

Detection of a yet unidentified TeV gamma-ray Source HESS J1303-631 with H.E.S.S.

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Abstract

Following the detection of the binary system PSR B1259-63/SS 2883 at TeV energies (see poster #2404), another TeV source named 'HESS J1303-631' has been discovered serendipitously close to the galactic plane in the same field of view. The data were taken between February and June 2004. Up to now, no counterpart at other wavelengths was found. This makes HESS J1303-631 the second unidentified TeV γ -ray source following TEV J2032+4130 discovered in the Cygnus region by HEGRA.



GeV/TeV gamma-ray observations with the H.E.S.S. Cherenkov telescopes

The H.E.S.S. collaboration operates an array of four imaging atmospheric Cherenkov telescopes (IACTs) in stereoscopic mode in Namibia.

- Energy range: **100 GeV up to ~20 TeV**
- Energy resolution: **~15%**
- Angular resolution: **~0.1 deg** (per event)
- Field of view diameter: **~5 deg**
- Observation technique: illustrated on Fig1a -c.

The large field of view allows for searches for TeV sources in sky regions of $\sim 4 \times 4$ degree per pointing. A detailed description of the data analysis technique can be found in: [Aharonian et al., A&A, submitted (2004) or astro-ph/0411582]

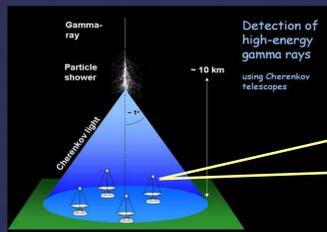


Fig. 1a: The Cherenkov light of an extended air shower is recorded by the H.E.S.S. telescope cameras.

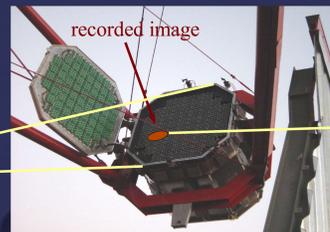


Fig. 1b: Each H.E.S.S. camera consists of 980 photomultiplier tubes and a fast read-out electronic.

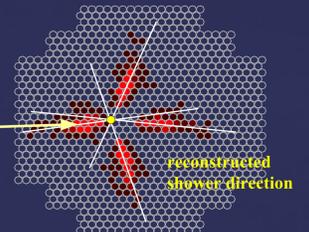


Fig. 1c: Stereoscopic reconstruction of the shower direction from all images in a common coord. system.

Serendipitous discovery of HESS J1303-631

Initial observation were performed on the binary system PSR B1259-63/SS 2883 from February to June 2004.

Shortly after the detection of this binary system at TeV energies, **another highly significant (20 σ) excess** was discovered in the same field of view.

Since this detection of another TeV source was not expected, a variety of consistency checks have been applied and passed successfully to underline the celestial origin of the **discovery of HESS J1303-631**.

For the first time in TeV γ -ray astronomy: two sources in the same field of view.

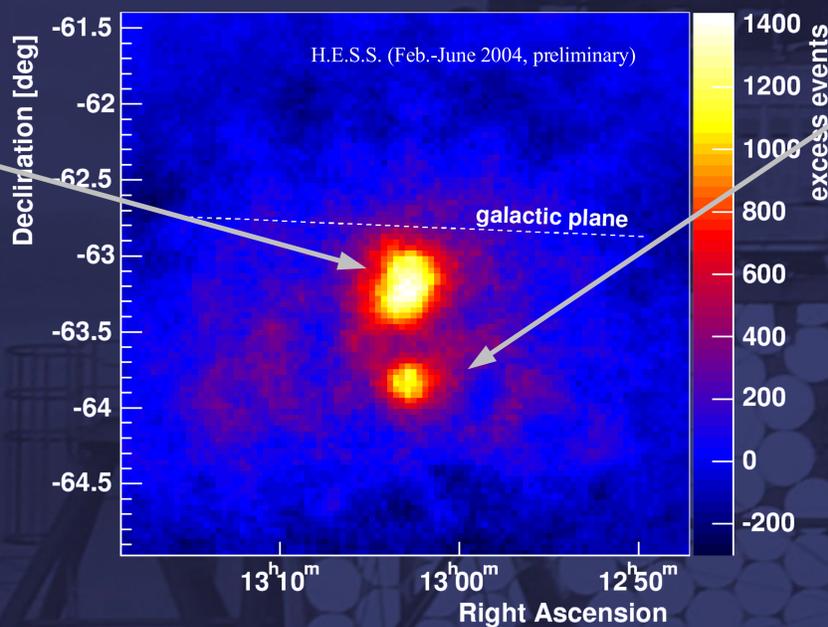


Fig. 2: Discovery skymap showing both TeV sources in the field of view: the binary system PSR B1259-63/SS2883 and the unidentified TeV source HESS J1303-631.

