Exploring the Galaxy at TeV energies: Latest results from the H.E.S.S. Galactic Plane Survey

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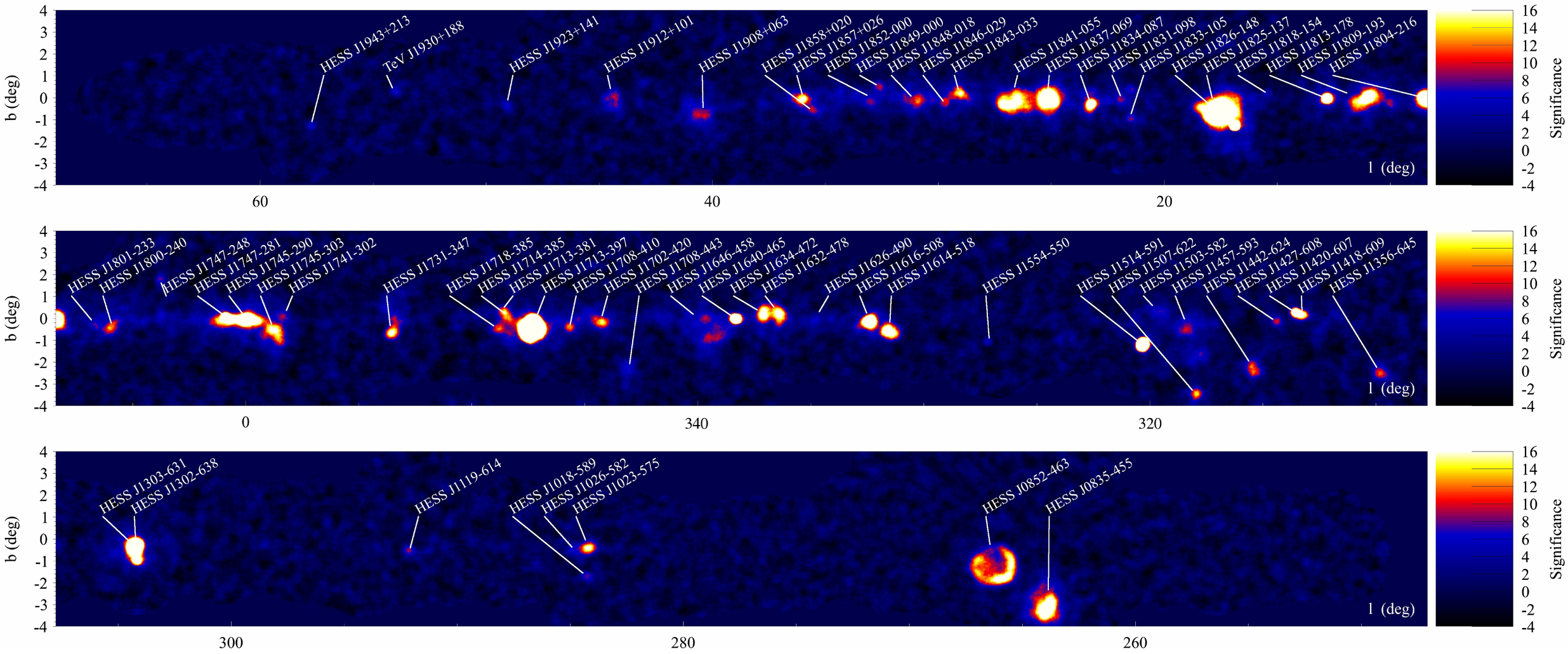
Abstract: The High Energy Stereoscopic System (H.E.S.S.) is an array of four imaging atmospheric-Cherenkov telescopes located in Namibia and designed to detect extensive air showers initiated by γ-rays in the very-high-energy (VHE; E > 0.1 TeV) domain. It is an ideal instrument for surveying the Galactic plane in search of new sources, thanks to its location in the Southern Hemisphere, its excellent sensitivity, and its large field-of-view. The efforts of the H.E.S.S. Galactic Plane Survey, the first comprehensive survey of the inner Galaxy at TeV energies, have contributed to the discovery of an unexpectedly large and diverse population of over 50 sources of VHE γ-rays within its current range of ℓ=250° to 65° in longitude and |b| ≤ 3.5° in latitude. The population of VHE γ-ray emitters is dominated by the pulsar wind nebula and supernova remnant source classes, although nearly a third remain unidentified or confused. The sensitivity of H.E.S.S. to sources in the inner Galaxy has improved significantly over the past two years, from continued survey observations, dedicated follow-up observations of interesting source candidates, and from the development of advanced methods for discrimination of γ-ray-induced showers from the dominant background of hadron-induced showers.

