



Fermi

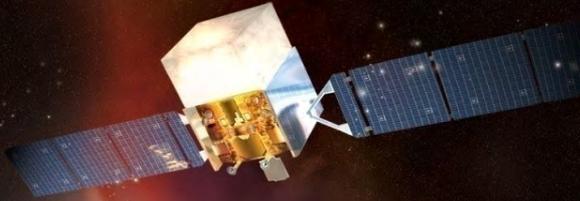
Gamma-ray Space Telescope



Pulsations from PSR B1821-24 in M28 Using Reprocessed Pass 7 LAT Data

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on behalf of the *Fermi* LAT
Collaboration and Pulsar Timing
Consortium



Fermi Gamma-ray Space Telescope

also with:
Lucas Guillemot (MPIfR Bonn),
Matthew Kerr (Stanford), Mike
Wolff (NRL),
and everyone involved in the Pass 7
reprocessing



First pulsar ever discovered in a globular cluster:

Radio pulsations by Lyne+ '87

X-ray pulsations with *ASCA* (Saito+ '97) & *RXTE* (Rots+ '98)

Only MSP known to have glitched (Cognard & Backer '04)

Known to emit giant radio pulses (Romani & Johnston '01)

B1821-24 vital stats:

Period: 3.05 ms

dP/dt : $1.62 \times 10^{-18} \text{ s s}^{-1}$ (likely intrinsic, Phinney '93)

\dot{E} : $2.2 \times 10^{36} \text{ erg s}^{-1}$

d : $5.1 \pm 0.5 \text{ kpc}$ (Rees & Cudworth '91)

Isolated



4.2 σ signal seen by *AGILE* (Pellizzoni+ '09):

Only in first 5 days of observation

Single, broad pulse

Slightly brighter than EGRET 3 σ upper limit

(< $16.1 \times 10^{-8} \text{ cm}^{-2} \text{ s}^{-1}$) (Fierro+ '95)

LAT point source detection:

1FGL J1824.5-2449 and 2FGL J1824.8-2449

associated with M28 (no pulsations)

Exponentially cutoff power law spectrum,

Abdo+ '10 estimate 43 (+24 -21) MSPs (12 known)

Sky-survey data through mid-June '12,

only 4.8 σ (spectrally weighted) pulsed detection

using current (Pass 7) LAT data



Use improved instrument calibration constants:

Light-yield: Correspondence between energy deposition and light output in each CAL crystal

Light-asymmetry: Mapping of light ratio seen at both CAL crystal ends as a function of interaction position

See Pass 7 performance paper (Ackerman+ '12) and poster on the Reprocessing (J. Bregeon, 5.4) for more info.

Data Changes:

Improved PSF above 3 GeV

Change in background contamination for event classes

Stabilized energy scale (had decreased by up to 4%)



Vela region

See overall increase in SOURCE events ~ 0.3 to 3 GeV

DM line search

See talk by A. Albert (Friday 9:45 am)

Inferred CR spectrum

Poster by W. Mitthumsiri (3, Monday-Tuesday)

Reevaluate the PSF with bright AGN and pulsars

See poster by M. Wood (2.6, Monday-Tuesday)



Use Reprocessed data (P7REP):

