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The displaced TeV signal of globular cluster Terzan 5 and implications for CR transport

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Terzan 5 is the most luminous Galactic globular cluster in the Fermi band. Uniquely amongst globular clusters, it also has an associated TeV band source (HESS Collaboration, 2011). Strangely, however, the centroid of this extended TeV source is appreciably offset from the cluster itself by about 8 pc. We show that this displacement is naturally explained by cosmic ray electrons accelerated in the bow shock around the cluster, which then propagate a finite distance down the magnetotail of the cluster before pitch-angle scattering processes re-orient enough of them towards Earth to produce a detectable γ -ray signal. The angular distance between the cluster and the signal places tight constraints on the scattering rate, which we show are consistent with a model in which scattering is primarily due to excitation of magnetic waves by the cosmic rays themselves. The analysis method we develop here will make it possible to use sources with similarly displaced non-thermal X-ray and TeV gamma-ray signals as direct probes of cosmic ray scattering across a range of Galactic environments.

Summary

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