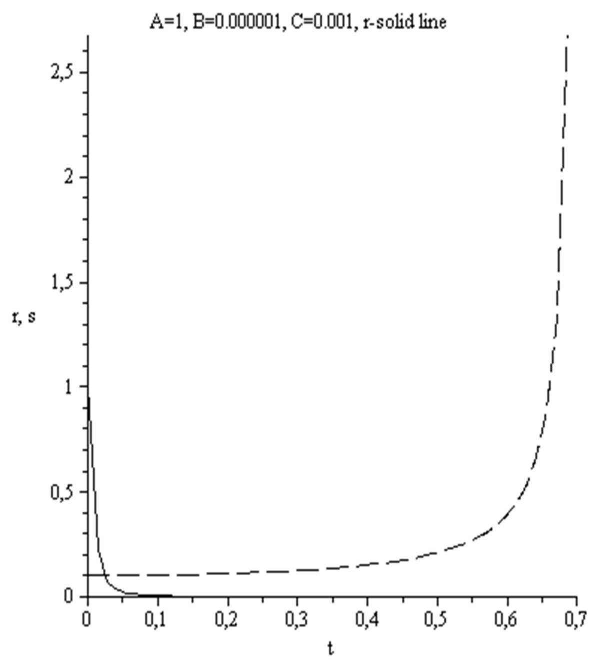


Fig. 6. *r-* $\tilde{q}_i(\tilde{r})$ *and s -* $\tilde{q}_e(\tilde{r})$*, (s – dashed line). VARIANT 3.*

The soliton configurations can remind the atomic structures with the separated positive and negative shells (Fig. 6).

Fig. 6 reflects the results of calculations for VARIANT 3:
p(0)=1, q(0)=0.9, v(0)=1, r(0)=1, s(0)=0.1, D(p)(0)=0, D(q)(0)=0, D(v)(0)=0, D(r)(0)=0, D(s)(0)=0; $A=1$, $B^{-1}=\mathrm{Re}_i=10^6$, $C^{-1}=\mathrm{Re}_e=10^3$; $\tilde{r}_{\lim}=0.699$.

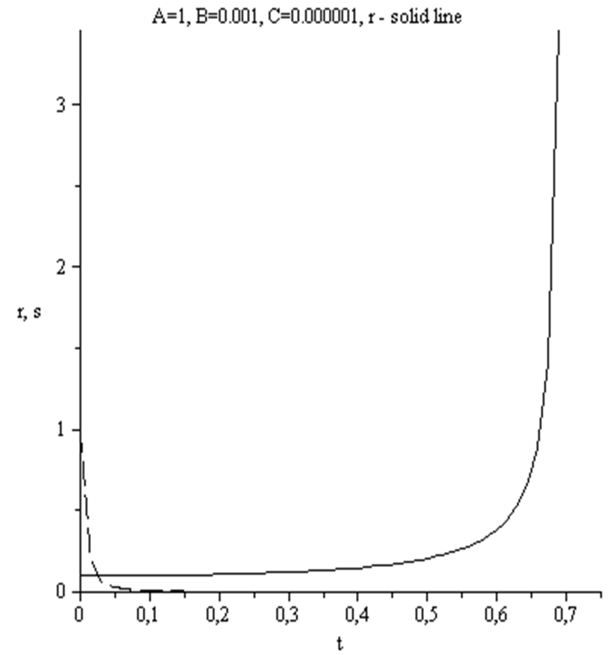


Fig. 7. *r- $\tilde{q}_i(\tilde{r})$ and s - $\tilde{q}_e(\tilde{r})$, (s – dashed line). VARIANT 4.*

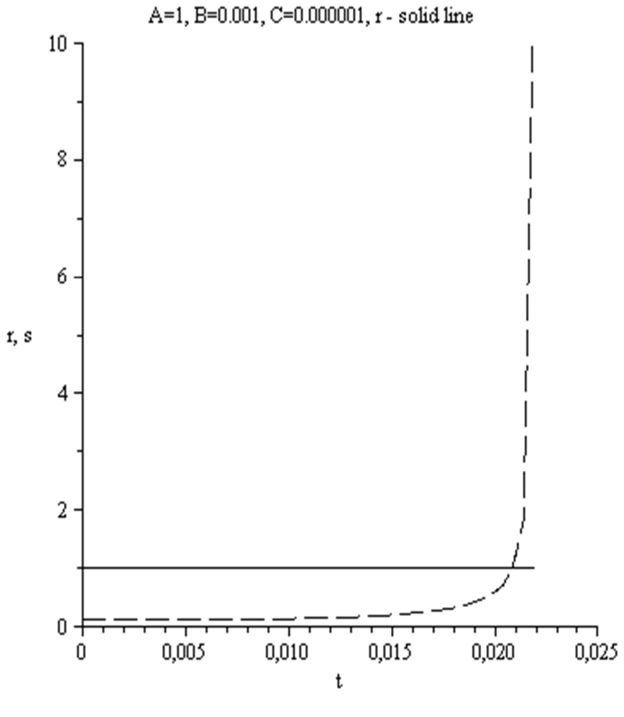


Fig. 8. *r- $\tilde{q}_i(\tilde{r})$ and s - $\tilde{q}_e(\tilde{r})$, (s – dashed line). VARIANT 5.*

Fig. 7 reflects the results of calculations for VARIANT 4:
p(0)=0.9, q(0)=1, v(0)=1, r(0)=0.1, s(0)=1, D(p)(0)=0, D(q)(0)=0, D(v)(0)=0, D(r)(0)=0, D(s)(0)=0; $A=1$, $B^{-1}=\mathrm{Re}_i=10^3$, $C^{-1}=\mathrm{Re}_e=10^6$, $\tilde{r}_{\lim}=0.699$.

