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The search for dark matter halo substructure with gamma rays

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A natural consequence of the hierarchical structure formation scenario in Λ CDM is that it predicts abundant substructure (or subhalos) inside larger halos, i.e. galaxies like ours. The most massive of these subhalos host the known dwarf satellite galaxies, while smaller subhalos may host no stars/gas at all and thus may not possess astrophysical counterparts. Yet, if dark matter (DM) particles are weakly interacting massive particles (WIMPs), we expect these “dark satellites” to emit gamma rays that can be detected with current or planned gamma-ray experiments like the Fermi LAT or the future Cherenkov telescope array (CTA). Indeed, hundreds of Fermi-LAT sources remain unidentified and there is the exciting possibility that some of these unidentified sources are subhalos simply awaiting a proper classification. A careful scrutiny of these sources can be made that takes into account both our best knowledge of the subhalo population and of the properties of the expected DM signal. In this talk, I will summarize the current status of such subhalo searches, paying particular attention to the most recent Fermi-LAT analyses. I will also show how this kind of search can yield very competitive limits on the nature of the DM particle, particularly in the absence of potential subhalo candidates in gamma-ray catalogs. These limits are comparable to the best constraints in the field so far.

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