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LETTERS TO PROGRESS IN PHYSICS

Unmatter Plasma Discovered

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The electron-positron beam plasma was generated in the laboratory in the beginning of 2015. This experimental fact shows that unmatter, a new form of matter that is formed by matter and antimatter bind together (mathematically predicted a decade ago) really exists. That is the electron-positron plasma experiment of 2015 is the experimentum crucis verifying the mathematically predicted unmatter.

Unmatter Plasma is a novel form of plasma, exclusively made of matter and its antimatter counterpart. It was first generated in the 2015 experiment [1, 2] based on the 2004 considerations [3].

There are four fundamental states of matter: solid, liquid, gas, and plasma. Plasma consists of positive ions and free electrons (negative particles), typically at low pressures, and it is overall almost neutral. Plasma is an ionized gas (as in fluorescent neon, in lightning, in stars, in nuclear reactors). An ion is a positive or negative charged particle. A positive ion is called cation, while a negative ion is called anion. If the ion is an atom, then it may contain less electrons than needed for being neutrally charged (hence one has a cation), or more electrons than needed for being neutrally charged (hence one has an anion). Similarly if the ion is a molecule or a group (of atoms or molecules). The process of forming ions is called ionization. The degree of ionization depends on the proportion of atoms that have lost or gained electrons. By applying a strong electromagnetic field to a gas, or by heating a gas, one obtains plasma.

Unmatter as theoretically predicted in the framework of the neutrosophic logic and statistics [4–6] is considered as a combination of matter and antimatter that bound together, or a long-range mixture of matter and antimatter forming a weakly-coupled phase. For example, the electron-positron pair is a type of unmatter. We coined the word *unmatter* that means neither matter nor antimatter, but something in between. Besides matter and antimatter there may exist unmatter (as a new form of matter) in accordance with the neutrosophy theory that between an entity and its opposite there exist intermediate entities.

The 2015 experiment [1, 2] on matter-antimatter plasma (*unmatter plasma*, in terms of the neutrosophic logic and statistics) was recently successful in the Astra Gemini laser facility of the Rutherford Appleton Laboratory in Oxford, United Kingdom. The 2015 experiment has produced electron-positron plasma. The positron is the antimatter of the electron, having an opposite charge of the electron, but the other properties are the same.

Also, the meson is a clear example of unmatter whose configuration includes a pair quark-antiquark. Unmatter is mostly expected to emerge in exotic states outside the boundaries of the Standard Model for particle physics (for example in the Dark Matter sector) and in the regime of high-energy astrophysical objects [7].

“It is definitely a jet of unmatter, because a plasma consisting of the electrons and the positrons is neither matter nor antimatter in the same time. This experiment is the truly verification of unmatter as the theoretical achievements of neutrosophic logic and statistics. This experiment is a milestone of both experimental physics and pure mathematics” [8].

Submitted on May 24, 2015 / Accepted on May 26, 2015

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