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Early-time Thermalization of Cosmic Components? A Hint for Solving Cosmic Tensions

We study an expanding two-fluid model of nonrelativistic dark matter and radiation, which are allowed to interact during a certain time span and to establish an approximate thermal equilibrium. Such an interaction, which generates an effective bulk viscous pressure at background level, is expected to be relevant for times around the transition from radiation to matter dominance. We quantify the magnitude of this pressure for dark-matter particle masses within the range $1\ \mathrm{eV} \lesssim m_\chi \lesssim 10\ \mathrm{eV}$ around the matter-radiation equality epoch (i.e., redshift $z_{eq} \sim 3400$) and demonstrate that the existence of a transient bulk viscosity has consequences which may be relevant for addressing current tensions of the standard cosmological model: (i) the additional (negative) pressure contribution modifies the expansion rate around z_{eq}, yielding a larger H_0 value, and (ii) large-scale structure formation is impacted by suppressing the amplitude of matter overdensity growth via a new viscous friction-term contribution to the Mészáros effect. As a result, the H_0 and S_8 tensions of the current standard cosmological model are both significantly alleviated.

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