

Fermi's view of the gamma-ray sky above 10 GeV

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for the LAT Collaboration

A. Domínguez, M. Ajello, B. Lott, S. Cutini, P. Fortin, et al.

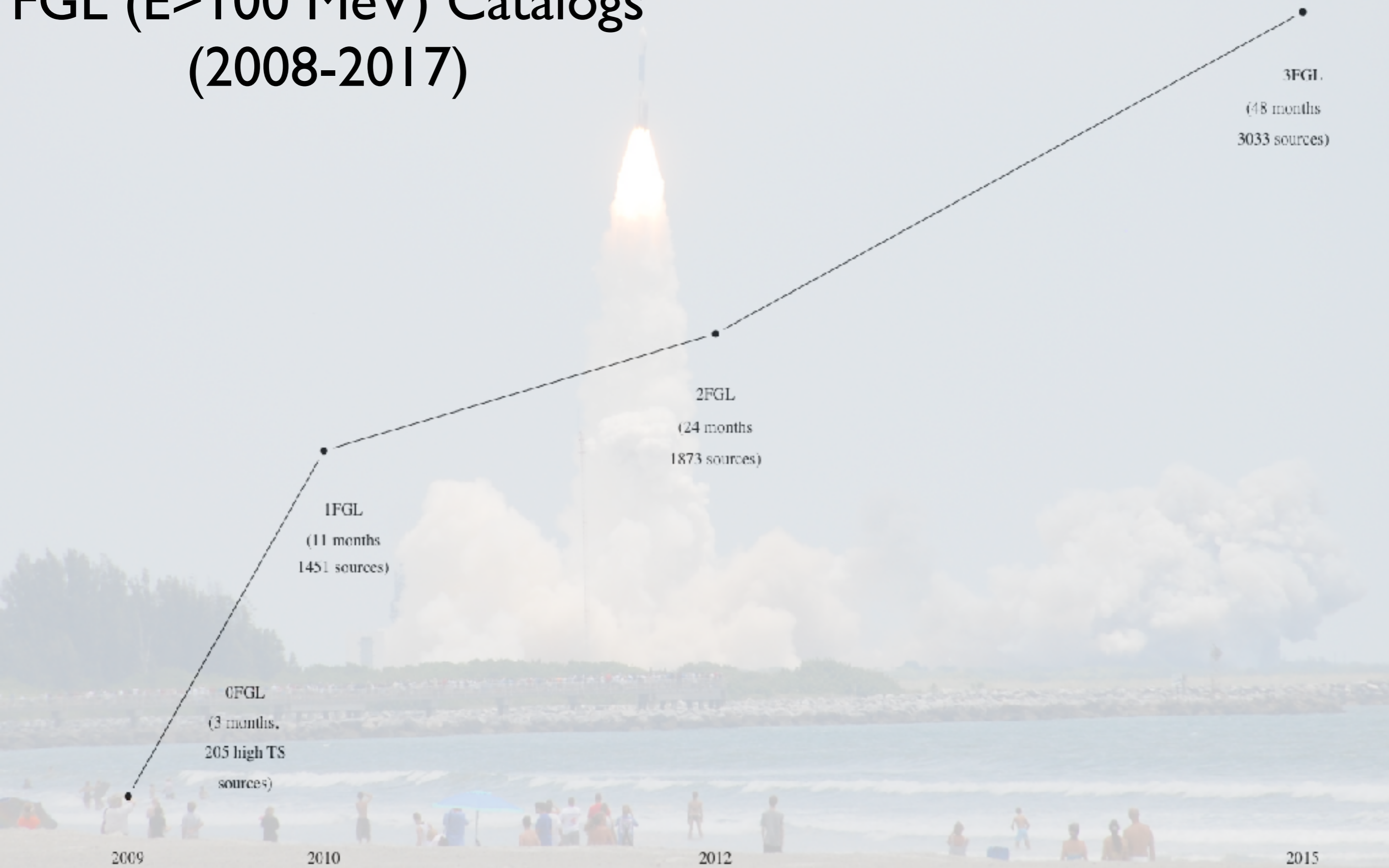


TeV Particle Astrophysics (TeVPA) 2017
Columbus, Ohio, USA
10 August 2017



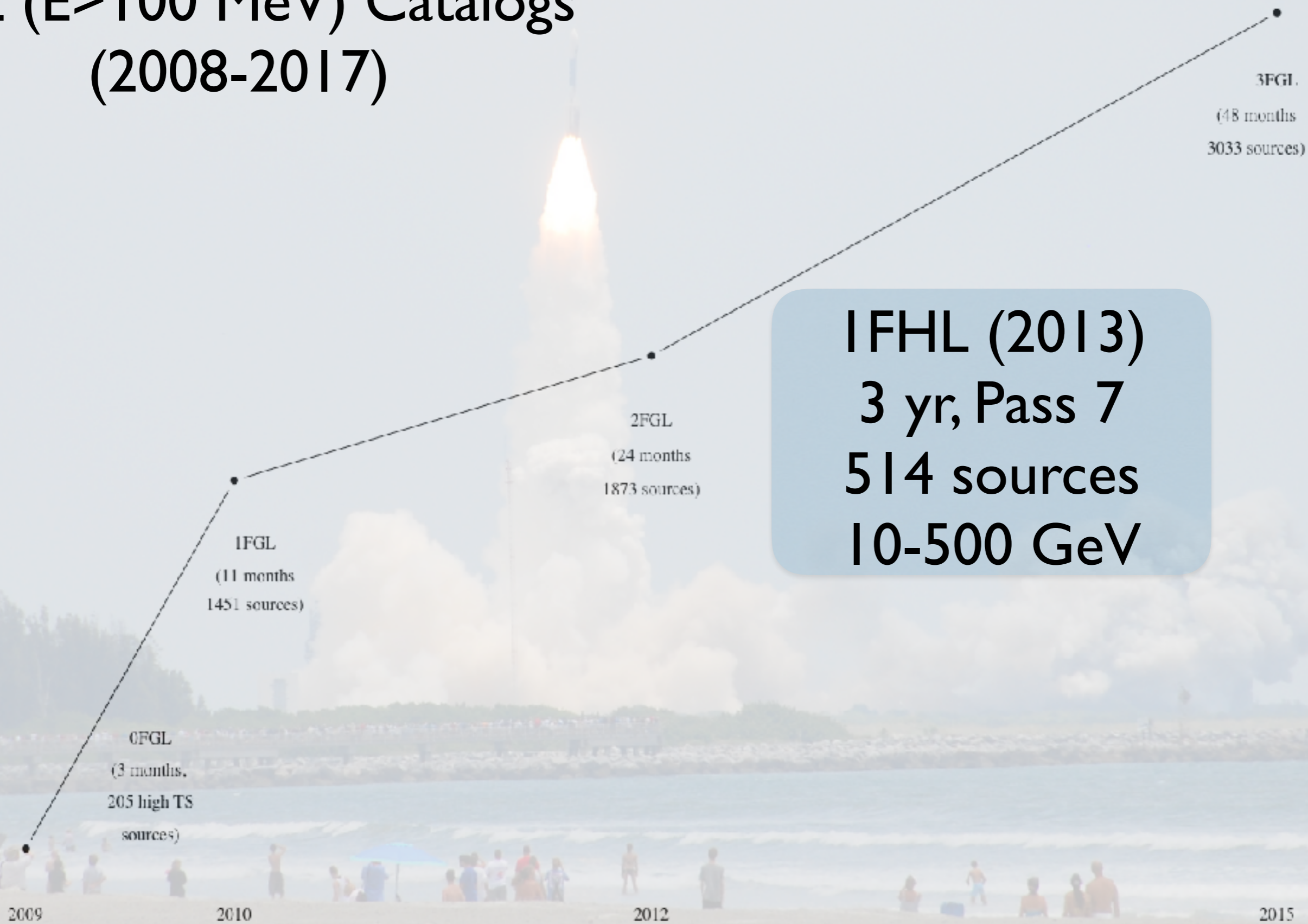
Fermi LAT

FGL ($E > 100$ MeV) Catalogs (2008-2017)



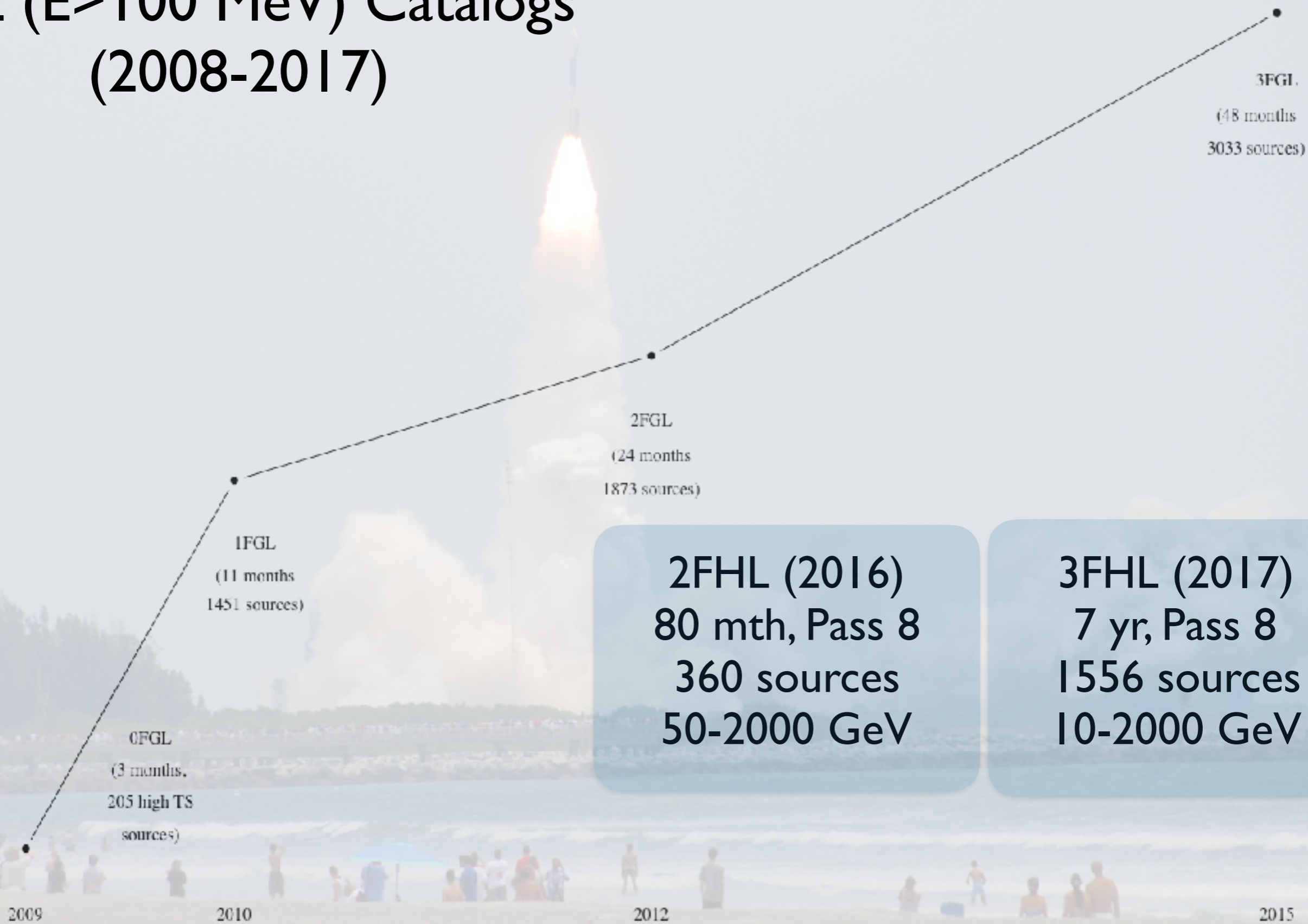
Fermi LAT

FGL ($E > 100$ MeV) Catalogs (2008-2017)