Figs. 8, 9 reflect the results of calculations for VARIANT 5:
p(0)=1, q(0)=0.9, v(0)=1, r(0)=1, s(0)=0.1, D(p)(0)=0, D(q)(0)=0, D(v)(0)=0, D(r)(0)=0, D(s)(0)=0; $A=1$, $B^{-1}=\mathrm{Re}_i=10^3$, $C^{-1}=\mathrm{Re}_e=10^6$, $\tilde{r}_{\lim}=0.220$.

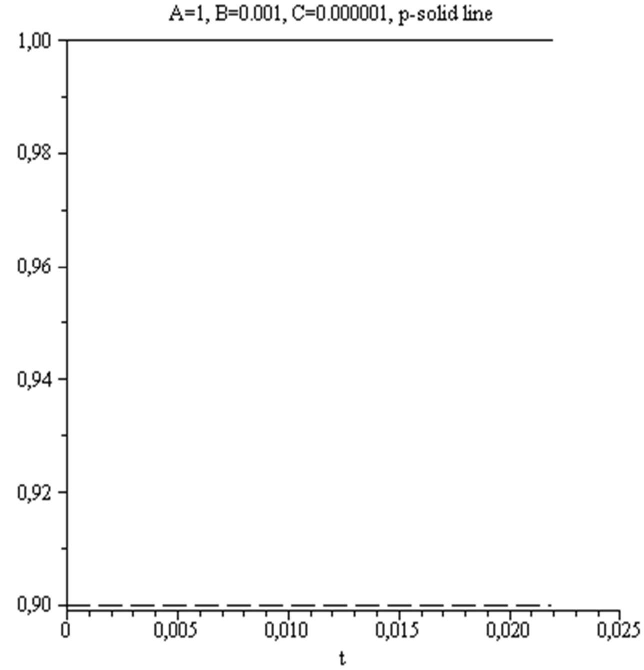


Fig. 9. *$\tilde{p}_i(\tilde{r})$ and $\tilde{p}_e(\tilde{r})$, (dashed line). VARIANT 5.*

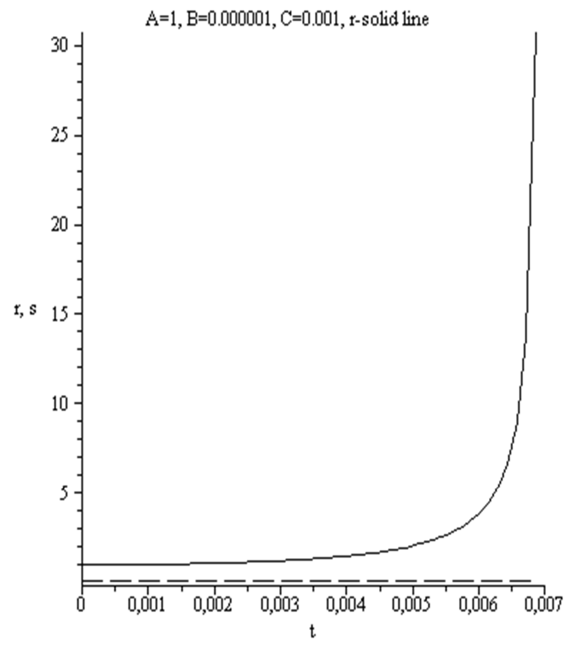


Fig. 10. *r- $\tilde{q}_i(\tilde{r})$ and s - $\tilde{q}_e(\tilde{r})$, (s – dashed line). VARIANT 6.*

Figs. 10 and 11 reflect the results of calculations for VARIANT 6:
p(0)=0.9, q(0)=1, v(0)=1, r(0)=1, s(0)=0.1, D(p)(0)=0, D(q)(0)=0, D(v)(0)=0, D(r)(0)=0, D(s)(0)=0; $A=1$, $B^{-1}=\mathrm{Re}_i=10^6$, $C^{-1}=\mathrm{Re}_e=10^3$, $\tilde{r}_{\lim}=0.00697$.

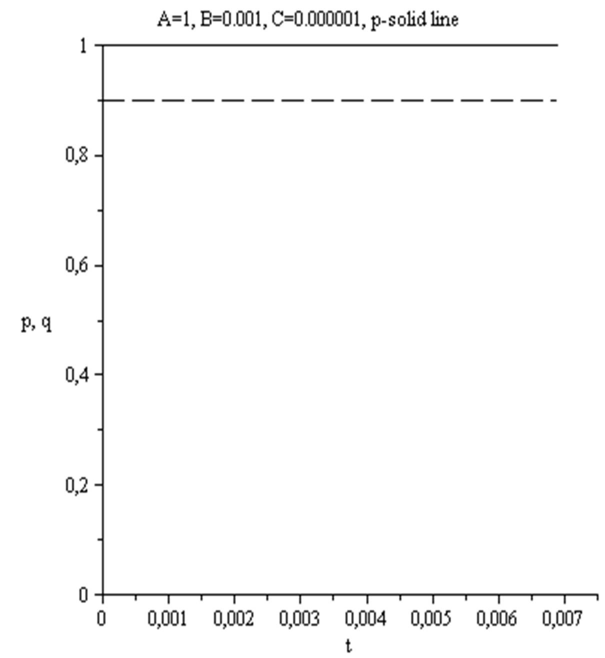


Fig. 11. *$\tilde{p}_i(\tilde{r})$ and $q = \tilde{p}_e(\tilde{r})$, (dashed line). VARIANT 6.*

