Spectral Trends in the Second *Fermi* LAT Catalog of Gamma-ray Pulsars

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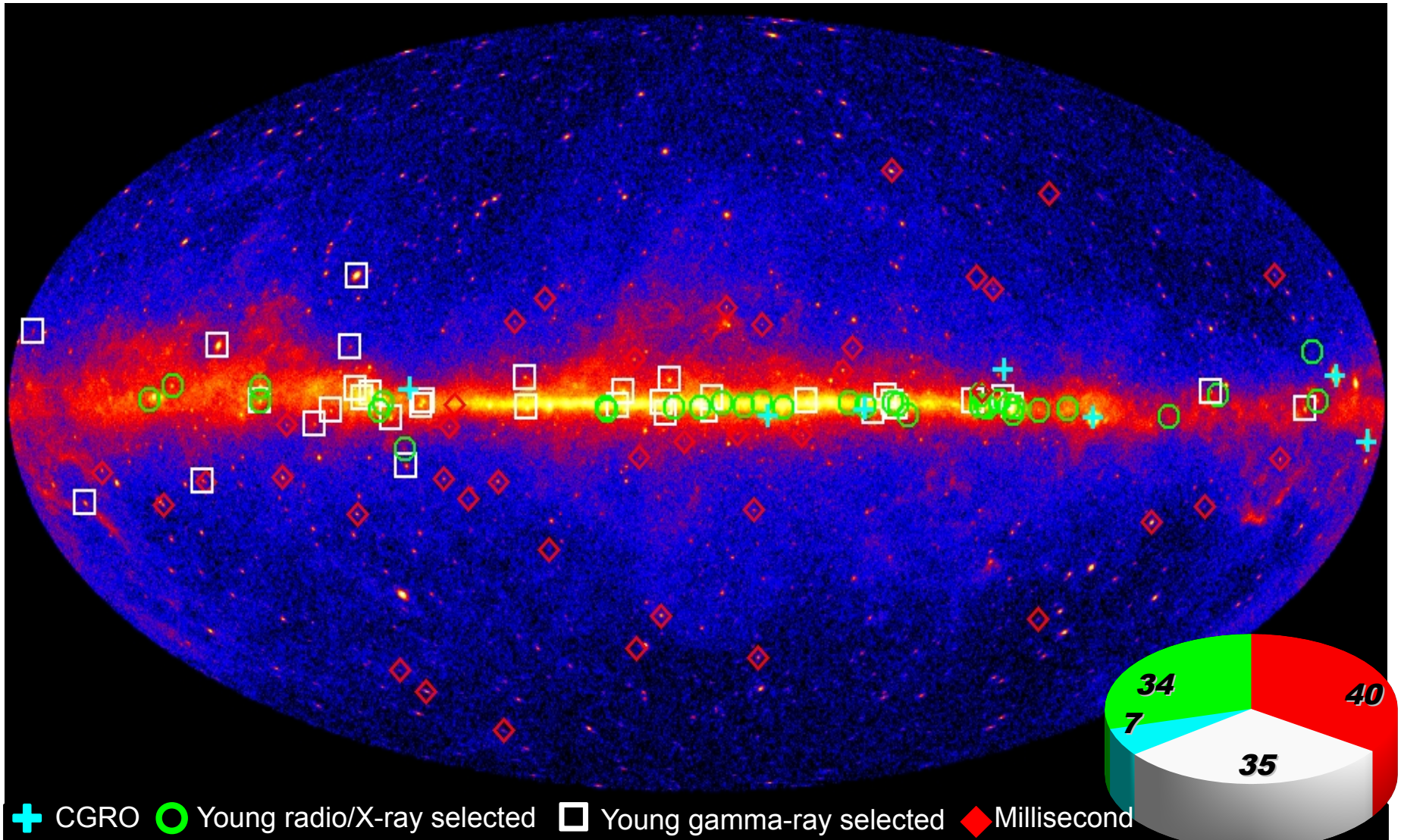
on behalf of
Fermi LAT Collaboration
Pulsar Timing Consortium

