

Fermi- LAT

AAS Austin Jan 11 2012

Fermi Gamma-Ray Space Telescope - LAT:

LS I +61 303 & LS5039
At 2.5 Years

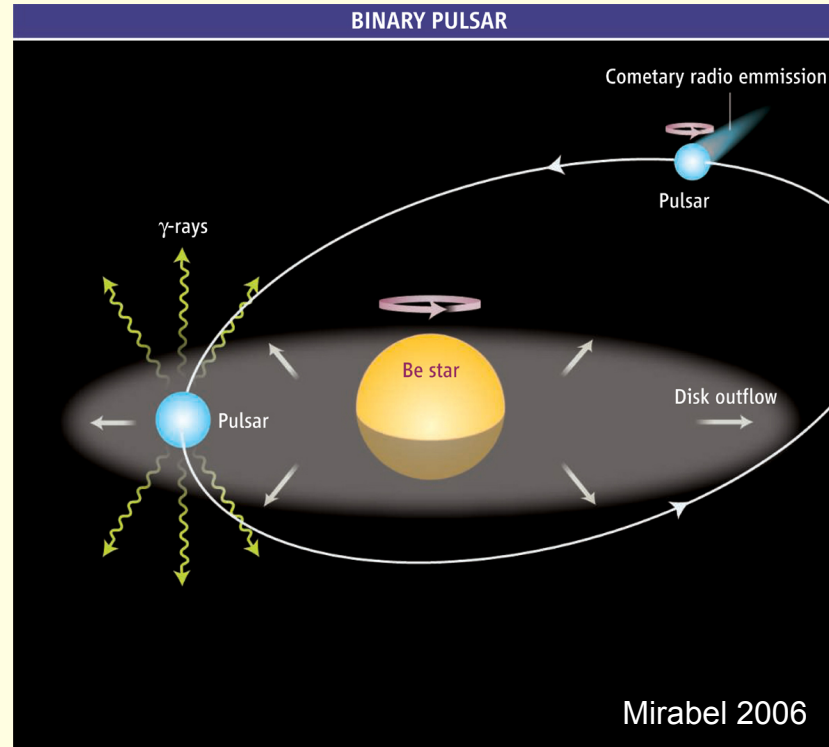
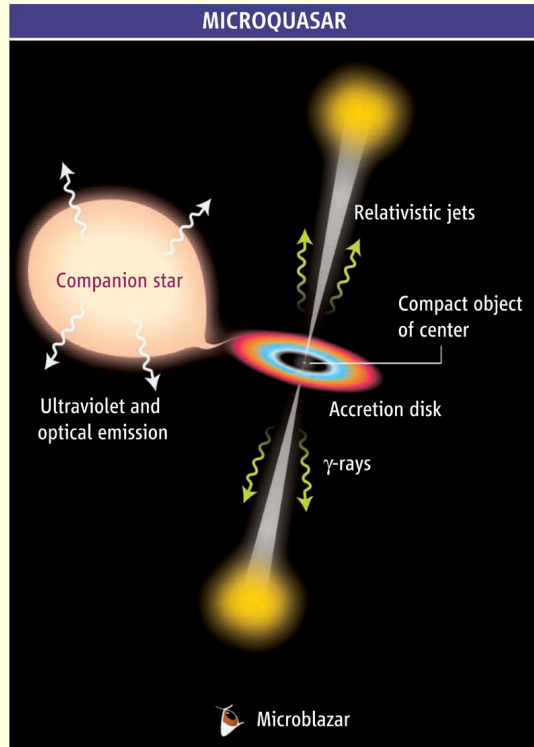
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for the LAT Collaboration



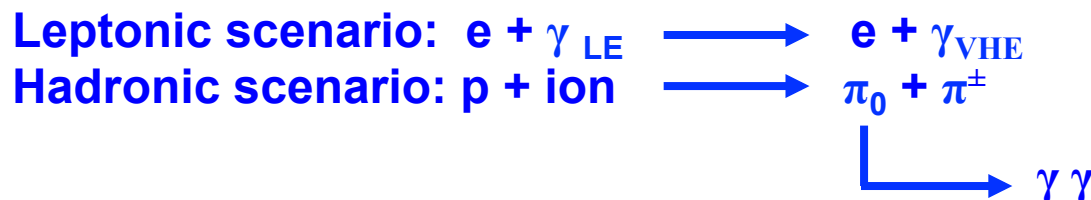
Submitted to ApJ - Daniela Hadasch contact author

Microquasars or binary pulsars?



