Contribution ID: **70** Type: **Contributed**

SNR G39.2-0.3, an hadronic cosmic rays accelerator

Wednesday 14 April 2021 19:00 (15 minutes)

Recent results obtained with gamma-ray satellites have established supernova remnants as accelerators of GeV hadronic cosmic rays. In such processes, CRs accelerated in SNR shocks interact with particles from gas clouds in their surrounding. In particular, the rich medium in which core-collapse SNRs explode provides a large target density to boost hadronic gamma-rays. SNR G39.2-0.3 is one of the brightest SNR in infrared wavelengths, and its broad multiwavelength coverage allows a detailed modelling of its radiation from radio to high energies. We reanalysed the Fermi-LAT data on this region and compare it with new radio observations from the MWISP survey. The modelling of the spectral energy distribution from radio to GeV energies favours a hadronic origin of the gamma-ray emission and constrains the SNR magnetic field to be at least ~100 μG. Despite the large magnetic field, the present acceleration of protons seems to be limited to ~10 GeV, which points to a drastic slow down of the shock velocity due to the dense wall traced by the CO observations, surrounding the remnant. Further investigation of the gamma-ray spectral shape points to a dynamically old remnant subjected to severe escape of CRs and a decrease of acceleration efficiency. The low-energy peak of the gamma-ray spectrum also suggests that that the composition of accelerated particles might be enriched by heavy nuclei which is certainly expected for a core-collapse SNR. Alternatively, the contribution of the compressed pre-existing Galactic cosmic rays is discussed, which is, however, found to not likely be the dominant process for gamma-ray production.

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Session Classification: Exploring the Galaxy: Supernova Remnants & Pulsar Wind Nebulae

Track Classification: SNR/PWN