



Three Energetic Pulsars Coincident with EGRET sources



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Summary

- PSR J1420-6048 D'Amico et al., ApJ, 552, L45, 2001
- PSR J1837-0604 D'Amico et al., ApJ, 552, L45, 2001
- PSR J1016-5857 Camilo et al., ApJ, 557, L51, 2001

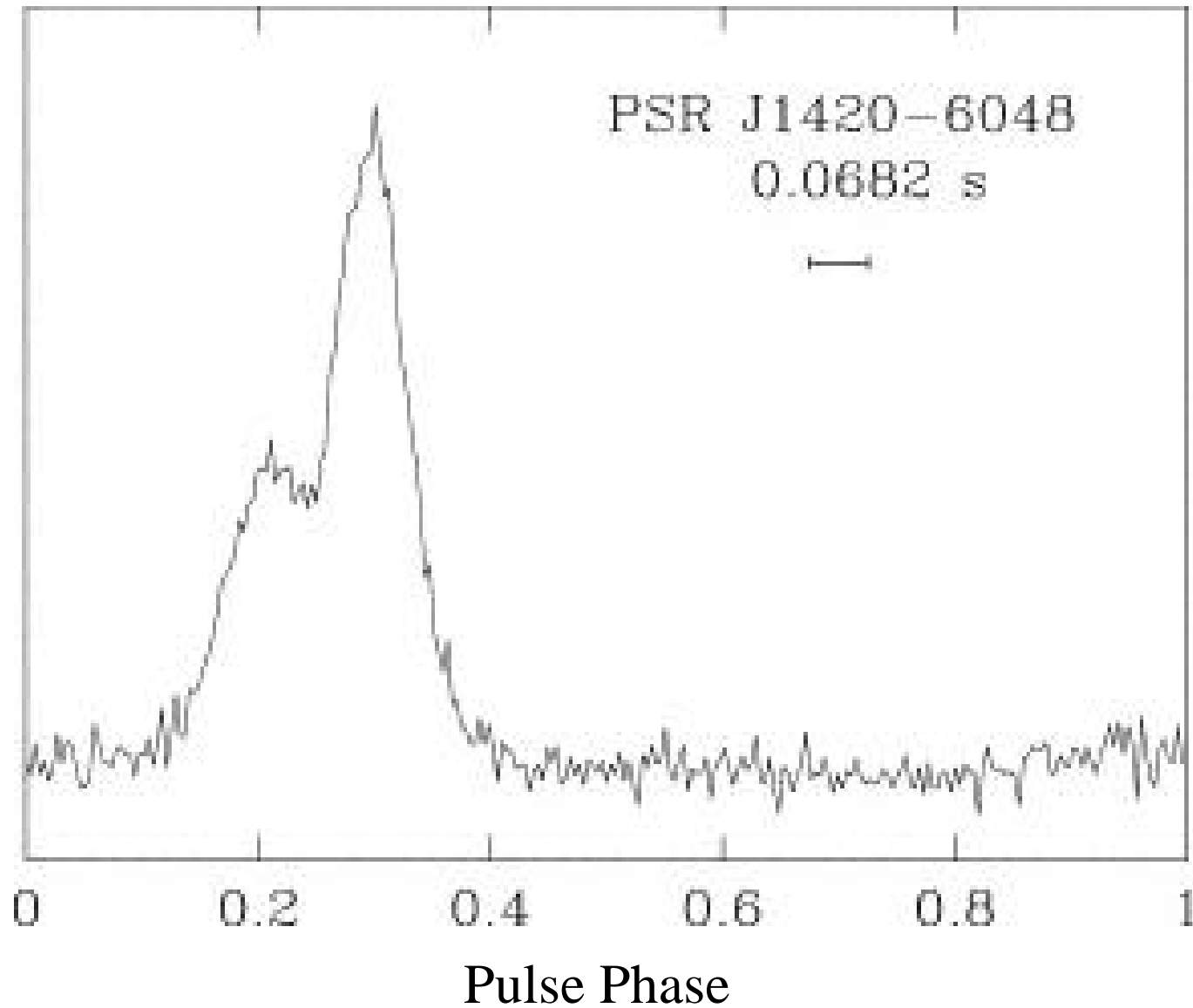
All are Parkes survey pulsars.