First detection of PSR B1259-63 at TeV energies

More information about the detection of the binary system PSR B1259-63/SS 2883 at TeV energies can be found on: poster #2404.

Analysis results on HESS J1303-631

Excess:
>2000 evens (20 σ)

Sky position (J2000):
2-dimensional free elliptical fit:
 $\alpha = 13^{\text{h}}03^{\text{m}}00.4^{\text{s}} \pm 4.4^{\text{s}}$
 $\delta = -63^{\text{d}}11^{\text{m}}55^{\text{s}}.2 \pm 31^{\text{m}}.1$
(tracking accuracy: $\sim 20''$)

Extension:
Determined from the 1-dimensional excess distribution (see Fig. 3):
 $\sim 0.2^\circ$

Energy spectrum:
Derived with a relaxed angular cut of 0.05 deg^2 (Fig. 4). Power-law fit:
Photon index:
 $\Gamma = 2.3 \pm 0.2_{\text{stat}} \pm 0.2_{\text{syst}}$
Integral flux above 1 TeV:
 $\sim 15\%$ of the flux of the Crab nebula.

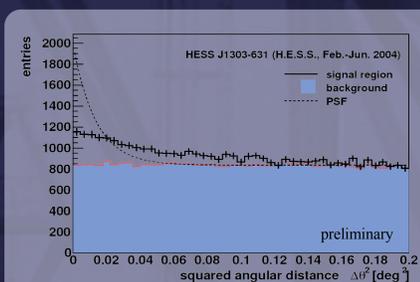


Fig. 3: Distribution of events vs. sq. angular distance $\Delta\theta^2$ between shower direction and object position. The expected distribution for a point-source is indicated by the dotted line. The excess corresponds to a significance of 20 σ .

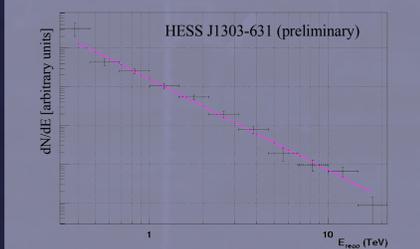


Fig. 4: The differential energy spectrum (in arbitrary units). Power-law fit: photon index of $\Gamma = 2.3 \pm 0.2_{\text{stat}}$

Day-by-day lightcurve:

Fit of a constant function: χ^2/dof of 38/35 is compatible with **constant emission** from HESS J1303-631 during the observed time.

Search at other wavelength:

No obvious counterpart found. This makes HESS J1303-631 the **second unidentified TeV source**, following TEV J2032+4130 discovered by the HEGRA collaboration [Aharonian et al., A&A, 393, L37 (2002)].

Possible TeV production scenarios: will be discussed in a forthcoming paper. [Aharonian et al., A&A, in prep. (2005)]

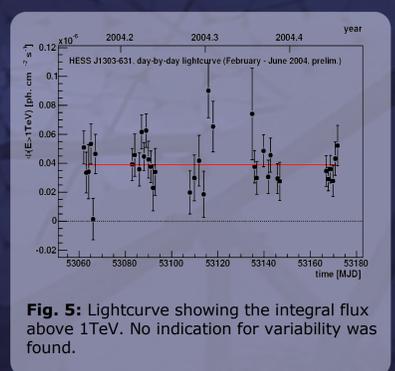


Fig. 5: Lightcurve showing the integral flux above 1TeV. No indication for variability was found.

Conclusions

A yet unidentified TeV γ -ray source named HESS J1303-631 has been serendipitously discovered in a dataset which was initially taken on the also detected binary system PSR B1259-63/SS 2883 (see poster #2404). For the first time in TeV γ -ray astronomy, the detection and analysis of two sources within the same field of view is achieved, showing the potential of the new generation experiments (such as H.E.S.S.) with the stereoscopic observation mode and its large field of view of ~ 5 degree.

Acknowledgements

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