

Six PeVatron Candidates in the Galactic Disk: Independent Detection Above 398 TeV with LHAASO

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>398 TeV Gamma-ray Emission in Galactic Plane

Data Selection

Time: 2019/12/27 - 2025/07/31; **Energy select:** >398TeV; **Zmax:** 50; **BKG:** Direct integral

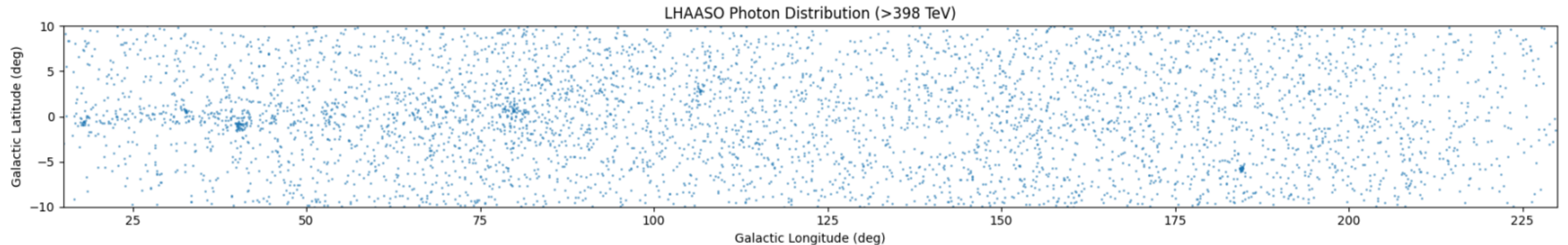


Fig 1. The observed counts map of gamma-ray candidates above 398 TeV in the Galactic Plane ($|b| < 10^\circ$ & $15^\circ < l < 230^\circ$).

UHE Gamma-ray Possible Origins

- **Electron PeVatron** – Gamma rays produced by electrons accelerated by astrophysical sources
- **Proton PeVatron** – Gamma rays produced by protons accelerated by astrophysical sources
- **Diffuse Gamma-ray Emission (DGE)** – Gamma rays from interactions between the cosmic-ray sea and the interstellar medium
- **Misidentified CR protons** – Cosmic-ray protons misidentified by gamma-proton discrimination

Diffuse Gamma-ray Emission

The 2nd LHAASO Collaboration Conference in 2025. Poster 34

Part II: Testing Hypotheses for cosmic Ray Propagation

With the contribution from known discrete sources established, we investigate the origin of the remaining diffuse emission. We perform a likelihood analysis to compare two physical models for the remaining diffuse emission:

Model A – Uniform CR Sea:

The emission is modeled using the gas distribution template, which assumes UHE cosmic rays are uniformly distributed throughout the Galactic Plane.

Model B – SNR-driven CRs:

This model tests the hypothesis that the emission is dominated by cosmic rays recently accelerated by nearby SNRs. This template models the hadronic gamma-ray emission from SNR-accelerated cosmic rays on the gas.

