

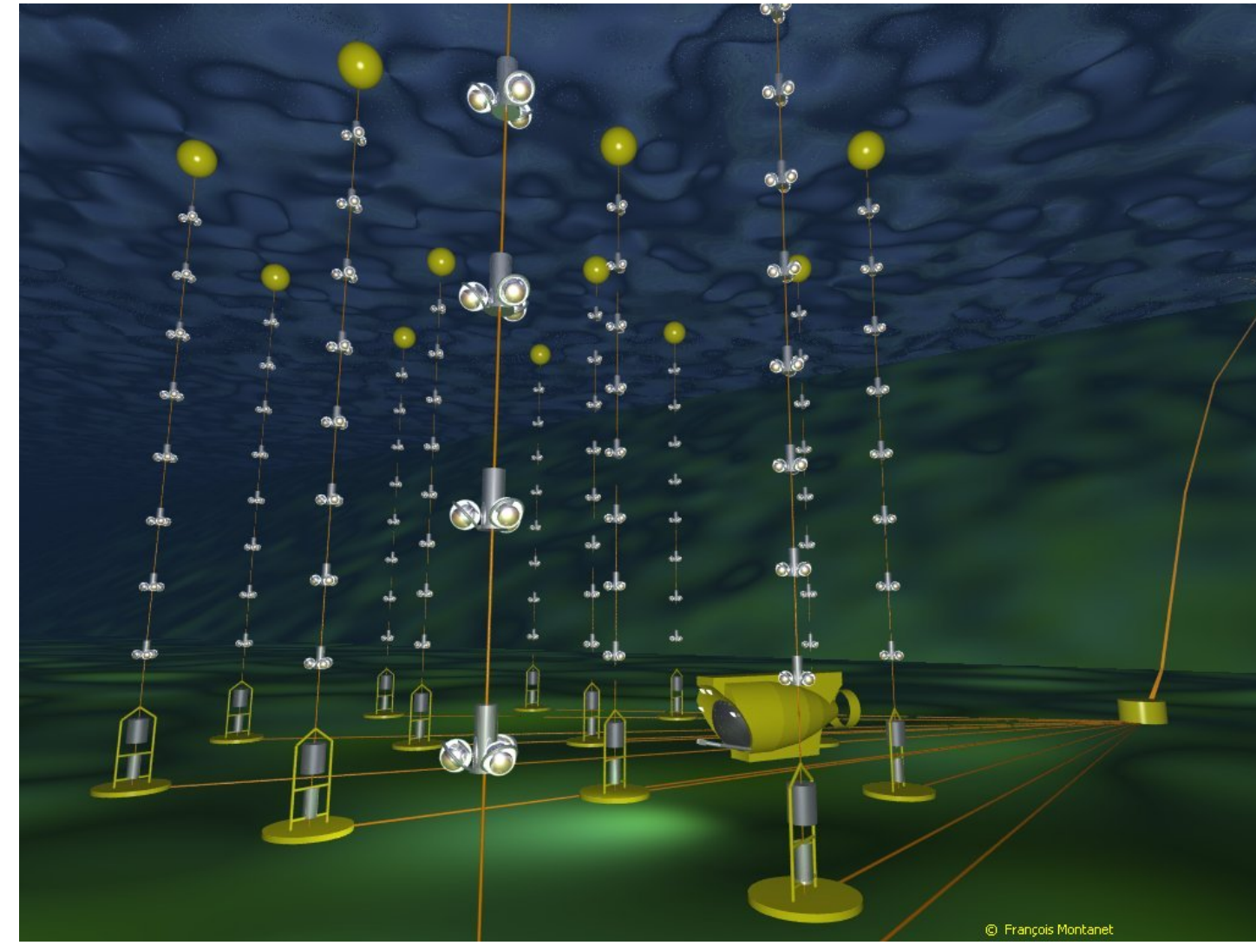
ANTARES Neutrino Telescope and Data Set

ANTARES neutrino telescope:

- A 3D array of **885 PMTs** covering $\sim 0.015 \text{ km}^3$.
- 2500 m below the surface of the **Mediterranean Sea**.
- Completed in 2008, decommissioned in 2022.