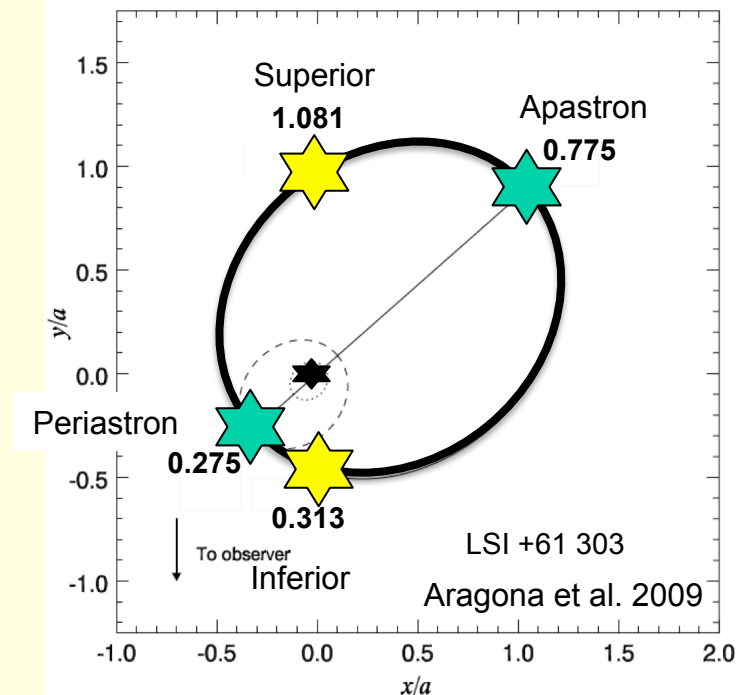
γ_{LE} : synchrotron radiation or from star
 e^- and p : accelerated in the jet
 ion : from companion star

γ_{LE} : from companion star
 e^- and p : from relativistic pulsar wind
 ion : from companion star

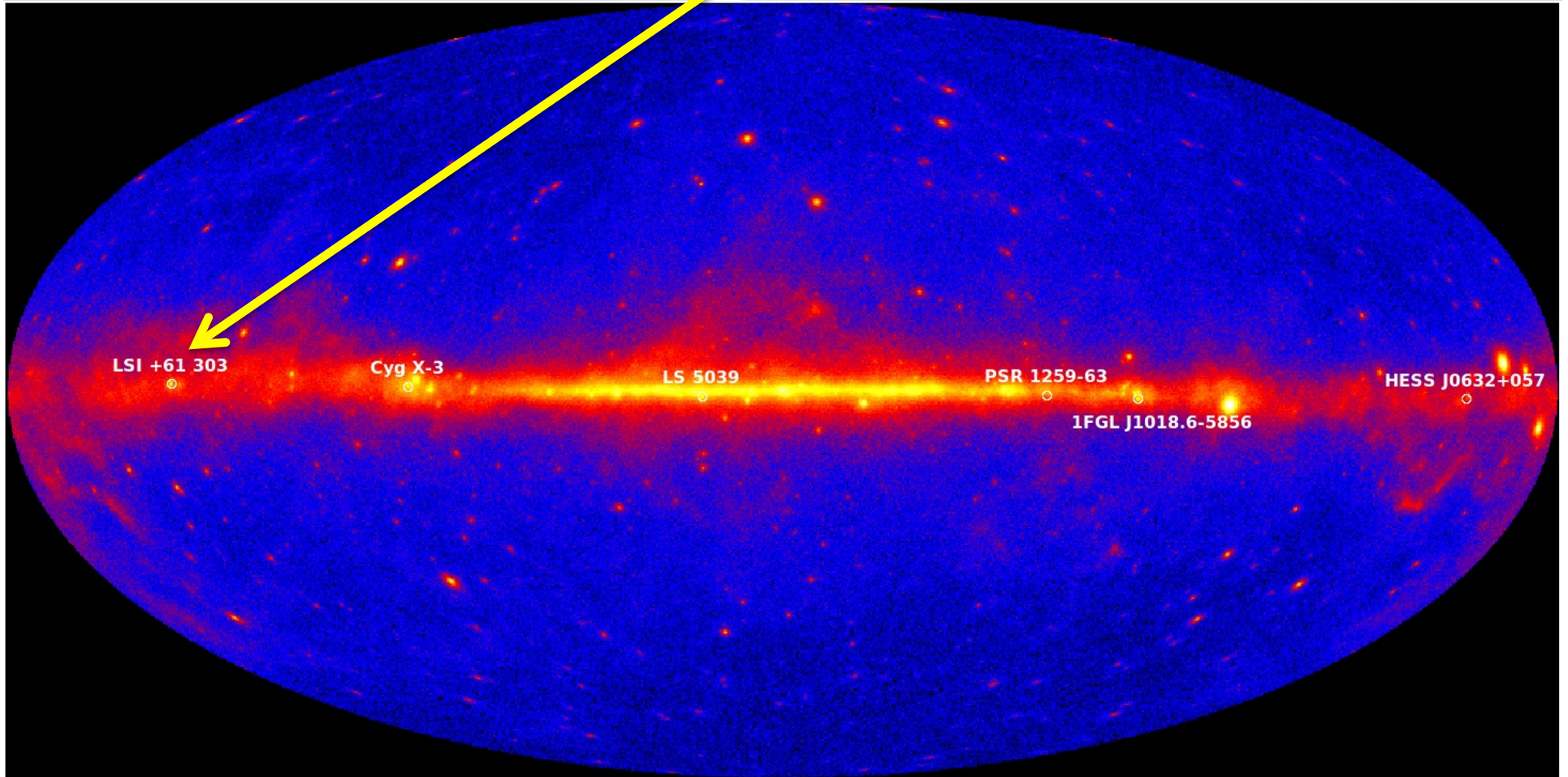


Binary Systems Phase Definitions

- **Inferior conjunction**
 - Compact object in **front of the star** with respect to the observer
 - Forward scatter: less flux, more energy
- **Superior conjunction**
 - Compact object **behind the star** with respect to the observer
 - Backscatter: Kinematics increase flux, but decrease energy
- **Periastron**
 - Compact object and star **closest** to each other
 - Brighter “target”
- **Apastron**
 - Compact object and star **furthest** away from each other
 - Dimmer “target”