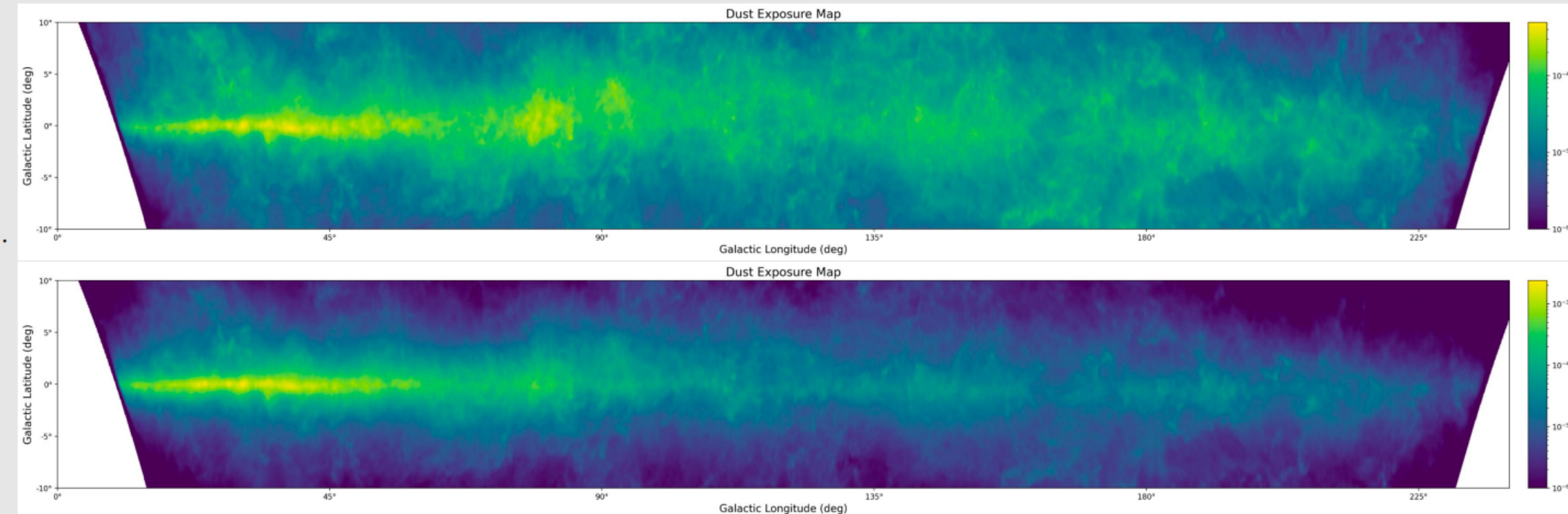


Fig 3. Spatial templates used to model the diffuse UHE gamma-ray emission. Top (Model A): The **Dust template**, representing a uniform CR sea. Bottom (Model B): The **SNR*Dust template**, representing a non uniform CR distribution clustered near sources.

Based on these two templates, we identified six discrete sources from the observational data, with a significance above 5σ .

The positions and various parameters of these six sources are roughly the same under the two templates.

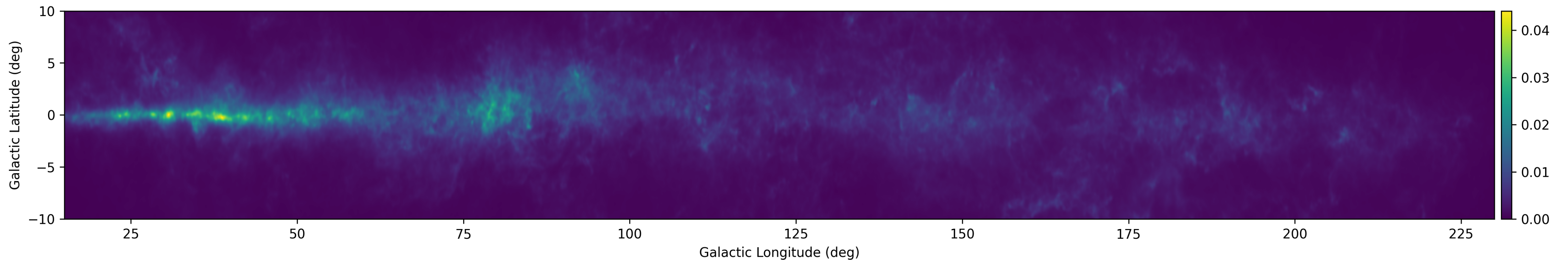


Fig 2. Expected gamma-ray counts map of DGE above 398 TeV in the Galactic Plane, which is convolved with Planck dust opacity distribution.

