

Stellar Clusters as Major contributors to Galactic Cosmic Rays at PeV Energies

Tuesday, 11 January 2022 12:35 (30 minutes)

Massive stars with powerful winds represent alternatives to supernova remnants as major contributors to CRs. Currently, based on the spectral and morphological studies of GeV and TeV gamma-rays, the evidence is mounting that young massive stellar clusters are indeed the highest energy CR factories. The colliding stellar winds and SN explosions can drive superbubbles filled by highly turbulent plasma. Strong shocks or interacting stellar winds can initiate effective particle acceleration. The recent discovery of gamma-rays extending to 1.4 PeV reported by the LHAASO collaboration from the so-called Cygnus Cocoon surrounding Cygnus OB2 implies that clusters of stars can accelerate protons beyond 10 PeV, performing as Super-PeVatrons. The PeV γ -rays are of particular interest. For typical scattering environments, the transport of the parent 10 PeV protons would proceed in the (quasi)ballistic regime producing gamma-rays with a compact image projected on the accelerator. The realisation of this effect would provide unique tools for the localisation and identification of PeVatrons.

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Session Classification: Gamma ray astronomy II