Matter and antimatter asymmetry in the early universe: new hypothesis of hydrogen formation based on wave-particle duality or dipole asymmetry

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Summary

A new hypothesis of matter formation after the big bang based on either particle-wave duality or electric dipole asymmetry. Both assumptions allow to postulate that the probability of matter formation is slightly higher than that of antimatter formation. As a consequence, this difference of probabilities ΔPp for protons and ΔPe with regard to electrons avoided complete annihilation in the beginning.

key words: annihilation, matter, antimatter, wave-particle duality, electric dipole asymmetry.

Introduction

The possible phenomenon of mutual annihilation of matter and antimatter remains a question in physics and cosmology since the big bang theory was accepted (1,2,3,4,5,6). Different approaches to explain baryon asymmetry have been tried, including some supposed domains of antimatter in the universe, but as no corresponding γ- ray bursts could be detected, we could almost exclude this hypothesis, although some groups claim for such an asymmetry (7). CP (charge parity) violations are also discussed, also these sophisticated theories lack sound experimental support (8). A new hypothesis claims that electrical dipole moments of matter and antimatter differ (9). This excellent theory, although breaking both parity and time symmetry, allows matter and antimatter to decay with different rates and can be subject to experimental proof. This concept leads us to think about probabilities, whether a particle - and his antiparticle - exists or not at a time given. In this case dipole-dipole-interaction would not only be substantial for life - structure of biological macromolecules - but also the origin of matter during creation.

As we do admit that physical laws should exist for both matter and antimatter, the author´s proposal is that matter-antimatter asymmetry after the big bang existed per se. Two hypotheses may be suited to explain this paradoxon. First, the above mentioned theory of dipole difference and secondly the wave matter duality. In case of dipole asymmetry, one particle would disappear earlier due to difference in decay, and therefore the anti-matter particle had gone before the partners were able to annihilate. The second approach supposes that a matter-antimatter pair could only react, if both partners possessed particle property simultaneously. Whatsoever, in both cases, the probabilities of existence of matter or antimatter differ.

Theoretical concepts

In general, matter-antimatter reactions are written as annihilation equations with creation of γ-rays (10). For electrons or positrons and protons or antiprotons the reactions conform to the following simple equations:

$e^+ + e^- \rightarrow \gamma + \gamma$ 1

$p^+ + p^- \rightarrow \gamma + \gamma$ 2

The energy is 0.511 keV per photon in the case of an electron-positron pair, if kinetic energy is not taken into consideration. However, these equations do not bear in mind that – according the matter or de Broglie wave principle - both particles exist both as a particle and wave (for review see 10). There is a duality between the state of a wave and the state of a particle. Another assumption to explain different probabilities of existence of particles may be electric dipole asymmetries which could lead to different decay half-lives (8).

We may suppose that for each matter or antimatter particle, either for an electron (-) or positron (+) for example, there should some probability P of being a wave Pw and of being a particle Pp, where Pp- + Pw- = 1 (electron) or Pp+ + Pw+ = 1 (positron), respectively. The probability of being or behave as a wave or particle differs between matter and antimatter. We postulate therefore a matter-particle difference of probability with regard to electrons and positrons Pp- - Pw+ = ΔPpe or protons and anti-protons Pp+ - Pp- = ΔPpp.

Hence, we may therefore re-write equation 1 as follows:

$Pw+ * e^+ + Pp+ * e^+ + Pw- * e^- + Pp- * e^- \rightarrow \gamma + \gamma + \Delta Pe * e^-$ 3

The equation 2 for protons p^+ and anti-protons p^- could be formulated analogously.

$Pw+ * p^+ + Pp+ * p^+ + Pw- * p^- + Pp- * p^- \rightarrow \gamma + \gamma + \Delta Pp * p^+$ 4

If we use the second approach of dipole asymmetry, a similar approach holds. Following the first asymmetric decay of matter or antimatter, $\Delta Pe * e^-$ and $\Delta Pp * p^+$ are the remaining amounts of matter.

As a consequence, matter is the result of the slight differences $\Delta P * e^-$ and accordingly $\Delta Pp * p^+$, which prevented complete annihilation of matter by antimatter. In addition, we conclude that hydrogen formation is the result of this asymmetry of matter-wave probabilities:

$2\ \Delta Pp * p^+ + 2\ \Delta Pe * e^- = H_2$ 5

Conclusion

This hypothesis based on the wave-particle duality principle or electric dipole-asymmetry does not require special gamma bursts, matter-antimatter domains or continuous reactions of matter and antimatter wherever in the universe. It is therefore supposed to be a plausible hypothesis of matter formation in the early beginning of the universe.

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