Six PeVatron Candidates

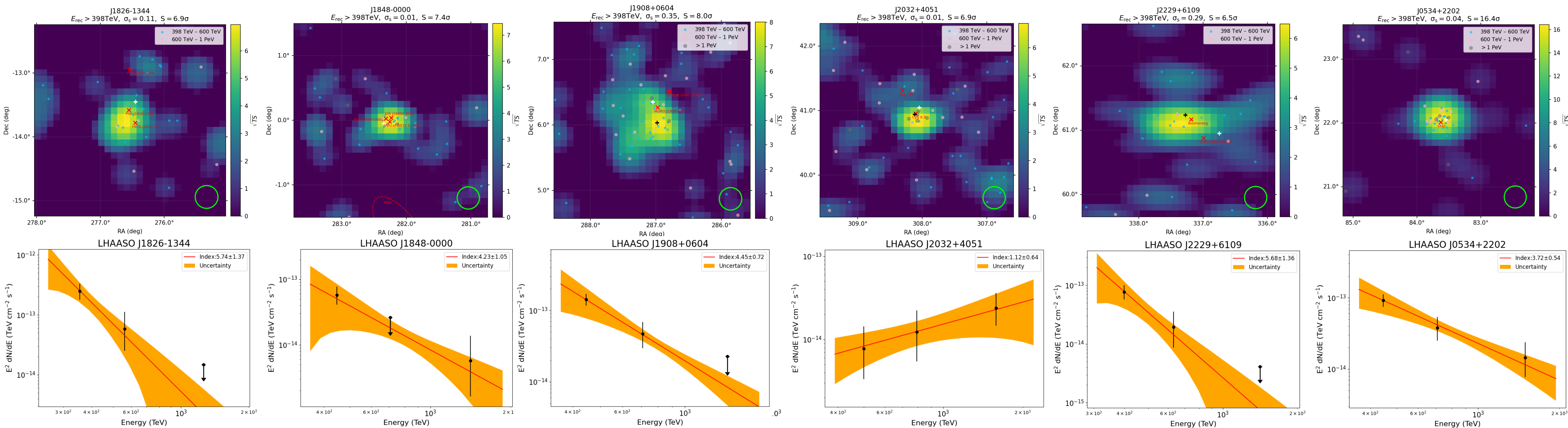
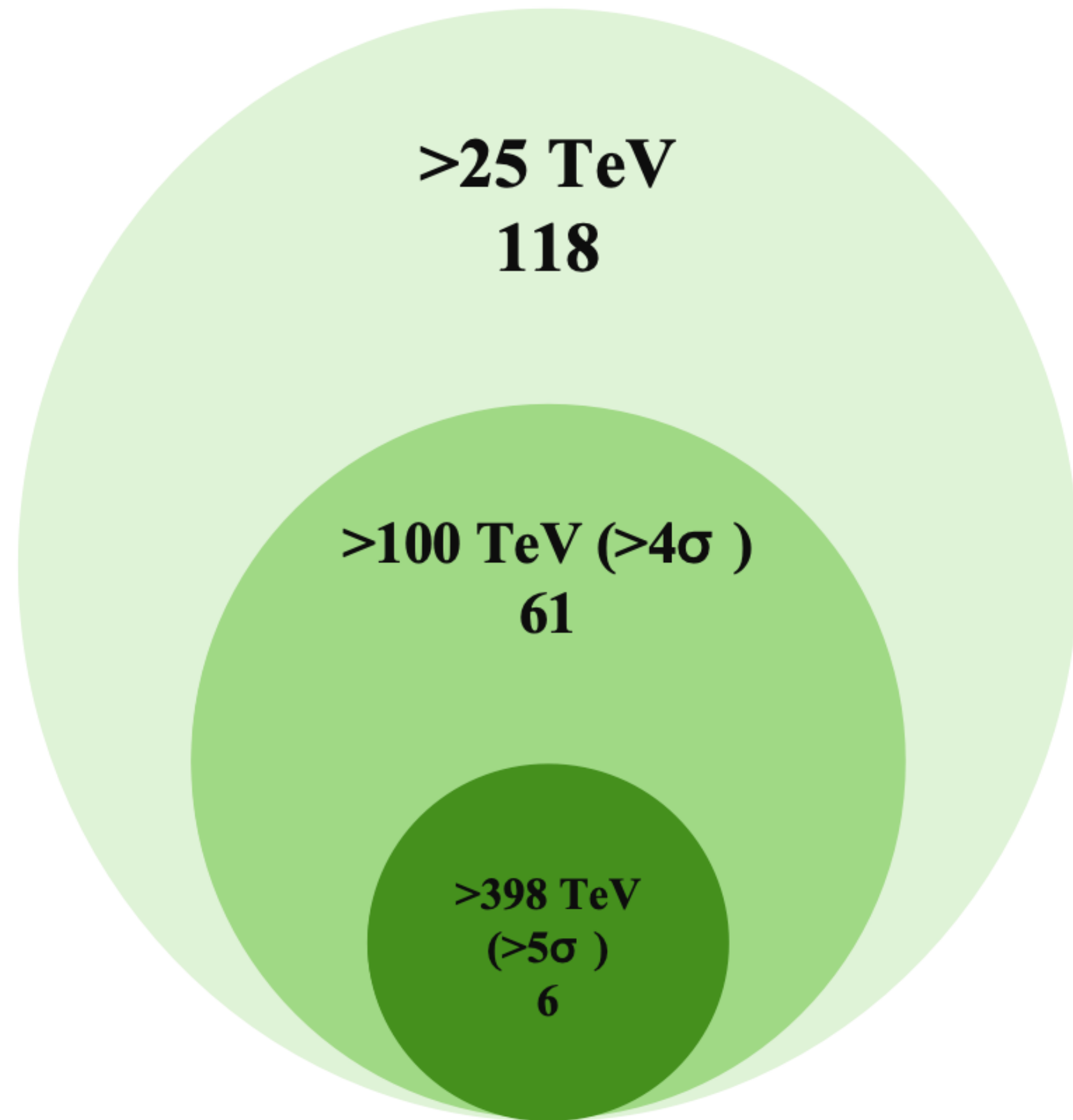


