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First very-high-energy joint likelihood analysis of the region around the second most powerful pulsar in our galaxy with H.E.S.S. and HAWC Observatories

The Galactic plane is full of bright gamma-ray sources whose astrophysical nature remains unknown. The region surrounding the second most powerful pulsar in our galaxy, PSR J1813-1749, hosts one of such intriguing sources. Multiwavelength observations of this region show a multitude of sources, including a pulsar wind nebula (PWN) embedded in a supernova remnant (SNR) in X-rays and also SNRs and a star-forming region (SFR) in radio. In 2024, a very-high-energy detailed spectro-morphological analysis of this complex region was performed with H.E.S.S. telescope array data from hundreds of GeV to tens of TeV. The study highlighted one previously detected compact emission believed to be associated with the PWN and unveiled one new extended emission using an improved background method. The latter could be the TeV halo created by electrons escaping from the PWN, which is supported by a leptonic model fitted on the multiwavelength data. However, these systems are observed around middle-aged pulsars, whereas PSR J1813-1749 is young. On the other hand, the possible hadronic scenario of proton acceleration in SNRs or/and a SFR does not explain the large size of the emission. Further investigations are required to conclude on the physical mechanisms at-play.

We conducted a new study of this mysterious region to determine the origin of the emissions. Here we present the first spectro-morphological analysis with very-high-energy data from the HAWC observatory, which is more sensitive from ten to hundreds of TeV. We also report two emissions of which the extended one displays different characteristics from the H.E.S.S. results. Finally, we present the first H.E.S.S./HAWC joint likelihood analysis across the entire energy range of both telescope arrays, which benefits of the good spatial resolution of H.E.S.S. and the wider energy range of the HAWC. This study constrains gamma-ray morphologies and sheds light on non-thermal radiation processes arising from particle acceleration to such high energies. In addition, the joint likelihood technique, possible with gammapy software, has proven very efficient and will be essential for the future of multi-wavelength and multi-messenger astronomy.

Secondary track

Author: Ms CHAMBERY, Pauline (College of Science and Technology at Temple University)

Co-authors: COLLABORATION, H.E.S.S.; COLLABORATION, HAWC; Prof. AYALA, Hugo (PSU/Temple University); MOSTAFA, Miguel (Penn State Univ.); Prof. BANGALE, Priyadarshini (Temple University); REMY, Quentin; Dr BABU, Rishi (Michigan State University)

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