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Unassociated Gamma-ray Sources as Targets for Indirect DM Detection with Fermi-LAT

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One of the predictions of the LCDM cosmological model is the hierarchical formation of structure, giving rise to DM halos and subhalos. When the latter are massive enough they retain gas (i.e. baryons) and become visible. This is the case of the dwarf satellite galaxies in the Milky Way. Yet, less massive subhalos may remain completely dark. Nevertheless, if DM particles are WIMPs, we expect them to annihilate in subhalos, producing gamma rays which can be detected with the Fermi satellite. Using the most recent point-source Fermi catalogs (3FGL, 2FHL and 3FHL), we search for DM subhalo candidates within the unassociated catalogued sources. We apply several selection criteria based on the expected properties of the DM-induced emission from DM subhalos, which allow us to significantly reduce the list of potential candidates. Then, by carefully characterizing the minimum detection flux of the instrument and by comparing our sample to predictions from the Via Lactea II (Vl-II) N-body cosmological simulation, we place conservative and robust constraints on the $\langle \sigma v \rangle - m_{DM}$ parameter space. For $\tau^+\tau^-$ channel, we put an upper limit of $4 \cdot 10^{-26} (10^{-25})\ cm^3 s^{-1}$ for a mass of $10\ (100)\ GeV$. We find it critical for this result the repopulation we made to VL-II to include low-mass subhalos below the original VL-II mass resolution. Although the constraints are roughly an order of magnitude weaker than those obtained from dwarfs with Fermi, the sensitivity reach of our method can potentially improve them by a factor $9\ (3)$ for $\tau^+\tau^-\ (b\bar{b})$ channel.

Primary author: CORONADO, Javier (IFT UAM/CSIC)

Co-author: Dr SÁNCHEZ-CONDE, Miguel (IFT UAM/CSIC)

Presenter: CORONADO, Javier (IFT UAM/CSIC)

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