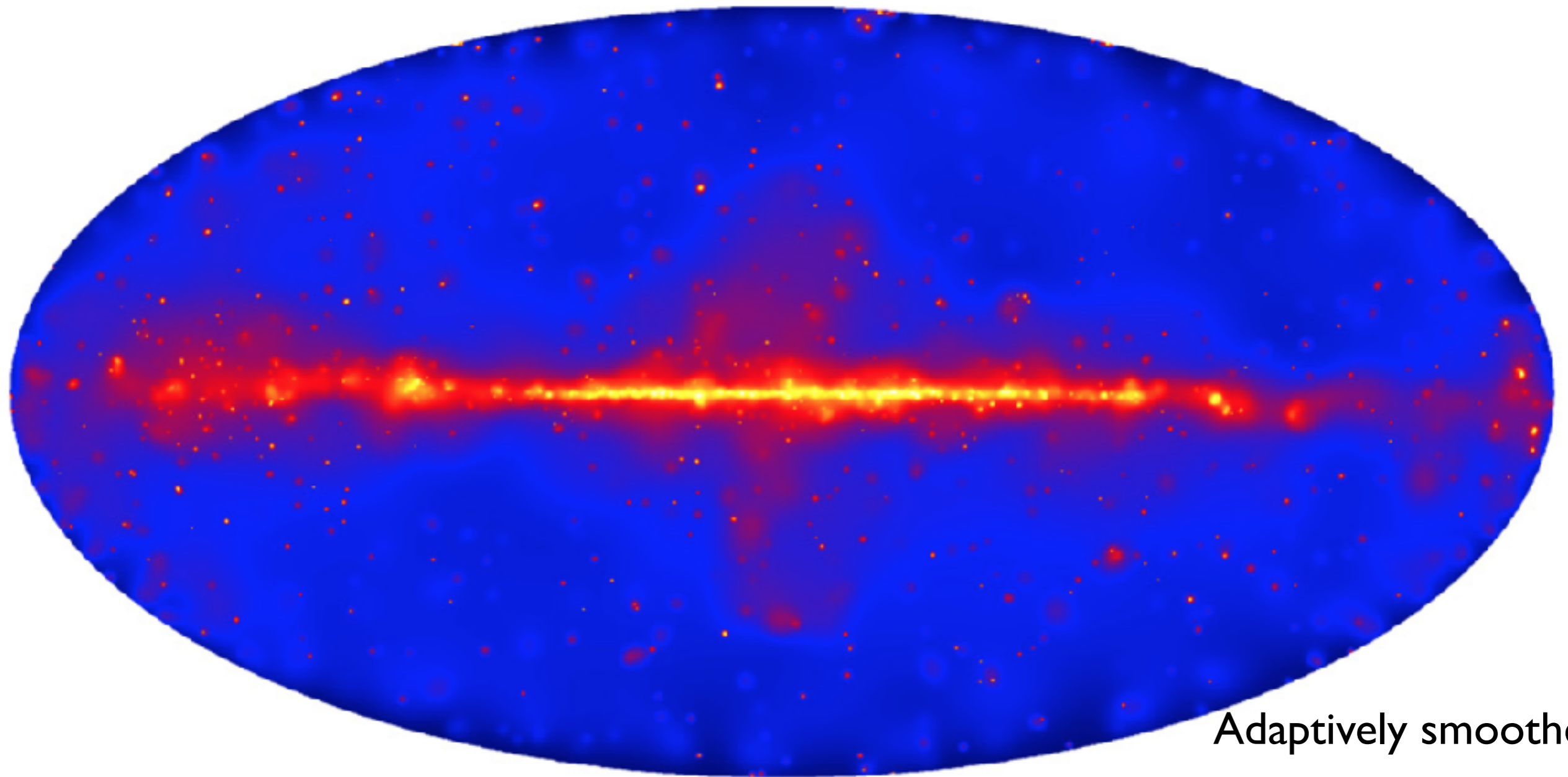
Fermi LAT

FGL ($E > 100$ MeV) Catalogs (2008-2017)



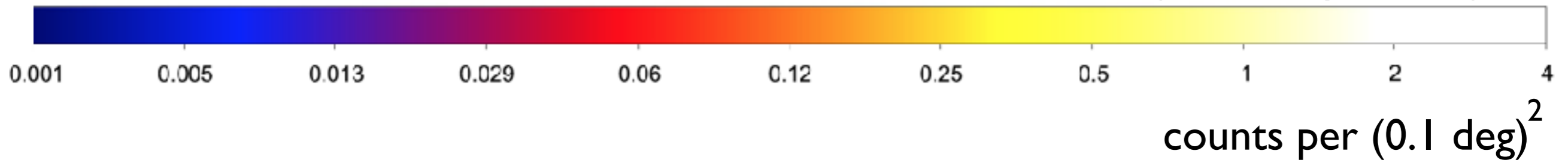


2FHL (Ackermann et al. 2016)



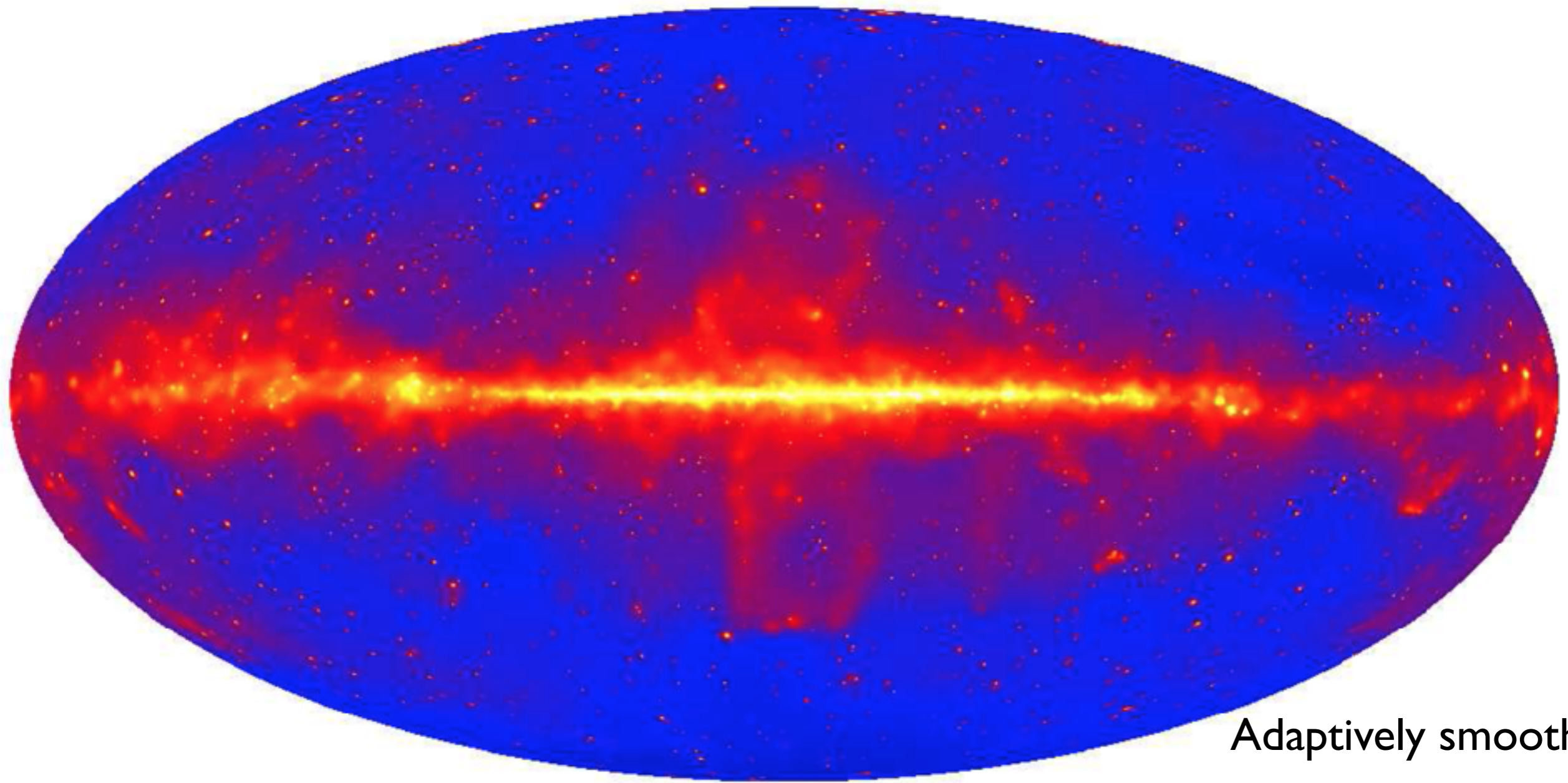
Adaptively smoothed

360 sources at $E > 50$ GeV in 80 months of Fermi LAT data ($\sim 61,000$ photons)





3FHL (Ajello et al. 2017)



Adaptively smoothed

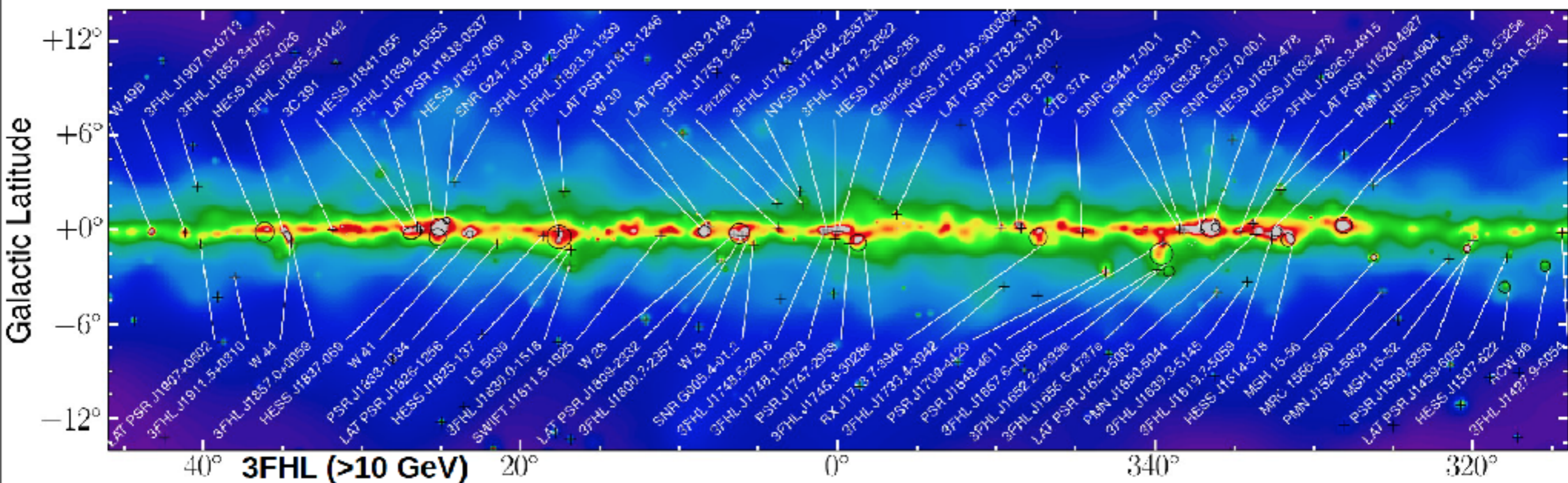
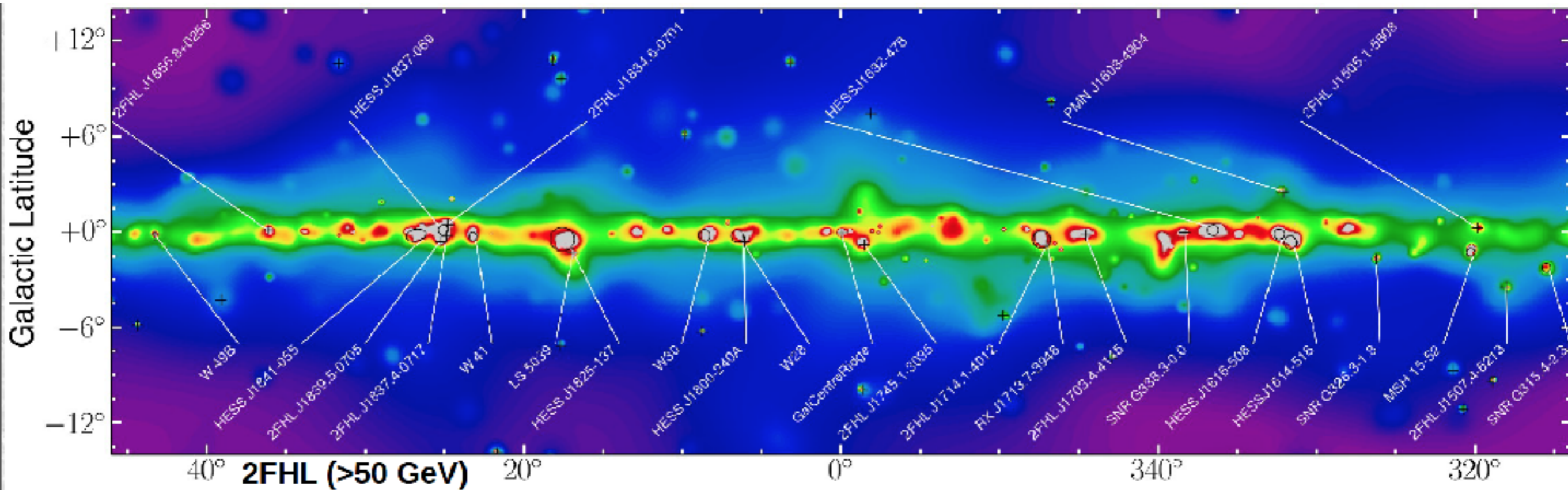
1,556 sources at $E > 10$ GeV in 84 months of Fermi LAT data ($\sim 700,000$ photons)



