A Discussion On A Physical Model Of Ball Lightning And UFO

Ivan L. Bajak

Abstract: It is proposed that the ball lightning and UFO are analogous objects. The variety of different observations is explained. It is proposed on a uniform basis using a hypothesis that the ball lightning and UFO are created like a spherical capacitor filled by polar molecules mainly and in some cases by various chemicals which influence the final manifest of the object. A mechanism of a formation of the spherical capacitor is discussed. A peculiar behavior like e.g. sudden change of direction of motion, shape of disc and possible penetration through wall is explained as a consequence of internal structure of the object. Finally an experimental verification of the hypothesis is suggested.

Keywords: Ball lightening, UFO.

1 Introduction

The ball lightning (BL) and UFO have been observed many times but there is not generally accepted explanation of their occurrence. . A good review of the BL has been published by Brand [1] He introduced a great variety of different models of BL which have some common features presented by Barry [2] Theoretical model of BL presented by Lowke [3]. assumes that the BL is a time varying glow discharge similar to corona discharge. Recently published observation of BL by Durand and Gaines [4] present the BL as a consequence of a volcanic air pollution. Some interesting features of BL we can find in works Stenhoff [5] and Tchvirinsky [6]. One of the oldest model created by Tessan [7] presents the BL like a spherical capacitor and it seems to be a good start to introduction of the hypothesis on creation of an atmospheric spherical capacitor which depending on conditions of its development and chemical composition , and size of its volume can behave either like UFO or BL with variety of its properties.

2 Stages of the development of the atmospheric spherical capacitor

In the following we shall discuss stages of the creation of the atmospheric spherical capacitor (ASC).

2.1. The creation of a charged ball

It is well known fact that the atmosphere from 60km to 1000km, above the earth surface contains a highly ionized gas of temperature 200 – 500 K. Gas in lower layer of ionosphere contains clusters of $H^+\cdot(H_2O)$, then with increasing height ions of O_2^+, NO^+ and O^+, H^+ a He^+. We shall assume that due to electromagnetic disturbances or falling meteoroid a huge and deep fluctuation of ionized gas will be created and it starts with continuous movement towards the earth (Fig.1).

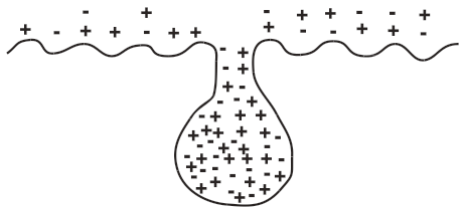

Figure 1. *Creation of a ball of ionized gas*

- *Ivan Ľ. Bajak, Svatoplukova 44, 01001 Zilina, Slovakia E-mail:* bajakov@gmail.com

The huge fluctuation can be separated from the ionized region and falling down creates an electrically neutral ball which contains the ionized gas. The ball surrounded by dry air moves towards the earth. The diameter of the ball with increasing atmospheric pressure decreases. In some cases the ball can find oneself between two regions with opposite charges which are separated by neutral air containing high concentration of polar molecules and micro crystals of ice (Fig. 2.).

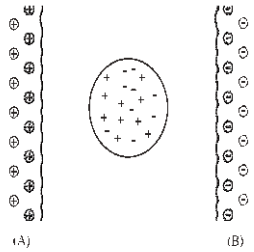

Figure 2. The ball of the ionized gas between the positive zone A and negative zone B.

