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Christopher Michael Karwin (UCI): Evidence for Extended Gamma-ray Emission Toward the Outer Halo of M31 from Fermi-LAT Observations

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The dark matter (DM) halo of M31 is predicted to extend to roughly 300 kpc from its center, and have a mass on the order of $10^{12} M_{\text{sun}}$, which amounts to roughly 90% of the galaxy's total mass. The halo is also predicted to contain a large amount of substructure, a subset of which hosts M31's population of satellite dwarf galaxies. At a distance of about 785 kpc from the Milky Way (MW), the halo diameter covers over 30 degrees across the sky; however, there is significant uncertainty pertaining to the actual extent, geometry, and substructure content. To search for extended gamma-ray emission from M31's DM halo, we conduct an analysis of 91.4 months of Fermi-LAT observations of a $28^{\circ} \times 28^{\circ}$ square region centered at M31, and we employ specialized GALPROP-based interstellar emission models to characterize the foreground gamma-ray emission from the MW. Significant excess emission is detected in the 3-20 GeV energy range, which extends outward to a projected radius of approximately 200 kpc from the center of M31. The spectral characteristics of the observed excess are roughly consistent with expectations for DM annihilation from M31. However, significant uncertainties remain, both observationally and in regards to modeling the DM halo. Our observations of M31 are presented.

Author: MICHAEL KARWIN, Christopher

Presenter: MICHAEL KARWIN, Christopher

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