counts per $(0.1 \text{ deg})^2$



Galactic Plane

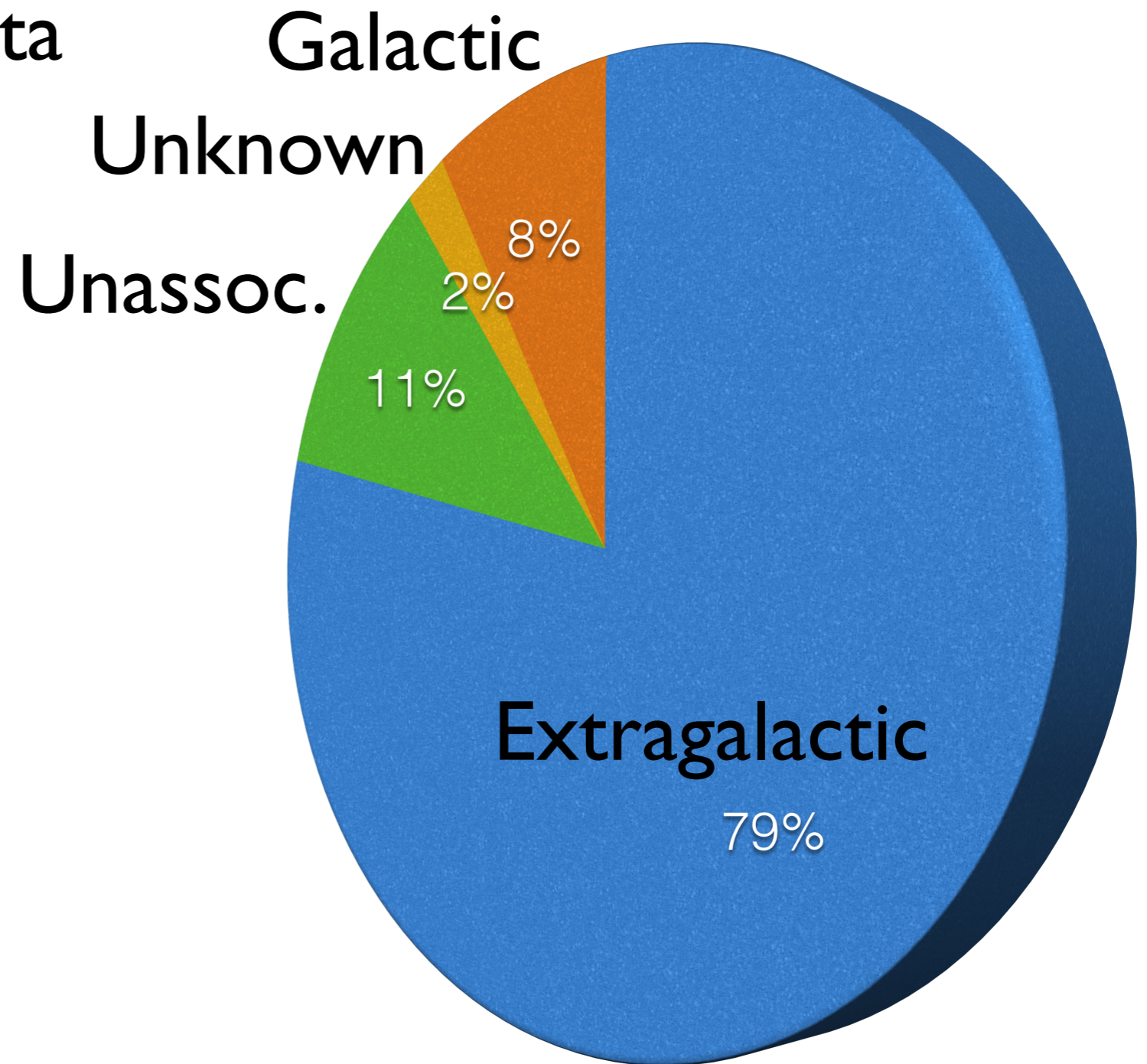




The 3FHL Catalog



- 7 years of Pass 8 data
- 10 GeV - 2 TeV
- PSF types
- 1556 sources
 - 1286 3FGL
 - 476 1FHL
 - 312 2FHL
 - 133 in TeVCat
 - > 200 new sources



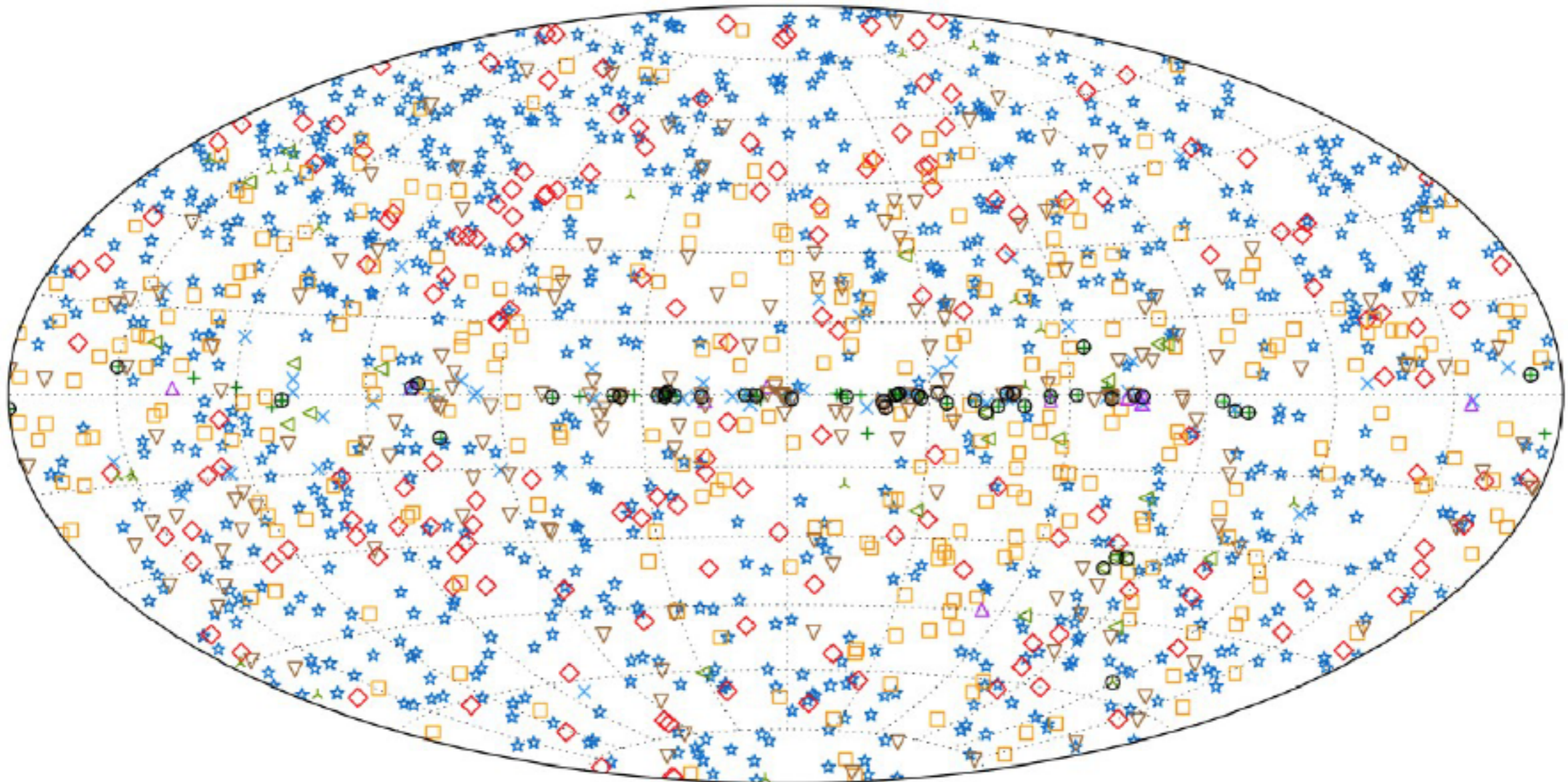
48 (previously known) extended sources
See Talk by Manuel Meyer
on searches for new extended sources



3FHL Associations



3FHL, $E > 10$ GeV



+	SNRs and PWNe	★	BL Lacs	□	Unc. Blazars	△	Other GAL	▽	Unassociated
×	Pulsars	◇	FSRQs	▲	Other EGAL	◀	Unknown	○	Extended

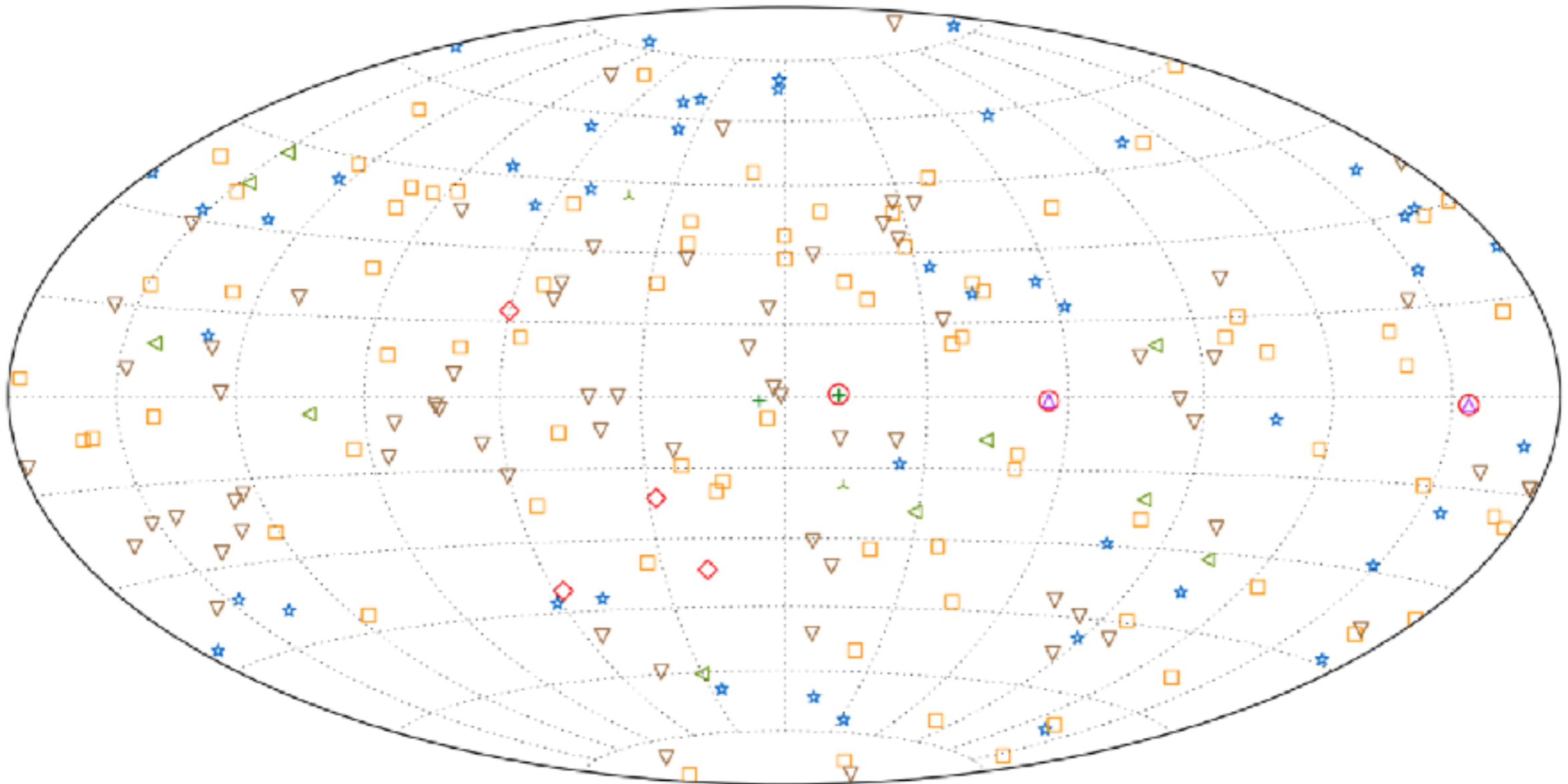


New gamma-ray sources



3FHL, $E > 10$ GeV

There are 214 sources that are not included in previous LAT catalogs, 3 of these are found by IACTs.



