Shell like Supernova Remnants observed with *Fermi*-LAT

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on behalf of the Fermi LAT collaboration

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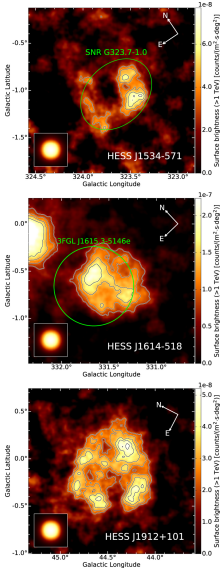
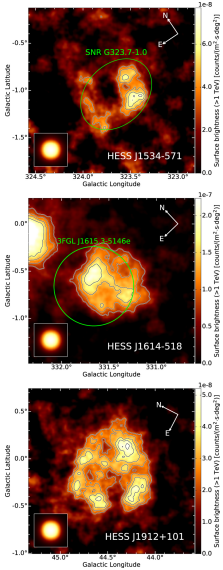
Introduction



- Three candidate Shell SNRs in H.E.S.S.Collab. et al., A&A 2018.
- detected in the HGPS dataset for their shell-shape.
- All three are detected by *Fermi*-LAT as extended in the `4FGL`
- HESS J1534−571 is the only one with a possible MW counterpart SNR G323.7−1.0 in Radio.
- HESS J1534−571 has a possible partial X-rays counterpart in Suzaku data (Saji, S. et al., 2018, PASJ)
- HESS J1534−571 previous *Fermi*-LAT analysis in Araya, M. ApJ 2017

Introduction



- In this talk we will discuss about HESS J1534−571 and HESS J1614−518
- HESS J1912+101 will be discussed in the following talk by Dr. D. Green

Data Selection and Software

- 10.5 yrs of P305 *Fermi*-LAT data;
- Bright Flares and GRBs removed as for the `4FGL`;
- Spatial and spectral analysis energy range: 1 - 2000 GeV ;
- Spectral analysis energy range: 0.1 - 2000 GeV ;
- RoI = 10° (14°) above 1 GeV (between 0.1 and 1 GeV);
- ST version 11-07-00, fermipy version 0.17.4;
- Summed likelihood analysis with the different PSF event types (4 components above 1 GeV, plus 3 from 0.1 and 1 GeV, PSF0 is dropped);
- Energy dispersion is applied;

Background

- Background sources from `4FGL` plus new ones added automatically with *fermipy*;
- Diffuse backgrounds: Interstellar Emission Model with template `gll_iem_v07.fits` and Isotropic with spectrum `iso_P8R3_SOURCE_PSF[0/1/2/3]_V2_v1.txt`;
- The sources are spectrally modeled with a PL2, LP and BPL and spatially adopting their `4FGL` model, a RadialDisk, a RadialGaussian and the H.E.S.S.template.
- Systematic errors on the SED are evaluated using the alternative Interstellar Emission Models technique developed for the first *Fermi*-LAT SNR catalog.

HESS J1534−571 Analyses (1-2000 GeV)

Name	shape	R.A. deg.	Dec. deg.	68% containment radius deg.	TS ext
J1534-471	RadialDisk	233.69 ± 0.05	-57.19 ± 0.05	0.35 ± 0.03	57.5
J1534-471	RadialGauss	233.73 ± 0.06	-57.28 ± 0.05	0.33 ± 0.03	50.7
4FGL J1533.9-5712e	RadialDisk	233.5	57.2	0.328	

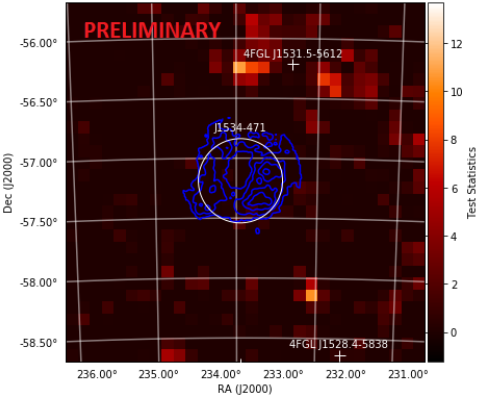
Table: Morphological Analysis

Name	shape	flux $ph\ cm^{-2}\ s^{-1}$	index	TS
J1534-471	H.E.S.S. map	2.16e-10 ± 1.16e-10	-1.251 ± 0.190	64.1
J1534-471	RadialDisk	2.14e-10 ± 7.84e-11	-1.253 ± 0.119	61.8
J1534-471	RadialGauss	2.03e-10 ± 7.34e-11	-1.251 ± 0.116	57.2
4FGL J1533.9-5712e	RadialDisk	2.02e-10 ± 8.42e-11	-1.255 ± 0.148	54.0

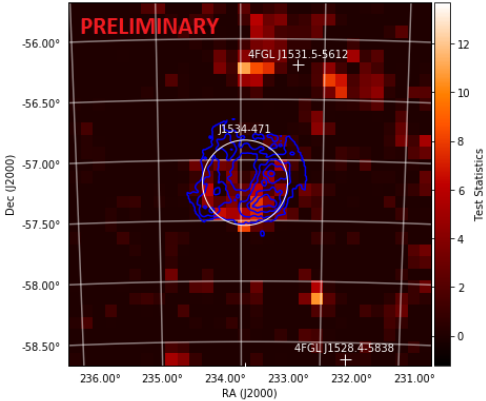
Table: Spectral Analysis

HESS J1534−571 TS maps (1-2000 GeV)

