XMM-Newton Observations and Multi-Wavelength Studies of the TeV Source HESS J1427–608

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Abstract
The TeV gamma-ray source HESS J1427–608 was discovered during the H.E.S.S. Galactic Plane Survey. At the time, there was no evidence for a counterpart at other wavelengths, and it was therefore considered a dark, or unidentified, source. In this contribution, we present a new multi-wavelength view of this enigmatic source. Furthermore, additional H.E.S.S. observations have nearly doubled the exposure in the TeV domain, confirming earlier results. In order to investigate the keV X-ray environment in the direction of the TeV gamma-ray emission, dedicated observations were carried out with XMM-Newton. The results of a search for both point-like and diffuse X-ray emission will be shown. Archival radio data at 843 MHz from the Molonglo Galactic Plane Survey and 165-MHz radio emission were also analysed to complement the high-energy view of this source and to search for any evidence of a coincident molecular cloud. We describe the spectral energy distribution with models for leptonic and hadronic emission. Different scenarios for the nature of this source, in particular a hypothetical pulsar wind nebula, will be discussed.

The TeV source HESS J1427–608

- discovered in the H.E.S.S Galactic Plane survey
- no counterpart at other wavelengths [Aharonian et al. 2008]
- new data since discovery
- currently 36th exposure
- source extended
  - RA: 14:27:25.8±0.2; Dec: 60°50′35″±41″
  - intrinsic extension (corrected for the instrument’s resolution): 0.08 x 0.07° (10 pc 2-dimensional Gaussian source profile)
- smoothed HESS excess map (colour scale: excess counts)
  - 4 and 6σ significance contours (green)
  - intrinsic source size (best fit value, black circle)
  - spectrum extraction region (white circle)

Search for X-ray counterpart

[XMM-Newton observations
- ObsID 0504990101
- 24ks exposure (15ks after flare removal)
- several point-like sources
- XMM J142754–6051.1 in centre of TeV source, could be related to TeV source
- two faint (0.02–0.02 etau/s) for detailed energy spectrum

Spectral Energy Distribution

- data points:
  - radio MGPS J142755–605038 (black triangle)
  - X-ray upper limit (blue line)
  - Fermi (blue line):
    - no counterpart in the 1st catalogue
    - the spectral data of the faintest source in 1st catalogue which is less than 5′ from Galactic Plane (1FGL J0513.0+4048)
  - HESS (black circles)
- leptonic model:
  - electron spectrum with index 1.6 and exponential cut-off at 9 TeV
  - magnetic field of 3μG, inverse Compton scattering off CMB
- hadronic model:
  - proton spectrum with index 2.0 and exponential cut-off at 28 TeV

Discussion

- TeV source with possible radio counterpart (angular size not matching)
- X-ray point-like source possibly related, no diffuse X-ray emission → upper limit on flux
- Fermi TeV/GeV (Fermi) counterpart
- leptonic model likely: hypothetical pulsar wind would need spin-down power of ~10³⁰ (d1 kpc) erg s⁻¹
- Fermi non-detection disfavours hadronic model, further detailed analysis necessary

The X-Ray Universe 2011
Berlin, Germany, 27 – 30 June 2011
poster E06

Bibliography

The H.E.S.S. Detector

- High Energy Stereoscopic System
- 4 Imaging Atmospheric Cherenkov telescopes
- 107m mirror surface each
- photo-tube camera with 960 pixels
- 5° field of view
- energy range: >100 GeV up to several 10 TeV
- single shower resolution better than 0.1°
- energy resolution ~15%