+	SNRs and PWNe	★	BL Lacs	□	Unc. Blazars	▲	Other GAL	▽	Unassociated	○	TeVCat
×	Pulsars	◇	FSRQs	✚	Other EGAL	◀	Unknown	○	Extended		



3FHL vs 1FHL



Comparison Summary	1FHL (3 years+Pass7)	3FHL (7 years+Pass8)
Number of sources	514	1556
Number of extended sources	18	48
Flux above 10 GeV (ph/cm ² /s)	1.29 (0.87, 2.74) × 10 ⁻¹⁰	5.03 (3.22, 10.33) × 10 ⁻¹¹
Spectral Index	2.36 (2.01, 2.90)	2.47 (2.13, 2.93)
Positional Uncertainty (deg)	0.079 (0.054, 0.097)	0.038 (0.028, 0.049)
Significance	6.17 (4.71, 9.37)	7.04 (5.18, 10.88)

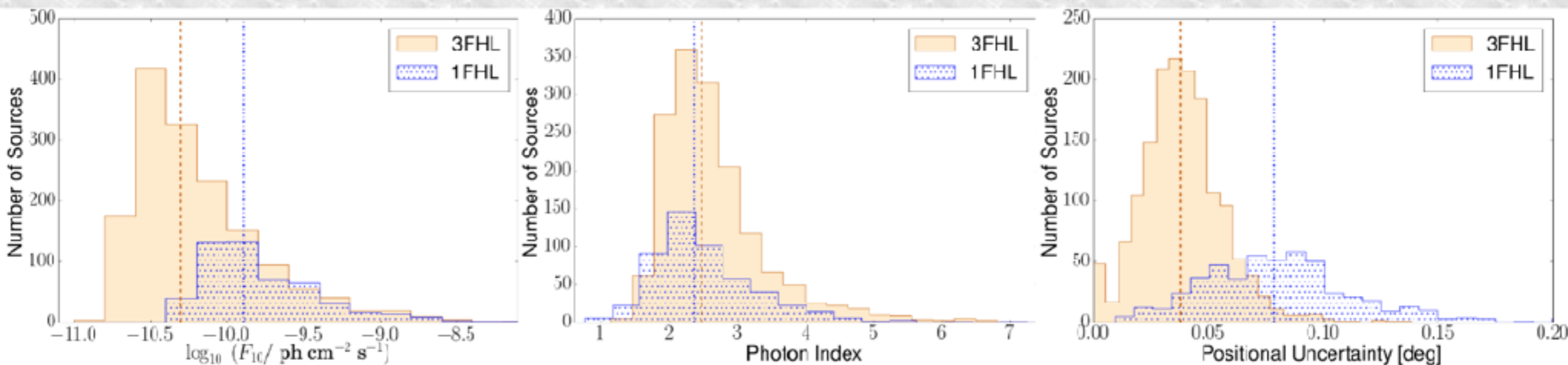
X 3.0 more sources

X 2.7 more extended sources

x 2.6 deeper in flux

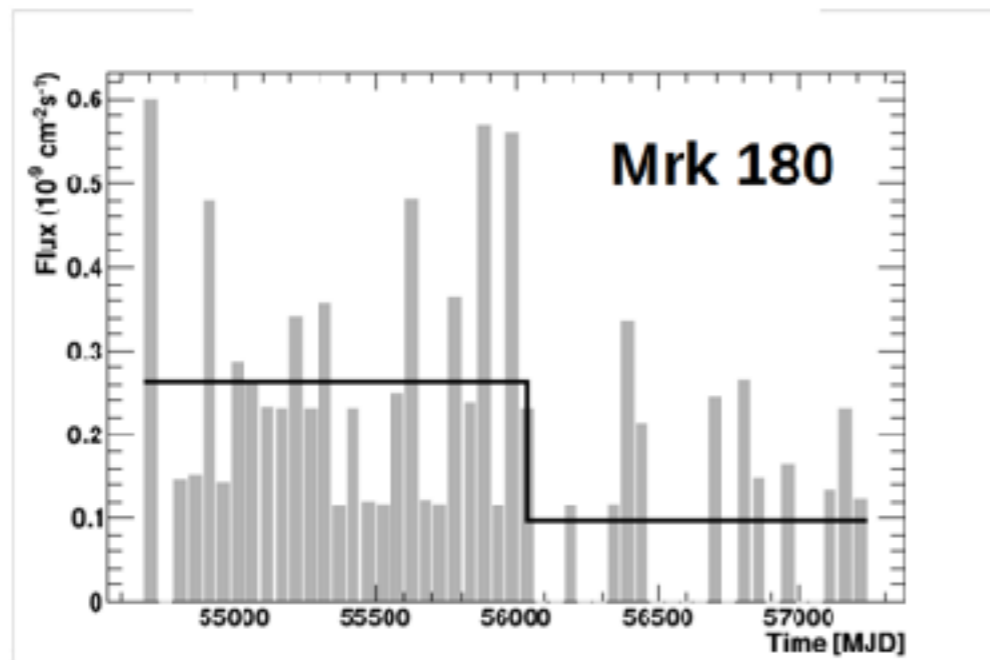
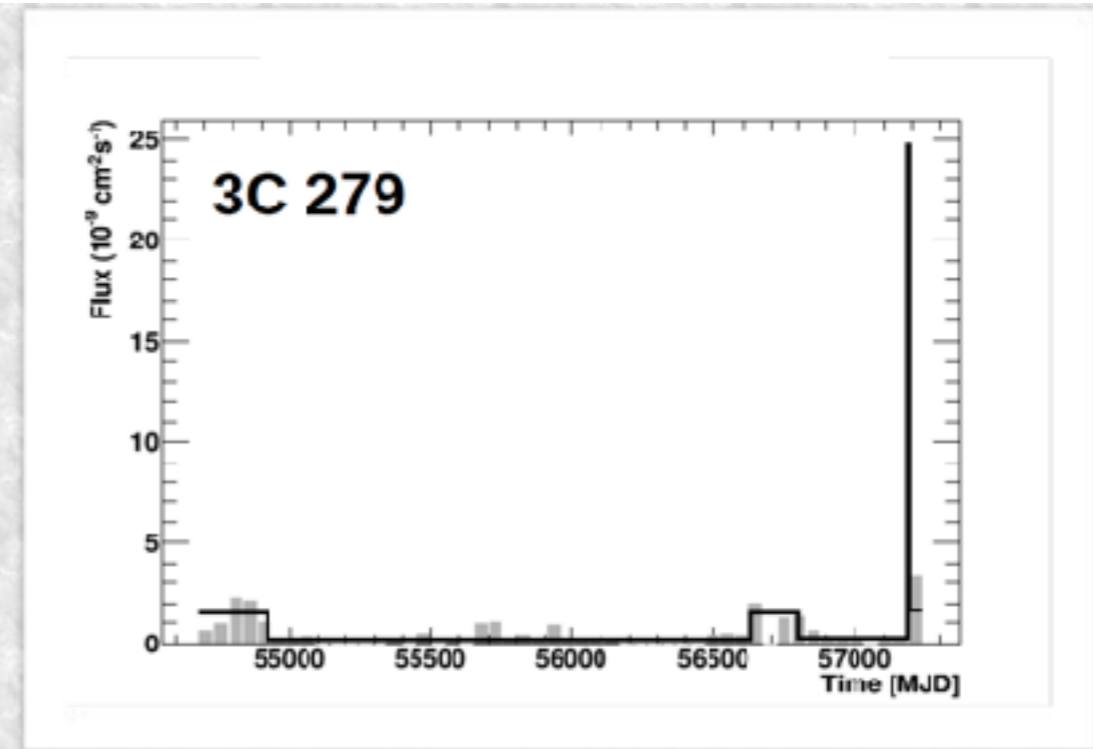
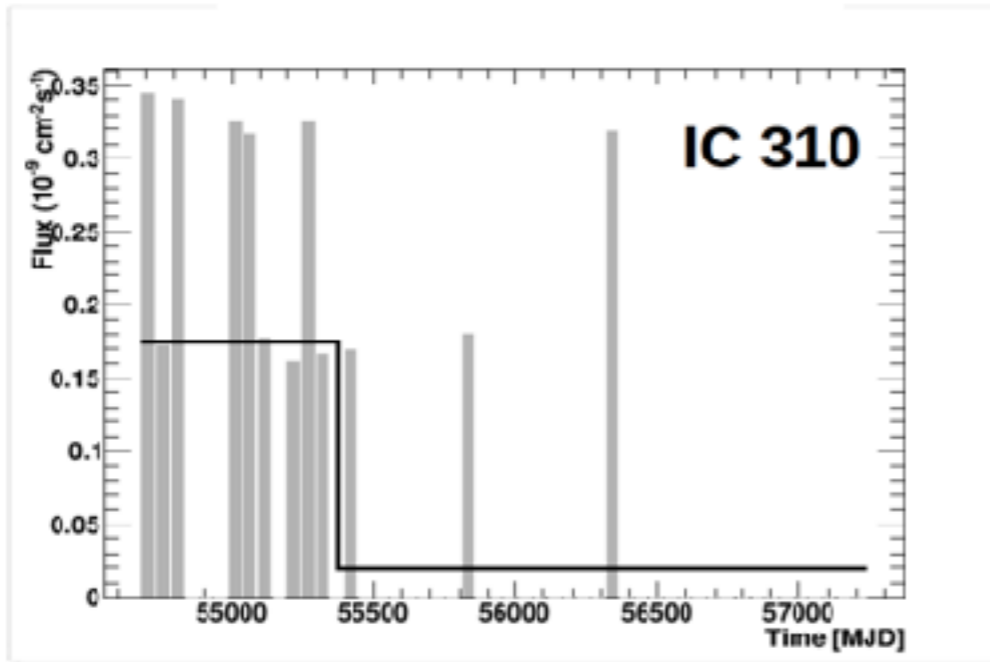
x 2.1 better location accuracy

