Natural low energy nuclear fusion reaction

Boris A. Andrianov
National Research South Ural State University, Chelyabinsk, E-mail: aba@susu.ac.ru

Abstract

Hypothesis is put forward explaining a superpower flash, a shock wave and instant evaporation of the most part of Chelyabinsk meteor by the emergence of conditions for a low energy fusion exothermic reaction between Mg and Si nuclei contained in olivine and pyroxene, which were found in the meteorite. The possible initiators of that reaction are considered. They are supposed as common for the known experiments of similar type.

Keywords: fireball; explosion; olivine; pyroxene; isotopes; silicon; magnesium; iron; nickel; chromium; nuclear fusion; LENR

The most mysterious feature of an airborne meteor is its sudden burst in atmosphere accompanied by a dazzling continuous flash and a power shock wave with estimated energy reaching several megatonnes of TNT equivalent. These events happened in the history of mankind several times [1]. Maximum values have Tunguska phenomenon (10-15 Mt) and Chelyabinsk bolide (0.44 Mt) [2]. The actual data famine in the first case gave rise to assumption about a natural nuclear fusion reaction in a nucleus of a comet [3,4], which is, however, inconsistent with our knowledge of the chemical composition of comets and of the temperature and pressure conditions necessary for initiating this reaction [5]. But the second case shows that the idea of a natural nuclear reaction is not devoid of sense by itself and deserves attention.

Meteorite fragments were a persuasive proof that on 02.15.2013 at an altitude of 23.3 km it was just a meteor of mass about 11,000 tonnes that has exploded, which was traveling at the moment of its burst at a velocity of 18.6 km/s [2]. It is unlikely that the meteor lost 9/10 of its initial mass due to ablation in traveling time of 13 s in atmosphere [6], but even so, about 1000 tonnes of meteor's substance, to say the least, instantly evaporated leaving a dense smoky trace in the air, which was absent before the burst. The assertion that 1000 tonnes of fragments fell down [6] looks rather doubtful and is obviously based on simple arithmetic.

Thus not for the first time Nature demonstrates us the experiment in which there happens a powerful burst and instant evaporation of a stone block containing no explosives. Among all known means only a nuclear explosion is capable to provide the energy required for that. There is ample evidence for that conclusion. Just the main features of a nuclear explosion characterize the behavior of Chelyabinsk meteor.

First of all, there is superpower light radiation lasting 5 seconds as an extraordinarily increasing fireball. The radiation did not increase gradually but appeared suddenly and considerably exceeded heat radiation of burning gases attending the meteor flight. Approximate total radiated energy of the fireball was $3.75 \cdot 10^{14}$ J [7]. The flash brightness was so awful that a lot of eyewitnesses got a

tan on their faces even the man who was sitting in the back of his car. It is well known that light duration of nuclear explosion in seconds is equal to the cube root of its energy in kilotonnes [8]. From this correlation it is possible to make the rough estimate of energy as 125 kt that is of the same order of value with estimated in [2].

The second sign is penetrating radiation. Indirect but quite essential its evidence is represented by many eyewitnesses who felt the smell of spent gunpowder just after the flash. As is generally known such the smell is a distinctive feature of nitrogen oxides which could be formed in the air only under powerful gamma radiation at the moment of the burst. There are no data about neutrons in this penetrating radiation. Also there are no valid data about electromagnetic pulse besides short-time disappearance of mobile communication which could be caused by overloading of cellular networks.

The third sign is three shock waves, the first of which came to Chelyabinsk after 177 s , i.e. the explosion occurred at a distance (measured along an inclined straight line) about 60 km. If the explosion had happened at a lower height the shock wave force would have been much greater. There has not been any radioactive contamination, possibly, not only due to the high-altitude burst, but mainly because of total absence of unstable reaction products.

So the subject under consideration may appear as follows: at the input: a stone meteor (chondrite) of an estimated initial mass of 11,000 tonnes traveling at a velocity of 18.6 km/s; at the output: "pure" nuclear explosion. What kind of effects and processes during the object moving could bring to this result? First of all, of course, there are huge aerodynamic loads due to strongly compressed and heated atmospheric air. For example, pressure difference between front and back sides of a body moving at 20 km/s varies from 10^7Pa at a height of 30 km to 10^8Pa at a height of 15 km [9]. This air disrupts and heats body surface up to melting and even to evaporation whereas its interiors have no time to acquire heat, so that an effect of an overheated pressure cooker does not work hear.

