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Detecting and characterizing dark matter sub-halos with the Cherenkov Telescope Array

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Numerous observations confirm the existence of dark matter at astrophysical and cosmological scales, yet the fundamental nature of this elusive component of our universe remains unknown. Theory and simulations of galaxy formation predict that dark matter should cluster on small scales in bound structures called sub-halos or clumps. Sub-halos are thought to be abundant in the Milky Way and can produce high-energy gamma rays as final products of dark matter annihilation. Recently, it has been highlighted that the brightest halos should also have a degree scale extension in the sky. In this study, we examine the prospects offered by CTA for detecting and characterizing such objects. From simple models for individual sub-halos and their population in the Milky Way, we examine under which conditions such sources can be identified with the Galactic Plane Survey (GPS) observations. We use a full spatial-spectral likelihood analysis to derive the sensitivity of CTA to extended dark matter sub-halo emission and assess to what extent the main physical parameters of the phenomenon can be determined.

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