The table shows the median and the 25% and 75% quartiles





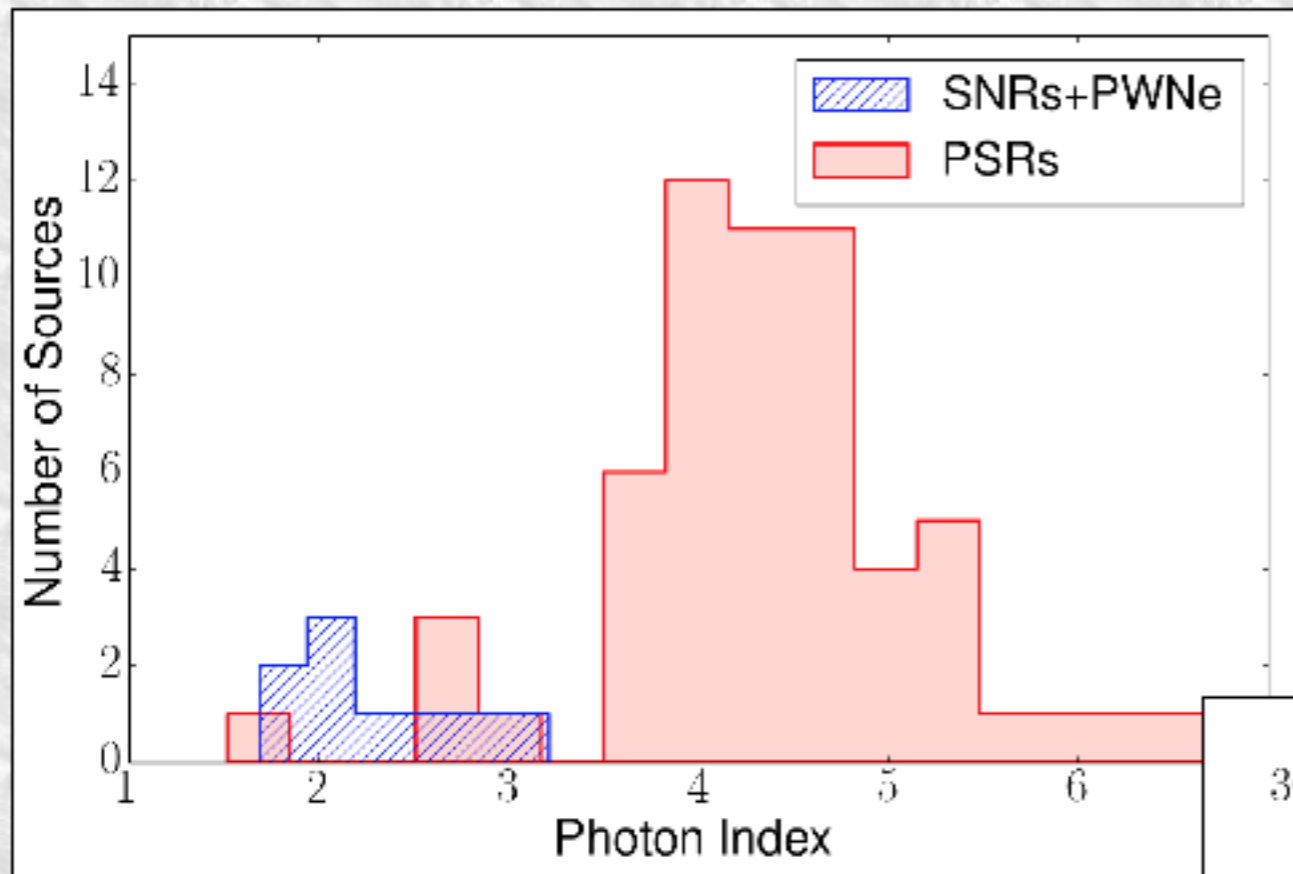
3FHL Flux Variability



- **Bayesian Block Analysis results in 163 variable sources at $E > 10 \text{ GeV}$**
- **85 BL Lacs, 61 FSRQs, 11 BCUs, 2 RDGs, 1 Narrow-line Seyfert, 1 PSR, 1 PWN, 1 unassociated**