Thus, the first two actions are high surface pressure and temperature. The third action which is not usually taken into account in meteors' behavior consideration is an acquirement of a negative charge by a cosmic body. This can cause the body's potential to rise up to 10kV or more [10]. Similar potentials create high values of the electric field strength and of the current density on sharpened parts of the body's surface. In other words, we are dealing with an electromagnetic action.

Just listed three actions, the main of which is the third one, are used in low energy nuclear reaction (LENR) experiments where mutual conversions of chemical elements are obtained at concentrations in excess of a possible error. Under these conditions an excess energy release and an absence of radioactivity were observed [11, 12, 13, 14]. A common feature of all these experiments is high values of current density, i.e. the high electron concentration on some parts researched samples.

A new hypothesis have been proposed in [15] that two electrons with opposing spin magnetic moments are capable of direct pairing by tunneling through the Coulomb barrier to the region of the dominant values of their negative spin-spin interaction energy. The most favorable conditions for this pairing are

obtained at high surface densities of the negative charge, particularly on metallic points at high negative potentials. The pair dimensions are determined by geometry of the potential well in electron-electron interaction energy and are about classical electron radius, i.e. $2.8 \cdot 10^{-15}$m.

The response of the pair to an external permanent electric field is that the pair executes rotation in the plane which is orthogonal to the vector of the electric field strength. The factor of proportionality ("giroelectric ratio") between the pair rotation frequency and the electric field strength is estimated theoretically in [15]. The rotation of the electron spin magnetic moments brings into existence the additional internal electric field, which completely compensates the external field and causes the translational movement of the centre-of-mass of the pair at right angles to the external electric field, so that the pair tends to be pushed out from this field along the equipotential surface. Such movement is an electrical analogy Meissner – Ochsenfeld effect and its indirect evidence was first observed by Prof. N.P. Myshkin in 1899 [16].

The strong evidence of the concept of directly paired electrons is the phenomenon of resonance absorption of alternating electric field energy by structural products of the corona discharge on the negative point [17, 18]. It occurs at the frequency connected with the permanent electric field strength (at its low values) by the linear dependence. The factor of proportionality in this linear dependence was found to be almost equal to theoretical one. Consequently, experimentally measured frequency of the resonance absorption of the alternating electric field energy is very close to the theoretical frequency of the electron pair rotation in the applied permanent electric field.

Owing to unexpected peculiarities of their behavior in the external electric field paired electrons elude usual observation and remain in the shadow of researchers' attention. "Selfconcealment"of directly paired electrons impedes estimation of their possible importance in a lot of natural processes and phenomena. With regard to considered properties of paired electrons there has been proposed their ability to take part in "cold" nuclear reactions as a peculiar kind of a catalyst [15], inasmuch as they move orthogonally to a vector of an electric field strength and are capable to penetrate between a nucleus and an electron shell possibly causing its disturbance and making nuclei approach each other.

The research has shown that the main minerals of Chelyabinsk meteorite fragments are olivine $(Fe, Mg)_2SiO_4$ and pyroxene $(Mg, Fe)_2Si_2O_6$ [6]. There are also native iron, nickel and chromium in them. So that possible natural low energy nuclear fusion reactions can occur as follows:

$$^{24}_{12}Mg + ^{30}_{14}Si \Rightarrow ^{54}_{26}Fe + 17.886MeV$$

$$^{26}_{12}Mg + ^{28}_{14}Si \Rightarrow ^{54}_{26}Fe + 12.412MeV$$

$$^{26}_{12}Mg + ^{30}_{14}Si \Rightarrow ^{56}_{26}Fe + 13.825MeV$$

$$2\,^{29}_{14}Si \Rightarrow ^{58}_{28}Ni + 16.437MeV$$

$$2\,{}^{30}_{14}Si \Rightarrow {}^{60}_{28}Ni + 15.606MeV$$

$$2\,{}^{26}_{12}Mg \Rightarrow {}^{52}_{24}Cr + 10.772MeV$$

Mg and Si nuclei flow together forming a stable isotope Fe, or two Si nuclei turn into Ni nucleus, or two Mg nuclei turn into Cr nucleus. An oxygen nucleus does not take part in this process since it is double-magic and has a greater stability. All these reactions obey the conservation laws of charge, nucleon-number and isotopic spin. Energy yield of the reaction is calculated as the difference in rest energies of initial and ultimate products [19]. As mentioned above, paired electrons may act as an initiator of these reactions. As the heat release thereafter increases, the reaction may become self-sustained that seemingly has happened in Chelyabinsk. Reaction products have instantly evaporated and left a dense smoky trace in the air which has disappeared little by little and has not caused radioactive fallout since there have not been any radioactive materials. For 440 kt ($1.841 \cdot 10^{15}$J) of explosion energy it is required $6.43 \cdot 10^{26}$ nuclear fusions in accordance with the first mentioned reaction, i.e. 32 kg of silicon and 25.6 kg of magnesium, the amount of which in that meteor was excessive.