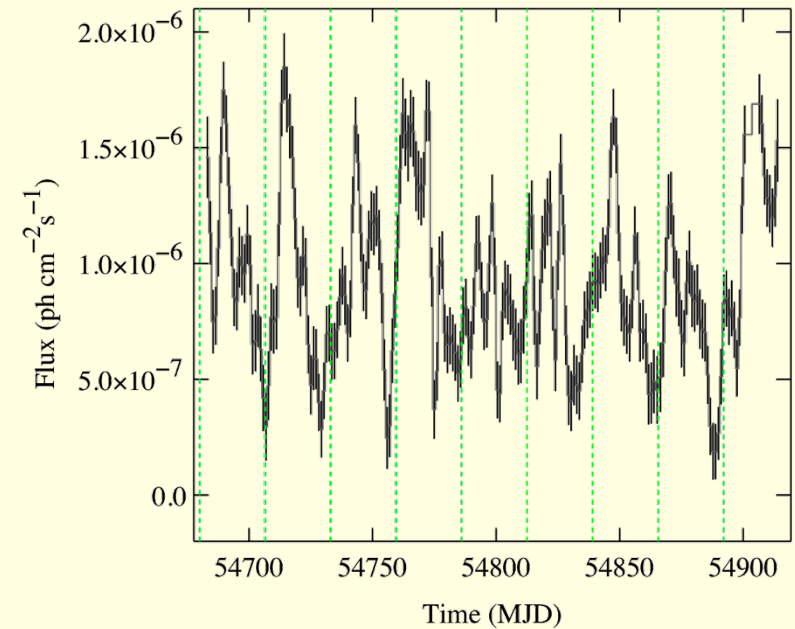
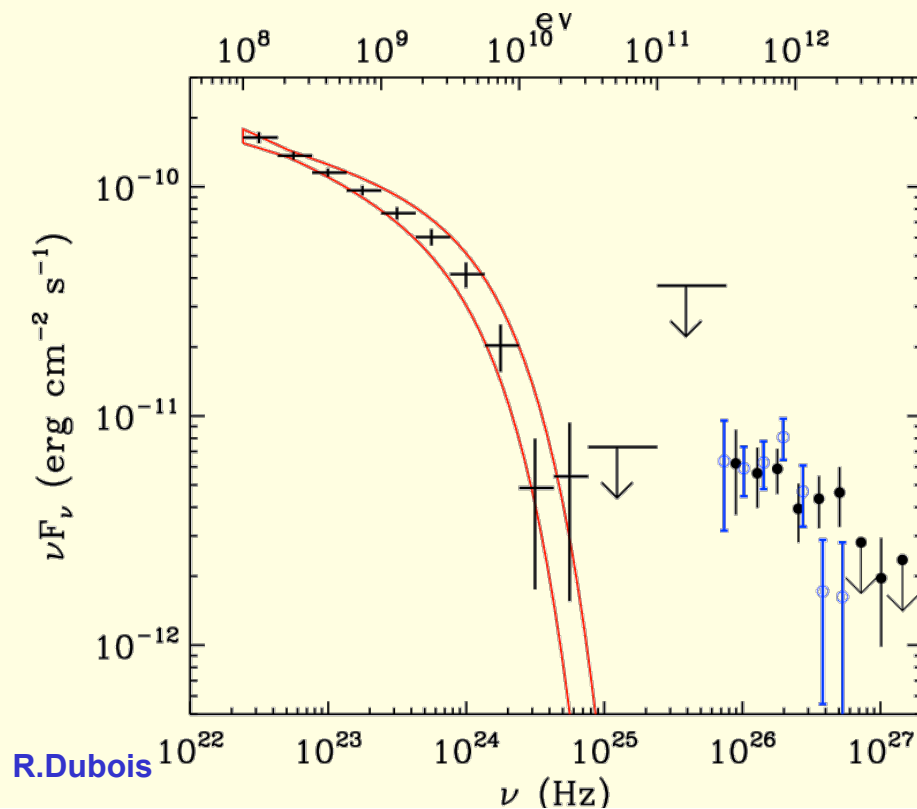
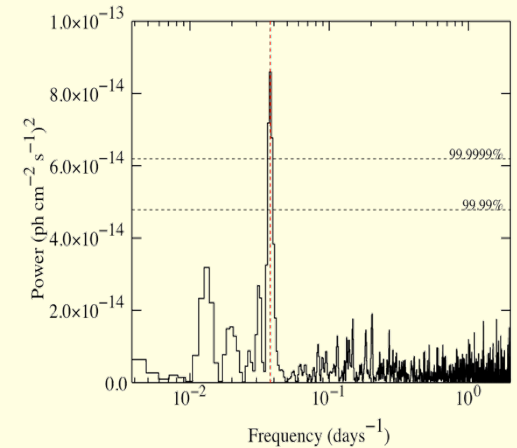
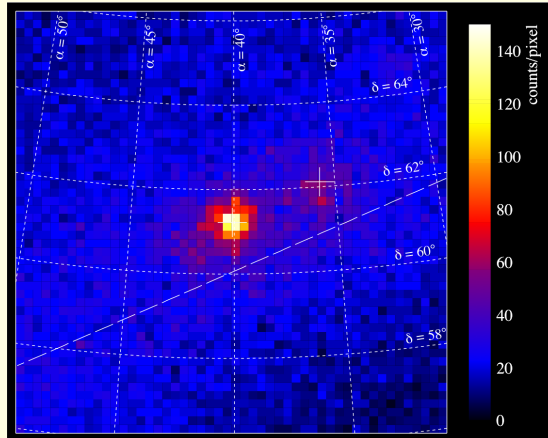
LS I +61 303