2.2 Formation of the atmospheric spherical capacitor

We denote the charge mobility of the positive ions in the region A as μ_p and the mobility of the negative ions in B as μ_n. The charge mobility of the positive ions in the ball will be denoted as β_p and the negative as β_n. Let the motilities fulfil the following relation

$$\beta_n > \beta_p > \mu_n > \mu_p \qquad (1)$$

The relation (1) is a consequence of the fact that the mass of the negative ions is much smaller than the mass of the positive ions in the ball and both of them are much smaller than the mass of the ions in the region A and B. (Here we take into account the fact that ions in the in the ball comes from higher region of atmosphere and are lighter than that in A and B.) Since the average velocity of an individual ion is a product of the mobility and the strength of electric field, the absolute values o the velocities of the ions fulfill relation

$$v_n > v_p > V_n > V_p \qquad (2)$$

Where the capital letters denote the velocities of the ions in the regions A and B while the small ones the velocities of the ions in the ball. We also assume that the electric field between the region A and B has been originally nearly homogeneous. The entering ball and the following movement of the charges

destroy the relative homogeneous electric field which leads to a motion of the polar molecules along the field gradient. So the second stage of the creation of the ASC is characterized by simultaneous movement of all charges and polar molecules. In spite of the fact that this movement is chaotic, we can distinguish in it several steps (Fig 3.).

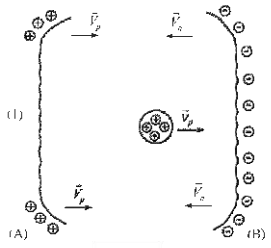

Figure 3. *Negative charges of the ball due to recombination with central part of the positive zone A created a neutral area (1). The positive charges of the ball move towards the zone B having velocity V_p while the charges of B move with velocity V_n towards the ball and periphery of A. Ions of the periphery have velocity V_p .*

- The negative charges from area of ball penetrate with high velocity trough neutral gas toward the zone A. They recombine with the positive ions of A creating a neutral area (1) .
- In the same time the positive charges of the ball move toward the region B. The ions of the region B move toward the ball and to the periphery of A which remained positively charged. These movements are slowing down by neutral gas and polar molecules.
- The negative charges of B envelope the region of the positive charges so that the positive and the negative areas remain separated by a dense layer of neutral gas consisting polar molecules and micro crystals of ice mainly.

The positive charge Figure 3. Negative charges of the ball due to recombination with central part of the positive of the ball due to repulsive forces expand in the radial direction forming a spherical layer of positive ions. Expansion of this layer is slowing down by polar molecules and by neutral atoms. Thus the central area of the ASC is a bubble which wall has positive charge, Neutral atoms diffuse into inner space if the positive sphere. In the same time the negative charges braking by polar molecules and micro crystals of ice surround the positive bubble creating a spherical layer and consequently ASC.

2.3. Stabilization of the spherical atmospheric capacitor

We can assume that the polar molecules and micro crystals of ice envelope the charges that form outer and inner surfaces of the charged layers that shape ASC and so create a dense film - the walls of both bubbles. A gap between the positive and negative bubbles is filled by polar molecules mainly. Because of relatively dense films on the surfaces of the bubbles a diffusion of the polar molecules through the walls of the bubbles is very slow. On the other hand neutral atoms can diffuse through the walls easily. Due to this fact the inner volume of the positive bubble will be filled by neutral atoms mainly. The strength of the electric field in the gap between the positive and negative bubbles

$$E = Q/4\pi\varepsilon r^2 \qquad (3)$$

Where r is distance from the centre of the inner bubble to the considered point. Let us assume that the thickness of the walls of the bubbles can be neglected with respect to their diameters. Let R_1 and R_2 are average radii of the positive and negative bubbles respectively. Then r in equation (3) fulfils the relation $R_1 \le r \le R_2$. For the energy of the electric field in the gap we get

$$W = Q^2\Delta R/8\pi\varepsilon R_1 R_2 \qquad (4)$$

Where $\Delta R = R_2 - R_1$ is the width of the gap.

