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Light Dark Matter Accumulating in Terrestrial Planets: Nuclear Scattering

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The direct capture and accumulation of Galactic dark matter in astrophysical bodies can occur as a result of its scattering with nuclei. In this work we investigate the detailed capture and evaporation of dark matter in terrestrial planets, taking Earth as an example. We focus on the strongly interacting case in which Earth may be opaque to dark matter, referred to as the “optically thick” limit. We investigate light dark matter in particular, addressing important dynamical processes such as the “ping-pong effect” during dark matter capture and the heating of Earth by dark matter annihilation. We do this using Monte-Carlo simulations as well as detailed analytical computations, and obtain improved bounds on dark matter direct detection for both spin dependent and spin-independent scattering, and also allowing for the interacting species to make up a sub-component of the dark matter density.

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