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The gamma-ray emission properties of translucent cirrus clouds

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Abstract content

Using archival data from the Fermi Large Area Telescope in the 0.1 - 300 GeV photon energy range, we detect and characterise the gamma-ray emission counterpart on parsec scales to the optically translucent, infrared-emitting and dominantly neutral "Cirrus" clouds, which carry the bulk of gas mass in the disk of the Milky Way at the solar circle. The detection is achieved using a stacking analysis of a statistical sample of clouds at high galactic latitude, selected according to dust column as derived from the Planck all-sky maps of dust opacity in the 353 micron band.

We analyse substacks of clouds ordered according to gas column, as unambiguously derived from a cross-calibration between the dust emission at 353 micron and the emission in the optically thin 21 cm hyperfine hydrogen line. Both the amplitude and form of the 1 - 100 GeV emission SED of Cirrus are consistent with the predicted emission from the decay of pions produced from collisions between gas nuclei and CR protons with a flux similar to that measured at the Earth. This is jointly consistent with there being no systematic contrast between the CR proton fluxes incident on the cirrus clouds and the fluxes within the clouds, and, further, with there being no systematic variation of the CR proton flux with vertical position in the gas layer at the solar circle. We also place limits on the putative inverse-Compton component of gamma-ray emission resulting from the scattering of infrared photons from dust grains in the clouds by CR electrons.

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