Fast-Changing Map of Gamma-Ray Pulsars

NASA Press Release (11.03.11): 101 gamma-ray pulsars on the sky

Now: 15 more .... 116 pulsars, and still counting

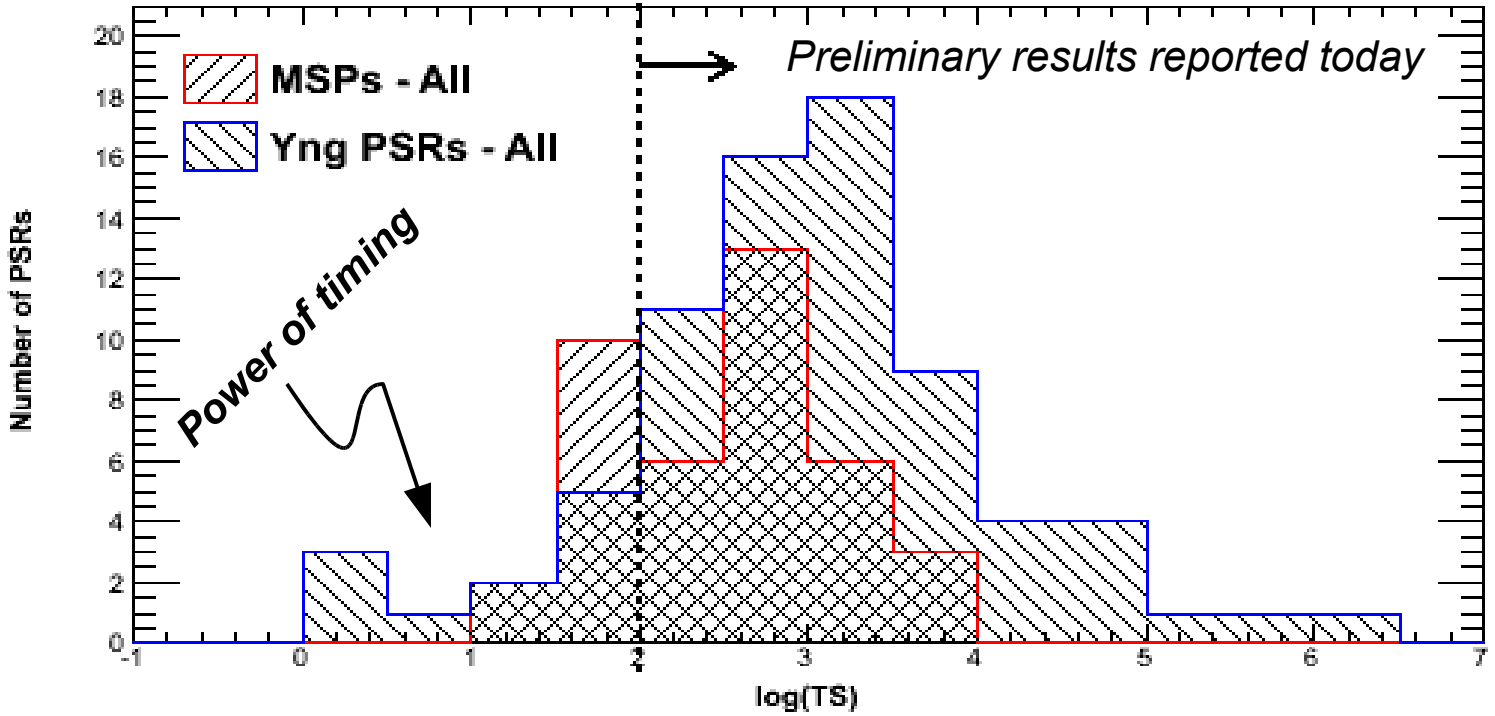


Second *Fermi* LAT Catalog of Gamma-Ray Pulsars

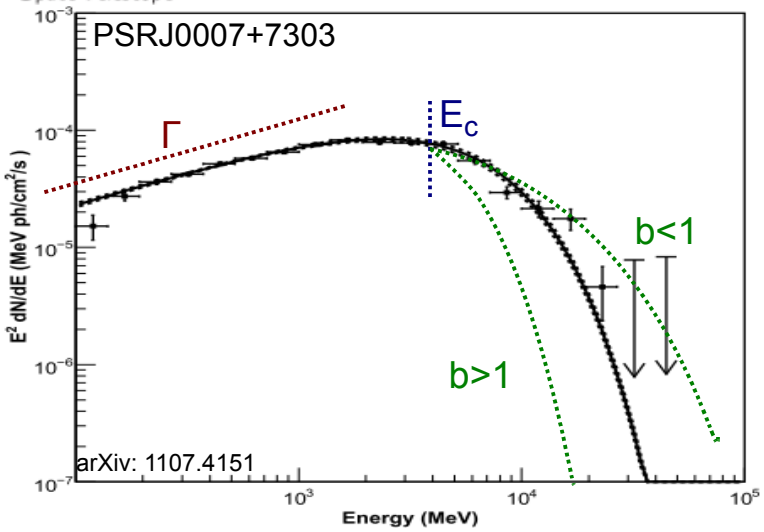
Second *Fermi* LAT Catalog of Gamma-ray Pulsars is coming soon, featuring 116 pulsars

- Consistent treatment of all gamma-ray pulsars to obtain their spectral and timing characteristics using 3 years of data
- See poster by T. Johnson for more information on the construction of the catalog and some light curve samples.
