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Research Result Report
ICRR Inter-University Research Program 2022

Research Subject:

Constraining the nature of the emission in PeVatrons observed by Alpaca

Principal Investigator:

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Summary of Research Result :

We publish the paper entitled "Detection of a new molecular cloud in the LHAASO J2108+5157 region supporting a hadronic PeVatron scenario" in the Publications of the Astronomical Society of Japan (PASJ); https://doi.org/10.1093/pasj/psad018 with authors:
Eduardo de la Fuente, Ivan Toledano-Juarez, Kazumasa Kawata, Miguel A Trinidad, Daniel Tafoya, Hidetoshi Sano, Kazuki Tokuda, Atsushi Nishimura, Toshikazu Onishi, Takashi Sako, Binita Hona, Munehiro Ohnishi, Masato Takita (some of them members of ICRR)

In this work, we have developed a method to detect molecular clouds that are targets for gamma-ray emission produced by PeVatrons, with a methodology to determine the nucleon density required to produce the observed (sub)PeV emission. This method will be used to study objects observed in Alpaca (e.g., those like LHAASO J2108+5157). Sources such as LHAASO J2108+5157 could be observed with Alpaca in the Southern Hemisphere. I also visited Chacaltaya in Boliva to help and support the installation of Alpaquita, the Alpaca prototype. Here, we installed several sensors starting testings.

On the other hand, another paper entitled “Hadronic interaction model dependence in cosmic Gamma-ray flux estimation using an extensive air shower array with a muon detector” with the authors "The Alpaca collaboration” was published in

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Experimental Astronomy (2023) 55:325–342 DOI: 10.1007/s10686-022-09883-4. In this work, the model dependence on hadronic interaction models was quantitatively evaluated for first time, using Alpaquita.

Finally, we performed Nobeyama 45m radio telescope observations for five Tibet AS _Gamma events to discover possible associated PeVatrons candidates and investigate the molecular environment. In addition, we observed LHAASO J2108+5157 region.

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