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Updated constraints from cosmic-ray upscattering of GeV-scale dark matter

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Dark matter particles with sub-GeV masses can be notoriously difficult to probe, because their typical momenta are insufficient to induce nuclear recoils above the thresholds of conventional direct detection experiments. In fact, it has repeatedly been claimed that even very strongly interacting dark matter could hide in this mass range, supposedly evading all observational bounds. In this talk I present updated constraints resulting from an irreducible component of relativistic halo dark matter, due to cosmic rays continuously upscattering initially non-relativistic dark matter particles. I will demonstrate the importance of accurately modelling the momentum-transfer dependence of the scattering cross section in deriving such constraints, as well as the impact of inelastic scattering events of dark matter particles on their way through atmosphere and soil to the detector location. With all these effects taken properly into account, it turns out that the effect of cosmic-ray upscattering robustly closes a significant part of otherwise unconstrained parameter space for dark matter at the GeV scale.

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