Data set:

- **Full data-taking period:** from January 29, 2007 to February 13, 2022 (4541 days of livetime).
- **11029 track-like** and **200 shower-like** events.
- Tracks: $\sim 0.45^\circ$ median angular resolution.
- Showers: $\sim 3.2^\circ$ median angular resolution.



Search Method: Unbinned Likelihood

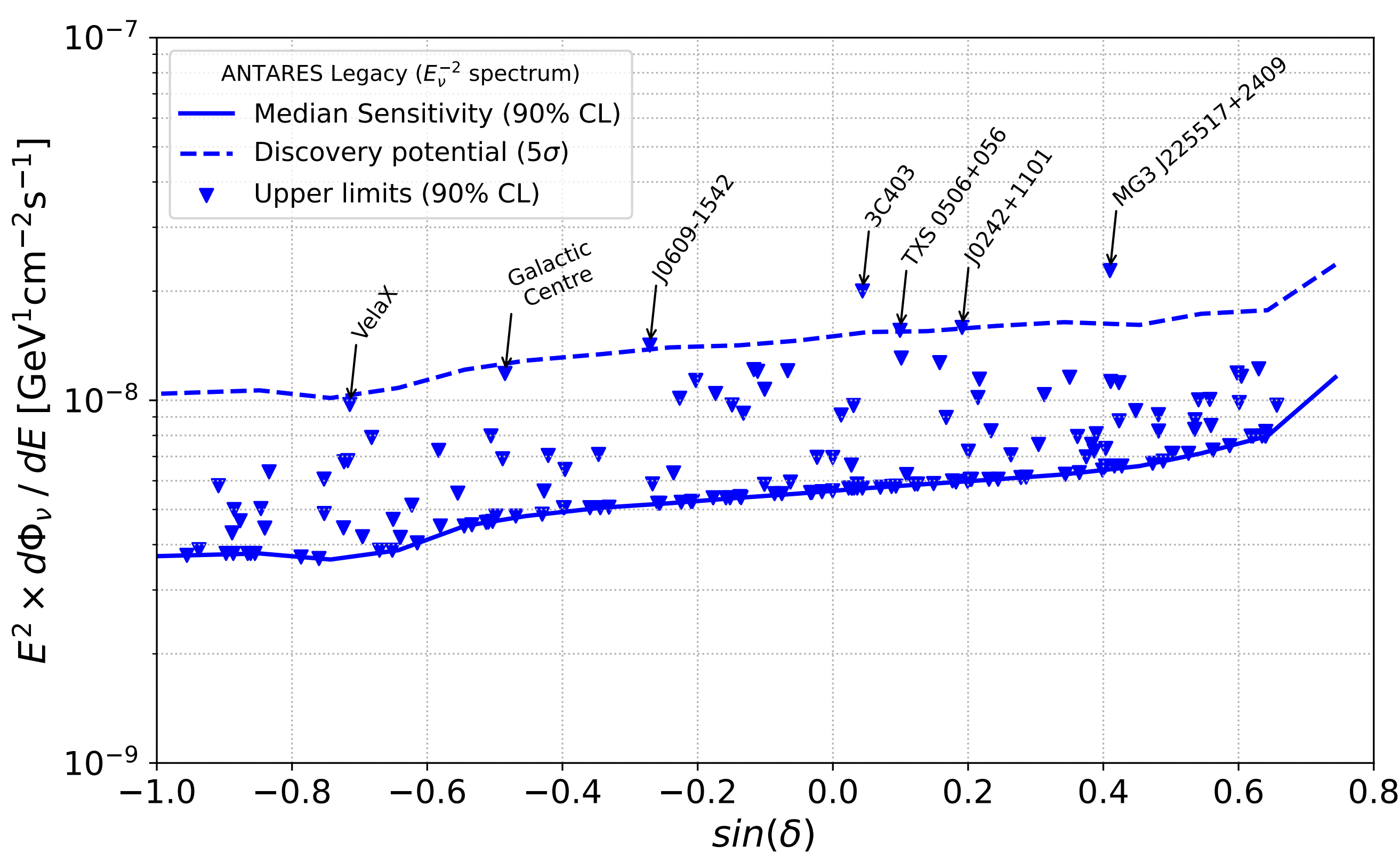
$$L(\mathbf{n}_s) = \prod_{j \in \{tr, sh\}} \prod_{i \in j} \left[\frac{n_s^j}{N_j} S_i^j + \left(1 - \frac{n_s^j}{N_j} \right) B_i^j \right]$$