Important conclusions follow from mathematical modeling:

1. Plasmoid (Ball lightning) is the non-equilibrium product of the matter self-organization, placed in the finite domain of space. This non-equilibrium object has the excess charge (in comparison with the equilibrium state) of one sign along the radial direction and a deficit of the charge of another sign. Figures 1 and 4 demonstrate the existence of two spherical layers of the significantly different linear sizes. For example one of these domains has the excess positive charge near the kernel (VARIANT 1), but the excess negative charge moves at the periphery. The stability of the plasma object has been reached as the result of the equilibrium of forces of the electrostatic origin and kinetic pressure of the non-local origin. In this case the external spherical layer can have the negative charge if $\tilde{p}_i(0) < \tilde{p}_e(0)$, or the positive charge if $\tilde{p}_i(0) > \tilde{p}_e(0)$. From the experimental data follow that both these cases can be realized in the actual practice [13, 14].

2. Mathematical modeling realized in the frame of non-local physics, leads to existence of the stable objects even in the absence of magnetic fields.

3. In the delivered theory no needs to use the external boundary conditions. The radial dimensionless size of plasmoid is a result of the self-consistent solution of non-local equations and corresponds to the area of the solution existence. For the considered variants 1 and 2 the dimensionless plasmoid radius $\tilde{r}_{BL}$ has the same value, $\tilde{r}_{BL} \sim 4.09$.

4. The theory does not contain restrictions for the charge scales or the object sizes. No needs to introduce the convoying magnetic field. It is no surprise – the Schrödinger – Madelung atom theory is the theory of plasmoid with the separated charges (as postulate) without the magnetic confinement of the physical system.

5. As follows from calculations (as minimum) two kinds of plasmoids can exist. Plasmoids as product of plasma polarization (see figures 1 – 5) and plasmoids with atomic structures (like figure 6). Obviously the theory of the second type plasmoids describes (in the frame generalized quantum hydrodynamics) the atom structure with the coincident description of nucleus and the electron shell.

6. The controlled discharge should serve for the plasmoid production; this charge should follow the solution of the *non-stationary* non-local equations which leads to the stationary (considered here) charge separation.

7. The main result can be formulated as the proved theorem - the plasmoid theory can not be constructed in the frame of local physics.

The moving soliton's type of solution of the generalized hydrodynamic equations for plasma in the self consistent electrical field is obtained in [5 – 7].

4. About Some Mysterious Events of the Last Hundred Years

4.1. Tunguska Event (TE)

The Tunguska event was an enormously powerful explosion that occurred near the Podkamennaya Tunguska River in what is now Krasnoyarsk Krai, Russia, at about 07:14 (Krasnoyarsk local time, 00:14 Universal time) on June 30, 1908. The explosion had the epicenter 60°55′N 101°57′E. Tunguska explosion caused the felling of 80 million trees over area of over 2,000 square kilometers.

The explosion registered at seismic stations across Eurasia. The resulting shock wave was equivalent to an earthquake measuring 5.0 on the Richter scale. It also produced fluctuations in atmospheric pressure strong enough to be detected in Great Britain. Over the next few days, night skies in Asia and Europe were aglow. An explosion of this magnitude is capable of destroying a large metropolitan area; a tremendous sound wave traveled twice around the globe. Since then, dozens of research expeditions have visited the area, hundreds of scientific papers (mainly in Russian) have been written and several hundred hypotheses put forward about the causes of the event. Not one of them, however, has been able to explain fully the complex phenomena that preceded and accompanied the Tunguska explosion. Many scientists have participated in Tunguska studies; the best known are Leonid Kulik, Yevgeny Krinov, Kirill Florensky, N. V. Vasiliev. The results of their investigations are well known and have the free access in Internet. From the first glance the simple explanation can be used for the TE – impact of the celestial bodies. The chief difficulty in the celestial impact hypothesis is that a stony object should have produced a large crater where it struck the ground, but no such crater has been found. Many people believe that the crater lies under the water of Lake Checko in Western Siberia. Yet, the scientists have found no object or material from this cosmic body itself.

Maybe we have with the probable airburst of small asteroid or comet? But a body composed of cometary material, travelling through the atmosphere along such a shallow trajectory, ought to have disintegrated, whereas the Tunguska object (TO) apparently remained intact into the lower atmosphere. The leading scientific explanation for the explosion is the air burst of an asteroid 6–10 kilometers above Earth's surface.

Practically all energy estimations are based on the asteroid version. Meteoroids enter Earth's atmosphere from outer space every day, travelling at a speed of at least 11 kilometers per second. In literature we have tremendous differences in estimations of size and mass of the object. Different studies have yielded widely varying estimates of the object's size, on the order of 60 m to 190 m.

If we have the stone spherical object which diameter are roughly 30 meters and the mass of about 10^8 kg moving with the velocity of 15 km/s, the kinetic energy of the object as large as $\sim 10^{16}$ joules. Obviously it is only the rough estimation biased to the concrete (maybe wrong model). The "megaton of TNT" is a unit of energy equal to 4.184 petajoules. The Hiroshima bomb represented only $8 \cdot 10^{13}$ joules of energy. Thus, our estimate is that the Tunguska had an explosive energy on order of 2 MT of TNT. It was closer in effect to a very large H-bomb. Most likely estimates are between 10–15 megatons of TNT (42–63 PJ).

