A Note on the Antimatter

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José Francisco García Juliá
C/ Dr. Marco Merenciano, 65, 5.
46025 Valencia (Spain)
E-mail: jose.garcia@dival.es

The antimatter has not disappeared; it could be anywhere in the universe and in the same proportion as the matter.

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The matter is composed, principally, of protons, neutrons and electrons. The proton and the electron are stable, but the neutron is unstable decaying to (beta decay) a proton and an electron (plus an antineutrino). The proton has positive electric charge and the electron has the same electric charge, but negative. The antimatter would be composed by the corresponding antiparticles with opposite electric charges (charge conjugation). As the processes of creation and annihilation are by particle-antiparticle pairs (pair production/annihilation), the matter and the antimatter would exist in the same proportion.

Although the bodies are, generally, electrically neutral; for a proton or an electron, the bodies are collections of nuclei charged positively with its clouds of electrons charged negatively. In the case of the antimatter, the antinuclei are negatives and the antielectrons positives. As the electromagnetic interaction is many orders of magnitude greater than the gravitational interaction (the typical coupling constants for the electromagnetic and gravitational interactions are, respectively, $e^2/\hbar c = 1/137$ and $Gm^2/\hbar c = 2\times 10^{-45}$, where e and m are the electric charge and the mass of the electron, respectively, G the Newton's gravitational constant, $\hbar = h/2\pi$ and h is the Planck's constant, and c the speed of the light in the vacuum) [1], and as the signs of the electric charges of the particles and the antiparticles are opposite, both particles and antiparticles will go towards opposite sides. Therefore, the matter and the antimatter can be located in different places. In addition, as the photon and the antiphoton are indistinguishable from one another, we cannot distinguish between a galaxy and an antigalaxy.

For all these reasons, we conclude, finally, that the antimatter has not disappeared; it could be anywhere in the universe and in the same proportion as the matter.

[1] Donald H. Perkins, Introduction to High Energy Physics, p. 21, Addison-Wesley, Reading, Massachusetts, 1972.