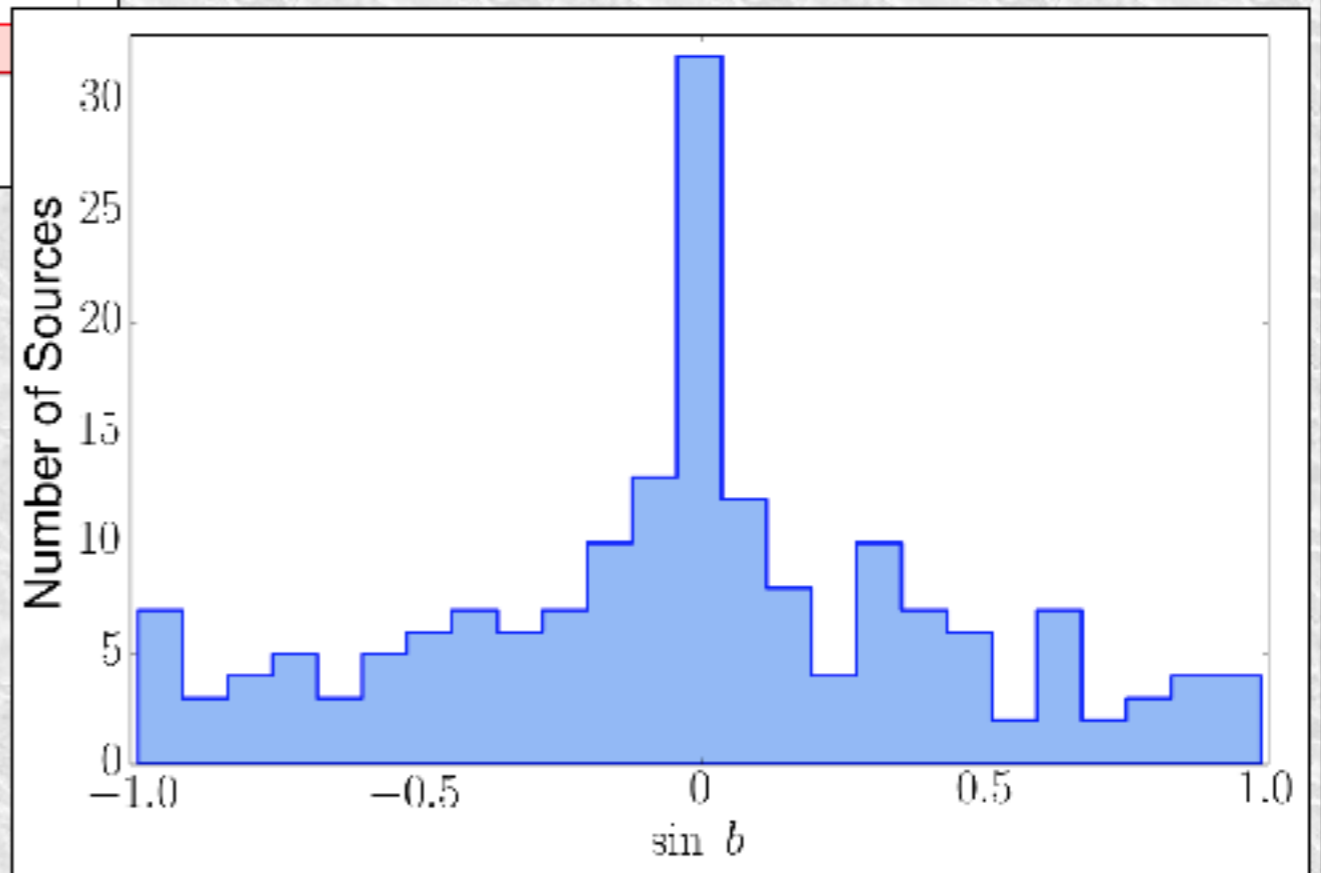


Distribution of sources



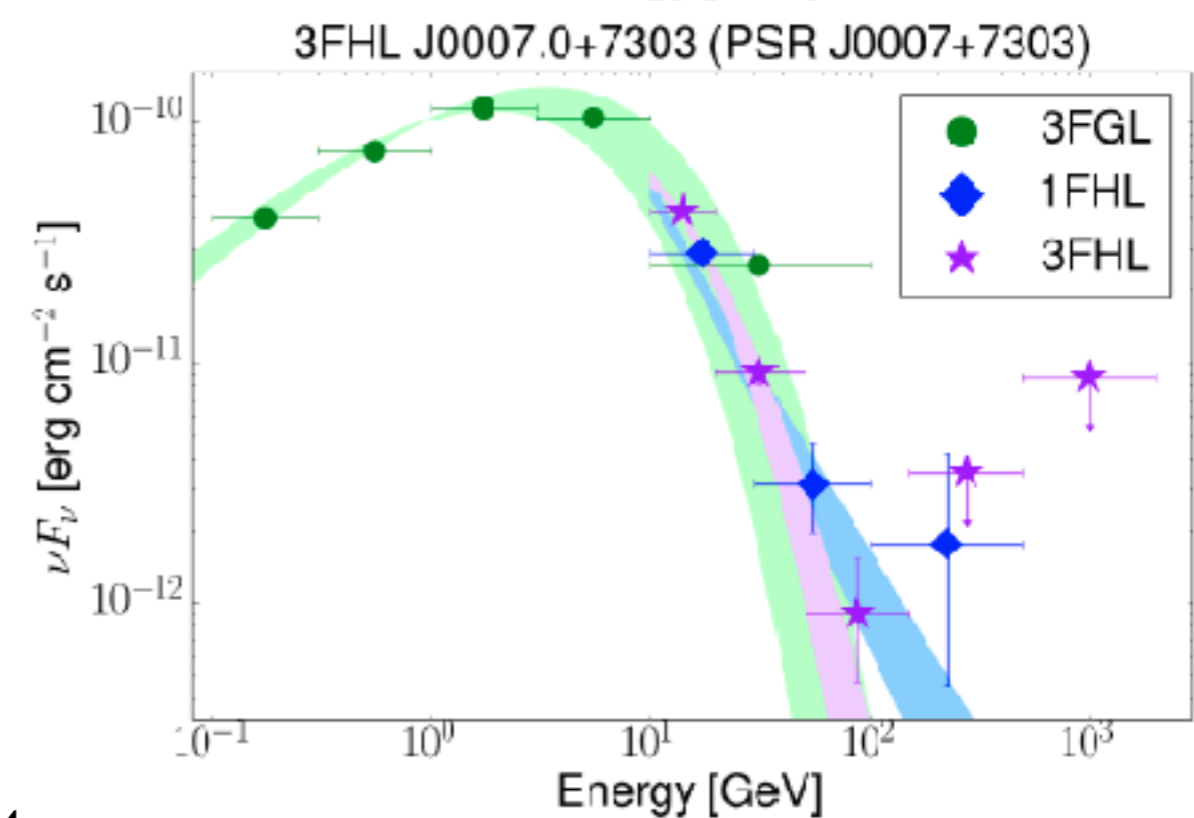
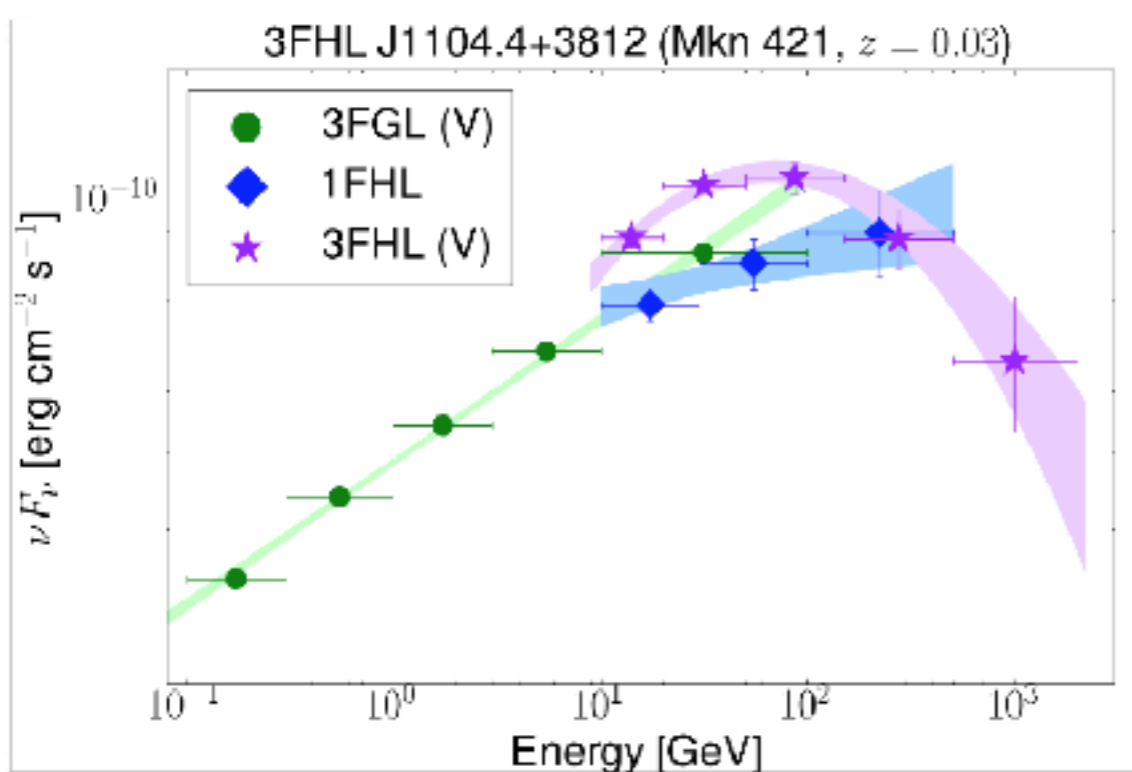
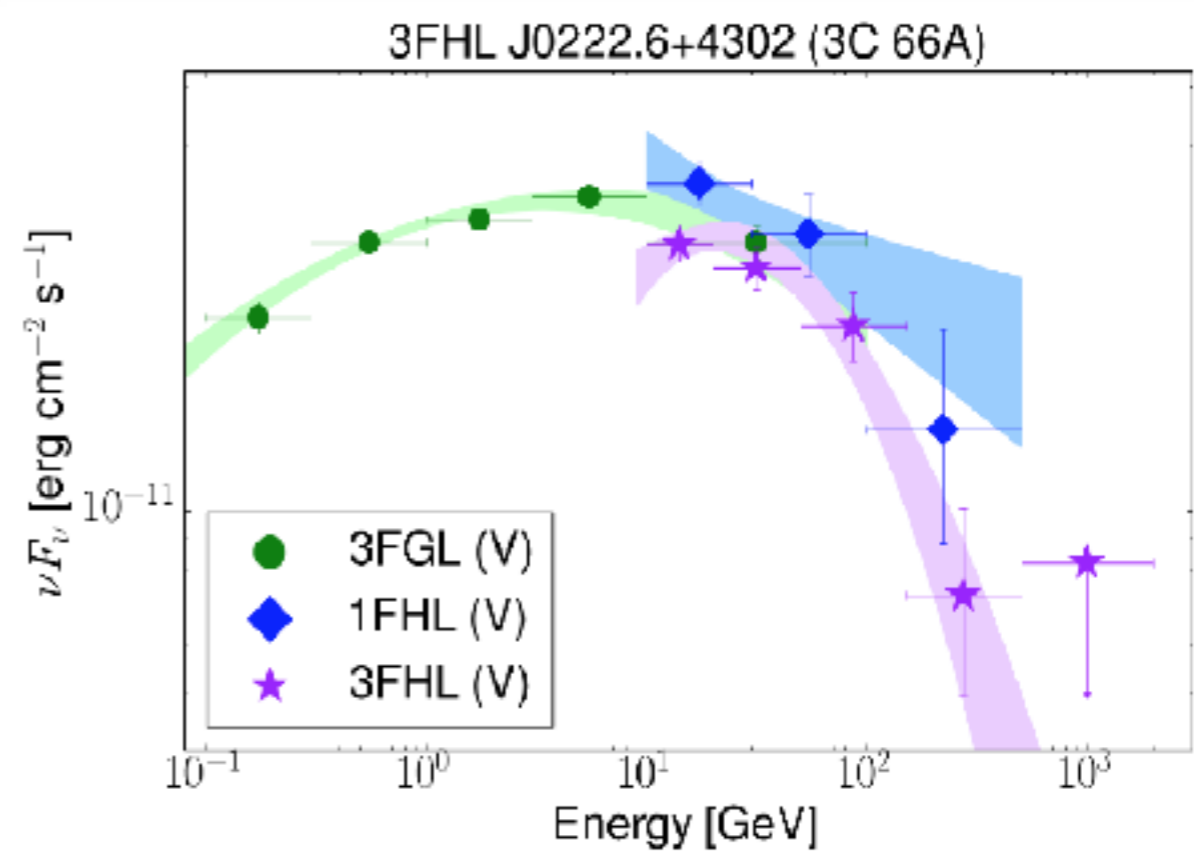
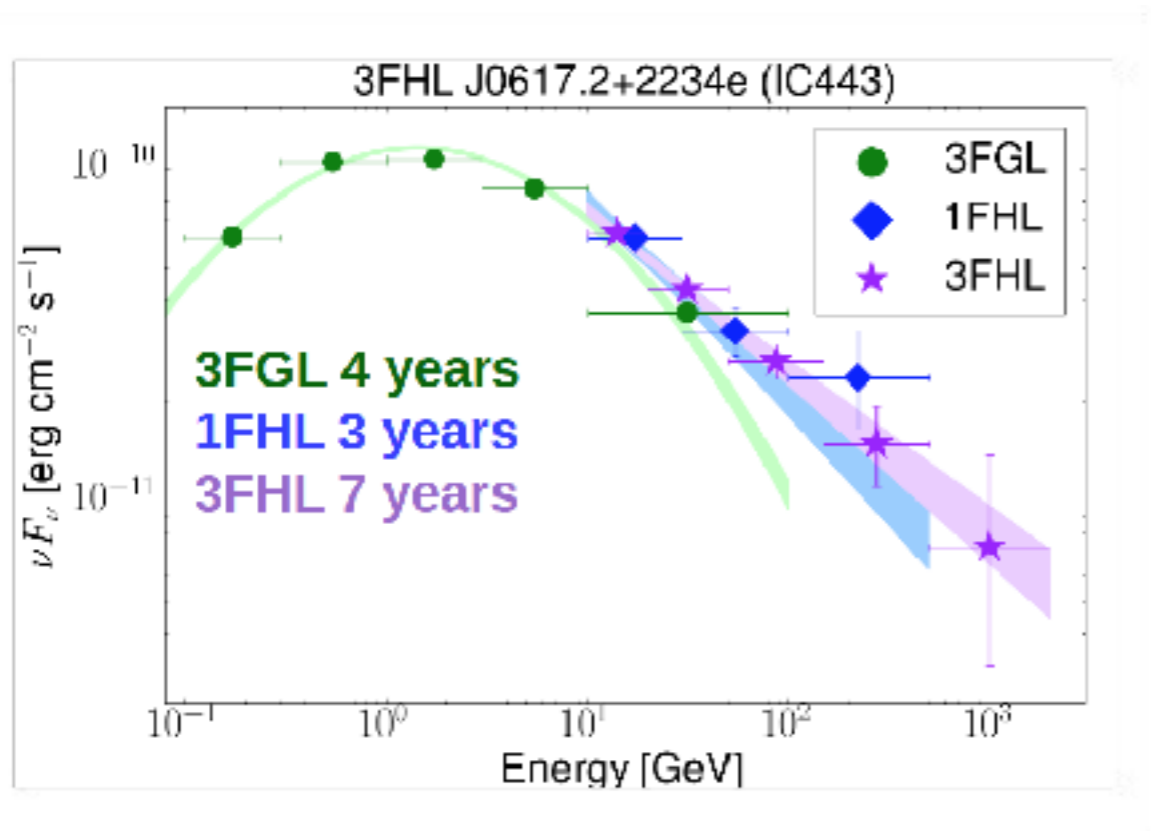
PSRs tend to be softer than SNRs+PWNe