By the way the Tsar Bomba (the nickname for the AN602 hydrogen bomb developed by the Soviet Union) had the yield of 50 to 58 megatons of TNT (210 to 240 PJ). Only one bomb of this type was ever officially built and it was tested on October 30, 1961, in the Novaya Zemlya archipelago, at Sukhoy Nos.

Many unusual effects convoyed Tunguska event; these effects cannot be explained from positions of the celestial impact. Really,

1. Many meteorological factors point towards the possibility of a meteorological event occurring. There was evidence of strong cyclones near Siberia that summer. Significant increases in air pressure were associated with the area at that time. Increased thunderstorm activity and intensity inundated Siberia. Witness accounts detail hearing thunder and seeing lightning as the event occurred. Perhaps there is some credit to the theory that the Tunguska event transpired as a meteorological occurrence.

2. It was established that the zone of leveled forest occupied an area of some 2,150 square kilometers with the shape resembling a gigantic spread-eagled butterfly with a "wingspan" of 70 kilometers and a "body length" of 55 kilometers. Upon closer examination it was found that several explosions took place. Siberian Life newspaper (July 27, 1908) reported about some kind of artillery barrage, that repeated in intervals of 15 minutes at least 10 times.

3. In the 10 days before the explosion, in many countries of Europe as well as western Siberia, the darkness of night was replaced by an unusual illumination as if those areas were experiencing the "white nights" phenomenon of high-latitude summers. Everywhere there appeared, shining brightly in the twilight of dawn and dusk, silvery clouds stretching east to west that formed like along “the lines of force”. Professor Weber about a powerful geo-magnetic disturbance observed in a laboratory at Kiel University in Germany for three days before the intrusion of the Tunguska object, and which ended at the very hour after the explosion in the Central Siberian Plateau. There was a sense of the approach of some unusual natural phenomenon.

4. Some climatologists and scientists concur that the Tunguska event caused major damage to the air layer of the mesosphere. These atmospheric changes resulted in an ozone depletion lasting up to four years after the event. A cooling trend in the years following the 1908 event was recorded in weather records around the Earth.

5. The TO followed a trajectory from southeast to northwest. It was the discrepancies in the accounts of eyewitnesses - who at one and the same time observed objects above areas of Siberia far remote from one another, moving on different courses but towards a single point - that confused researchers, prompting the hypothesis that it was probably a spaceship that had been maneuvering above the Siberian taiga. Meteorites and comets do not fly like that!

6. The reports contain information about objects moving slowly, parallel to the Earth’s surface, sometimes stopping, changing course and speed. Thousands of observers could not have mistaken what they saw, as the sky was cloudless that morning. People living within a radius of over 800 km from the place where the cosmic intruder fell observed the unusual flight of enormous fiery bodies giving off sparks and leaving rainbow trails behind them. As result, one of hypothesis sounds that they did not all see one and the same object, but several different bodies.

One other possible cause of the Tunguska event which can explain all main character features of the TE, is plasmoid (ball lightning). It can move horizontally, hover or in a zigzag motion. It is not a new idea, but until now, ball lightning was a phenomenon not consensually understood in the scientific world. The non-local theory of plasmoids gives grounds to solve the TO problem. Energy content of plasmoids has no restrictions in comparison with the chemical models. The energy density is defined by the initial conditions of the plasmoid creation and call s for the application of the non-stationary models. It has been known about the very large plasmoids with diameter up to 260 m.

As it follows from the calculations, the separated charges in plasmoid can correspond to the model of the spherical capacitor. The maximum energy that can be stored in a capacitor is limited by the breakdown voltage. But the breakdown process can have rather lengthy character realized in the several stages. This fact can explain the anomalies in the forest felling.

The spherical capacitor energy W is written as

$$W = 2\pi\varepsilon_0\varepsilon \frac{R_1 R_2}{R_2 - R_1} (\Delta\psi)^2 , \tag{4.1}$$

where $\Delta\psi = \psi_1 - \psi_2$, is the potential difference between the conductors for a given charge q on each. The voltage between the spheres can be found by integrating the electric field along a radial line:

$$\Delta\psi = \psi_1 - \psi_2 = \frac{q}{4\pi\varepsilon_0\varepsilon}\int_{R_1}^{R_2}\frac{dr}{r^2} = \frac{q}{4\pi\varepsilon_0\varepsilon}\left(\frac{1}{R_1} - \frac{1}{R_2}\right), \quad (4.2)$$

If $R_2 >> R_1$, then

$$W = 2\pi\varepsilon_0\varepsilon R_1 \left(\Delta\psi\right)^2 . \quad (4.3)$$

The force $\mathrm{F} = -\frac{dW_p}{dr}\frac{\mathrm{r}}{r}$, acting on the internal conductor

$$F_{\text{in}} = -\frac{\partial W_p}{\partial R_1} \cong 2\pi\varepsilon_0\varepsilon\left(\Delta\psi\right)^2, \quad (4.4)$$

does not depend in the first approximation on the radius of the internal sphere. For the external sphere, the force acts in the opposite direction.

$$F_{\text{ex}} = -\frac{\partial W_p}{\partial R_2} = -2\pi\varepsilon_0\varepsilon_1\left(\Delta\psi\right)^2\frac{R_1^2}{\left(R_2 - R_1\right)^2} . \quad (4.5)$$

If $R_2 >> R_1$, then

$$F_{\text{ex}} = -\frac{\partial W_p}{\partial R_2} = -2\pi\varepsilon_0\varepsilon_1\left(\Delta\psi\right)^2\left(\frac{R_1}{R_2}\right)^2, \quad (4.6)$$

If for the TO $W = 10^{16}\,\mathrm{J}$, radius of the internal sphere is 100 m, $\varepsilon = 1$, then $\Delta\psi = 1.34\cdot 10^{12}\,\mathrm{V}$.