Free parameter: total number of signal events

Signal PDFs: $S_i = S_{space} \cdot S_{energy}$

Background PDFs: $B_i = B_{space} \cdot B_{energy}$

Candidate List Search



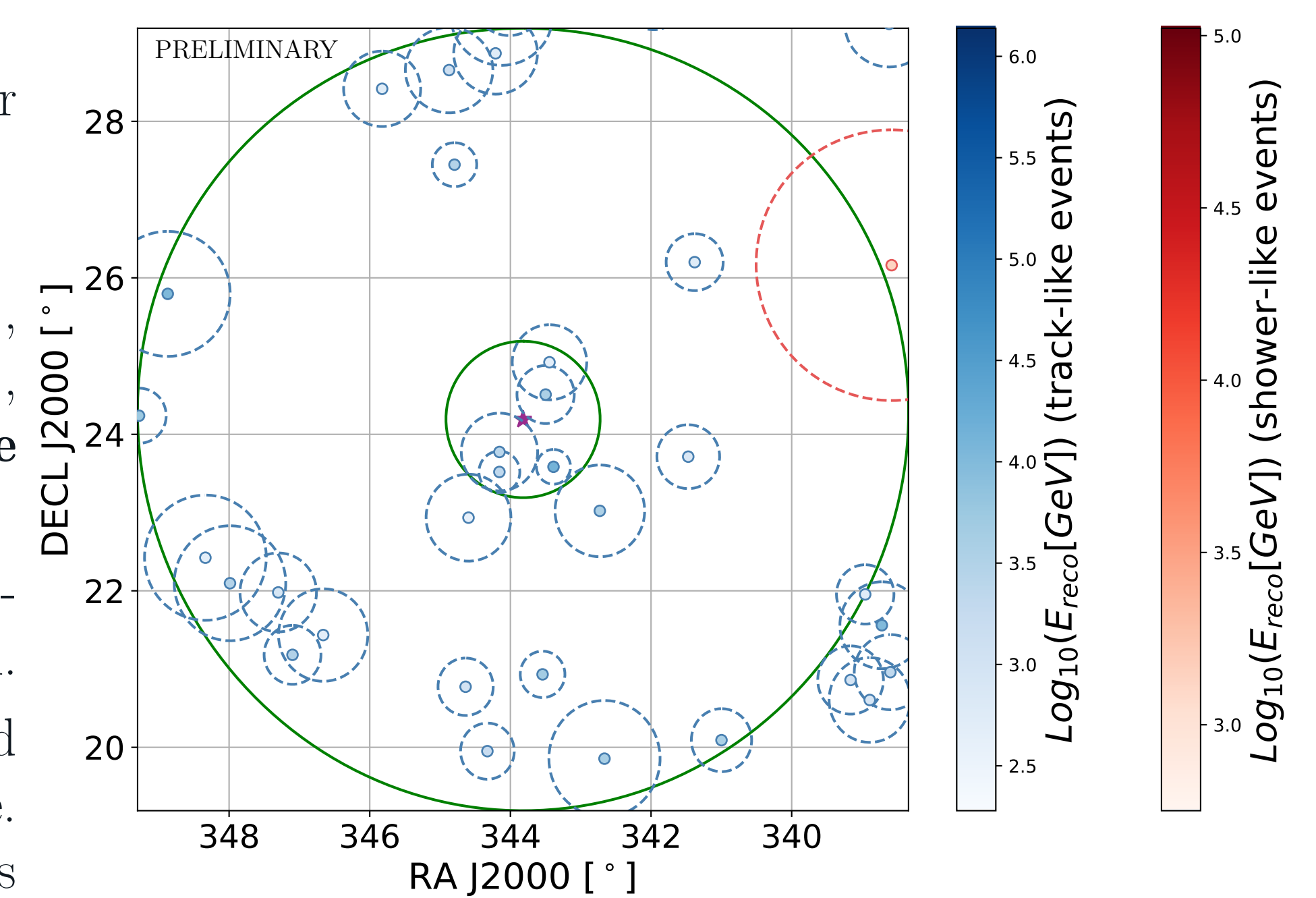
- **169 targeted sources:** 155 point-like and 14 with extended Gaussian morphology.

