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Lower Mass Bounds on Freeze-in Dark Matter

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Feebly Interacting Massive Particles (FIMPs) are dark matter candidates that never thermalize in the early universe and whose production takes place via decays and/or scatterings of thermal bath particles. If FIMPs interactions with the thermal bath are renormalizable, a scenario which is known as freeze-in, production is most efficient at temperatures around the mass of the bath particles and insensitive to unknown physics at high temperatures. Working in a model-independent fashion, we consider three different production mechanisms: two-body decays, three-body decays, and binary collisions. We compute the FIMP phase space distribution and matter power spectrum, and we investigate the suppression of cosmological structures at small scales. Our results are lower bounds on the FIMP mass. Finally, we study how to relax these constraints in scenarios where FIMPs provide a sub-dominant dark matter component.

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