Fig 3. Top: Significance maps of the six sources, obtained for gamma rays above 398 TeV. The white and black + signs mark the locations identified by LHAASO and Fermi. The red x marks the possibly associated objects. The size of PSFs (68%) are shown at the bottom right of each map. Bottom: SED points derived from observations (no extinction correction).

Identified Name (RA, Dec, extension)	J1826-1344 (286.59, -13.75, 0.11)	J1848-0000 (282.23, -0.03, 0.01)	J1908+0604 (287.12, 6.11, 0.35)	J2032+4051 (308.06, 40.85, 0.01)	J2229+6109 (337.14, 61.18, 0.29)	J0534+2202 (83.62, 22.08, 0.04)
Possible Counterpart (distance [kpc], separation angle [deg])	PSR J1826-1334 (3.2, 0.3) PSR J1826-1256 (1.6, 0.5)	PSR J1849-0001 (7, 0.08)	SNR G40.5-0.5 (3.4, 0.52) MGRO J1908+06 (-, 0.21)	Cygnus X-3 (8.96, 0.11)	Boomerang (0.8, 0.09), SNR G106.3+2.7 (0.8, 0.33)	Crab (2.0, 0.04)
DGE flux/Planck dust opacity	1	0.26	0.34	0.41	0.97	-

Future Plan



We produce a supplement to the LHAASO 2nd catalog

1. Multi-Messenger Analysis

We will use the expected sensitivity of IceCube-Gen2, together with the LHAASO second catalog, to predict the neutrino detectability of these PeVatron candidates (stacking analysis).

2. Cosmic-Ray Spectrum

We will study the contribution of these sources to the knee of the cosmic-ray spectrum. (Boomerang PWN, MGRO J1908+06, Cygnus X-3...)

3. Deepening the Analysis of DGE in UHE band

We will extend the analysis of diffuse gamma-ray emission (DGE) in the UHE band by applying more cosmic-ray models to these resolved sources.

4. The spatial distribution of diffuse gamma-ray emission

We will study the spatial distribution of DGE using different templates considering different sources and diffuse emission models.

We will also conduct research by varying the gamma/proton discrimination.