- **Most significant source:** γ -ray blazar **MG3 J225517+2409**, 3.5σ pre-trial (2σ post-trial) significance.

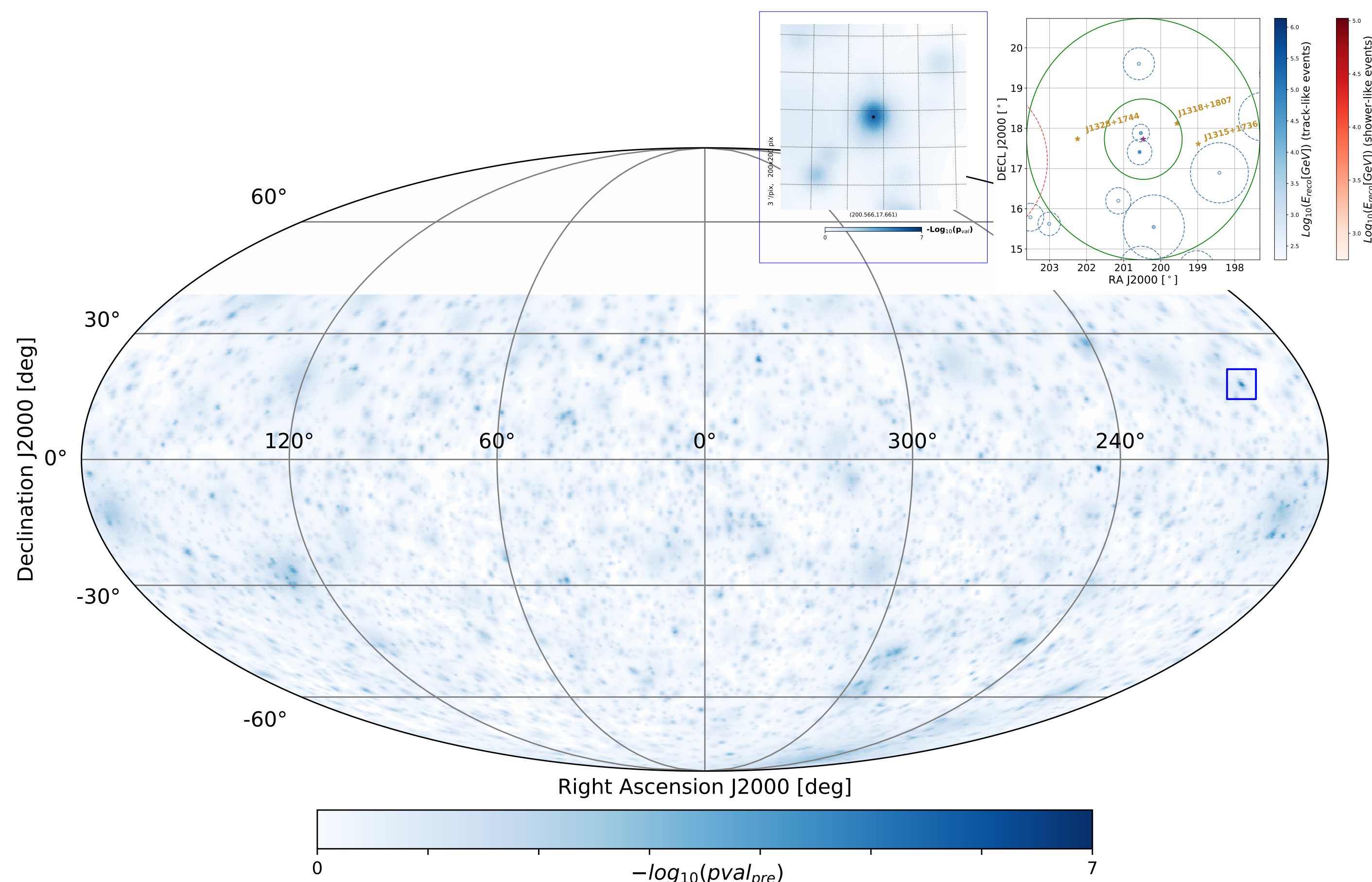
- **Other significant sources:** **3C 403** (3.3σ), **TXS 0506+056** (2.4σ), **J0242+1101** (2.4σ), the **Galactic Centre** (2.1σ) and PWN **VelaX** (1.9σ), pre-trial.

