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Reproducing H.E.S.S. dark matter limits with Gammapy, an open-source Python package for gamma-ray astronomy

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The search for dark matter (DM) is a long-standing quest. Accelerator and underground experiments provide direct limits on DM. Using astronomical observations at TeV energies, it is possible to derive indirect limits on the annihilation cross section of DM particles. While original data, pipelines, and even derived data are typically not available for joint analyses, we illustrate the TA6 work on open data and open tools with one example: we show how to replicate the limits derived with H.E.S.S. –the best-located Imaging Atmospheric Cherenkov Telescopes observatory in the Southern hemisphere to observe the center of the Milky Way and thus derive the most constraining limits for WIMP annihilation cross section –with published data and Gammapy, an open-source Python package for gamma-ray astronomy built on Numpy, Scipy, and Astropy. The code for the analysis is hosted in the PUNCH TA6 WP4 GitLab repository, where we keep testing CI/CD pipelines for open-source PUNCH software. Moreover, several analyses of TeV gamma-ray sources can be performed with public H.E.S.S. data, a part of which we have made accessible via the Virtual Observatory. This is meant as part of TA6's effort to facilitate synergies and exchange within different physics domains, which are investigating the same subject but with different data and analysis techniques.

Type of submission

Talk

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