Three Energetic Pulsars Coincident with EGRET sources

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Summary


All are Parkes survey pulsars.
PSR J1420-6048

- $P = 68\,\text{ms}$, $dP/dt = 83\times10^{-15}$
- characteristic age $= 13\,\text{kyr}$
- $B = 2.4\times10^{12}\,\text{G}$
- $dE/dt = 1\times10^{37}\,\text{erg/s}$
- $DM = 360\,\text{pc/cm}^3$, $d = 7.7\,\text{kpc}$
- flux density @ 1400 MHz $= 0.9\,\text{mJy}$

D’Amico et al. 2001
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 ~19’
- 100 MeV - 10 GeV photon index 2.02 +/- 0.14
- flux is (3.3 +/- 0.9)e-10 erg/s/cm^2
- 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
• PSR J1837-0604 is 10’ from likeliest 3EG position
• 95% confidence region has radius ~11’
• 100 MeV - 10 GeV photon index 1.82 +/- 0.14
• flux is (3.7 +/- 0.9)e-10 erg/s/cm^2
• 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

- $P = 107$ ms, $\frac{dP}{dt} = 80 \times 10^{-15}$
- characteristic age = 21 kyr
- $B = 3.0 \times 10^{12}$ G
- $\frac{dE}{dt} = 2.6 \times 10^{36}$ erg/s
- $DM = 394$ pc/cm$^3$, $d = 9$ kpc
- flux density @ 1400 MHz = 0.5 mJy

Camilo et al. 2001
MOST 843 MHz image

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

d(SNR) = 3 kpc
(Ruiz & May 1986)
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
PSR J1837-0604 well within 2 sigma error box
95% confidence region has radius ~11’
100 MeV - 10 GeV photon index 2.32 +/- 0.13
flux is (3.3 +/- 0.6)e-10 erg/s/cm^2
for d=3 kpc and beaming of 4pi 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