PSR J1420-6048

- $P = 68 \text{ ms}$, $dP/dt = 83e-15$
- characteristic age = 13 kyr
- $B = 2.4e12 \text{ G}$
- $dE/dt = 1e37 \text{ erg/s}$
- $DM = 360 \text{ pc/cm}^3$, $d = 7.7 \text{ kpc}$
- flux density @ 1400 MHz = 0.9 mJy

D'Amico et al. 2001

PSR J1420-6048

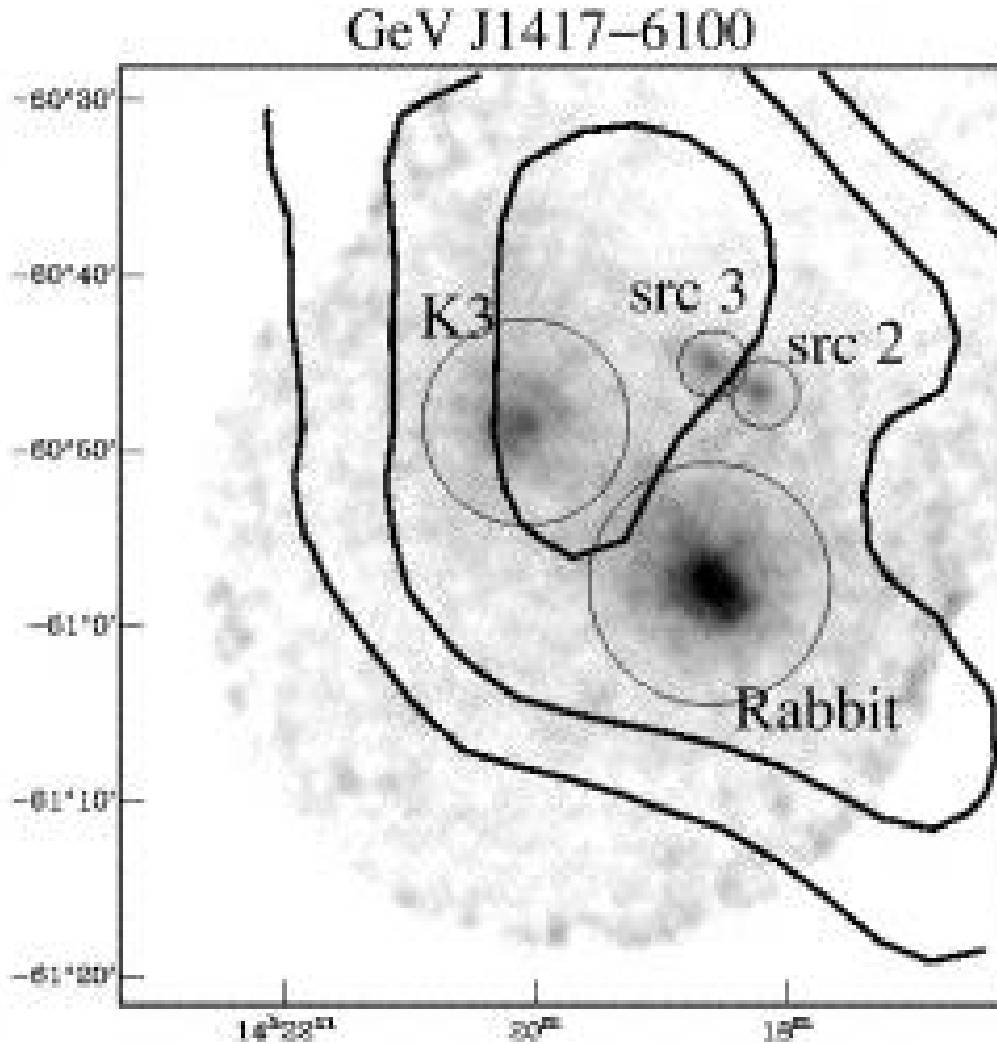


Average
pulse at
1400 MHz

3EG J1420-6038

- aka GEV 1417-6100
- PSR J1420-6048 is 10' from likeliest 3EG position
- 95% confidence region has radius $\sim 19'$
- 100 MeV - 10 GeV photon index 2.02 ± 0.14
- flux is $(3.3 \pm 0.9) \times 10^{-10}$ erg/s/cm²
- for $d=7.7$ kpc and beaming of 1 sr, gamma-ray efficiency is 2%
- EGRET source non-variable (McLaughlin et al. 96)