- Gamma-ray pulsations from all of them were detected with a significance greater than 5 sigma (H-Test>34). Some of them are very weak gamma-ray sources - can not even be detected significantly as a gamma-ray point source.

Gamma-ray Point Source Detection Significances



Spectral Analysis of Gamma-Ray Pulsars



MSPs and young pulsars display similar spectral shapes:

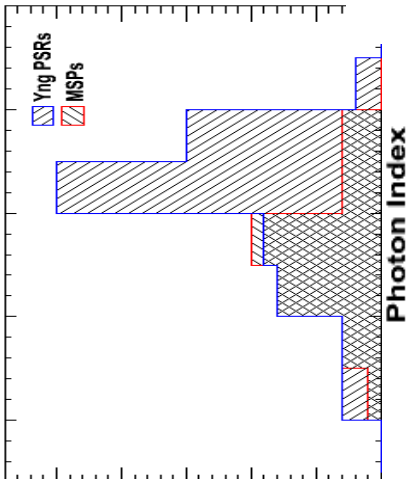
Gamma-ray emission originates at similar locations in the pulsar magnetosphere relative to the light cylinder.

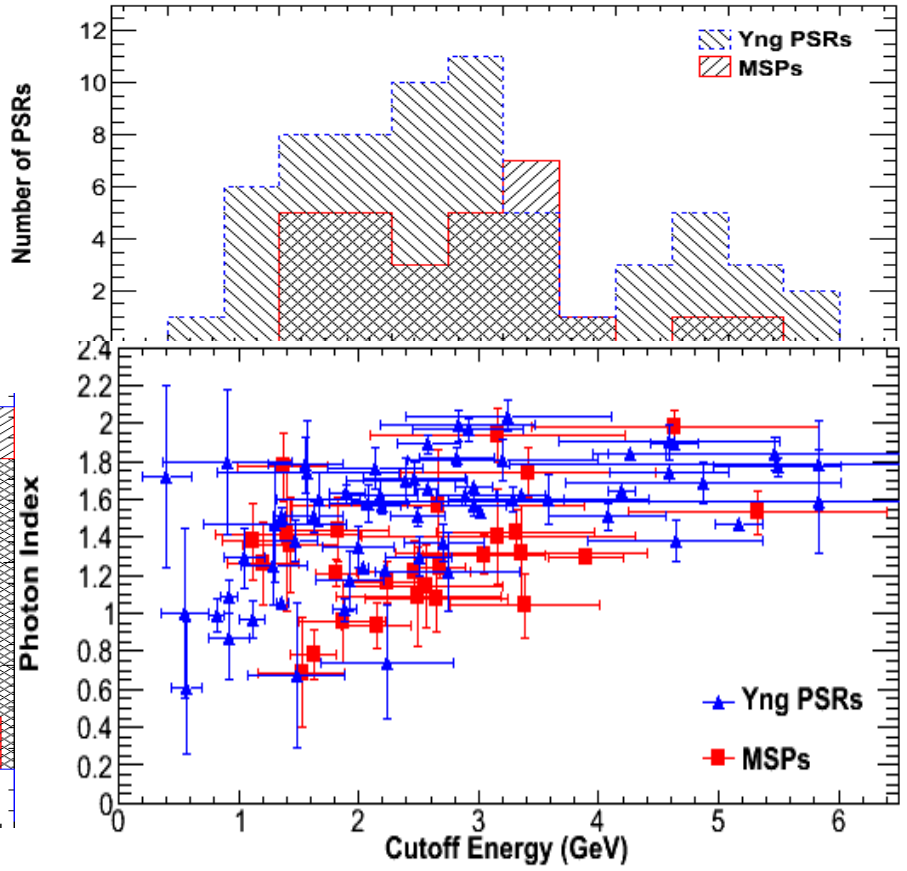
A trend (?): Steeper the rise in the spectrum, smaller the cutoff

