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Dark matter signals from the gamma-ray sky

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Unveiling the nature of dark matter is one of the biggest challenges of particle physics and cosmology. Beside direct detection and collider experiments, it is possible to look for a dark matter signal through indirect searches whose goal is to disentangle the signal from particle dark matter annihilation or decay from the large astrophysical background. I will discuss messengers and targets for indirect dark matter searches and I will then focus on gamma rays, the golden channel for dark matter indirect searches. Since its launch in 2008, the Fermi-LAT is taking snap-shots of the whole gamma-ray sky with unprecedented accuracy.
Besides astrophysical processes, the gamma rays collected by the Fermi-LAT offer the unique possibility to probe dark matter at the center of the Milky Way. Recently, a spatially extended excess of gamma rays collected by the Fermi-LAT from the inner region of the Milky Way has been claimed by different and independent groups. I will review previous analyses claiming the discovery of a spatially extended excess of gamma rays above standard astrophysical backgrounds. I will then characterise the spatial and spectral properties of such an extended diffuse emission in light of background model systematics. Finally, I will scrutinise the most promising interpretations - among others, the possibility that the signal originates from dark matter annihilation - in order to shed light onto the origin of this yet unknown extra-emission at the Galactic Center.

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