

Research Result Report

ICRR Inter-University Research Program 2025

Research Subject: Constraining the nature of the emission in PeVatrons observed by Alpaca

1. - Research focuses on the detection and observation of sources of high-energy cosmic and gamma radiation with the Alpaca experiment (under construction)

2. Research on PeV sources of cosmic rays (PeVatrons) to clarify the nature of gamma rays in a hadronic context, with synergies to radio astronomy to determine the density of nucleons (protons; hadrons), and with synergies to X-rays to complement the leptonic (electron) component.

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Participating Researchers:

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Summary of Research Result :

We have published two JCR articles, one on Alpaca and one on the PeVatron candidate LHAASO J2108+5157. The Alpaca publication is about Gamma-hadron discrimination by analysis of the muon lateral distribution in the ALPAQUITA array, and the LHAASO J2108+5157 consists in study the star clusters and star forming region in the vicinity of LHAASO J2108+5157 to confirm if they can be considered the counterpart. The result confirm the source still as a dark PeVatron

1.- Alpaca:

Anzorena, M., de la Fuente, E., Fujita, K., Garcia R., et al., 2025, Experimental Astronomy, Volume 59, Issue 1, id.13, DOI: 0.1007/s10686-025-09981-z

In the Alpaca experiment, a new method is presented that uses the muon lateral distribution and an underground muon detector to achieve a high discriminating power against hadrons. 2.- PeVatrons: A) -- <i>PeVatron LHAASO J2107+5158: Hadrons</i> Akash Gupta, Eduardo de la Fuente , Ram K. Yadav, Alicia Porras, et al. “<i>Are Kronberger 80 and/or Kronberger 82 regions PeVatron candidates for LHAASO J2108+5157?</i>”, Publications of the Astronomical Society of Japan, accepted April, 10, 2025 This paper explains and quantify for the first time why the star-forming regions in the vicinity of the PeV emission region LHAASO J2108+5157 cannot be considered as Pevatrons for the observed PeV emission. <i>Comment about the microquasar V4641 Sgr paper</i> On the other hand, just for information, the paper “<i>Detection of Extended X-Ray Emission around the PeVatron Microquasar V4641 Sgr with XRISM</i>” by Suzuki, Hiromasa, Tsuji, Naomi, Kanemaru, Yoshiaki, ; Shidatsu, Megumi, Olivera-Nieto, Laura, Safi-Harb, Samar Kimura, Shigeo S., de la Fuente, Eduardo et al, The Astrophysical Journal Letters, Volume 978, Issue 2, id.L20, 7 pp.. was accepted in December, 10, 2024 and published on January, 3, 2025. The research was conducted in 2024 but published in early 2025 This paper explain that if the X-ray rays is of thermal origin, the measured extension, temperature and plasma density can be explained by a jet with a luminosity of $\sim 2 \times 10^{39} \text{ erg s}^{-1}$, which is comparable to the Eddington luminosity of this system.