Electrostatic generator (which uses a moving belt to accumulate very high amounts of electrical potential on a hollow metal globe on the top of the stand) was invented by American physicist Robert J. Van de Graaff in 1929. The potential difference achieved in Van de Graaff generators reaches $7\cdot 10^6$ volts in the 30th of the last century.

A Marx generator (Arkadyev – Marks generator in the Russian scientific literature) generates a high-voltage pulse. The circuit generates a high-voltage pulse by charging a number of capacitors in parallel, then suddenly connecting them in series. Marx generators are used in high energy physics experiments, as well as to simulate the effects of lightning on power line gear and aviation equipment. The high-voltage pulse can reach up to 10^7 V. The mega-joule estimates are known for the ball lightings.

It is stated that the ball lighting explosion damages the plane navigation equipment, but it is the theme of the next section.

4.2. Gagarin and Seryogin Air Crash

In 1960, after much searching and a selection process, Yuri Gagarin was chosen with many other pilots for the Soviet space program. A Soviet Air Force doctor evaluated his personality as follows:

"Modest; embarrasses when his humor gets a little too racy; high degree of intellectual development evident in Yuri; fantastic memory; distinguishes himself from his colleagues by his sharp and far-ranging sense of attention to his surroundings; a well-developed imagination; quick reactions; persevering, prepares himself painstakingly for his activities and training exercises, handles celestial mechanics and mathematical formulae with ease as well as excels in higher mathematics; does not feel constrained when he has to defend his point of view if he considers himself right; appears that he understands life better than a lot of his friends."

Gagarin was also a favored candidate by his peers. When the 20 candidates were asked to anonymously vote for which other candidate they would like to see as the first to fly, all but three chose Gagarin. On 12 April 1961, aboard the Vostok 1, Gagarin became both the first human to travel into space, and the first to orbit the earth.

On 27 March 1968, while on a routine training flight from Chkalovsky Air Base, he and flight instructor Vladimir Seryogin died in a MiG-15UTI crash near the town of Kirzhach. The bodies of Gagarin and Seryogin were cremated and the ashes were buried in the walls of the Kremlin on Red Square. It was the tragedy of the national scale. (Read more for example: [15 – 18). The cause of the crash that killed Gagarin is not entirely certain, and has been subject to speculation about conspiracy theories over the ensuing decades.

In April 2011, documents from a 1968 commission set up by the Central Committee of the Communist Party to investigate the accident were declassified. Those documents revealed that the commission's original conclusion was that Gagarin or Seryogin had maneuvered sharply either to avoid a weather balloon, leading the jet into a "super-critical flight regime and to its stalling in complex meteorological conditions," or to avoid "entry into the upper limit of the first layer of cloud cover".

Soviet documents declassified in March 2003 showed that the KGB had conducted their own investigation of the accident, in addition to one government and two military investigations. The KGB's report dismissed various conspiracy theories.

In the years and decades that followed, rumors swirled about Gagarin's death. No reason to discuss fantastic hypotheses on the level of the provocation like "Had Gagarin been drinking?" or "Was he distracted, taking pictures of birds from the air when he should have been paying attention to his aircraft?"

About the aim of the Gagarin air plane flight, pilot-cosmonaut Vladimir Aksenov wrote in his book "The Roads of Tests":

"Gagarin and Yevgeny Khrunov were supposed to be the first to go through check flights. According to flight rules, check flights, prior to independent flights, could be conducted by the heads of flight departments, rather than instructor pilots. They could be squadron commanders, deputy commanders and commanders of regiments. So it was Vladimir Seryogin, the regiment commander, who joined

Yuri Gagarin in the check flight. Another important peculiarity of that check flight was as follows: it was a flight in the area for the execution of complex aerobatics stunts. In classical training programs, the check flight and the first solo flight are performed on the so-called "box" that is, takeoff, height gain, flying around the airfield, landing approach and landing. Prior to solo flights in the area to perform aerobatic maneuvers, another check flight should be made.” It should be added that V. Seryogin was the leading test-pilot for the plane MiG-15UTI.

The KGB report states that an air traffic controller provided Gagarin with outdated weather information, and that by the time of his flight, conditions had deteriorated significantly. Vladimir Aksenov writes: “On that day clouds were unusual. The lower edge of almost continuous clouds was about 600 meters above the ground. Then, 4,000 meters above, there were only dense clouds. The upper edge was flat, and there were no clouds above that - there was a clear sky and very good visibility.” The last message from the MiG-15UTI contains information (without unusual emotions in the voice), that the check-flight is finished and they return to landing. Further on the height less than 4,000 meters the plane entered in the clouds.