- **Left: 90% C.L. limits** on the all-flavour neutrino flux normalization for an E^{-2} spectrum.

- **Right: Skymap** of the events found around the direction of the most promising source. Color indicates energy, and dashed ellipses represent angular uncertainty. Green ellipses show the 1° and 5° distances to the source.

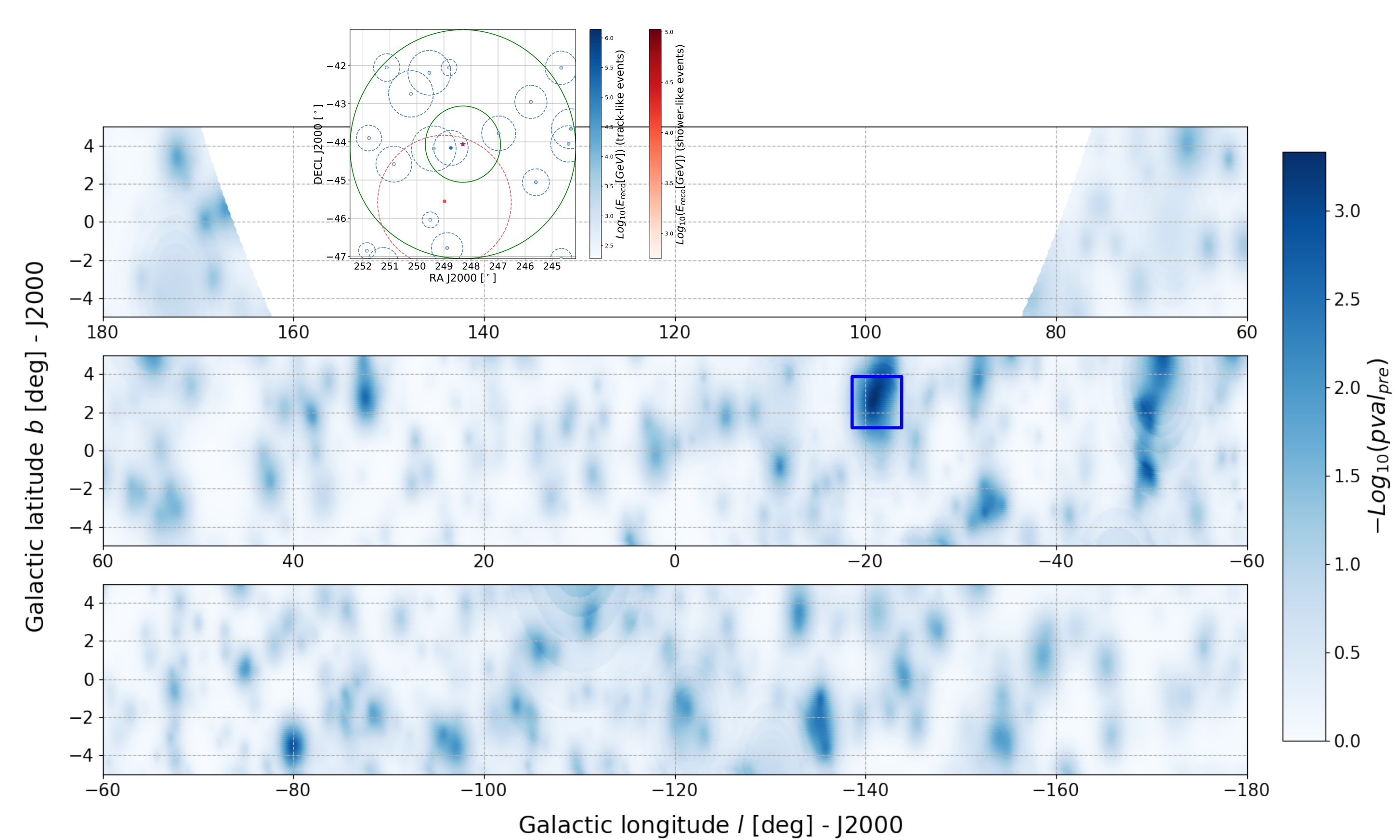


Full-Sky Search for Point-like Sources



- **Sky** divided into $\sim 0.11^\circ \times 0.11^\circ$ pixels using a HEALPix grid ($N_{\text{side}} = 512$). Each pixel is investigated, applying an up-going selection cut to suppress atmospheric muons. Directions with $\delta > 40^\circ$ lie outside ANTARES visibility and are not analyzed.
- **Complete sky map of pre-trial p-values** at each investigated direction is shown above.
- **Most significant cluster** found at $(RA, \delta) = (200.17^\circ, 17.5^\circ)$, with 4.5σ pre-trial (0.3σ post-trial) significance. A $10^\circ \times 10^\circ$ zoom-in can be found at the top-right corner inside a blue frame as in the skymap itself.
- The **event skymap** next to the zoom-in shows the same information as in the candidate list search. The significance of the best pixel is driven by two very nearby events with very small angular uncertainties.