4 August 2008 – end of March 2012

0.1-100 GeV

New isotropic template

Old Galactic diffuse

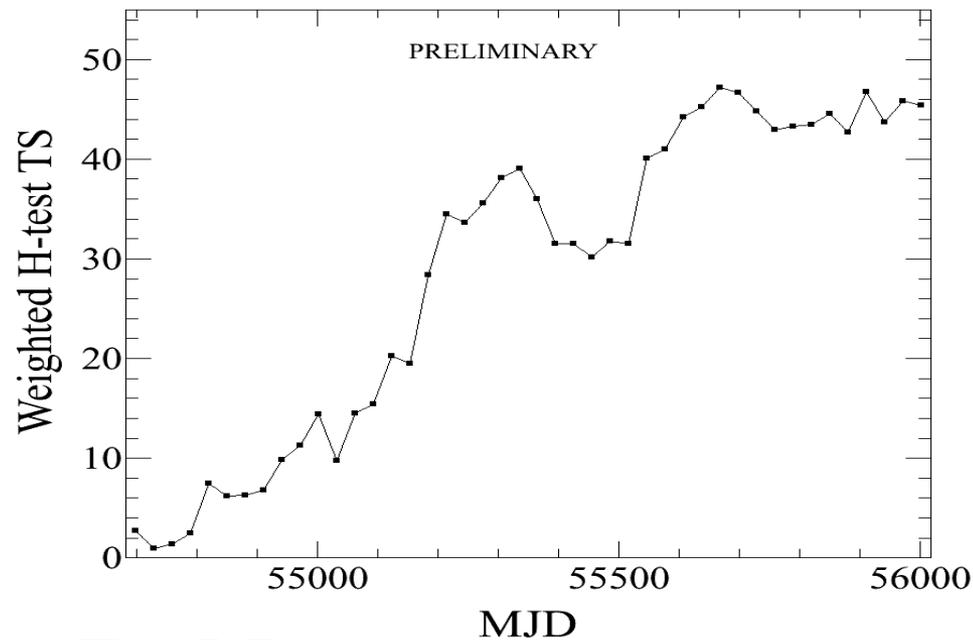
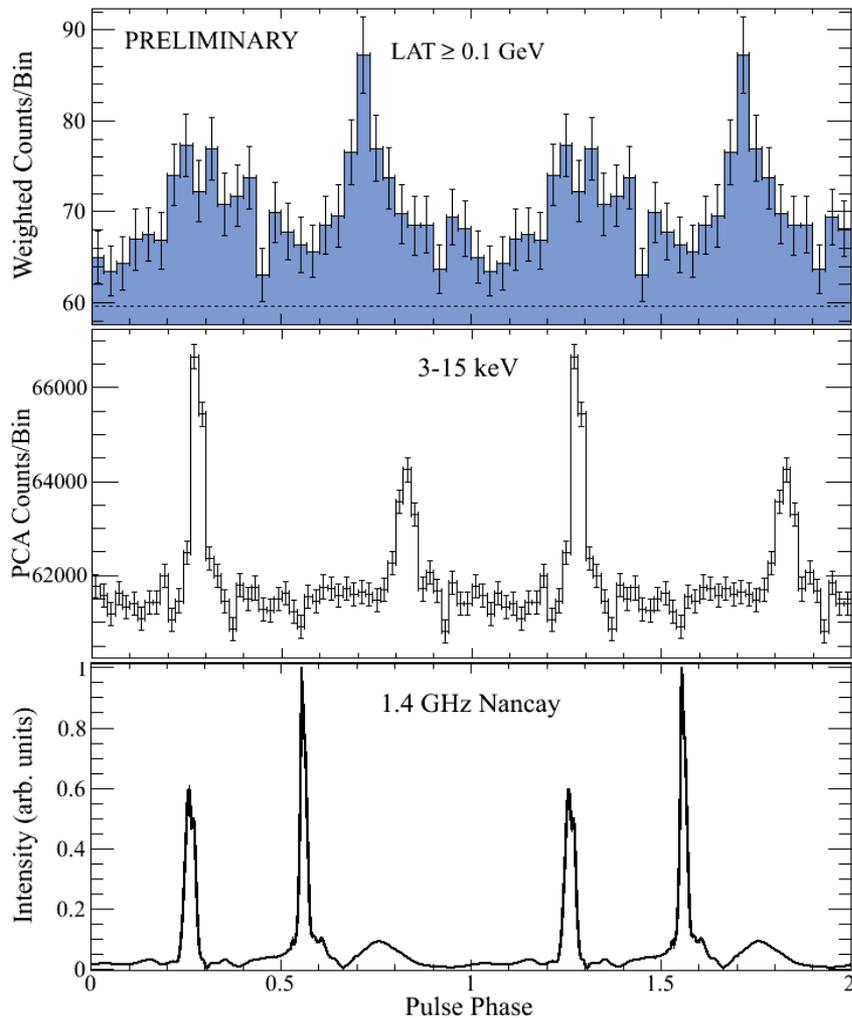
may bias the flux to be as much as ~20% too low

P7SOURCE_V6MC (MC PSF) IRFs

2FGL sources:

Sources within 8° free

Pulsar source at radio position



LAT – 5.7σ :