The pressure P_i of the gas in the inner volume of the positive bubble, the pressure P_g in the gap, as well as atmospheric pressure P_a, and effect of the electric field must stabilized whole object. The effective pressure (surface density of force) on the outer side of the inner bubble is

$$P_1 = Pg - AQ^2 / R_1^4 \qquad (5)$$

Where $A = 1/32\pi^2 \varepsilon$. The condition of force equilibrium yields $P_1 = P_i$. The effective pressure on the inner side of the outer bubble is

$$P_2 = P_g - AQ^2/R_2^4 \qquad (6)$$

The condition of equilibrium gives $P_2 = P_a$ Thus from relations (5) and (6) we get

$$P_i < P_g, \quad P_g > P_a, \quad \text{and} \quad P_i < P_a \qquad (7)$$

It means that the pressure in the gap is higher than the atmospheric pressure and it is also higher than the pressure in the volume of the inner bubble, which is ,however, smaller than the atmospheric pressure. An illustration of ASC is in figure 4.

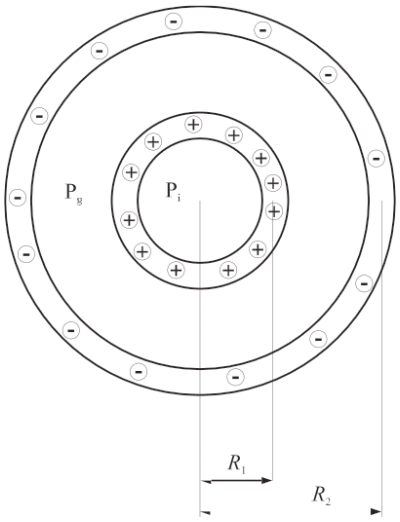

Figure 4. *The atmospheric spherical capacitor. R_1 and R_2 are average radii of the inner and outer bubbles respectively. P_a is atmospheric pressure, P_g is pressure in the gap, and P_i is the pressure in the inner bubble.*

The energy of BL, besides energy of the electrostatic field, can have also a chemical energy if it contains molecules which in

contact with oxygen can burn or explode. The filling of the inner volume can get contact with oxygen so that its molecules diffuse through the walls of the bubble from the surrounding atmosphere and then the filling can burn up. In this case the total energy of BL or UFO is higher than the energy given by relation (4). The ASC created in high layers of atmosphere can be observed rather like UFO than BL because there is only low probability that such object can survive the long process of falling to the earth surface. There are, however, conditions which can lead to creation of ASC of small dimensions at the earth surface occasionally. The highly ionized gas can appear also at the surface of earth as a consequence of a lightning stroke. When lightning strikes a point on the earth the ionized gas can find itself in the situation described in subsections 2.1 and 2.2, however, in much smaller dimensions and in conditions with variety of different chemical content of the considered area. The chemical content of the BL depends on the actual conditions of surroundings of its creation. The BL can contain carbon, ozone, and some other chemicals which electrochemical reaction gives enough energy for stable and relatively durable existence of BL. The charge of inner and outer bubbles makes the object electrically neutral and compact.

3. The shape and magnetic properties of BL and UFO

The bubbles of the UFO or BL have the surface films which tension give them spherical shape. Their average mass density is nearly equal to mass density of surrounding atmosphere and so the objects are as a toy in hands of wind. The large object like UFO can in horizontally flowing air receive rotation along vertical axis. The object due to centrifugal force obtains a shape of disc. It can be assumed that the angular velocity of the inner bubble will be much smaller than the angular velocity of the outer sphere. The difference in rotational state of the bubbles is a source of a magnetic field. This magnetic field contributes to centrifugal forces too. It also interacts with the magnetic field of earth and can evokes rather strange movement of the whole object. An additional magnetic field can be generated as a consequence of an arcing between bubbles. The arcing finally leads to a slow and probably silent vanish of the object. In a case when the BL or UFO bumps a hard or sharp object and so is forced to vanish quickly it emits energy in very short time with high power.

4. On a possibility of infiltration of BL through wall

We shall assume that the BL is approaching a wall. At the moment of touch between the BL and the wall begin overshoot following processes almost simultaneously.