ASCA 2-10 keV Image

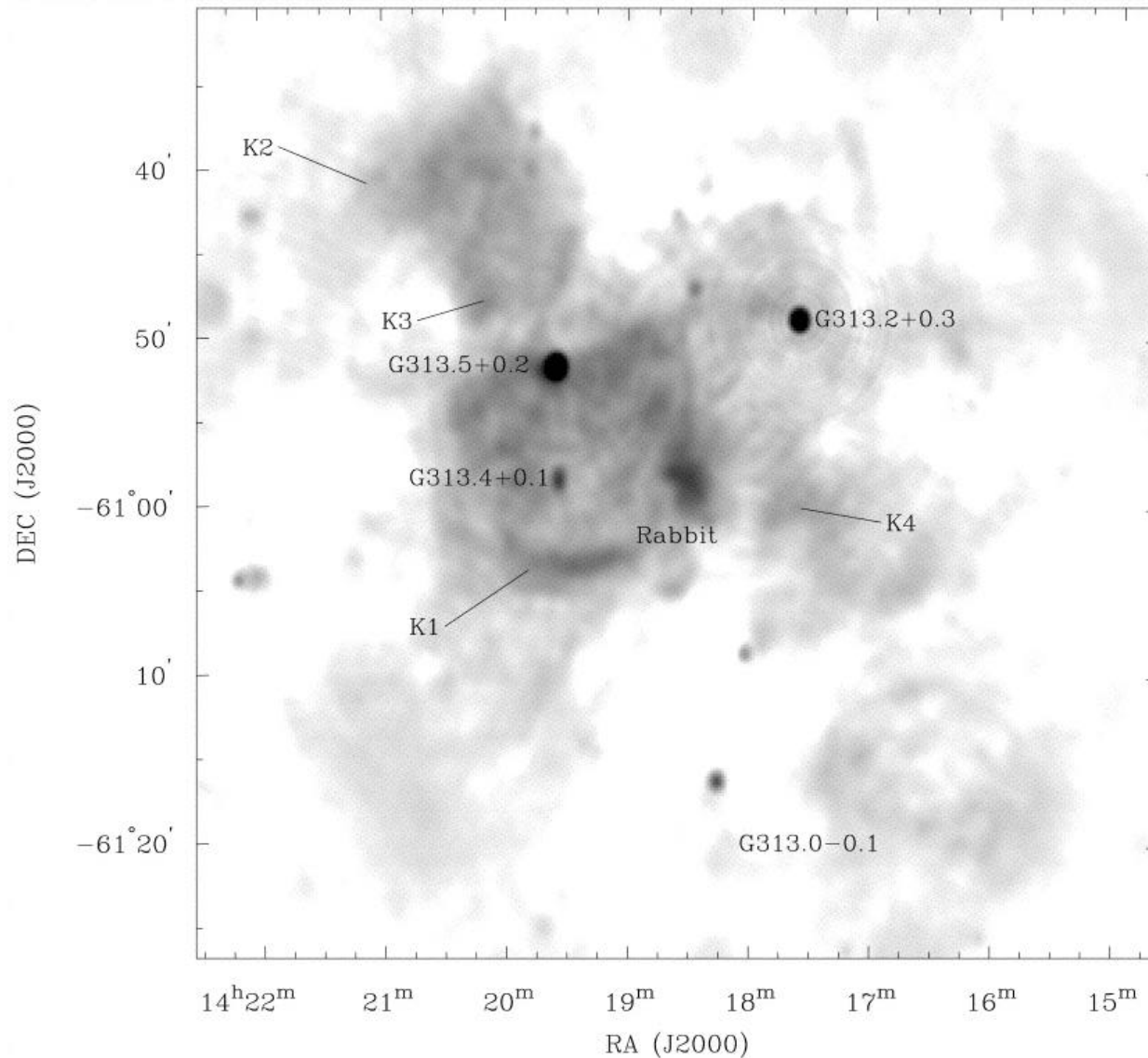


3EG error contours:
68%, 95%, 99%

Pulsar at K3

Roberts, Romani &
Kawai (2001)