Here is an extract from the book of distinguished test pilot of the USSR Stepan Mikoyan "We Are Children of War. Memoirs of a Military Test Pilot":

"The time determined by imprints of the hands of the remains of aircraft clock and Gagarin's watch differed by about 15 seconds. That moment occurred only in *45-60 seconds after the last broadcast* from Gagarin that was recorded on the magnetic tape." The investigation concluded that Gagarin's aircraft executes the maneuver trying to avoid the collision with unknown object. The hypotheses about possible objects like balloons or flocks of birds should be ruled out – too high for birds and no traces of the balloon on the place of the crash.

The investigation concluded that

1. The maneuver led to the aircraft going into a tailspin and crashing, killing both men.

2. Gagarin and Seryogin have the control until the end.

3. The crew believed their altitude to be higher than it actually was, and could not react properly to bring the MiG-15 out of its spin. It was discovered that altitude sensor was out of order but the crew believed their altitude to be higher than it actually was.

4. The plane was not destroyed in the air. It means that the plane with outboard tanks had the overloads less than 8 which were not unusual for the crew.

5. The reading of the pressure sensor scale displayed that the glass cockpit was destroyed. *Only* 2/3 of the glass splits were discovered on the crash place, *for other parts* ~ 96%. It means that cockpit was destroyed in air.

Hypotheses that a cabin air vent was accidentally left open by the crew or the previous pilot, leading to oxygen deprivation and leaving the crew incapable of controlling the aircraft, cannot be true. The height of about or even less than 4,000 meters is usual for alpinists. For example, the “Shelter of 11” (4,130 m) was a hotel near Elbrus. Large groups of climbers would usually leave this base camp at 2-3am to challenge the summit.

In his 2004 book Two Sides of the Moon, Alexey Leonov, who was part of a State Commission established to investigate the death in 1968, recounts that he was flying a helicopter in the same area that day when he heard "two loud booms in the distance." Corroborating other theories, his conclusion is that a Sukhoi jet (which he identifies as a Su-15) was flying below its minimum allowed altitude, and "without realizing it because of the terrible weather conditions, he passed within 10 or 20 meters of Yuri and Seregin's plane while breaking the sound barrier." The resulting turbulence would have sent the MiG into an uncontrolled spin. Leonov believes the first boom he heard was that of the jet breaking the sound barrier, and the second was Gagarin's plane crashing. In a June 2013 interview with Russian television network RT, Leonov said that a declassified report on the incident revealed the presence of a second, "unauthorized" Su-15 flying in the area. Leonov states that "the aircraft reduced its echelon at a distance of 10–15 meters in the clouds, passing close to Gagarin, turning his plane and thus sending it into a tailspin – a deep spiral, to be precise – at a speed of 750 kilometers per hour”.

It is the very significant evidence which was checked by cosmonaut Tolboyev. He said (for example during the television interview on January, 7 (2013)) that the special experiments were organized; during the Su-15 flight two MiG-15 UTI entered in the turbulent wake of Su-15. In all cases both MiG-15 UTI were pushed out from the stream without going into a tailspin.

Interesting information from cosmonaut Tolboyev during this interview – he retailed about the aviation accident in the Russian Ahtuba aviation division. The pilot broadcasted about the UFO (unknown flying object). He was commanded to return immediately for landing, but the pilot tried to close to this object. The result – he was landing with the tremendous difficulties without cabin electronics.

I believe that the cause of the Gagarin accident consists in the impact of the MiG 15 UTI with plasmoid.

4.3. Accident with Malaysia Airlines Flight MH370

Let us consider other mystery accidents from this point of view. For example, the Malaysia Airlines flight MH370 with 239 people onboard. It “lost all contact” with Subang Air Traffic Control at 2:40 a.m., two hours into the flight. The plane was expected to land in Beijing at 6:30 a.m. Saturday (on March 8, 2014). Known facts:

1. Around the time the plane vanished, the weather was fine and the plane was already at cruising altitude, making its disappearance all the more mysterious. Just 9 percent of fatal accidents happen when a plane is at cruising altitude, according to a statistical summary of commercial jet accidents done by Boeing.

2. Military radar indicated that the plane may have turned from its flight route before losing contact. Aviation sources in

China report that radar data suggest a steep and sudden descent of the aircraft, during which the track of the aircraft changed from 024 degrees to 333 degrees.

3. A Malaysia Airlines plane sent signals to a satellite for *four hours* after the aircraft went missing, an indication that it was still flying for hundreds of miles or more. Boeing offers a satellite service that can receive a stream of data during flight on how the aircraft is functioning and relay the information to the plane's home base. Malaysia Airlines not a subscriber to Boeing service but still automatically sent pings to satellite. If the plane had disintegrated during flight or had suffered some other catastrophic failure, all signals — the pings to the satellite, the data messages and the transponder — would be expected to stop at the same time.

4. There was no distress signal. The lack of a radio call suggests something *very sudden* and *very violent happened.*

5. The plane had enough fuel for *four* more hours of flight. The plane lost all contact and radar signal one minute before it entered Vietnam's air traffic control.

6. Officials said two men, later identified as Iranians, boarded the plane with stolen passports. It was later reported that they were unlikely to be linked to terrorist groups.

7. The plane was last inspected 10 days before the accident and found to be in proper condition.

Investigators have not ruled out any possible cause for the plane's disappearance. As result, experts say one possibility that could explain why the transponders were not working is that the pilot, or a passenger, likely one with some technical knowledge, switched off the transponders in the hope of flying undetected.