Distribution of unassociated sources over the sine of the Galactic latitude



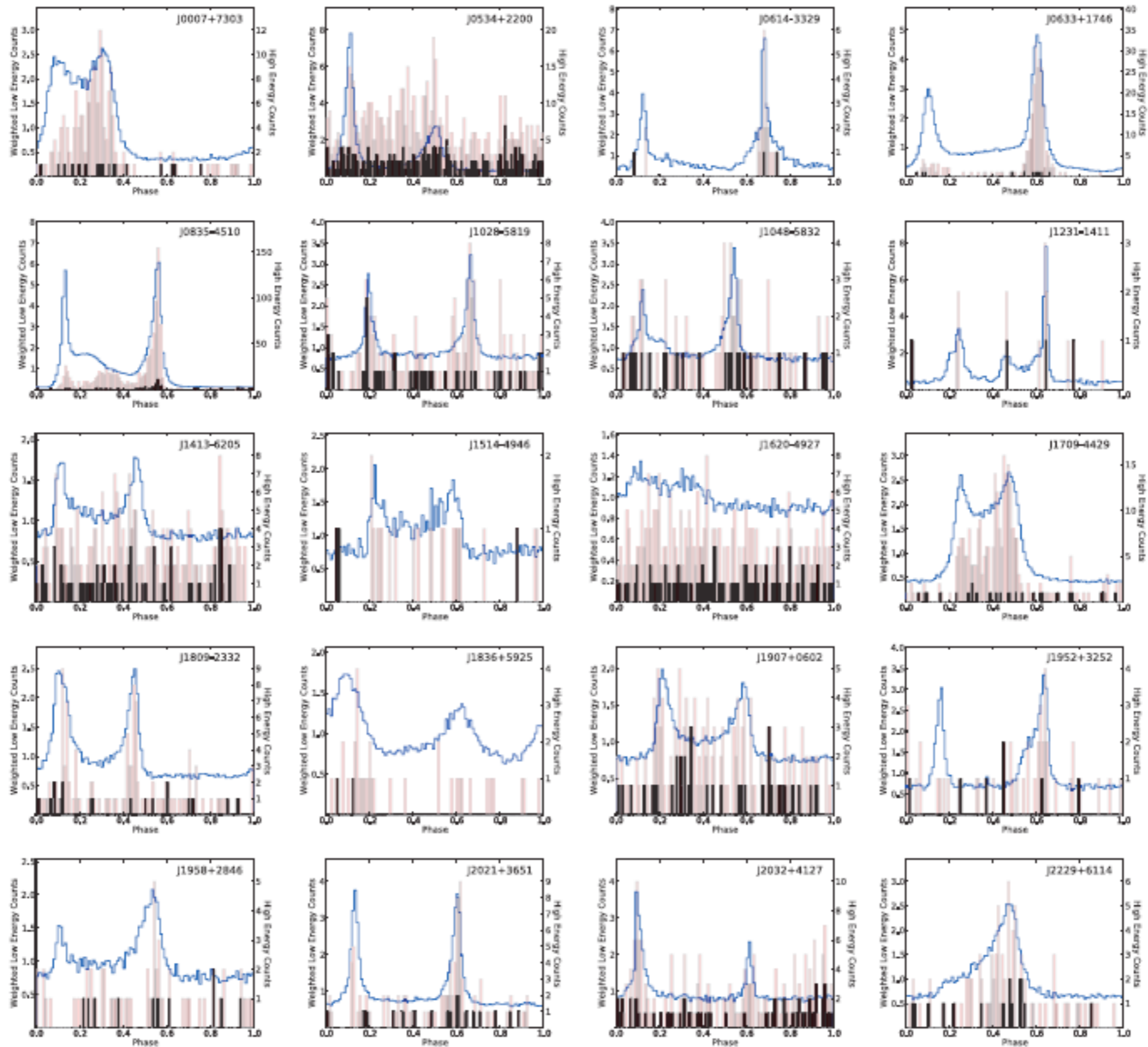


Spectral Energy Distributions





Pulsars in I FHL Catalog





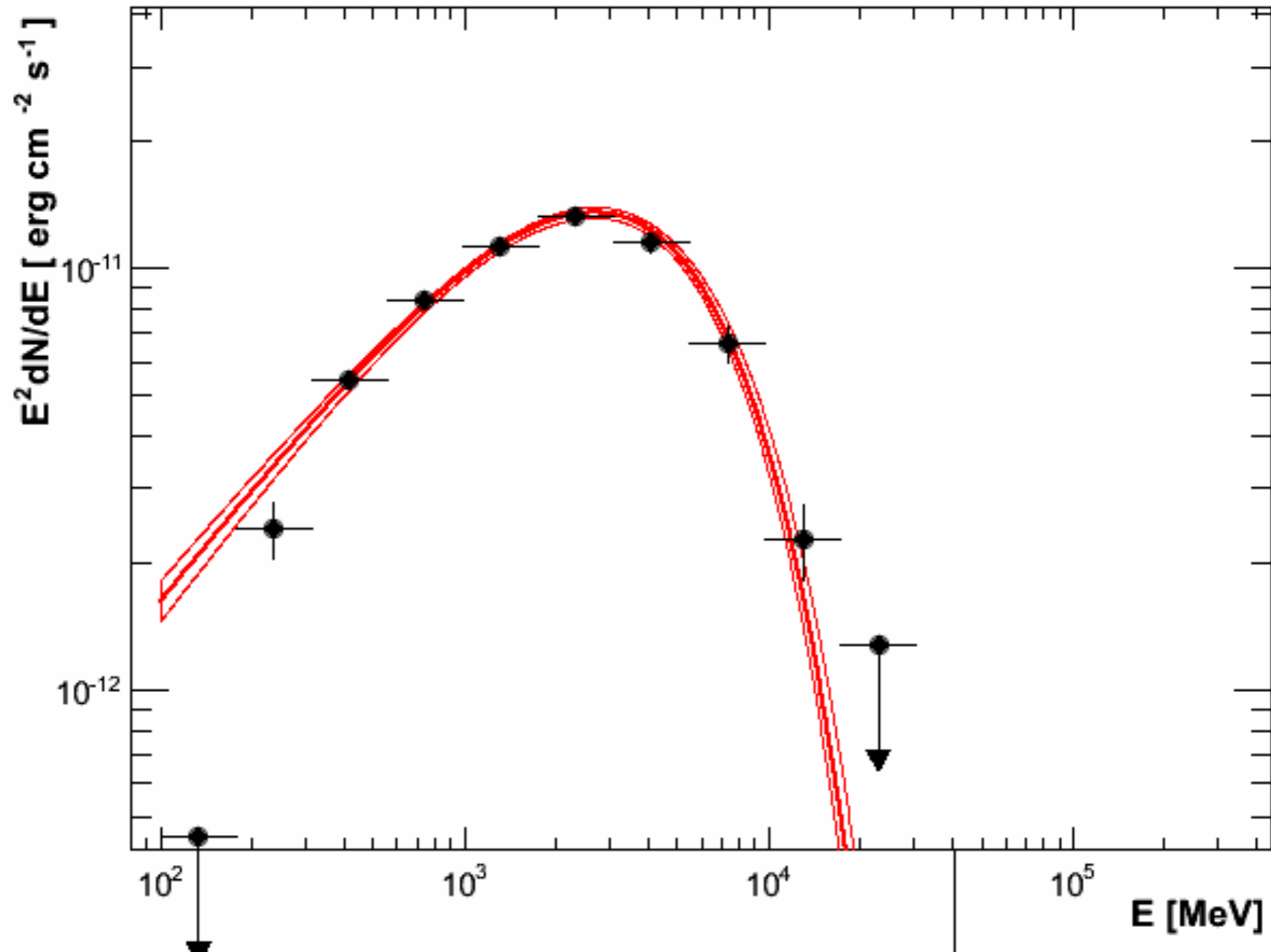
The search for new HPSRs



	1FHL	3FHL
Data Span	3 Years	7 Years
LAT IRFs	Pass 7	Pass 8
# Sources	514	1556
# Pulsar Associations	27	62
HPSR (>10 GeV)	20 (+8)	?
HPSR (>25 GeV)	12 (+1)	?

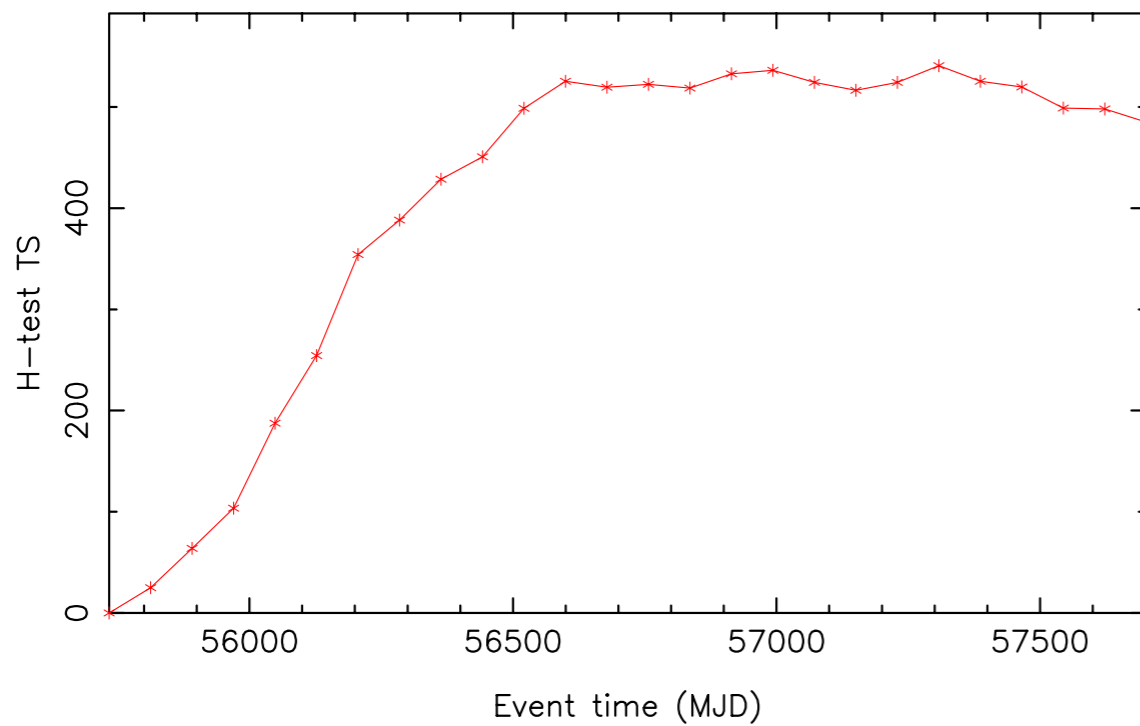
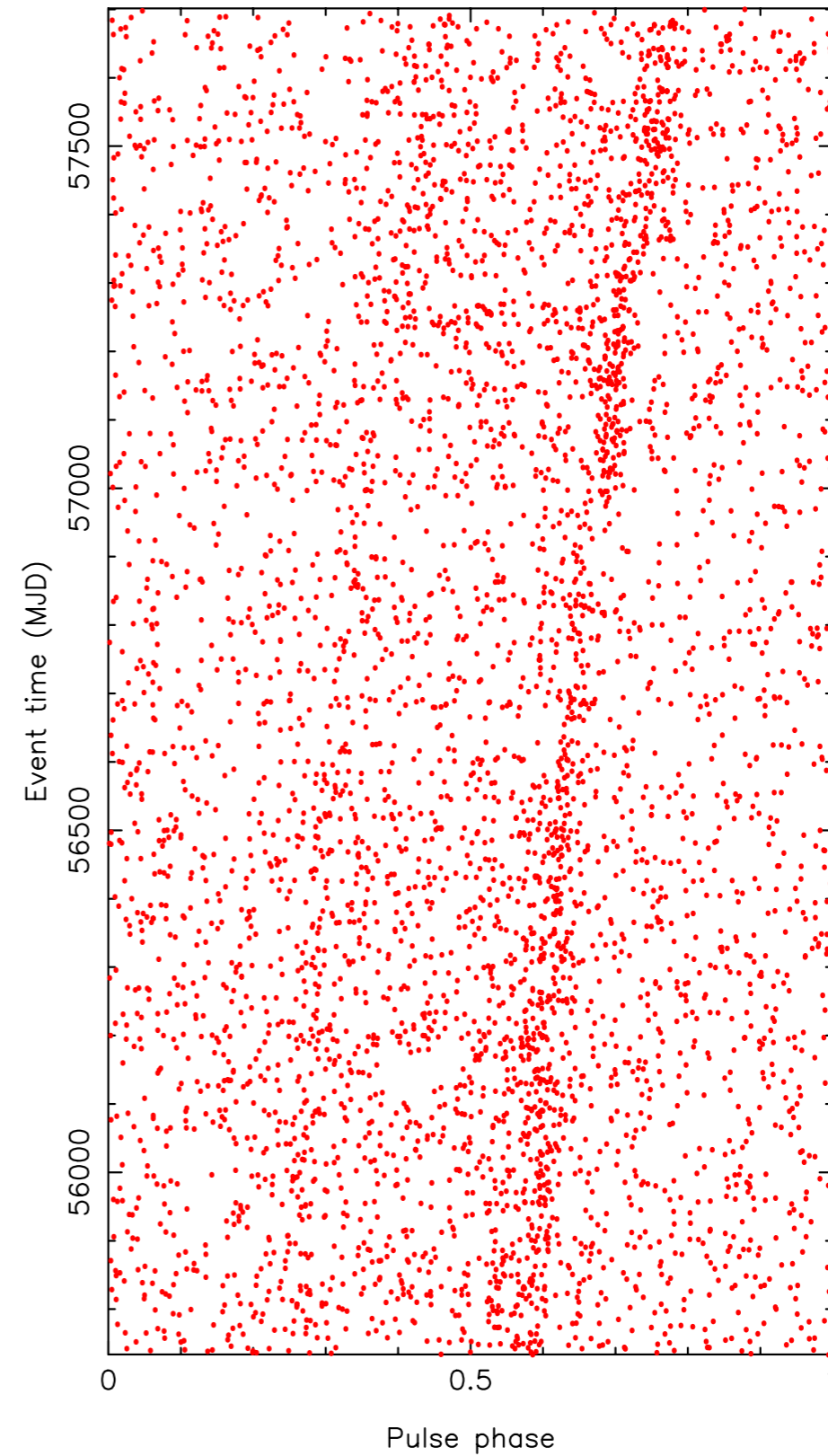
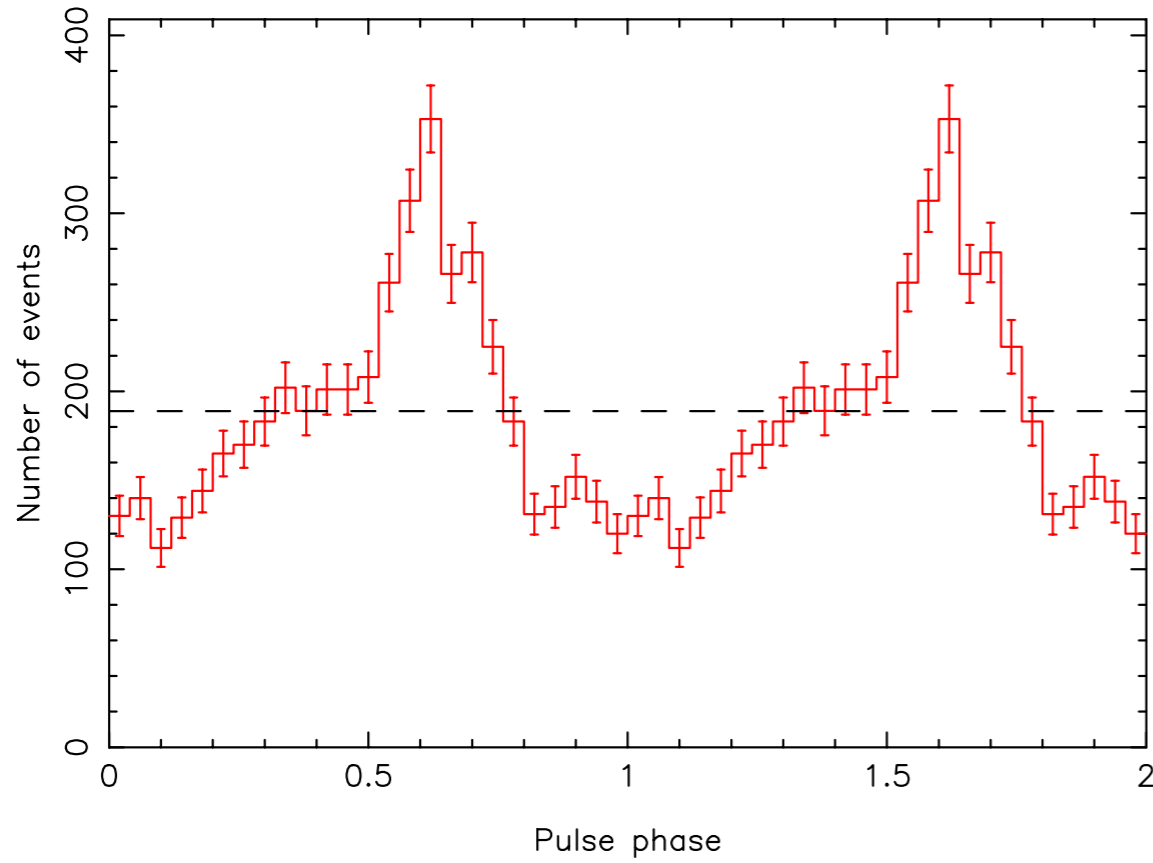


