



High Energy Physics - Phenomenology

A Unified Theory of Matter Genesis: Asymmetric Freeze-In

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We propose a unified theory of dark matter (DM) genesis and baryogenesis. It explains the observed link between the DM density and the baryon density, and is fully testable by a combination of collider experiments and precision tests. Our theory utilises the "thermal freeze-in" mechanism of DM production, generating particle anti-particle asymmetries in decays from visible to hidden sectors. Calculable, linked, asymmetries in baryon number and DM number are produced by the feeble interaction mediating between the two sectors, while the out-of-equilibrium condition necessary for baryogenesis is provided by the different temperatures of the visible and hidden sectors. An illustrative model is presented where the visible sector is the MSSM, with the relevant CP violation arising from phases in the gaugino and Higgsino masses, and both asymmetries are generated at temperatures of order 100 GeV. Experimental signals of this mechanism can be spectacular, including: long-lived metastable states late decaying at the LHC; apparent baryon-number or lepton-number violating signatures associated with these highly displaced vertices; EDM signals correlated with the observed decay lifetimes and within reach of planned experiments; and a prediction for the mass of the dark matter particle that is sensitive to the spectrum of the visible sector and the nature of the electroweak phase transition.

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