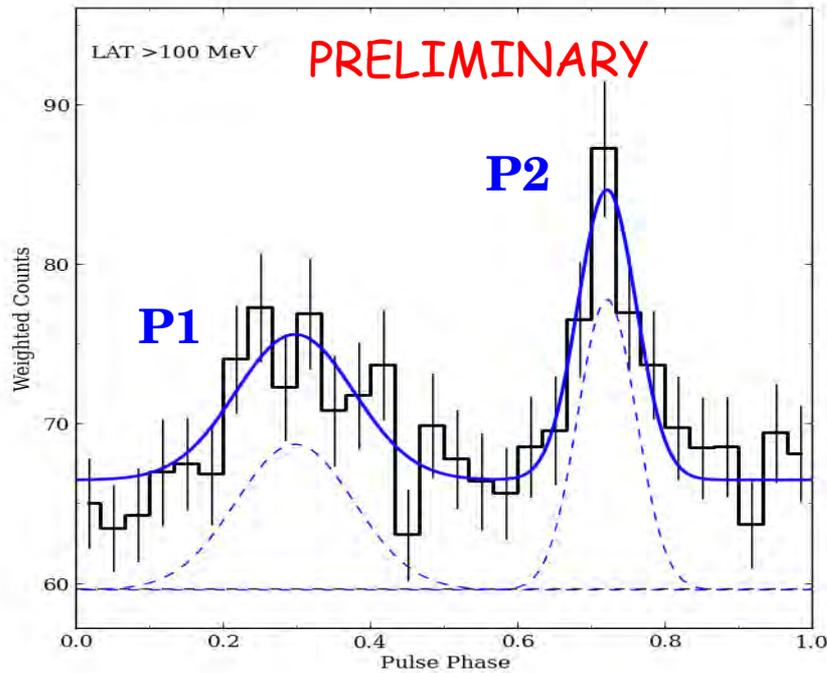
2 peaks, unpulsed component

RXTE – 27σ :

Obsvs. from ~July '06 – ~April '07

Radio:

Ephemeris valid from 29 Dec. 2004



Light curve fit:

P1: Gaussian, $\sigma = 0.08 \pm 0.02$

P2: Gaussian, $\sigma = 0.04 \pm 0.01$

Off-peak fit $\rightarrow 39 \pm 20$ MSPs

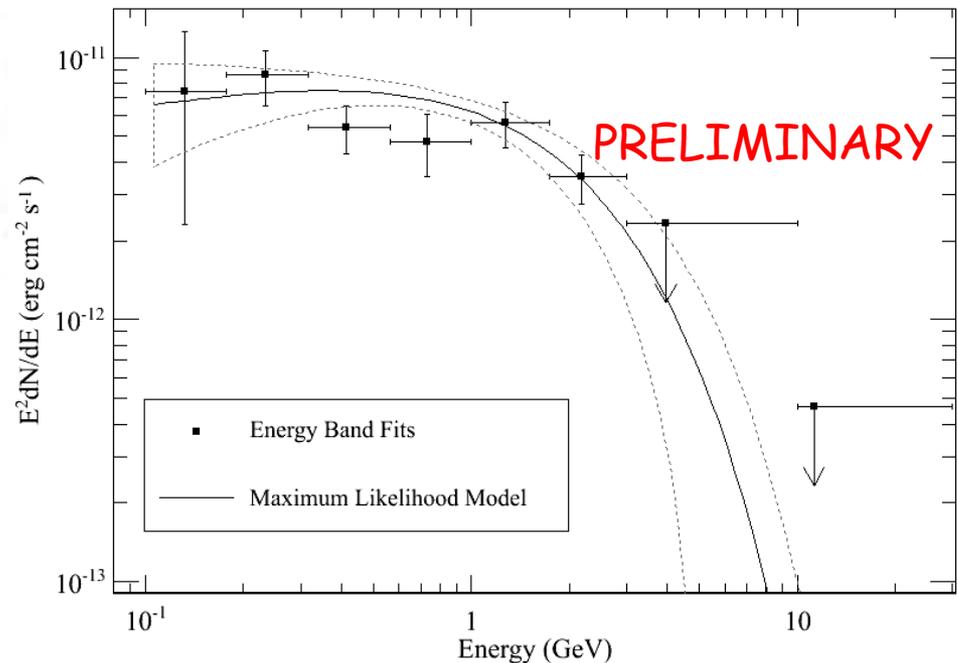
On-peak Spectrum:

$$F_{100} = 4.2 \pm 0.9 \times 10^{-8} \text{ cm}^{-2} \text{ s}^{-1}$$

(~70% M28 Flux)

$$L_{\gamma} = 6.2 \pm 1.5 \times 10^{34} \text{ erg s}^{-1}$$

$$\eta_{\gamma} = 2.8 \pm 0.7 \%$$



TJJ 4th Fermi Symposium Monterey, CA 30 October 2012



LAT Collaboration continuing to improve accuracy of data

Reprocessed data improves > 3 GeV PSF

Plan to release the P7REP data soon

Increase in pulsed significance for PSR B1821-24

Timing solution for 23 years, will be made available

Clear pulsed detection, 5.7σ

MSP does not account for all LAT emission

Estimate 39 ± 20 MSPs (+ B1821-24) in M28



References:

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-----Backup Slides-----

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AGILE signal, short term variability?

Flux light curve, weak source, try month- and week-long bins
See no significant variability but difficult to detect source on weekly time scales.

