Fermi-Large Area Telescope Observations of the region of MSH 15-52

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on behalf of the Fermi Large Area Telescope Collaboration

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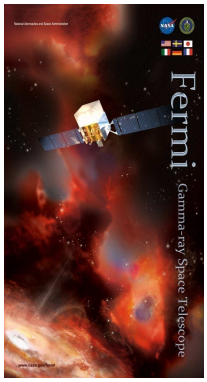
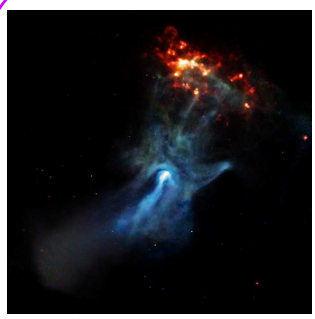


Summary: The results of the spatial and spectral analyses of the high energy gamma-ray emission observed in the region of the pulsar PSR B1509-58 and the supernova remnant MSH 15-52 are reported. A source spatially coincident with the pulsar wind nebula of MSH 15-52 is detected by the Fermi-LAT collaboration at a ~8 σ level.

Abstract

MSH 15-52 is a composite supernova remnant associated with the young energetic pulsar PSR B1509-58. The latter powers a bright X-ray and TeV pulsar wind nebula (PWN). EGRET observations of this region ended in a marginal source detection around the pulsar in sub-GeV energies. Using 1 year of survey data with the Large Area Telescope (LAT) onboard Fermi, significant high energy emission positionally coincident with PSR B1509-58 and the nebula is detected. We will report on the results of the spatial and spectral analyses of the gamma-ray emission observed in the region of the PWN MSH 15-52.

Introduction

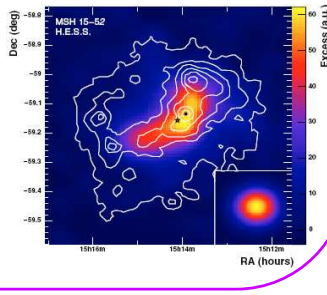


Top : A young pulsar shows its hand (Chandra, credit: NASA/CXC/SAO/P.Slane, et al.)

MSH 15-52 (aka SNR G320.4-1.2) is a young composite supernova remnant associated to the radio loud pulsar PSR B1509-58. This pulsar powers a bright X-ray and TeV pulsar wind nebula (PWN).

Pulsations were reported in γ-rays by CGRO COMPTEL in the 0.75-30 MeV energy range and by AGILE above 100 MeV.

The PWN is observed as extended:
- in X-rays (ROSAT, 10'*6')
- at TeV energies (H.E.S.S., 6.4'*2.3'



Right : H.E.S.S. smoothed excess map (Aharonian et al. 2005) . The white contours represent the PWN emission as seen by ROSAT (Trussoni et al. 1996) . The black point and black star lie at the pulsar position and at the excess centroid, respectively.

Fermi-LAT data analysis

Data selection :
- Time interval : August 4, 2008 to August 14, 2009
- Region of interest of 15° around the radio position of pulsar PSR B1509-58
- Events from the "Diffuse" class (highest quality photon data).

Temporal analysis performed on PSR B1509-58 using an ephemeris provided by the Parkes radio-telescope.

Morphological and spectral analyses are performed using two spectral methods :
- A maximum-likelihood method implemented in the *Fermi* Science Support Center science tools, *gtlike*
  - Bright (significance level larger than 5s) nearby sources taken into account
  - Galactic diffuse emission, extragalactic and instrumental background described by GALPROP and a single isotropic component respectively
  - Unbinned and binned analyses are performed on the entire energy range and in individual energy bins respectively.
- An analysis tool developed by the *Fermi*-LAT collaboration, *sourcelike (see poster ID P5 - 193)*, allowing the estimation of the position and the size of the source, assuming a spatial and spectral model for the diffuse emission and different morphologies.

References

Aharonian, F. A., et al. 2005, Astron. & Astrophys., 435, L17

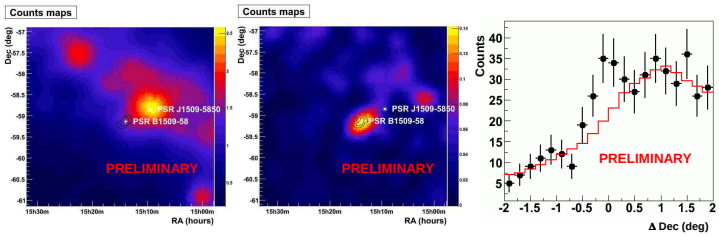
Nakamori, T., et al., 2008, ApJ, 677, 297

Trussoni, E. et al., 1993, Astron. & Astrophys., 306, 581

Results

A source spatially coincident with the PWN MSH 15-52 is detected at a ~8 σ level above 1 GeV, with a hard spectrum.

Morphological and spectral studies were performed to estimate the significance of the source extension and its spectral shape. They are reported in an upcoming paper by the *Fermi*-LAT collaboration.



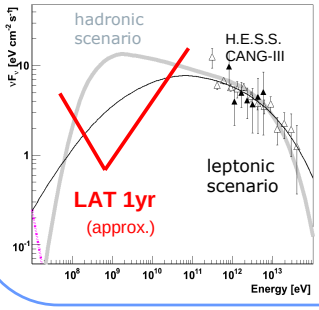
Left and *Middle:* LAT Counts maps above 1 GeV and 10 GeV. The H.E.S.S. contours of the PWN MSH 15-52 are overlaid in black. The positions of the pulsars PSR J1509-5850 and PSR B1509-58 are marked by white stars.
Right : Profile along Declination axis above 1.6 GeV (0 degree corresponds to the position of PSR B1509-58). The red histogram represents the background level.

Spectral modeling

The study of the PWN MSH 15-52 in the *Fermi*-LAT energy range (100 MeV – 300 GeV for spectral analyses) is required to constrain the emission model, and distinguish between the hadronic and leptonic scenarii.

The *Fermi*-LAT observations during the first year yield a spectrum nicely linking the Cherenkov spectral results.

Leptonic gamma rays seems to be favored from an energetic point of view.



High energy to very high energy spectral energy distribution of the PWN MSH 15-52. The expected LAT sensitivity is shown in red. H.E.S.S. and CANGAROO spectral points are taken from Aharonian et al. (2005) and Nakamori et al. (2008) respectively.

1-zone emission model curves in Nakamori et al.(2008) are also presented. In the leptonic model Inverse Compton scattering on IR dust emission is dominant.

Conclusions

A source spatially coincident with the PWN of MSH 15-52, powered by the young energetic pulsar PSR B1509-58, is detected using 1 year of LAT survey data.

Morphological and spectral analyses are reported in an upcoming paper by the *Fermi*-LAT collaboration. The analyses indicates a source slightly extended in comparison to the instrumental point spread function.

The analysis of the PWN MSH 15-52 in this high energy range source is of particular interest, providing new elements to the discussion concerning the processes responsible of the observed emission.