- Closest objects to the most significant pixel are the radio sources: **J1318+1807** (1°), **J1315+1736** (1.5°) and **J1328+1744** (1.7°).

Galactic Plane Search for Extended Emission



- The **Galactic Plane search region** is defined as the area with Galactic latitude $|b| < 5^\circ$, and is divided using a HEALPix grid of the same resolution ($N_{\text{side}} = 512$) as the full-sky analysis. Due to the limited visibility of ANTARES of the Northern Sky, some directions with Galactic longitude between 70° and 170° are not surveyed.
- Each **direction is tested with different profiles** for the hypothetical signal emission, assuming a 2D Gaussian with extensions $\sigma_e = 0.5^\circ, 1^\circ, 1.5^\circ$ and 2° .
- The **most significant direction** is found at $(l, b) = (-20.73^\circ, 2.59^\circ)$ for all four tested extensions. The best post-trial p-value is associated to $\sigma_e = 1^\circ$ for a 60% chance of a background fluctuation.
- The skymap above shows the p-value map for $\sigma_e = 1^\circ$ with the hotspot highlighted with a blue box. The **skymaps of events** around the best-fit cluster ($\hat{\mu}_{\text{sig}} = 3.5$) is also shown in **equatorial coordinates** $(RA, \delta) = (248.17^\circ, -44.07^\circ)$. Due to the low significance, no source association was derived.