

Missing antimatter challenges the 'big bang' theory.

According to the 'big bang' theory for the origin of the universe, equal amounts of matter and antimatter should have formed.¹ Antimatter is the same as matter except that each particle has the opposite charge, magnetic moment, etc. For instance, the antiparticle for the negatively charged electron is the positively charged positron. Antimatter is supposed to be an exact counterpart to matter, down to the same mass. This has been recently verified when it was shown experimentally that a proton and an antiproton have the same mass to within one part in 10 billion.² The problem is that, so far, no antimatter domains have been detected in space within 20 megaparsecs of the Earth. This '... underscores a long-standing mystery: why the big bang displays such blatant favoritism towards matter.'¹ Samuel Ting, one of the leading advocates in the search for antimatter in space, laments:

*'At the beginning, equal amounts of matter and antimatter were created [in the big bang]. Now there seems to be only matter. There have been theoretical speculations about the disappearance of antimatter, but no experimental support.'*³

One speculation of why there have been no antimatter domains detected, at least in the nearby universe, is that soon after the 'big bang', a slight asymmetry developed between matter and antimatter.¹ After equal amounts of matter and antimatter had destroyed each other, this asymmetry allowed matter to dominate in our region of space. A second speculation is that during the supposed inflation very early in the 'big bang', matter and antimatter became segregated into 'non-overlapping domains'.¹

Both speculations suggest that there would be some domains of space totally composed of matter and others totally of antimatter. Andrew Cohen, Alvaro De Rujula, and Sheldon Glashow have recently tested whether such domains would interact, what signals would be produced if the

domains interacted, and then searched the universe for two of the signals.⁴ They conclude that at the boundary of the domains it would be impossible to avoid matter-antimatter annihilation. One expected signal is a burst of gamma rays much higher than the gamma-ray background. Searching the universe, they failed to detect any gamma-ray bursts. The astronomers conclude:

*'On general grounds, we conclude that a matter-antimatter symmetric universe is empirically excluded.'*⁵

Thus, they deduce that there are no domains of antimatter in the universe. Excluding the loophole that there is one large domain of matter and one large domain of antimatter, the visible universe appears to be composed of all matter. I suppose theorists could quibble with the complex methodology used by Cohen, De Rujula, and Glashow, but many are impressed with the analysis. Michael Salamon, a physicist at the University of Utah, states:

*'The work is extremely compelling and gives me fresh pessimism. It is a big blow to the whole concept.'*³

In conclusion, physical laws indicate that equal amounts of matter and antimatter would have been created in the proposed 'big bang'. Therefore missing antimatter in the universe should challenge the 'big bang' theory, an implication none of the authors apparently is willing to entertain.

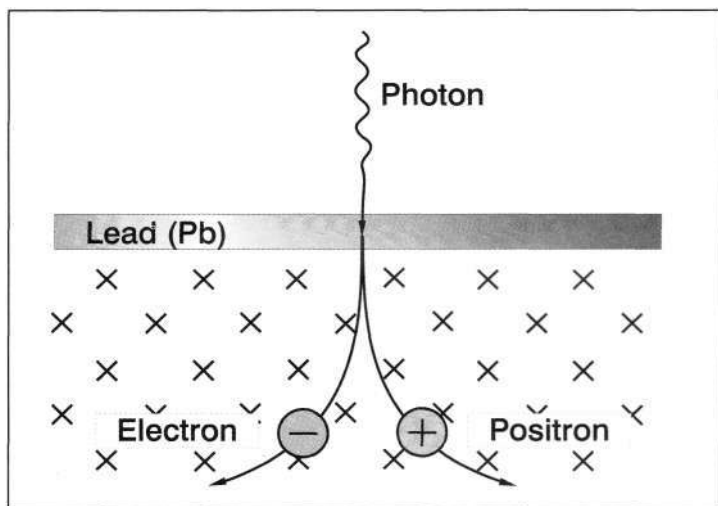


Figure 1. Pair production. Gamma ray photons with an energy of at least 1.022 MeV are targeted at a lead plate. Each photon, which has no electric charge, then disintegrates into an electron (negative charge) and its antiparticle, a positron (positive charge). The electron and positron are separated by a magnetic field (in the diagram, running into the page, as indicated by the crosses). This exerts an equal and opposite force on the two particles, thus attracting them in opposite directions. Otherwise, they would annihilate each other. Note that an equal number of particles and antiparticles is produced by such experiments.

References

1. Taubes, G., 1997. Theorists nix distant antimatter galaxies. *Science*, 278:226.
2. Hellemans, A., 1998. Putting antimatter on the scales. *Science*, 280:1526.
3. Antia, M., 1998. Ready to takeoff, antimatter experiment takes some flak. *Science*, 280:1339.
4. Cohen, A.G., De Rujula, A., and Glashow, S.L., 1998. A matter-antimatter universe? *The Astrophysical Journal*, 495:539-549.
5. Cohen et al., Ref. 4, p. 539.

Michael Oard