All pulsars show a cutoff in their spectrum and well fitted with a power law with an exponential cutoff shape – b parameter controls the sharpness of the cutoff.

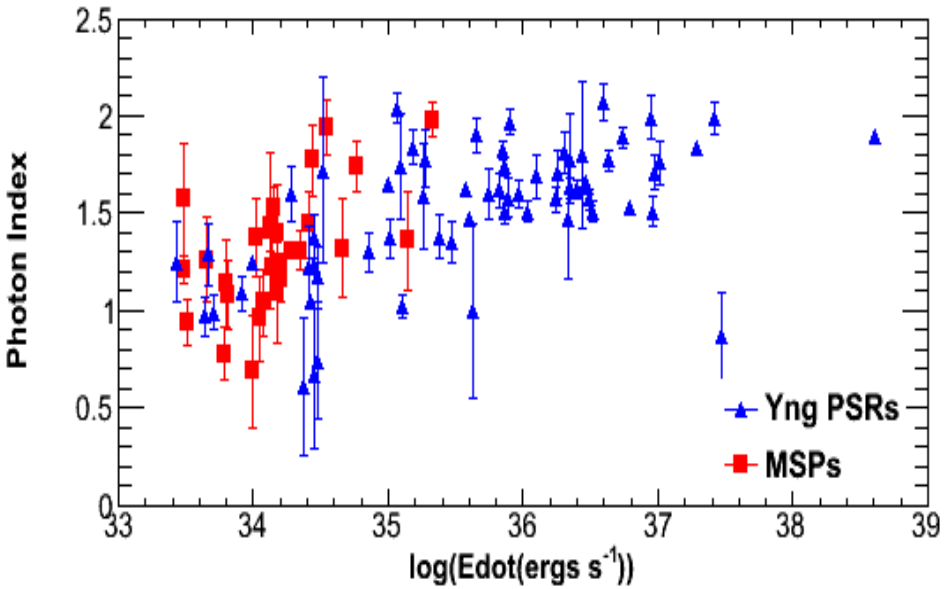
$$\frac{dN(E)}{dE} = AE^{-\Gamma}\exp[-(E/E_c)^b]$$

Although some pulsars prefer a gradual cutoff, b=1 is still a good fit for all pulsars. b=1 spectral fits are discussed here