Kookaburra

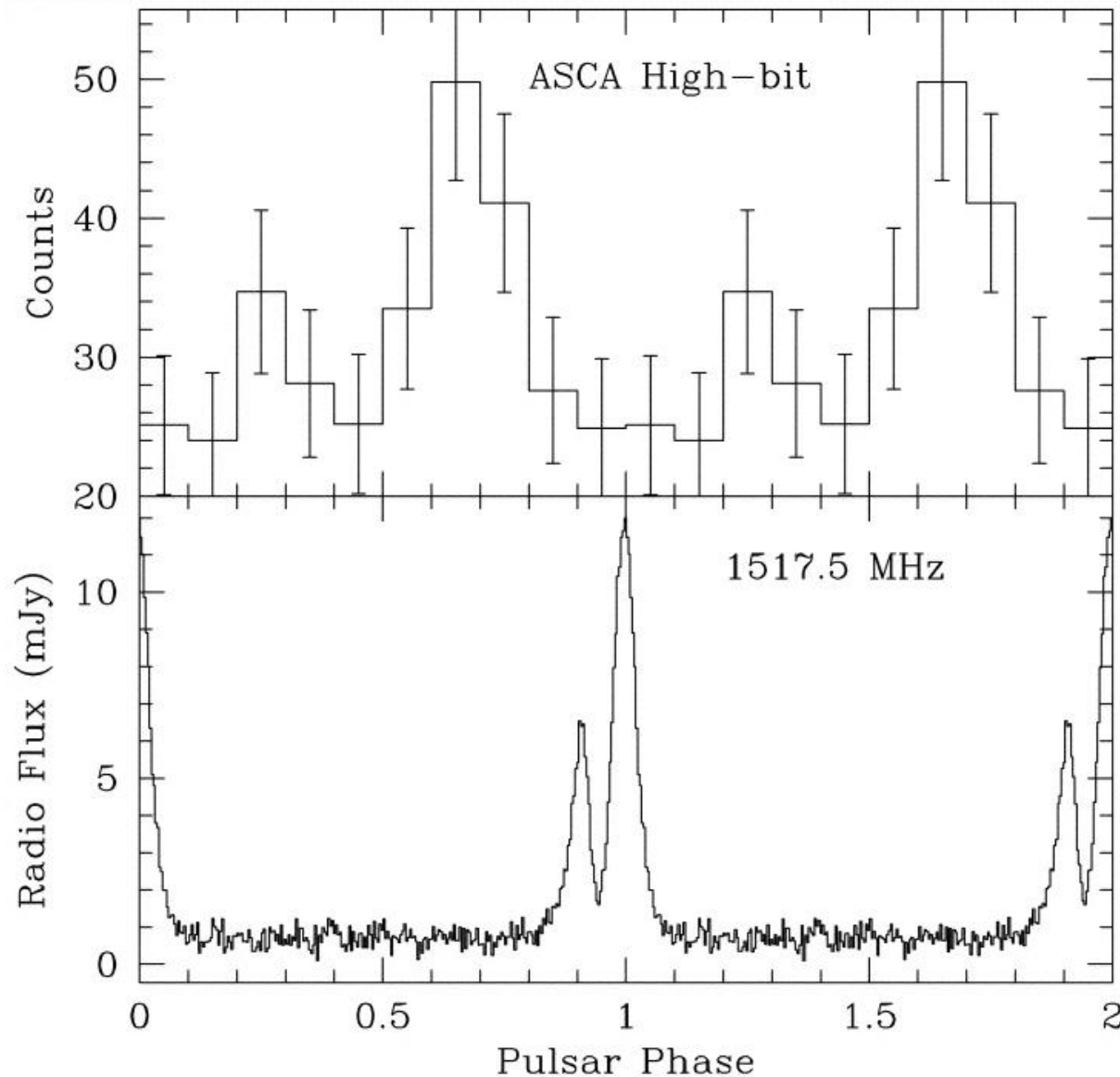


20 cm ATCA
image of field
of 3EG J1420-6038

Pulsar at K3
position.

Roberts et al. (1999)
suggest Rabbit may
be 3EG counterpart.

Evidence for X-ray Pulsations from K3



Possible pulsations support gamma-ray ID as both are likely magnetospheric emission.

