Contribution ID: **10** Type: **Contributed Talk**

Study of maximum electron energy of sub-PeV pulsar wind nebulae by multiwavelength modelling

Monday 10 October 2022 16:30 (15 minutes)

Recently, the Large High Altitude Air Shower Observatory (LHAASO) reported discovery of 12 ultrahigh-energy (UHE; $\varepsilon \geq 100$ TeV) gamma-ray sources located in the Galactic plane. Few of these UHE gamma-ray emitting regions are in spatial coincidence with pulsar wind nebula (PWN) objects. We consider a sample of five sources; two of them are LHAASO sources (LHAASO J1908+0621 and LHAASO J2226+6057) and the remaining three are GeV-TeV gamma-ray emitters. In addition, their X-ray and radio observations or upper limits are also available for these objects. We study multiwavelength radiation from these sources by considering a PWN origin, where the emission is powered by time-dependent spin-down luminosity of the associated pulsars. In this one zone, time-dependent leptonic emission model, the electron population is calculated at different times under the radiative (synchrotron and inverse-Compton) and adiabatic cooling. We estimate the upper limits on the minimum Lorentz factor of the electrons and it also infers the minimum value of the pair-multiplicity of charged pairs. Further, the maximum value of the electron Lorentz factor is estimated by the maximum observed photon energy in the sub-PeV range. In the special case of HESS J1640-465, a higher energy density of the stellar photons is required to fit gamma-ray data compared to the standard IR/CMB background used in the PWNe modelling. We also discuss the possible modification in the model parameters, if the escape of particles is allowed from the pulsar wind nebula. For example, we consider LHAASO 1908+0621 and discuss qualitatively the impact of escape of particles from this source.

Track

SNR/PWNe

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Session Classification: Parallel 2