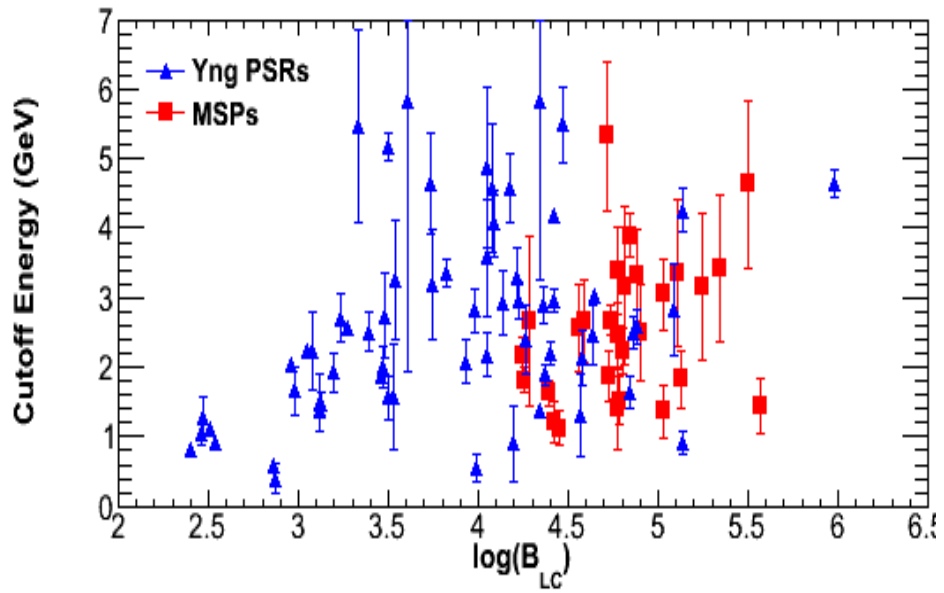


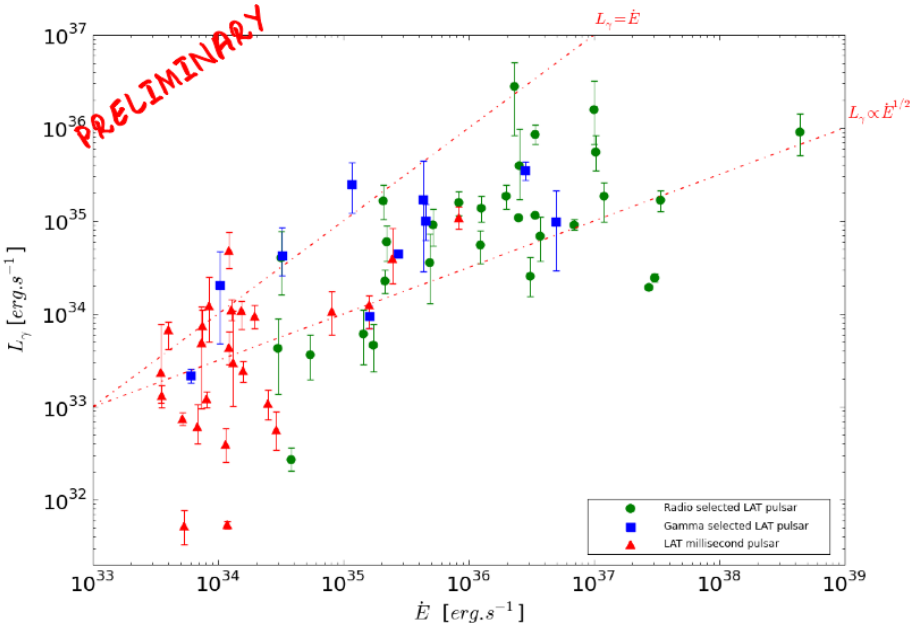


Any Spectral Trends?



- Softer spectrum at large Edot: Points to higher pair multiplicity for more energetic pulsars. MSPs seem to have steeper spectrum in comparison to more energetic young pulsars.
- There is a weak correlation between B_{LC} and Cutoff Energy: Argues against the low-altitude models (PC), but expected in outer magnetosphere models (OG, SG).
- (Incomplete) Lγ vs. Edot: MSPs do not seem to obey the trend energetic young pulsars follow





Summary

- Gamma-ray pulsars are everywhere in the sky & *Fermi* LAT is a successful pulsar finder!
- Third year surveying the sky, the detections of gamma-ray pulsations are still rapidly increasing from more and more pulsars – almost half of the gamma-ray pulsars are new discoveries by/with the aid of *Fermi* LAT.
- The second *Fermi* LAT catalog of gamma-ray pulsars will be out soon, reporting the spectral and timing properties of 116 pulsars.
- Exploiting the timing information helps us detect gamma-ray pulsations significantly from even very weak gamma-ray sources: We may not "see" some of the pulsars very well, but we still "hear" them in gamma-rays!
- All pulsars were found to have an exponential cutoff in their emission spectrum in 0.5-6 GeV range. (NOTE: Some has a very gradual cutoff shape)
- Young pulsars and MSPs display similar spectral shapes and trends.
- No strong spectral trends were found with respect to their intrinsic properties, such as Edot, age or magnetic field at the light cylinder.