

Early Matter Domination from Long-Lived Particles in the Visible Sector

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I show that a nonstandard cosmological history with a period of early matter domination driven by a sub-TeV visible-sector particle can arise rather naturally. This scenario involves a long-lived standard model singlet that acquires a thermal abundance at high temperatures from decays and inverse decays of a parent particle with SM charge(s), and subsequently dominates the energy density of the universe. Entropy generation at the end of early matter domination dilutes the abundance of dangerous relics (such as gravitinos) by a factor as large as 10^4 . The scenario can accommodate the correct dark matter relic abundance for a broad range of annihilation cross section. More importantly, the allowed parameter space can be directly probed by proposed searches for neutral long-lived particles at the energy frontier, allowing us to use particle physics experiments to reconstruct the cosmological history just prior to big bang nucleosynthesis.

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