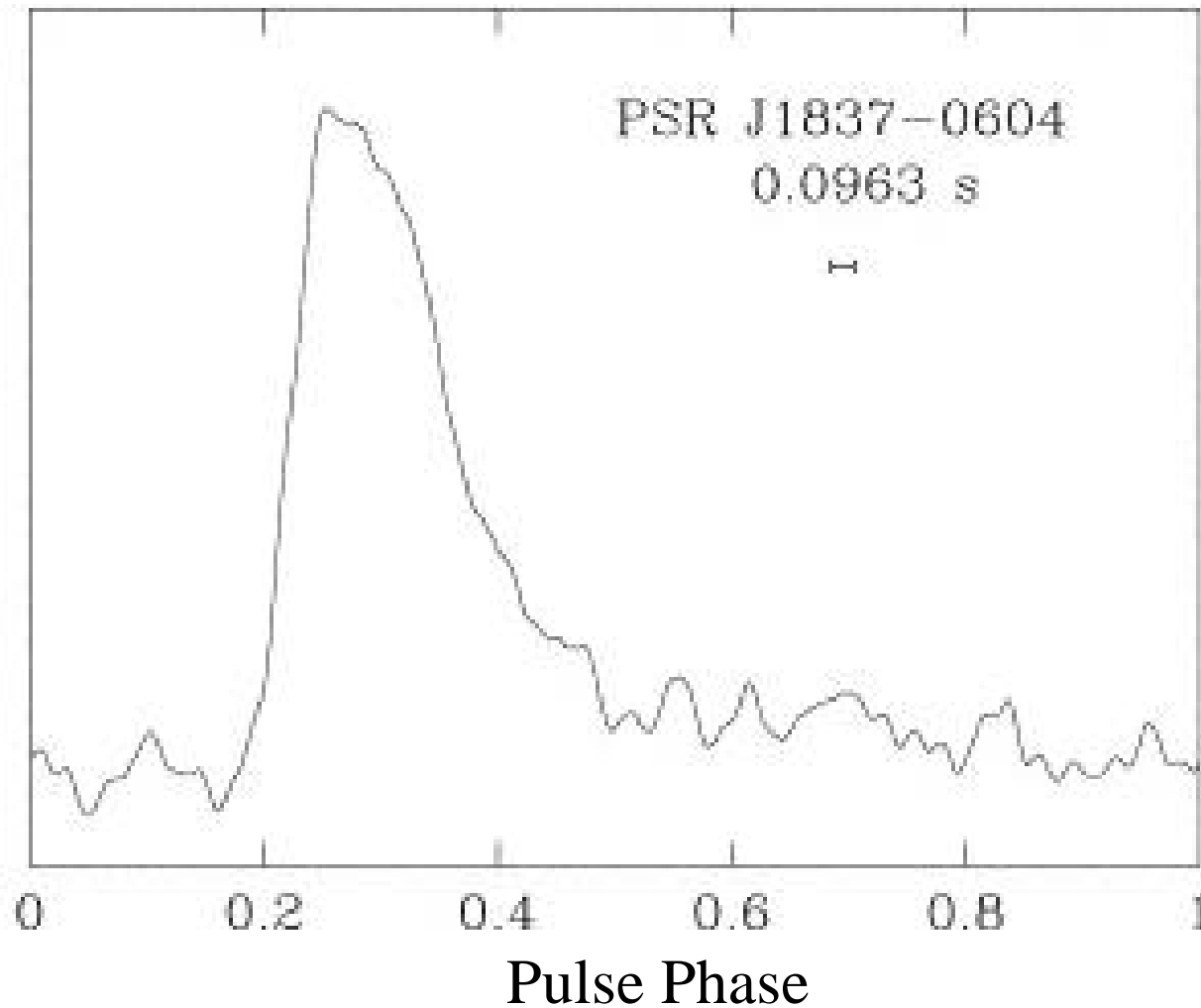
Roberts, Romani, Johnston (2001)

PSR J1837-0604

- $P = 96 \text{ ms}$, $dP/dt = 45e-15$
- characteristic age = 34 kyr
- $B = 2.1e12 \text{ G}$
- $dE/dt = 2e36 \text{ erg/s}$
- $DM = 462 \text{ pc/cm}^3$, $d = 6.2 \text{ kpc}$
- flux density @ 1400 MHz = 0.4 mJy