Process history must depend on aggregative state, temperature, pressure and density of initial components as well as on characteristic of the electrical action on them. It is not inconceivable and even more probable that within certain conditions these reactions can occur calmly, without burst, therefore their research is of specific interest for the purpose of obtaining cheap and pure nuclear energy.

References

1. List of meteor air bursts. April 10, 2013. https://en.wikipedia.org/wiki/List_of_meteor_air_bursts
2. Additional details on the large Feb. 15 fireball over Russia. March 21, 2013. http://www.jpl.nasa.gov/news/news.php?release=2013-061
3. S.J.D. d'Alessio, A.A. Harms, Comet induced nuclear fusion in the atmosphere, *Annals of Nuclear Energy* **15** (12) (1988) 567–569.
4. S. d'Alessio, The nuclear and aerial dynamics of the Tunguska Event, *Planetary and Space Science* **37** (3) (1989) 329–340.
5. J.M. Greenberg, Making a comet nucleus, *Astronomy and Astrophysics* 330 (1998) 375–380.
6. Results of study of Chelyabinsk meteorite. Vernadsky Institute March 14, 2013. Press-conference. Presenter: academician Eric Galimov, director of Vernadsky Institute of Russian academy of science. http://www.youtube.com/watch?v=VsGeD2ueyHU (In Russian).
7. Don Yeomans & Paul Chodas, Additional details on the large fireball event over Russia on Feb. 15, 2013. March 1, 2013. NASA/JPL Near-Earth Object Program Office. http://neo.jpl.nasa.gov/news/fireball_130301.html
8. Glossary: Cube Root Law. http://www.cddc.vt.edu/host/atomic/nukeffct/enw77m.htm
9. V.V. Busarev, Meteors and meteorites. (In Russian). http://selena.sai.msu.ru/Home/SolarSystem/meteorits/meteorits.htm

10. H.B. Garrett, The charging of spacecraft surfaces, *Reviews of Geophysics and Space Physics* **19** (4) (1981) 577-616. http://onlinelibrary.wiley.com/doi/10.1029/RG019i004p00577/abstract

11. V.F. Balakirev, B.V. Bolotov, V.V. Krymsky, *at al*. Transmutations of chemical elements. Collected papers. Under the edition of V.F.Balakirev (URO RAN, Ekaterinburg 2003) p.p. 1–97. (In Russian).
http://www.electrosad.ru/files/LENR/ICE.pdf
http://model.susu.ru/transmutation/cntnts.htm
12. V.I. Liksonov, V.G. Tsinoev, L.I. Urutskoev, Observation of transformation of chemical elements during an electric discharge, *Ann. Fond. L. de Broglie* **27** (4) (2002) 701–726.
13. L.I. Urutskoev, Review of experimental results on low-energy transformation of nucleus, *Ann. Fond. L.de Broglie* **29**, Hors Serie 3 (2002) 1149 – 1164.
14. S. Adamenko, Alwyn van der Merwe (Eds.), F.Selleri. Controlled Nucleosynthesis. Breakthroughs in Experiment and Theory, Series: Fundamental Theories of Physics. Vol. 156, (Dordrecht, Springer, 2007) p.p. 1–780. http://www.springer.com/physics/particle+and+nuclear+physics/book/978-1-4020-5873-8
15. B.A. Andrianov, Direct pairing of electrons, *Vestnik of South Ural State University* №8, issue 4 (2003) 46–50. http://pdf.vestnik.susu.ac.ru/mpc/04/10p046_Andrianov.pdf
16. N.P. Myshkin. A stream of electricity in the field of an electrified point and its action on dielectric. (Warsaw, S. Orgelbrand & Sons Joint-Stock Company Press, 1900) p.p. 1–88. (In Russian).
17. B.A. Andrianov, Resonance absorption of *rf* electric field energy by negative point-to-plane gap, *Vestnik of South Ural State University* №8, issue 4 (2003) 41–45. http://pdf.vestnik.susu.ac.ru/mpc/04/09p041_Andrianov.pdf
18. B.A. Andrianov. Electrical analog of magnetic resonance. Technical Physics Letters **26**, issue 3 (2000) 228–230.
19. Nucleus ground and isomeric states parameters search engine. http://cdfe.sinp.msu.ru/services/gsp.en.html