LS I +61° 303 – First 8 months

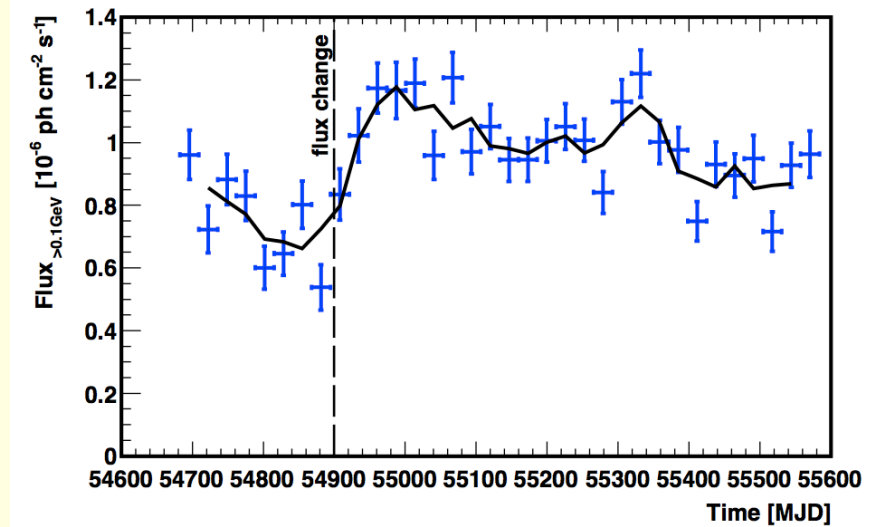
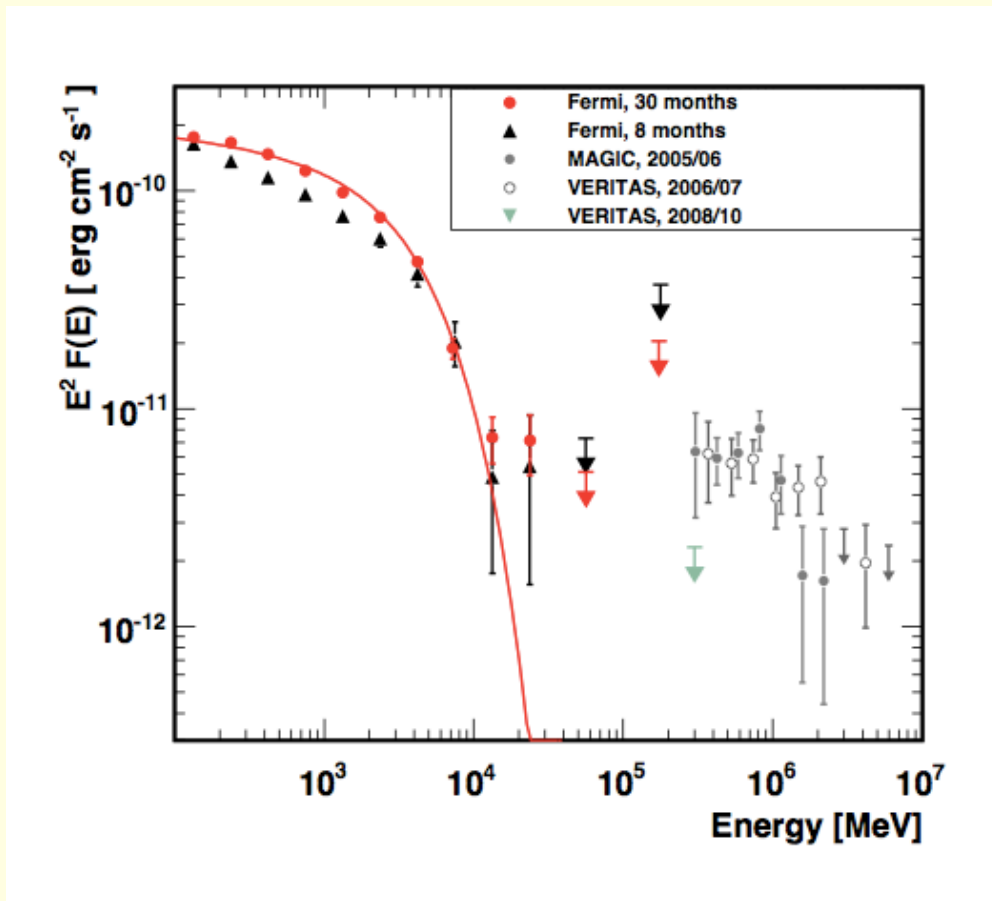
ApJL: 701 (2009) L123-L128