D'Amico et al. 2001

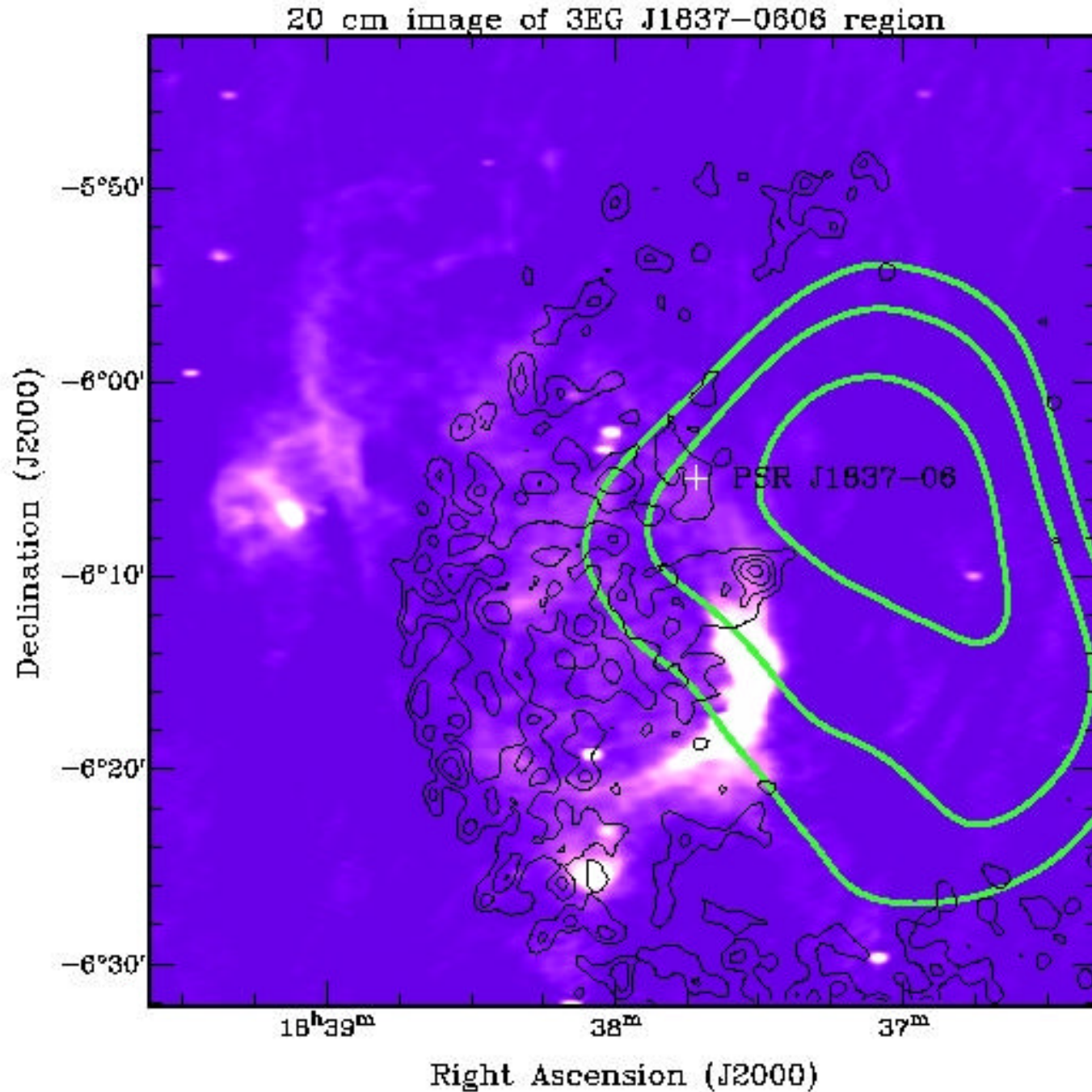
PSR J1837-0604



Average pulse
at 1400 MHz

3EG J1837-0606

- PSR J1837-0604 is 10' from likeliest 3EG position
- 95% confidence region has radius $\sim 11'$
- 100 MeV - 10 GeV photon index 1.82 ± 0.14
- flux is $(3.7 \pm 0.9)e-10$ erg/s/cm²
- for $d=6.2$ kpc and beaming of 1 sr, gamma-ray efficiency is 7%



Black contours:
ASCA - nothing
obvious at
pulsar position
(CXO also sees
nothing).