TS maps evaluated modelling the SNR with the H.E.S.S. template



HESS J1534−571 in the model



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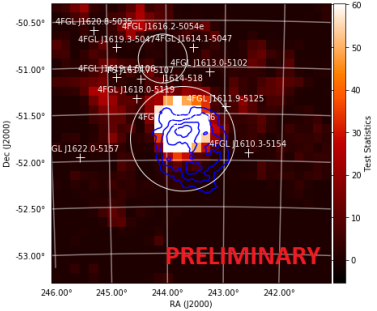
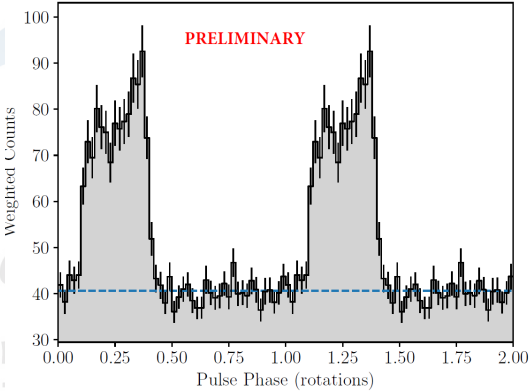
PSR J1615−5137 discovery and analysis





- Strong residuals if we use only an extended source.
- With a blind analysis, we found a new γ-ray pulsar, PSR J1615−5137.
- On- and off-phase selections as phases 0 to 0.5, and 0.5 to 1, respectively

HESS J1614−518 Analyses (1-2000 GeV)

Name	shape	R.A. deg.	Dec. deg.	68% containment radius deg.	TS ext
J1614-518	RadialDisk	243.64 ± 0.02	-51.83 ± 0.02	0.38 ± 0.01	378.6
J1614-518	RadialGauss	243.72 ± 0.03	-51.77 ± 0.03	0.56 ± 0.03	454.9
4FGL J1615.3-5146e	RadialDisk	243.83	-51.78	0.42	

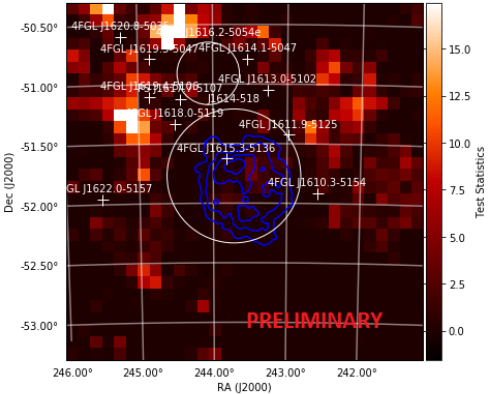
Table: Morphological Analysis

Name	shape	flux $ph\ cm^{-2}\ s^{-1}$	index	TS
J1614-518	H.E.S.S. map	4.28e-09 ± 2.56e-10	-1.757 ± 0.023	481.9
J1614-518	RadialDisk	4.75e-09 ± 5.69e-10	-1.772 ± 0.052	497.6
J1614-518	RadialGauss	8e-09 ± 4.97e-10	-1.816 ± 0.024	620.4
4FGL J1615.3-5146e	RadialDisk	4.43e-09 ± 2.68e-10	-1.786 ± 0.021	470.1

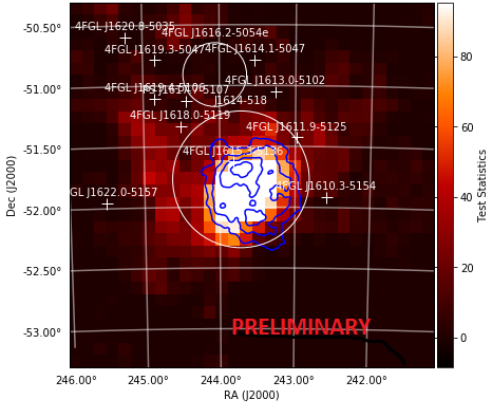
Table: Spectral Analysis

HESS J1614−518 TS maps (1-2000 GeV)

TS maps evaluated modelling the SNR with the RadialGaussian template



HESS J1614−518 in the model



HESS J1614−518 removed

Conclusions

- HESS J1534−571 is best described with the H.E.S.S. template and it has a simple PL spectrum. The different spectral index measured by *Fermi*-LAT and H.E.S.S. suggests that a curved model is required to describe the MeV-TeV SED.
- A blind pulsar search for a point source inside HESS J1614−518 led to the discovery of a new gamma-ray pulsar, PSR J1615−5137.
- HESS J1614−518 is best described with a RadialGaussian template and it has a curved spectrum.
- Given the presence of this new PSR and the Gaussian shape of HESS J1614−518 at GeV energy it is plausible that its emission is actually related to a PWN, further studies will be needed.
- The work on this paper is ongoing and hopefully submitted soon