Research Result Report ICRR Inter-University Research Program 2023

Research Subject:

Constraining the nature of the emission in PeVatrons observed by Alpaca

Principal Investigator: Eduardo de la Fuente Acosta

Participating Researchers:

Eduardo de la Fuente Acosta (Full-time researcher, Mexico) Ivan Toledano Juarez (Ph. D. Student, Mexico) Takashi Sako (Staff, ICRR, University of Tokyo) Katzumasa Kawata (Staff, ICRR, University of Tokyo) Masato Takita (Staff, ICRR, University of Tokyo)

Summary of Research Result :

We have published 5 papers this year: 3 JCR and 2 peer-reviewed.

1. - LHAASO J2107 PeVatron Candidate

This paper was worked in 2022 but published in 2023:

de la Fuente, E., et al., 2023, Detection of a new molecular cloud in the LHAASO J2108+5157 region supporting a hadronic PeVatron scenario, Publications of the Astronomical Society of Japan, 75, 546

This paper was worked and published in 2023:

de la Fuente, E., et al., 2023, Evidence for a gamma-ray molecular target in the enigmatic PeVatron candidate LHAASO J2108+5157, Astronomy & Astrophysics Letters, 675, id.L5, 8 pp.

In both papers we discuss a method to determine the nucleon density by combining observations of neutral and molecular hydrogen to constrain gamma-ray emission in favor of a hadronic scenario. The result of both papers was presented as a contribution at the 38th International Cosmic Ray Conference (ICRC2023) in Nagoya, Japan, as summarized in the peerreviewed paper:

Toledano-Juárez, I. et al. 2023, Unveiling the molecular environment of the enigmatic PeVatron candidate LHAASO J2108+5157, Proceedings of Science, 444, 809_1

2. Tibet-AS Gamma Ray Sources

We conducted radio observations for five Tibet-AS gamma events in 2023 to detect possible associated PeVatrons candidates and determine the density of nucleons to constrain gamma-ray modeling. The observations were made with the Nobeyama 45-m radio telescope. We publish first results in:

Toledano-Juárez, I. et al. 2023, Nobeyama Cygnus-X Survey: Physical Properties of C 18 O clumps in DR-6(W), DR-9 and DR-13S regions, Proceedings of Science, 444, 631_1

The study of the other 4 events is still ongoing and we expect to come to a conclusion by combining their results.

3. Other associated works related with PeVatrons and Alpaca

In early 2023, I was invited to give an invited talk at the 19th Rencontres du Vietnam, Theory Meets Experiment, in Quy-Nhon, Vietnam from January 5-11.

de la Fuente, E., et al., 2023, Book of contributions of the TMEX-2023: Theory meets experiments, January 5-11, 2023, Vietnam

Finally, regarding the Alpaca experiment, this paper was published in 2023:

Okukawa, S., et al, 2023, Hadronic interaction model dependence in cosmic Gamma-ray flux estimation using an extensive air shower array with a muon detector, Experimental Astronomy, 55, 325

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