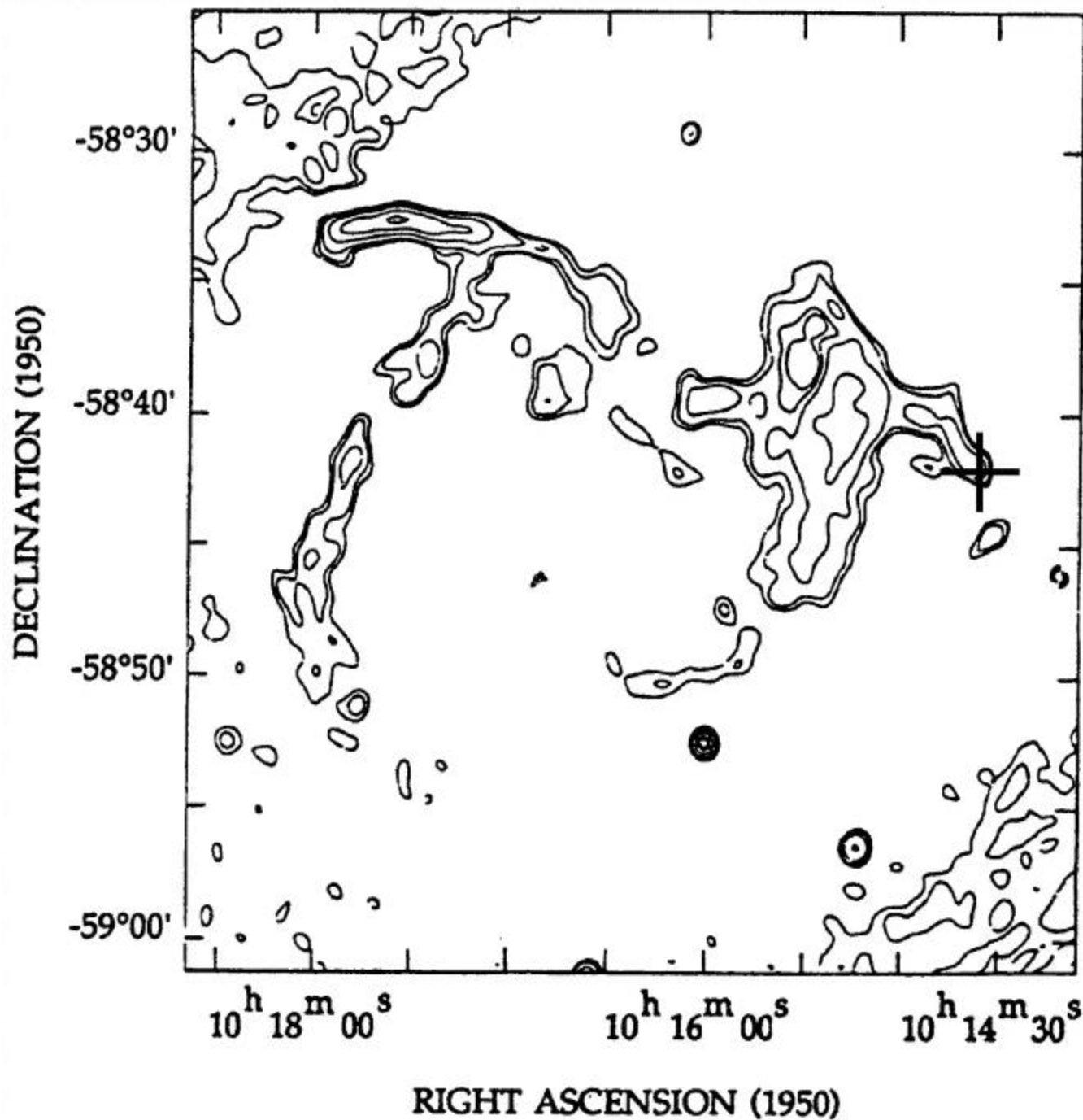
Green contours:
EGRET 68%,
95%, 99%

Radio shell is
probably thermal

Courtesy
M. Roberts

PSR J1016-5857

- $P = 107 \text{ ms}$, $dP/dt = 80e-15$
- characteristic age = 21 kyr
- $B = 3.0e12 \text{ G}$
- $dE/dt = 2.6e36 \text{ erg/s}$
- $DM = 394 \text{ pc/cm}^3$, $d = 9 \text{ kpc}$
- flux density @ 1400 MHz = 0.5 mJy

