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The Primary Importance of Secondaries: Gamma-Ray Detectability of MeV Dark Matter

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The past two decades have seen a rapid development of γ -ray astronomy, in particular at energies above a few hundred MeV where Fermi-LAT has revolutionised the field. As a result, extensive studies have been undertaken to characterise gamma-ray annihilation spectra of dark matter with masses above ~ 1 GeV. However, due to the lacking sensitivity of current experiments at lower energies, the so-called MeV gap, MeV dark matter has been much less studied. At these mass scales the main annihilation channels are to either neutrinos, electrons, pions or directly to photons. The electron channel has been extensively studied in the context of the 511 keV line. In this work, we study the general prospects for detecting MeV dark matter annihilating predominantly to electrons and positrons. We emphasise the importance of the often overlooked bremsstrahlung and in-flight annihilation spectral features, which in many cases provide the dominant γ -ray signal in this regime.

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