- The BL is de facto neutral object, but when it approaches a wall its outer sphere will act as negative charge and through electrostatic induction quickly muster positive ions at opposite side of the wall while the negative charges is pushed backward creating opportunity for formation of outer bubble. The positive charge gathered at the opposite surface is a nucleus of the inner bubble.
- In the same time the negative sphere in touch with the wall becomes unstable and due to repulsive forces begins to disintegrate.
- Now the positive bubble quickly reaches the wall and the positive charges in space on its other side moves out while the negative ones moves towards the wall and can enclose the positive bubble forming new BL.
- The electric charges of the incident BL are scattered and neutralized.

The dynamic of processes that are in progress during the infiltration of the ball through the wall is very similar to those described in section 2.2 Thus this process is simultaneous sequence of annihilation and creation.

5. Suggestion for experimental verification of the hypothesis

For the verification of the hypothesis we suggest an experiment which basic idea can be understood from figure 5. and which simulates conditions for development of ASC. The experiment should be performed in the following way: A planar capacitor (1) has electrodes cowered by thin layer of dielectrics (2). A high voltage is applied to the electrodes.

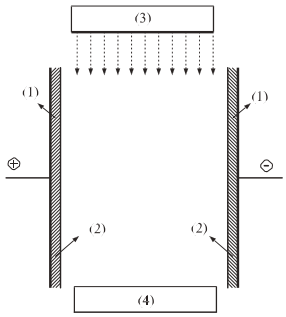

Figure 5. *A schematic sketch of apparatus simulating conditions for generation of ASC. A planar capacitor (1), a dielectric layer (2), a source of ionizing radiation (3), and a source of plasma (4) are basic elements of the apparatus.*

Space between the electrodes is filled with a gas containing polar molecules mainly. A source of ionizing radiation (3) irradiates the gas and produces ions which gather at the electrodes and imitate the positive (A) and the negative and zone (B). When we judge that the pumping of the ions into the zones A and B is sufficient the source (3) is switch off and a bubble of plasma is injected into the capacitor's interspaces. The described procedure should give a possibility to generate a BL or UFO. It is self evident that the optimal time of irradiation as well as value of the high voltage between the electrodes, volume of plasma, and chemical composition of the gas in the interspaces must be tuned empirically.

6. Conclusions

The presented consideration is a hypothesis only. However, it can be verified experimentally and so proved. It is shown that BL and UFO are analogous objects. They differ by conditions of their origin. While the UFO arises at higher layers of the atmosphere the BL is created at the earth surface. A quite large number of different observations describing BL in different conditions with great variety of its behavior can be explained on the uniform base using our hypothesis saying that the BL is the ASC which behavior depends on chemical composition of its volume mainly. It can be also claimed that the UFO is not an optical illusion but a huge ASC filled with polar molecules and light atomic gas. The average mass density of UFO is nearly equal to the mass density of

atmosphere so the UFO can quickly change its movement accommodating to agitating air. Its optical refractivity differs from refractivity of surrounding air and so it is visible. It also due to sparkling between inner and outer bubble can generate light and electromagnetic noise.

Reference

[1]. Brand W.: 1923 Der Kugelblitz (Hamburg: H Grand)

[2]. Barry J D.: 1980 Ball Lightning and Beat Lightning Extreme Forms of Atmospheric Electricity (New York: Plenum Press)

[3]. Lowke W. J.: 1996 Phys. D: Appl. phys. **29** 1237

[4]. Durand M Wilson Dr. J.: 2006 Dr J. Gaines: Ball lightning and fireballs during volcanic air pollution. Weather, Volume 61, Issue 2, pages 40–43, February 2006.

[5]. Stenhoff, Mark (1999). Ball Lightning – An Unsolved Problem in Atmospheric Physics. Kluwer Academic/Plenum Publishers. ISBN

[6]. Tchvirinskyi P N 1967 Priroda **6** 98.

[7]. Tessan M. De. : 1859b Forschr. Phys. 15 62