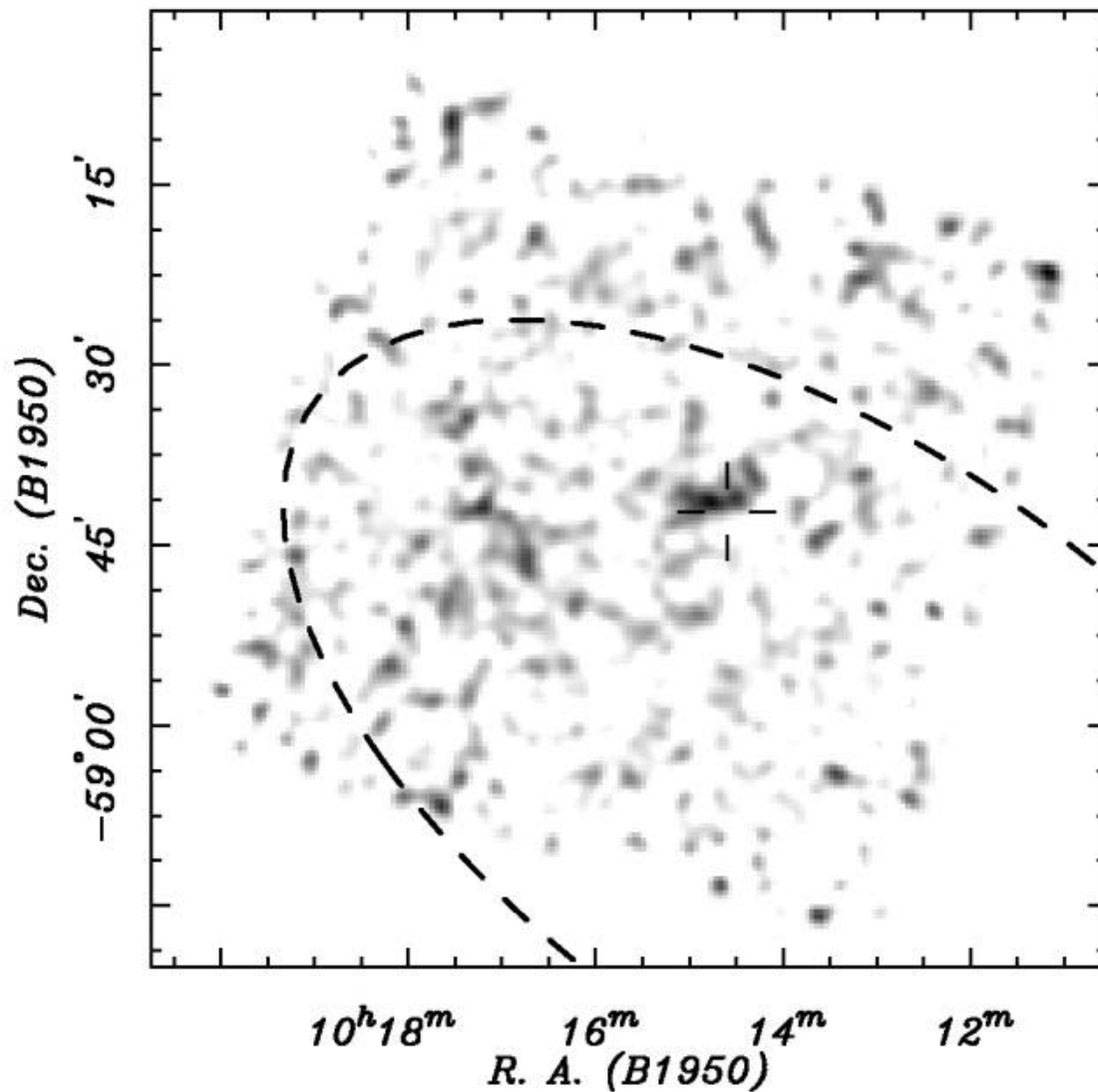


MOST 843 MHz
image

Ragged shell
SNR G284.3-1.8
(Milne et al. 1989)

$d(\text{SNR}) = 3 \text{ kpc}$
(Ruiz & May 1986)

Einstein IPC X-ray Image



4.8 sigma X-ray point source $1'.8$ from pulsar

X-ray efficiency 0.05% if associated

Dashed ellipse is 2 sigma error region for 3EG J1013-5915

3EG J1016-5857

- PSR J1837-0604 well within 2 sigma error box
- 95% confidence region has radius $\sim 11'$
- 100 MeV - 10 GeV photon index 2.32 ± 0.13
- flux is $(3.3 \pm 0.6)e-10$ erg/s/cm²
- for $d=3$ kpc and beaming of 4π sr, gamma-ray efficiency is 6%
- 3EG source non-variable

Conclusions

- Parkes survey finding promising EGRET source counterparts
- Each requires multiwavelength studies to help judge possible associations
 - such studies valuable for many reasons: PWN, SNRs...
- GLAST should decide unambiguously through detection of pulsations