Updating Spectral Models





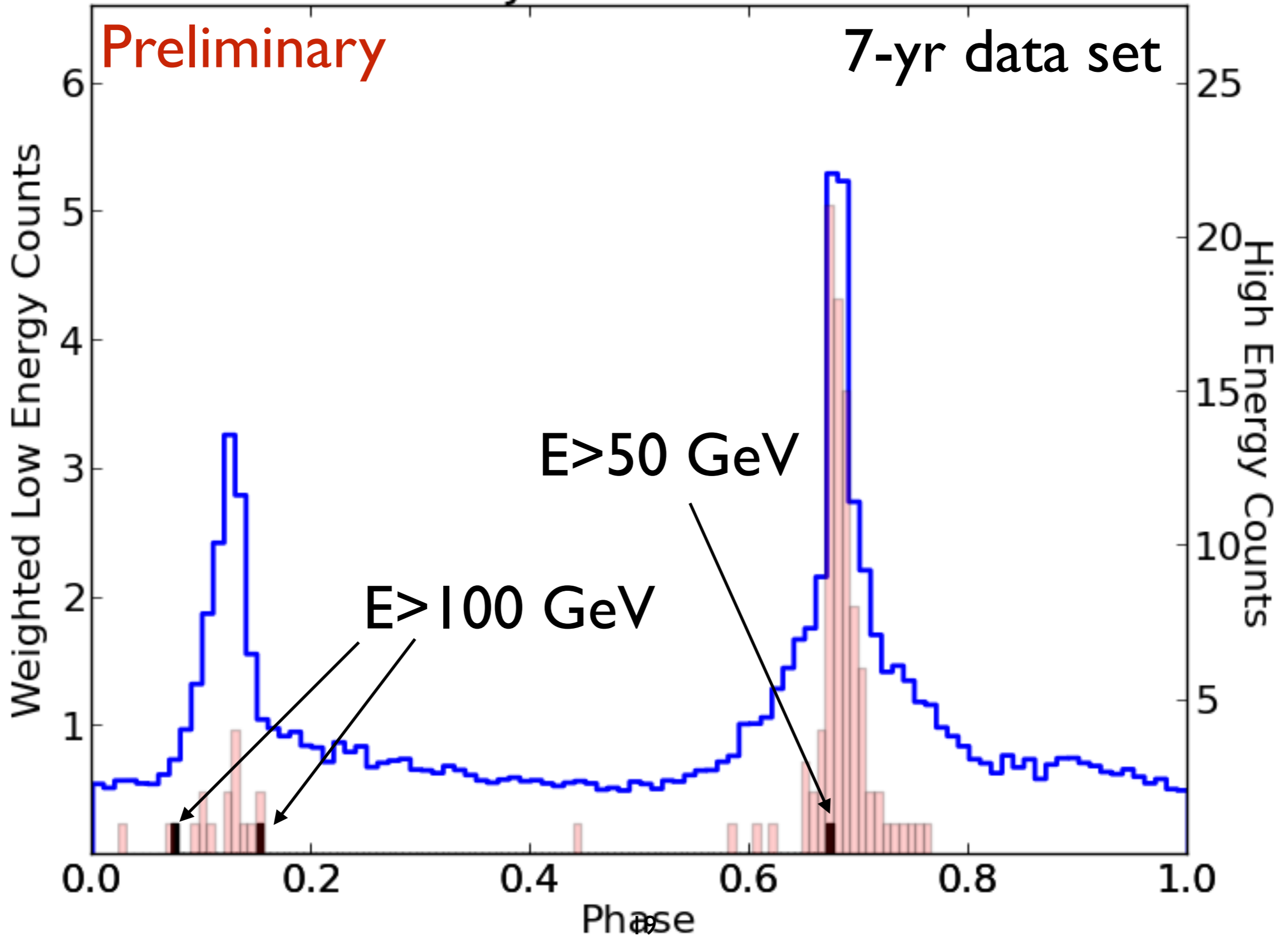
Updating timing models





Search for the highest pulsations from

J0614-3329



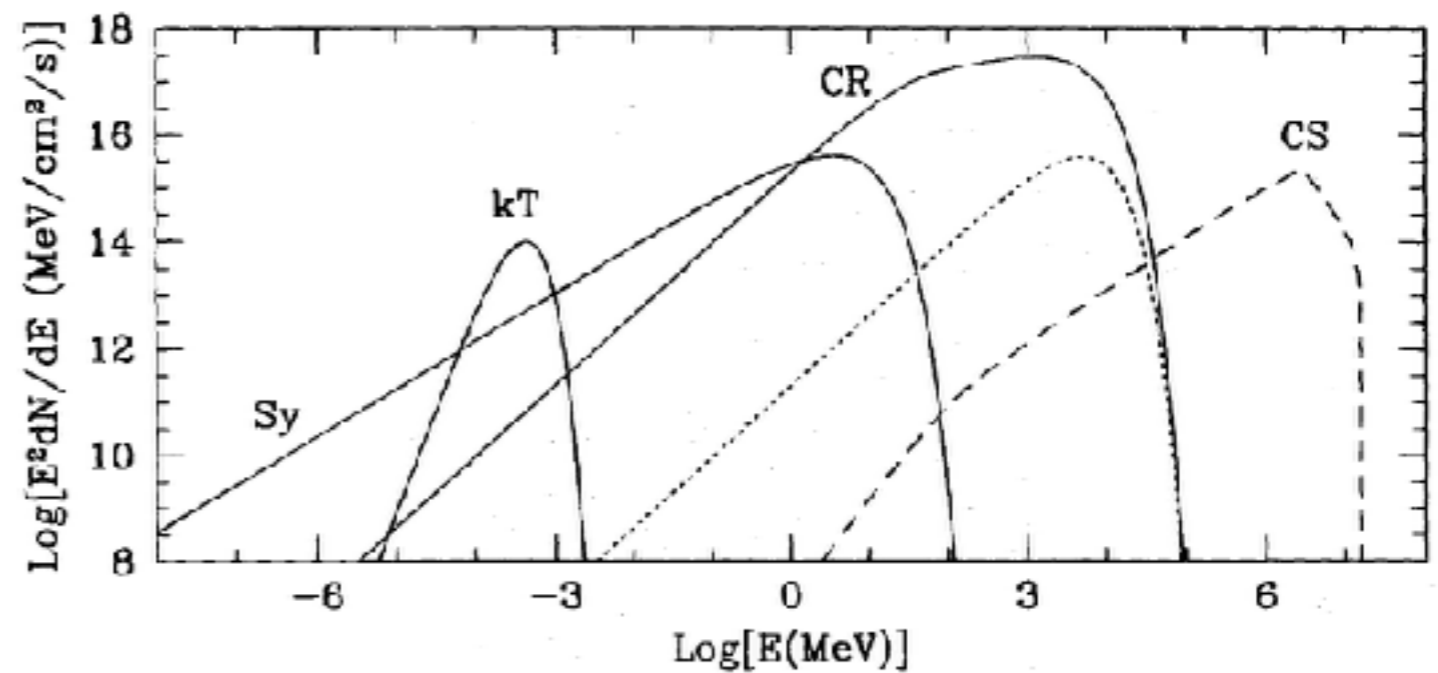
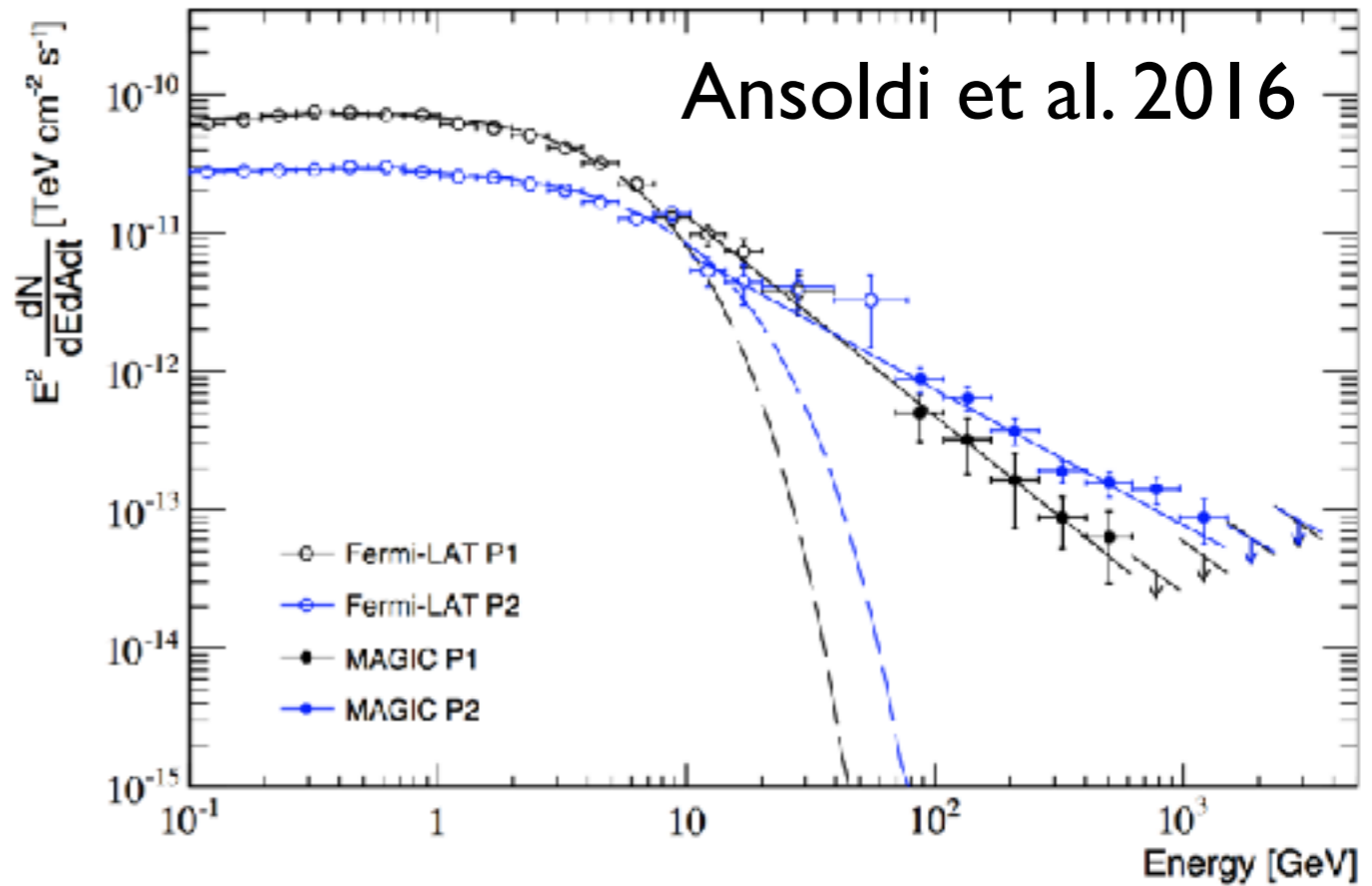


Pulsars at VHE?



- The Crab pulsar has been detected at energies > 1 TeV
- The Vela pulsar has now been detected up to 120 GeV
- Emission mechanism?
- What about other pulsars?

See talk by Jezabel Rodriguez Garcia





Summary

- Since launch (2008) Fermi has produced three general (FGL) catalogs in the 100 MeV-100 GeV energy range
- A number of High Energy (FHL) catalogs have also been generated, using only high-energy (> 10 GeV) events
- The recent 3FHL Catalog contains > 1500 sources detected in the 10 GeV - 2 TeV energy range
- 79% of 3FHL sources are extragalactic, $\sim 8\%$ are Galactic (> 50 pulsars), and $\sim 13\%$ are unassociated
- 3FHL is well suited for joint studies with ground-based instruments (HESS, MAGIC, VERITAS, HAWC, CTA)