

Systematic search for halos around pulsars in Fermi-LAT data

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Extended gamma-ray halos around middle-aged pulsars, discovered at TeV energies from HAWC observations, are a new and potentially rich source class. The phenomenon is interpreted as the inverse-Compton scattering of ambient photons by electron/positron pairs accelerated by pulsars and their nebulae and confined in their vicinity. Physically, the dynamics of this pair confinement remains poorly understood and halos offer an opportunity to probe the neighborhood of pulsar/supernova remnant systems, e.g., the magnetic field structure and conditions for energetic particle transport. As a population, due to their large sizes and long lifetimes, halos can be expected to have a non-negligible contribution to the GeV-TeV emission from the Galaxy, in the form of currently unidentified sources and/or unresolved emission on large scales.

In the GeV range, the first detections of halo candidates were achieved recently and the phenomenon essentially remains to be explored. We have performed a systematic search for halos around middle-aged pulsars using 12 years of Fermi-LAT data. We have set up an analysis suite to detect extended emission around a selection of ATNF pulsars likely to harbor halos at a detectable level. We present a list of promising halo candidates, together with dedicated studies in which we investigate the morphology and spectrum of a few selected targets. Combined with measurements at other wavelengths, this provides information on the physical processes underlying the formation of pulsar halos and contributes to a better assessment of halos as a population.

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Experimental Results

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