

Searching Accretion-Enhanced Dark Matter Annihilation Signals in the Galactic Centre

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This study reanalyzes the detection prospects of dark matter (DM) annihilation signals in the Galactic Center, focusing on velocity-dependent dynamics within a spike density near the supermassive black hole (Sgr A \ast). We investigate three annihilation processes – pp-wave, resonance, and forbidden annihilation – under semi-relativistic velocities, leveraging gamma-ray data from Fermi and DAMPE telescopes. Our analysis integrates a fermionic DM model with an electroweak axion-like particle (ALP) portal, exploring annihilation into two or four photons. Employing a comprehensive six-dimensional integration, we precisely calculate DM-induced gamma-ray fluxes near Sgr A \ast , incorporating velocity and positional dependencies in the annihilation cross-section and photon yield spectra. Our findings highlight scenarios of resonance and forbidden annihilation, where the larger ALP-DM-DM coupling constant $C_{\chi\chi}$ can affect spike density, potentially yielding detectable gamma-ray line spectra within Fermi and DAMPE energy resolution. We set upper limits for $C_{\chi\chi}$ across these scenarios, offering insights into the detectability and spectral characteristics of DM annihilation signals from the Galactic Center.

Presenter: TSAI, Yue-Lin Sming (Purple Mountain Observatory)

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