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BBN constraints on MeV-scale dark sectors

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Meta-stable dark sector particles decaying into electrons or photons may non-trivially change the Hubble rate, lead to entropy injection into the thermal bath of Standard Model particles and may also photodisintegrate light nuclei formed in the early universe. We study generic constraints from Big Bang Nucleosynthesis on such a setup, with a particular emphasis on MeV-scale particles which are neither fully relativistic nor non-relativistic during all times relevant for Big Bang Nucleosynthesis. These constraints turn out to be very relevant for a number of well-studied models, e.g. in the context of self-interacting dark matter with light mediators. We then further apply our calculations to the case of MeV-scale dark matter annihilating into electromagnetic radiation. We show that, for p-wave suppressed annihilations, these constraints turn out to be significantly stronger than the ones from CMB observations, and are even competitive with the strongest bounds from other indirect searches.

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