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How kinetic decoupling of dark matter during an early matter-dominated era affects small-scale structure[1] ISAAC WALDSTEIN, ADRIENNE ERICKCEK, University of North Carolina at Chapel Hill — An early matter-dominated era (EMDE) occurs when the energy content of the Universe is dominated by either massive particles or an oscillating scalar field before big bang nucleosynthesis. An EMDE enhances the small-scale matter power spectrum and increases the abundance of microhalos. This enhancement in the abundance of microhalos implies a substantially boosted dark matter (DM) annihilation rate. However, estimates of the DM annihilation rate show that it is highly sensitive to the free-streaming cutoff scale in the matter power spectrum, which is set by the kinetic decoupling temperature of DM. DM kinetic decoupling is radically different in an EMDE than it is in a radiation-dominated era: DM enters a quasidecoupled state in an EMDE, during which the DM temperature cools faster than the plasma temperature but slower than it would cool if the DM were fully decoupled. Moreover, radiation perturbations do not oscillate during an EMDE. We establish that interactions between DM and relativistic particles during an EMDE do not significantly suppress the growth of perturbations on small scales, in contrast to the impact of these interactions in a radiation-dominated era.

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