It is known that the appearance of the ball lightning in the airplane is dangerous, because it can cause a short circuit and hence lead to crash of the airplane. Plasmoids were really observed on board the air-plane [19]. Taking into account the plasmoid theory created by me, we can make the preliminary conclusions:

a) The accident has very sudden and very violent character. The aircraft was partly disintegrated, as result - the loss of pressure and practically of all electronic equipment.

b) The loss of pressure was so severe that it knocked passengers and crew out.

c) In this case, the pilots should have been able to react quickly and connect to oxygen masks, but didn't. The plane transformed into, so to speak, "flying Dutchman". The aircraft flew for the rest hours until it ran out of fuel and crashed. Really, the aircraft has fuel for approximately *four hours* for flight, and plane sent signals to a satellite for *four hours* after the aircraft went missing. This fact indicates the possible area of the crash. But this area has no site for landing. In its turn it excludes the version of hijacking.

d) It should be added that the area of the plane crash contains the boundary between two tectonic plates, the Burma plate and the Sunda Plate. The boundary between two major tectonic plates results in high seismic activity, *anomalous atmospheric and ocean events* in the region. Numerous earthquakes have been recorded, and at least six, in 1797, 1833, 1861, 2004, 2005 and 2007, had the magnitude of 8.4 or higher. On December 26, 2004, a large portion of the boundary between the Burma Plate and the Indo-Australian Plate slipped, causing the 2004 Indian Ocean earthquake. This earthquake had a magnitude of 9.3. Between 1300 and 1600 kilometers of the boundary underwent thrust faulting and shifted by about 20 meters, with the sea floor being uplifted several meters. This rise in the sea floor generated a massive tsunami with an estimated height of 28 meters that killed approximately 280,000 people along the coast of the Indian Ocean.

Now the final reasonable conclusion could be done from the position of the previous theory: *Malaysia Airlines flight MH370 met the atmospheric plasmoid.*

4.4. Accident with AirAsia Flight QZ8501

Following information contains quotes from officials. An AirAsia plane with 162 people (155 passengers and 7 crewmembers) on board went missing in bad weather en route from Indonesia to Singapore on Sunday 28 December 2014. The plane was in good condition - AirAsia has a "very good" reputation for safety. This plane disappeared from radar screen while it was at FL320 over the Java Sea. Debris and bodies have been recovered in the Java Sea. All the 162 people onboard were killed.

The aircraft experienced difficult weather conditions with storm cells while it was cruising over the java sea at FL320. The crew requested to deviate left of its airway and to climb to FL380. In other words the pilot asked to ascend 6,000 feet to 38,000 feet to avoid heavy clouds.

Flight 8501's captain has a total of 20,537 flying hours, with 6,100 of them with AirAsia Indonesia on the Airbus A320, the airline said. The first officer has a total of 2,275 flying hours, AirAsia said. The plane's last scheduled maintenance was on November 16.

At that time, the aircraft was observed normally. When the aircraft was radioed with the clearance to climb to FL340, there was no response anymore.

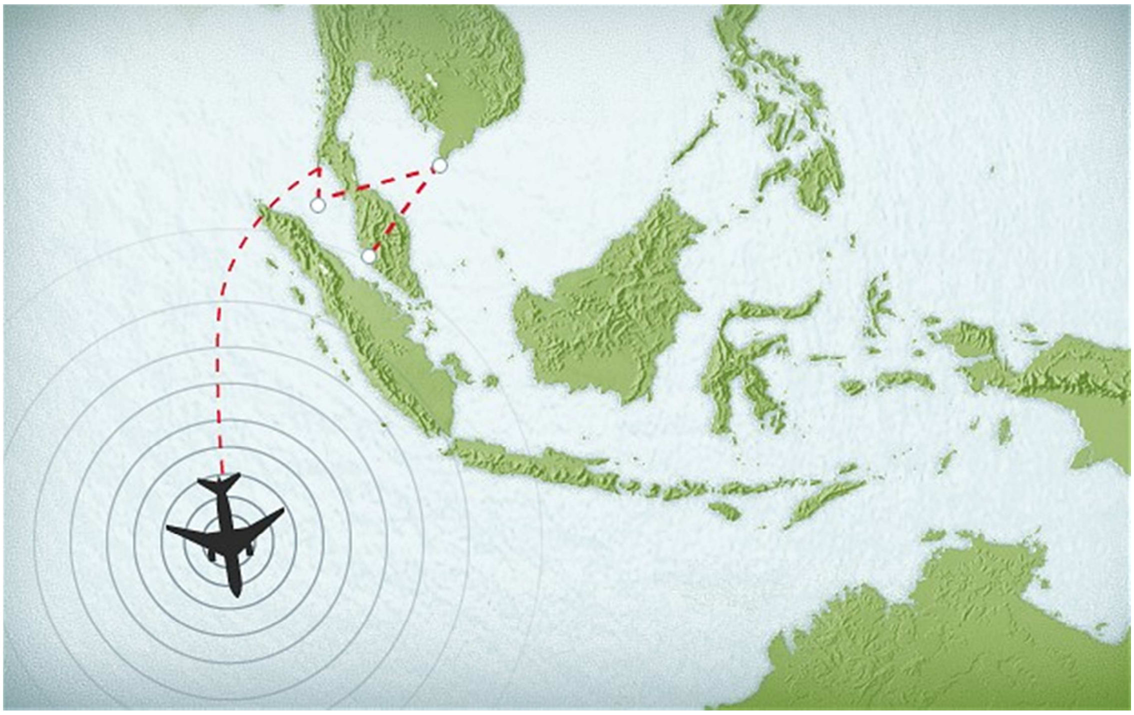
But the aircraft was still visible on radar screens (the ADS-B was still emitting); 1 minute later, the aircraft disappeared from radar screen. The last recorded position was about 110 NM East-South-East of Pulau Belitung.

