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The Matter Anti-Matter Asymmetry of the Universe: Why is there something, rather than nothing?

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Our universe is filled with matter, but antimatter is evanescent, rarely found and only in the debris of high-energy processes and cosmic rays. Yet the standard model of particle physics and cosmic evolution postulates that the universe started out completely symmetric between matter and antimatter, and that only about 1 proton or neutron in 10^{20} should have escaped annihilation into photons. The measured ratio, however, of baryonsprotons and neutronsto the photons left over is about 6 x 10^{-10}, about ten orders of magnitude greater. At some very early moment, something broke the initial symmetry of the universe, eventually yielding the stars, galaxies, and the universe we inhabit and explore today. How did this happen? I will discuss how one attractive theory-that neutrinos have very massive unstable partners that distinguish between matter and antimatter, did their work and then disappeared, and how we might learn something about this scenario by searching for an almost unimaginably rare nuclear decaywithout the emission of todays light neutrinosand how biochemistry might help us succeed. Strangely enough, if we do observe the decay, we also learn that the neutrino and the anti-neutrino are identical, a unique possibility among spin 1/2 particles.