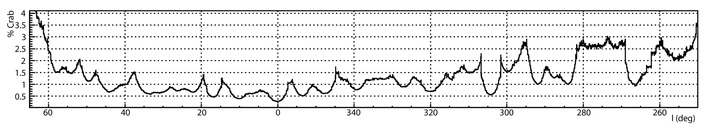


Latest significance map for the H.E.S.S. Galactic Plane Survey. The pre-trials significance for a correlation radius of 0.22° is shown. The colour transition from blue to red corresponds to ~ 5σ post-trials significance. The trial factor takes into account the fact that many sky positions are tested for an excess above the background, thus increasing the chance of finding a random upward fluctuation of the background. The map has been filled for regions on the sky where the sensitivity of H.E.S.S. for point sources (5σ pre-trials, and assuming the spectral shape of a power law with index 2.5) is better than 10% Crab.

H.E.S.S. instrument

- Array of four imaging atmospheric Cherenkov telescopes
- located at 1800 m a.s.l. in the Khomas highlands of Namibia
- stereoscopy: suppress hadronic background at trigger level, improve direction reconstruction
- E_{th} = ~100 GeV
- $\Delta E/E$ = 15%
- 5° field of view, 960 PMTs per camera
- angular resolution ~0.1°

Galactic Plane Survey



Sensitivity of H.E.S.S. to point-like γ-ray sources with an assumed spectral index of 2.5, for a detection level of 5σ pre-trials, at b = -0.3°, the approximate average latitude of Galactic sources.

- large FoV enables systematic scan of Inner Galaxy, ongoing since 2004
- aim: discovery of new γ-ray sources
- ~2300 h of good-quality data
- dataset = scan mode + pointed observations
- hotspot follow-up
- population: supernova remnants, pulsar wind nebulae, unidentified sources, binaries, one extreme BL Lac object?, open star cluster?, globular cluster?
- focus in 2011:
  - sensitivity goal of 2% Crab for core region (ℓ=282° to 60°),
  - deepening exposure in region ℓ=268° to 282°
- extension beyond ℓ=60° and below ℓ=275° shown here for the first time!

New discoveries

VHE γ-ray emission was recently discovered from the following sources discussed at this conference.

- **HESS J1018-589,** coincident with SNR G284.3-1.8 and the associated Vela-like pulsar PSR J1016-5857, counterparts in AGILE and Fermi-LAT [1].
- **HESS J1457-593** [2] and **HESS J1852-000** [8]: potential interaction of cosmic-rays accelerated in an SNR with spatially coincident molecular clouds.
- emission from the direction of PSR J1459-6053, a candidate Pulsar Wind Nebula driven by a rather old (64 kyr) γ-ray pulsar [3].
- **HESS J1554-550** in the direction of the composite SNR G327.1-1.1: SNR shell and central PWN seen in radio and X-rays [4].
- **HESS J1747-248** in the direction of the globular cluster Terzan 5: large population of ms pulsars, very large stellar core density, bright flux in GeV; several possible origins for the VHE gamma-ray source can be discussed [5].
- **HESS J1818-154**: coincident with shell-type SNR G15.4+0.1. VHE γ-ray emission significantly less extended than radio shell [6].
- **HESS J1831-098**: likely associated with PSR J1831-0952, a 67 ms pulsar, less than 1% of spin-down energy required to power VHE emission in PWN scenario [7].

References:

[1] E. de Ona Wilhelmi et al., for the H.E.S.S. Collaboration, ID 332
[2] P. Hofverberg et al., for the H.E.S.S. Collaboration, ID 1272
[3] R. de los Reyes et al., for the H.E.S.S. Collaboration, ID 1139
[4] F. Acero et al., for the H.E.S.S. Collaboration, ID 928
[5] W. Domainko et al., for the H.E.S.S. Collaboration, ID 403
[6] P. Hofverberg et al., for the H.E.S.S. Collaboration, ID 1271
[7] F. Sheidaei et al., for the H.E.S.S. Collaboration, ID 1225
[8] K. Kosack et al., for the H.E.S.S. Collaboration, this conference

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