- **LS I +61° 303** was detected at $\sim 70\sigma$
- Periodicity found at **26.6 ± 0.5 days**
- Exponential cutoff spectrum



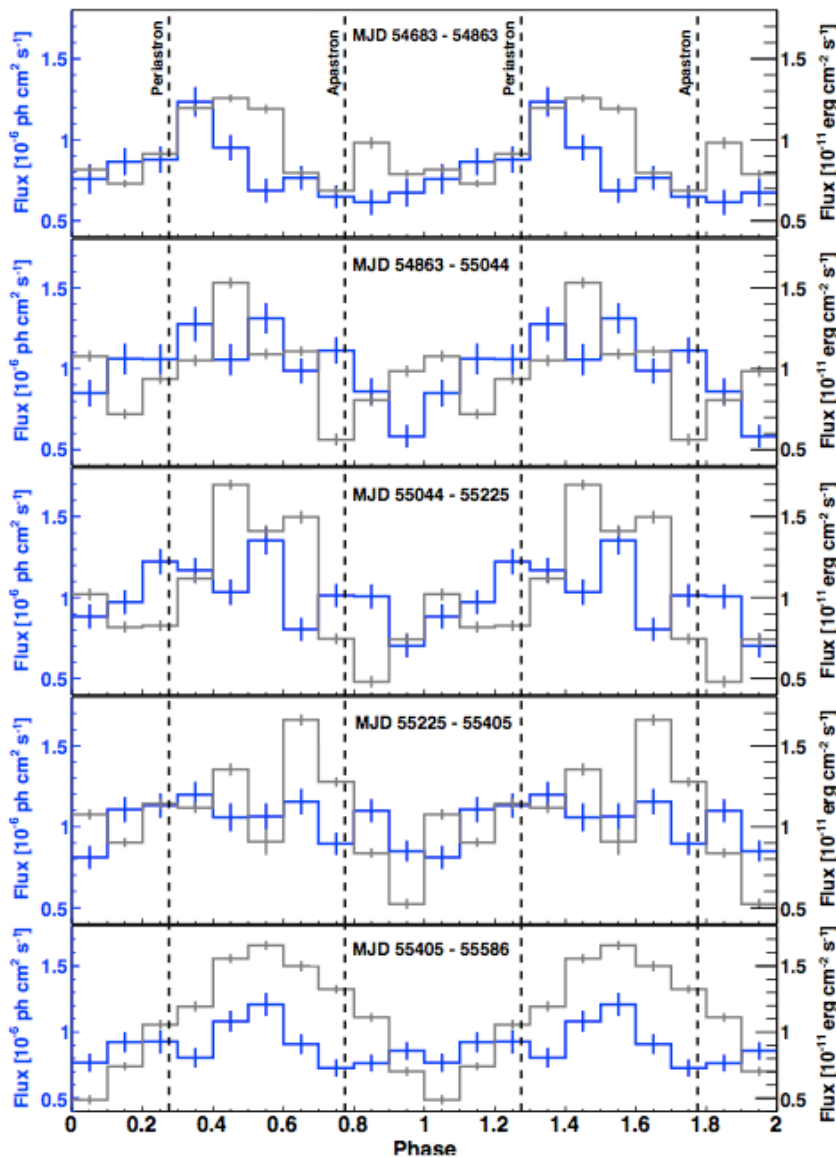
What's New - LSI – flux change

- 2 ½ years of data: Aug 08 - Jan 11
 - Flux rose ~30% in March 2009
 - 8 σ evidence for high energy PL component



Cannot say whether related to 4-yr super-orbital period

LSI Modulation: GeV and X-ray

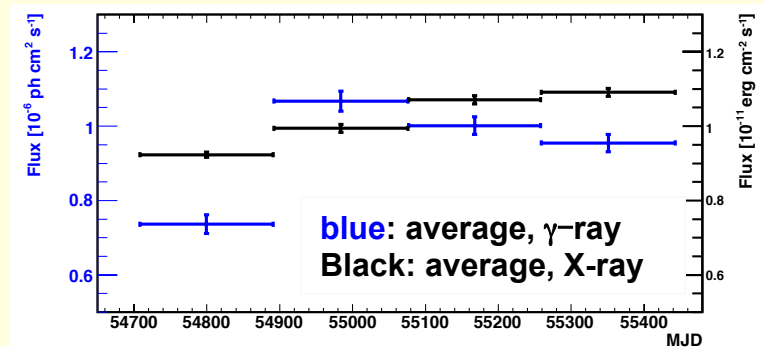


Folded **gamma-ray** light curves in half year bins:

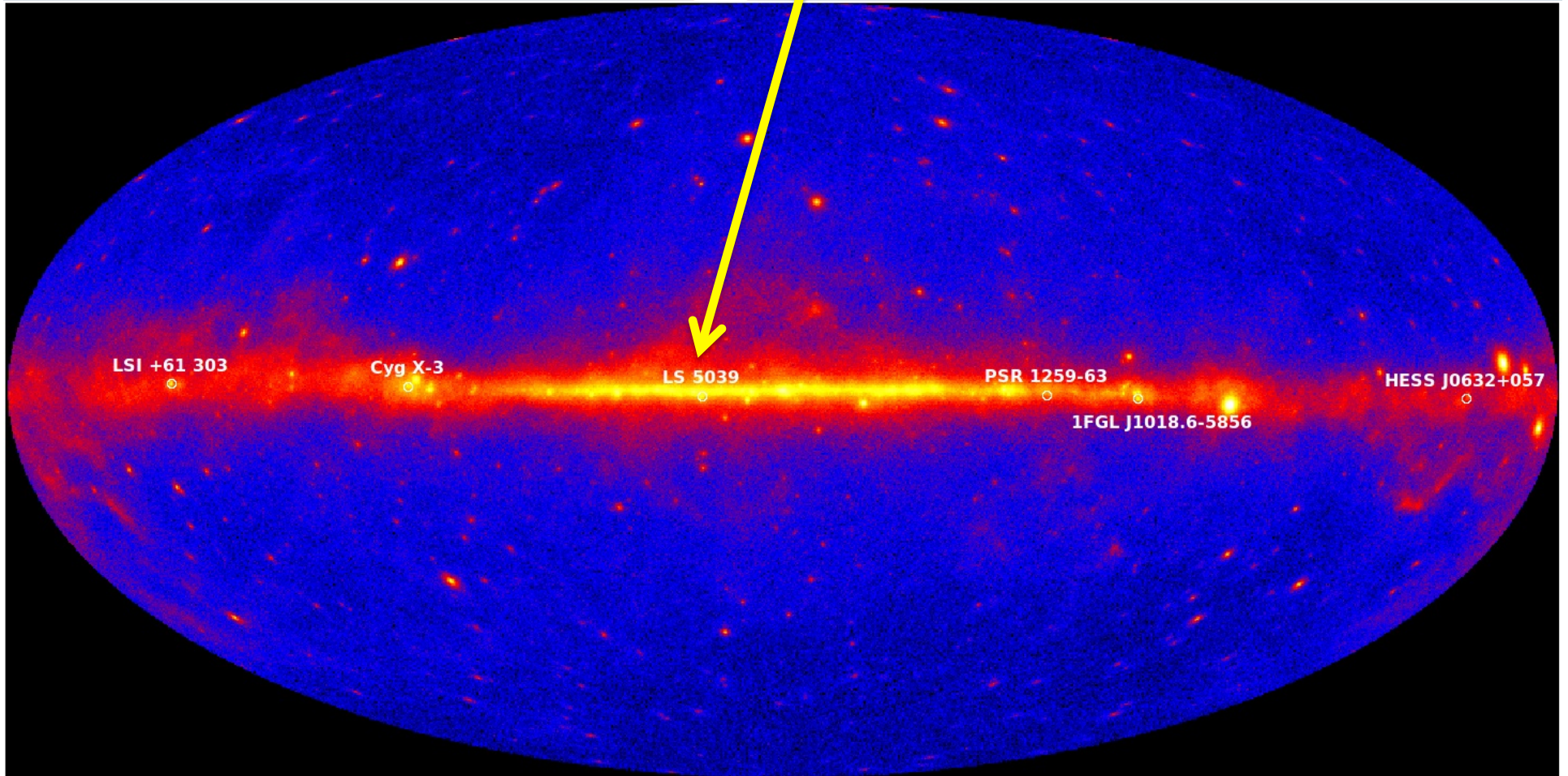
- **Modulation** gets fainter
- **Flux** increased after 1. half year

Folded **X-ray** light curves in half year bins:

- **Modulation** highly variable
- **Flux** increases

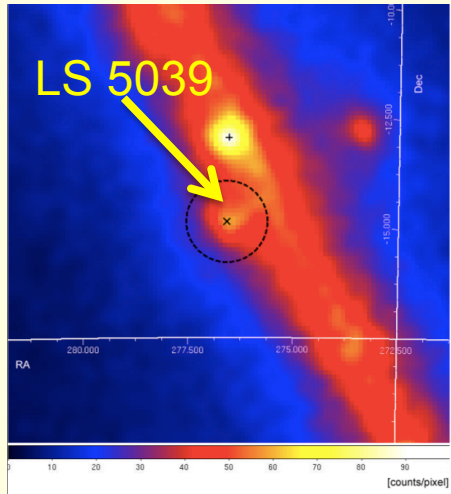


LS 5039

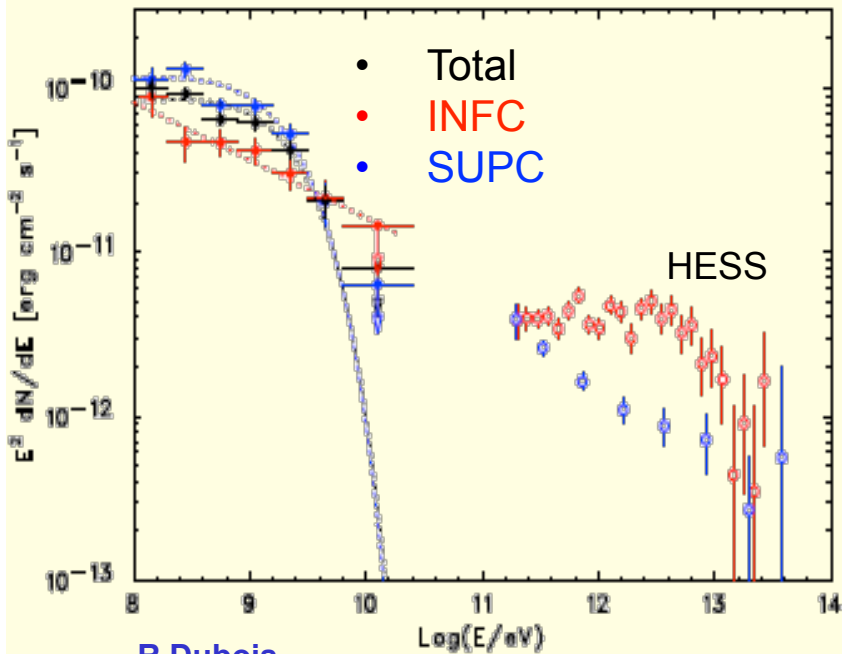
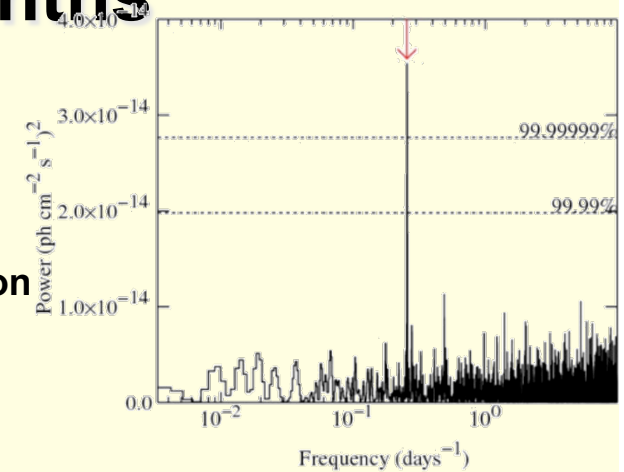


LS 5039 – First 10 months

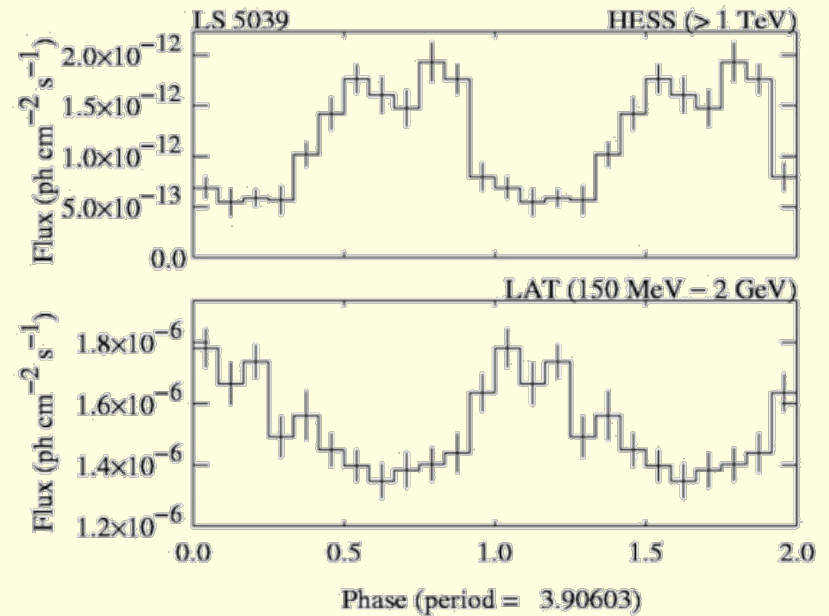
ApJL 706 (2009) L56



- LS5039 detected at $\sim 28\sigma$
 - It sits in a bath of galactic diffuse emission
 - Periodicity found at 3.91 days
 - Exponential cutoff spectrum
- Faint compared to Galactic plane and also emission from nearby pulsar PSR 1826-1256



