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Fingerprints of freeze-in dark matter in an early matter-dominated era

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We study the impact of an alternate cosmological history with an early matter-dominated epoch on the freeze-in production of dark matter. Such early matter domination is triggered by a metastable matter field dissipating into radiation. In general, the dissipation rate has a non-trivial temperature and scale factor dependence. Compared to the usual case of dark matter production via the freeze-in mechanism in a radiation-dominated universe, in this scenario, orders of magnitude larger coupling between the visible and the dark sector can be accommodated. Finally, as a proof of principle, we consider a specific model where the dark matter is produced by a sub-GeV dark photon having a kinetic mixing with the Standard Model photon. We point out that the parameter space of this model can be probed by the experiments in the presence of an early matter-dominated era.

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