There were seven aircraft passing through the area at that time at flight levels between 290 and 380, neither of them encountered any difficulties.

Debris and bodies of the aircraft have been located two days later, on Dec 30th 2014, in the Java Sea about 110 NM from Pulau Belitung, about 8 km from the last radar position. Bigger debris of what appeared to be the aircraft wreckage has been located ~ 70 km from the last radar position!

From the point of view of the developed non-local ball lighting theory there is a number of parallels between the two incidents (MH370 and AirAsia flight QZ8501). Namely:

A) The loss of contact with the AirAsia plane comes nearly 10 months after the disappearance of Malaysia Airlines Flight 370, which dropped off radar over Southeast Asia on March 8 with 239 people on board. The mysterious disappearance of AirAsia flight QZ8501 and MH370 vanished in March was happened practically in the same area containing the boundary between two tectonic plates, the Burma plate and the Sunda Plate. The boundary between two major tectonic plates results in high seismic activity, anomalous atmospheric and ocean events in the region. Look at the maps (Map 1 and Map 2) known from the Internet resources:



Map 1. *Area where MH370 disappeared on March 8, 2014.*

Map 2. *Area where Flight QZ8501 disappeared on Sunday 28 December 2014.*

Crash of Flight QZ8501. This is an estimated position of QZ8501 at 23:18 UTC when AirNav Indonesia says that they lost radar contact

B) There is a time lapse between the moment the plane lost contact with air traffic control and the declaration of an emergency. It means that the both planes flied during this time lapse in the regime of “flying Dutchman”.

C) No distress call in the both cases - accidents have very sudden and very violent character.

5. Some Conclusions

1. This isn't the only time a plane has disappeared without a trace or sparks an investigation surrounded by confusion. It is reasonable to look back at other baffling aviation disasters (this quantity may as much as 14%) from the formulated point of view.

2. The special programme should be developed for avoiding this class of accidents. For example the extremely important plane systems should be duplicated by devices which cannot be damaged by the strong external electric discharge.

3. From the point of view of non-local physics the Tunguska explosion, Gagarin catastrophe and accidents with Malaysia Airlines flight MH370 and AirAsia flight QZ8501 can have the same physical origin – *plasmoid appearance in the Earth atmosphere.*

References

[1] Bell J S, On the Einstein Podolsky Rosen paradox. *Physics*. V.1, p.195 (1964).

[2] Alekseev B V, Matematicheskaya Kinetika Reagiruyushchikh Gazov (Mathematical Theory of Reacting Gases) (Moscow, *Nauka* 1982)

[3] Alexeev B V, The generalized Boltzmann equation, generalized hydrodynamic equations and their applications. *Phil. Trans. R. Soc. Lond. A* 349, 417–443 (1994) (doi:10.1098/rsta.1994.0140)

[4] Alexeev B V, Generalized Boltzmann Physical Kinetics. Elsevier (2004)

[5] Alexeev B V, Unified non – local theory of transport processes. Elsevier (2015)

[6] Alexeev B V, Generalized quantum hydrodynamics and principles of non-local physics. *J. Nanoelectron. Optoelectron.* 3, 143–158 (2008) (doi:10.1166/jno.2008.207)

[7] Alexeev B V, Application of generalized quantum hydrodynamics in the theory of quantum soliton evolution. *J. Nanoelectron. Optoelectron.* 3, 316–328 (2008) (doi:10.1166/jno.2008.311

[8] Stenhoff M, Ball Lightning. An Unsolved Problem in Atmospheric Physics. New York: Kluwer/Plenum (1999)

[9] Singer S, The Nature of Ball Lightning; Plenum: New York (1971)

[10] Barry J D, Ball Lightning and Bead Lightning; Plenum: New York, 1980; pp 25−27, 59−60, 180−182.

[11] Kapitza P L, Phys. Blatter, 14, 11 (1958).

[12] Tesla N, Colorado Springs Notes 1899−1900; Marincic, A., Ed.; Nolit: Beograd, Yugoslavia, 1978; pp 368−370.

[13] Egorov A I, Stepanov S I, Journal of Technical Physics, 72, 12 (2002), 104 (In Russian).

[14] Oreshko A G, International Journal Unconventional Electromagnetics and Plasmas (UEP), 3, No.1-2, 77 (2011).

[15] Alexeev B V, To the Non local Theory of Plasmoids. Gagarin Catastrophe Version. Vestnik MITHT, Vol. 8, No. 2 (2013) (in Russian).

[16] Leonov A, D. Scott D, Two Sides of the Moon. New York: Thomas Dunne Books. (2004) p. 218. ISBN 0-312-30865-5. OCLC 56587777.

[17] Микоян С. А., Пушкин А. И., Петров С. В., Титов Г. С., Леонов А. А., Белоцерковский С. М., Майоров А. В., Сигов П. Г., Сосунов А. М. Заключение специалистов о причинах гибели Гагарина и Серёгина, //Гражданская авиация, № 7 (1989).

[18] http://ru.wikipedia.org/wiki

[19] Kawano S., Int. Journ. Unconventional Electromagnetics and Plasmas (UEP) 3, N. 1-2, 41 (2011)