

Searching for Galactic PeVatrons with VERITAS



**Priyadarshini Bangale for
the VERITAS Collaboration**

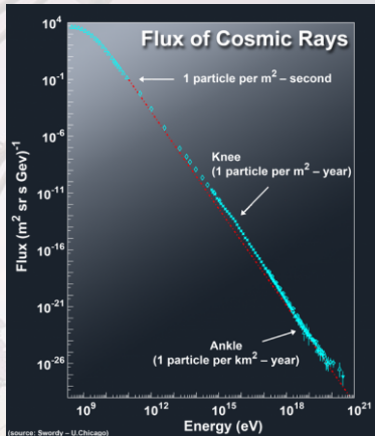
Bartol Research
Institute/University of Delaware

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Canada**

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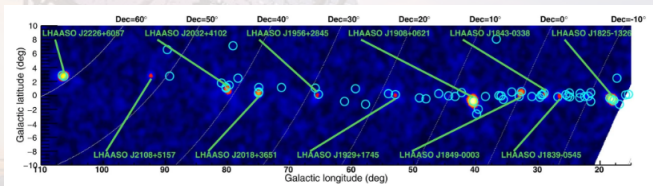
Introduction

- Galactic PeVatrons: astrophysical sources accelerating particles up to PeV energies (10^{15} eV)
- Current generation Cherenkov telescope $\rightarrow E < 0.1$ PeV gamma-ray sources
- LHAASO's discovery has increased the spectral cutoff limit of 0.1 PeV to even higher energies



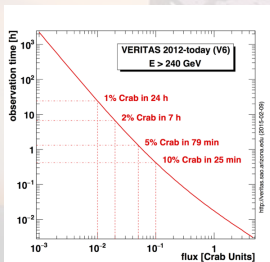
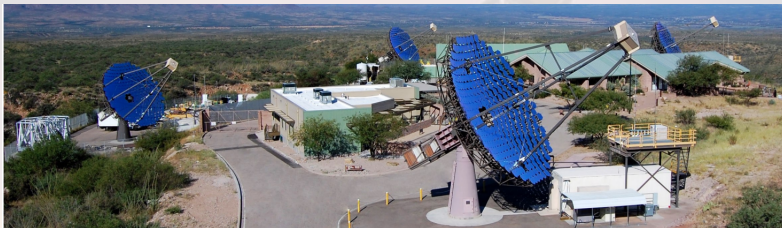
LHAASO Sources

- LHAASO detected 14 steady Galactic gamma-ray sources with energies up to 1.4 PeV
 - ↪ 12 sources have counterparts at lower energies
 - ↪ 2 unidentified sources
- Exact location, morphology, and broadband spectra unknown for these 2 sources
 - ↪ **VERITAS observations of 2 unidentified LHAASO sources**



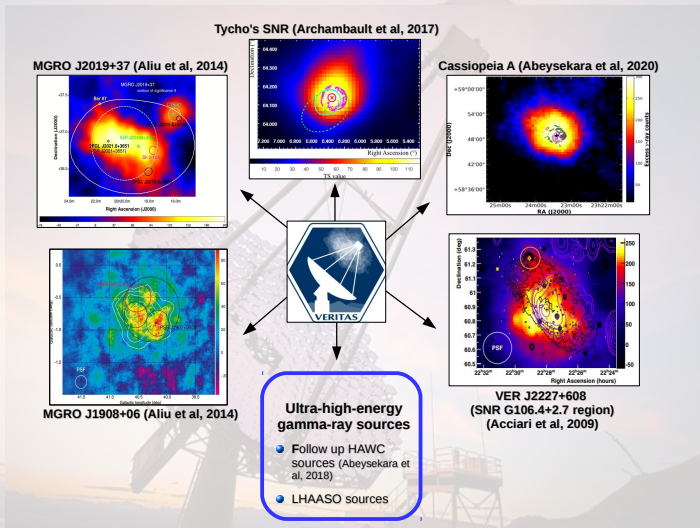
[Image Credit: Cao et al. 2021]

VERITAS

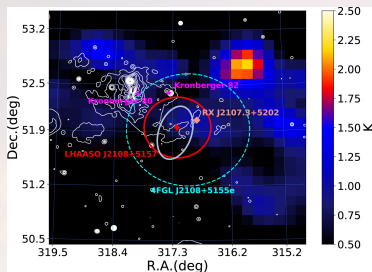


- Location: near Tucson, Arizona,
- Array of 4 Imaging Air Cherenkov Telescopes.
- Energy range: ~ 85 GeV - 30 TeV.
- FOV: 3.5° , Angular resolution: 0.08° at 1 TeV
- Point source sensitivity: 1% Crab in < 25 h, 10% in 25 min

VERITAS PeVatron Searches



LHAASO J2108+5155



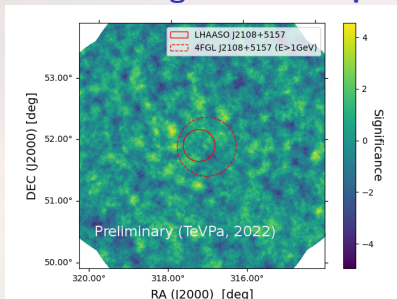
[Image credit: Cao et al. 2021a]

LHAASO follow-up:

- Point like source ($E > 100$ TeV), extension upper limit $< 0.26^\circ$
- Spatially coincident with 4FGL J2108+5155 at 0.13° offset, Fermi-LAT extension ($E > 1$ GeV): 0.48° [Cao et al. 2021]
- Spatial coincidence with molecular cloud

LHAASO J2108+5155

VERITAS Significance map

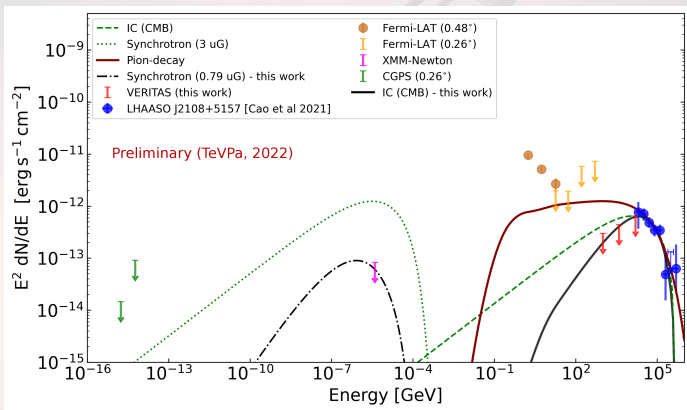


VERITAS follow-up:

- 35 hours of exposure time
- Both point source [$\theta < 0.09^\circ$] search & extended source [$\theta < 0.25^\circ$] search resulted in no detection

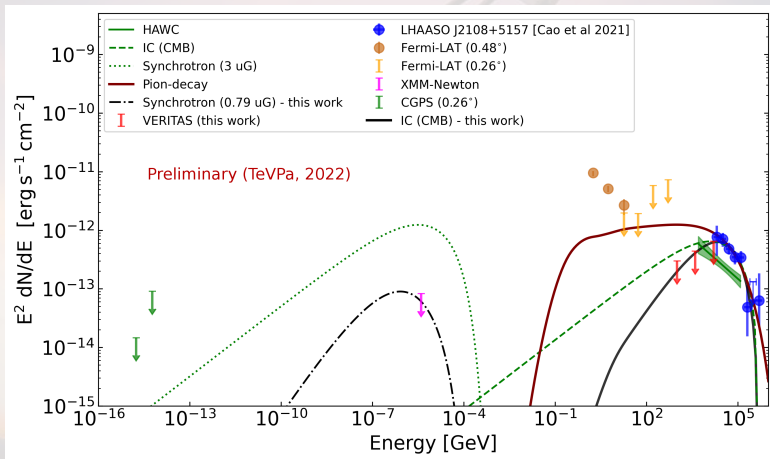
θ : integration region radius

LHAASO J2108+5155

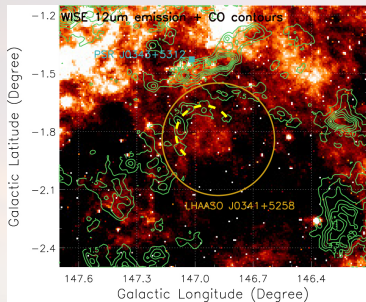


Preliminary VERITAS upper limits favor leptonic model.

LHAASO J2108+5155



LHAASO J0341+5258

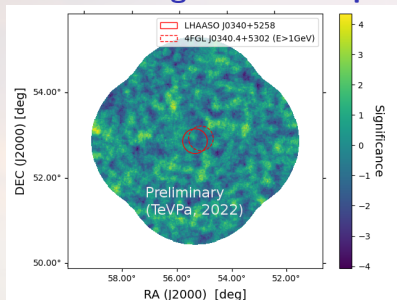


[Image credit: Cao et al. 2021b]

- Extended source ($E > 25$ TeV),
Angular size: $(0.29 \pm 0.06_{stat} \pm 0.02_{sys})^\circ$
- Nearest Fermi source (4FGL
J0340.4+5302) at angular distance of
 0.16° from LHAASO position
- Upper limits derived from Chandra data
at LHAASO position, two nearby X-ray
sources at $\sim 0.3^\circ$
- Partial spatial coincidence with molecular
cloud

LHAASO J0341+5258

VERITAS Significance map



VERITAS follow-up:

- 23 hours of exposure time
- Both point source [$\theta < 0.09^\circ$] search & extended source [$\theta < 0.25^\circ$] search resulted in no detection
- Detailed spectral analysis and interpretation are ongoing

θ : integration region radius

Summary

- The Galactic PeVatron search is one of the key science projects of VERITAS
- The recent discovery of LHAASO unveiled 14 new PeVatron candidates; 12 of them have known TeV counterparts and two are unidentified sources
- Multi-wavelength observations are essential to understand the nature of this exotic source population
- We report non-detection of LHAASO J2108+5157 and LHAASO 0341+5258 with 35 and 23 hours of VERITAS observation
↔ **Preliminary VERITAS upper limits for LHAASO J2108+5157 favor a leptonic model over the LHAASO hadronic model**

A large satellite dish antenna is the central focus, mounted on a complex metal structure. The dish is covered in a grid of small, reflective panels. The background shows a mountainous landscape under a sky with soft, warm light from a low sun, creating a hazy, golden atmosphere. In the lower right, there are some smaller structures and antennas on the mountain. The overall scene is a high-altitude astronomical or communication facility.

Thank you!