R.Dubois

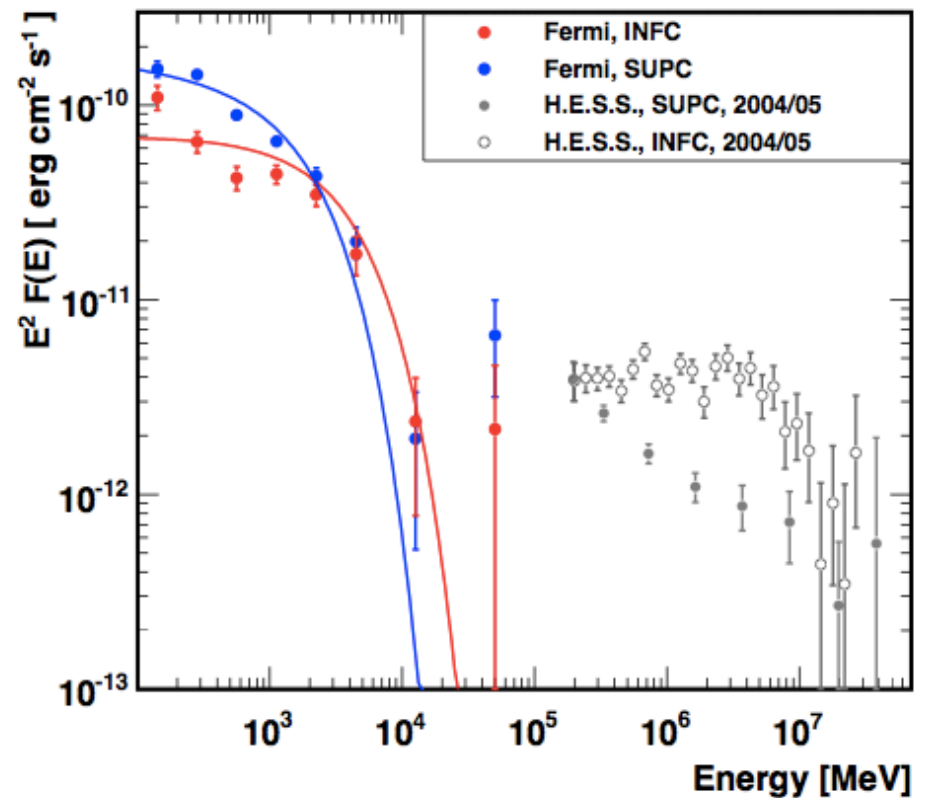
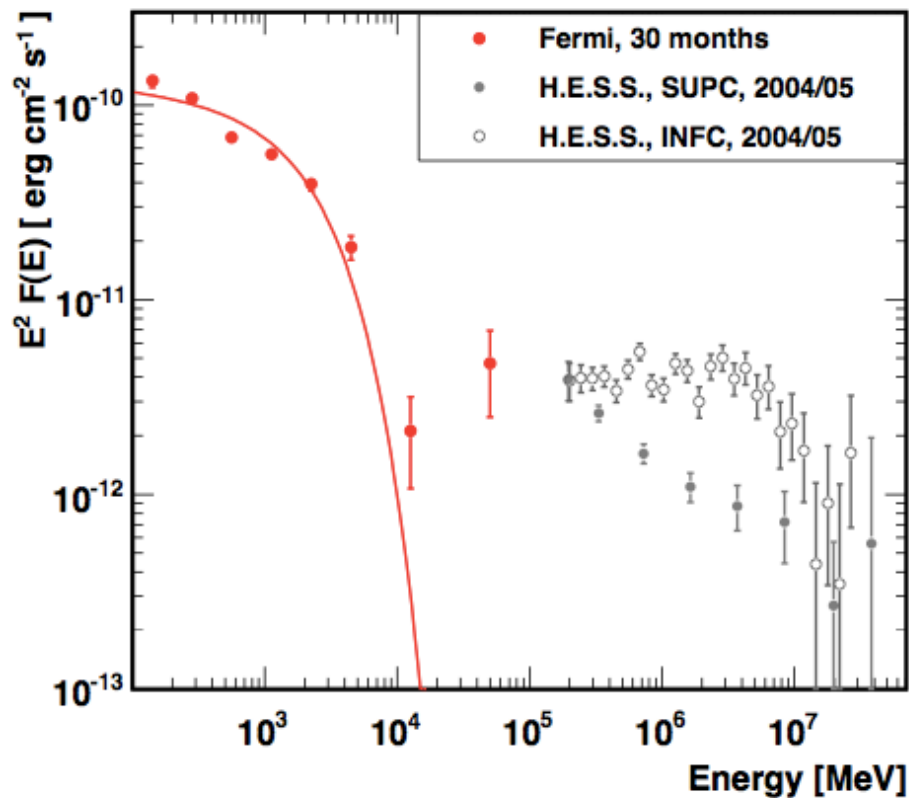


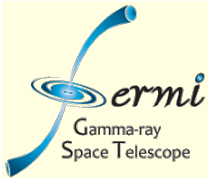
9/12

What's New - LS 5039 - spectra

- New data set: 2 ½ years (Aug 2008 – Jan 2011)
- **Additional data points** at higher energies (4.5σ)
- Separated in inferior and superior conjunction
 - **exponential cutoff at superior conjunction**
 - now enough statistics at **inferior conjunction** to confirm exponential cutoff there, too

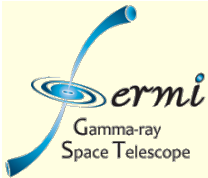
Flux and orbital modulation unchanged





Commentary

- **Fermi sees 3 gamma-ray binaries, and does not see HESS J0632**
 - **All the binaries behave differently**
- **All the gamma-ray binaries show an exponential cutoff**
 - **Seductive to associate them with the pulsars Fermi has been finding**
 - **BUT: magnetospheric emission is not expected to depend on the orbit!**
 - **Could we be seeing two components?**
 - **Striped wind – modulated/cutoff (Dubus & Petri 2011)**
 - **Pulsar wind nebula for VHE**
 - **Propellor flipflop (Torres et al 2011)**
- **Detailed differences in behaviour**
 - **More than inverse Compton scattering going on?**



Summary

- **LS I +61° 303**
 - showed a ~30% flux change in March 2009
 - Cutoff stable for different phases
 - Orbital modulation has faded away with time
 - Significant emission at highest energies
- **LS5039**
 - continues to show clear orbital modulation, stable over 2.5 years of monitoring
 - Spectral parameters stable
 - Peak emission around periastron
 - Significant emission at highest energies
- **Monitoring is ongoing**
- **Modeling is ongoing**