

Follow-up Analysis to Geminga's Contribution to the Local Positron Excess with HAWC Gamma-ray Observatory

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July 4, 2021

1 Summary

The contribution shows the first preliminary results of the follow up study of the particle diffusion coefficient in the regions of two nearby pulsars, Geminga and PSR B0656+14 (Monogem).

In 2008, the PAMELA collaboration presented measurements of an anomalous excess in the positron fraction of the cosmic ray flux. This excess showed an increase of positrons for energies above 10 GeV (10^9 eV). This excess was confirmed in 2012 by Fermi-LAT, and later in 2013 by AMS-02. There is no mechanism that can account for this excess, but there has been some work to suggest two possible origins: positrons can be the result of dark matter particle mechanisms such as annihilation. However other works suggests that astrophysical objects, for example, pulsar wind nebula, can explain the positron/electron emission.

The HAWC collaboration reported detection of two regions of extended gamma-ray emission coinciding with the locations of two relatively close pulsars, Geminga and PSR B0656+14 (Monogem). They presented ideal candidates to study the possible contribution to this positron excess. HAWC published the study of the positron excess with Geminga and Monogem with a model of diffuse gamma-ray emission from electron inverse Compton interactions with low energy photon fields. The results showed a slow diffusion coefficient, but a high electron/positron emission efficiency. This result suggests an insignificant contribution of electrons/positrons arriving at Earth.

This contribution presents an IC halo model with 1343 days of HAWC data. This model is developed to study TeV halo candidates, a new class of multi-TeV gamma-ray emission regions around PWNe, that may extend a few tens of parsec. We obtain a diffusion coefficient at energies of 100 TeV of $D(E_e = 100 \text{ TeV}) = (3.30 - 0.50 + 0.48) \cdot 10^{27} \text{ cm}^2/\text{s}$ for a injection spectral index $\alpha_e = (1.96 \pm 0.07)$, which is in agreement with HAWC's result $D_{100} = (3.2 - 1.0 + 1.4) \cdot 10^{27} \text{ cm}^2/\text{s}$ for Geminga.