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An Analytic Approach to Light Dark Matter Propagation

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Although searches for GeV-scale WIMPs are sensitive to very small cross sections, constraints on sub-GeV dark matter are significantly weaker, and largely constrain moderately- or strongly-interacting dark matter. But if dark matter interacts too strongly with nuclei, it could be slowed to undetectable speeds in Earth's crust or atmosphere before reaching a detector. For sub-GeV dark matter, approximations used to model the attenuation of heavier dark matter fail, necessitating the use of computationally expensive simulations. I present a new, analytic approximation for modeling attenuation of light dark matter in the Earth. I show that our approach agrees well with Monte Carlo results, and can be much faster at large cross sections. I show how this method can be used to reanalyze recently reported constraints on sub-dominant dark matter—that is, dark matter particles that make up only a fraction of the total dark matter density.

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