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**Growth of Dark Matter Perturbations during Kination** KAYLA REDMOND, ADRIENNE ERICKCEK, University of North Carolina Chapel Hill — Our ignorance of the period between the end of inflation and the beginning of Big Bang Nucleosynthesis limits our understanding of the origins and evolution of dark matter. We cannot calculate the dark matter relic abundance without knowing when the Universe became radiation dominated. If the Universe's energy density was dominated by a fast-rolling scalar field while the radiation bath was hot enough to thermally produce dark matter, then dark matter with larger-than-canonical annihilation cross sections can generate the observed dark matter relic abundance. To further constrain these scenarios, we investigate the evolution of small-scale density perturbations during such a period of kination. We determine that once a perturbation mode enters the horizon during kination, the gravitational potential drops sharply and begins to oscillate and decay. Nevertheless, dark matter density perturbations that enter the horizon during kination grow linearly with the scale factor prior to radiation domination. This linear growth generates enhanced substructure and effectively increases the dark matter annihilation rate, which could make thermal dark matter production during kination incompatible with observations.

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