

# Constraints on Light Dark Matter from Cosmic Ray Upscattering

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Direct detection experiments place strong constraints on dark matter scattering cross sections for DM masses  $m_\chi \gtrsim 1\text{GeV}$ . Below this mass range, the recoil energy imparted on a target is insufficient to induce a detectable signal. Searches for light DM therefore suffer from limited experimental sensitivity, with weak limits on scattering cross sections,  $\sigma \lesssim 10^{-28}\text{cm}^2$ . Cosmic ray (CR) protons are energetic enough to upscatter DM to relativistic speeds, such that sub-GeV dark matter can produce detectable recoil energies, even in detectors with relatively high thresholds. However, models with large cross sections require light mediators and are subject to other constraints. We compute limits on the coupling of sub-GeV DM to light mediators, using the direct detection of CR-upscattered DM, and compare these with constraints arising from other experiments and observations.