Initial Results from a Radio Pulsation Survey of Mid-Latitude Unidentified *EGRET* Error Boxes

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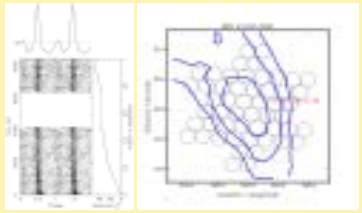
Abstract

The identification of the unidentified EGRET sources remains one of the outstanding problems in high-energy astrophysics. We report the preliminary results of a survey of 52 unidentified EGRET error boxes at galactic latitudes >5 degrees from the plane using the Parkes radio telescope at 20cm. Covering over 100 square degrees of sky, the 35 minute pointings using the sensitive Multibeam system provide a nominal sensitivity to pulsars with periods >20ms of ~0.2 mJy. We discuss both new and previously known pulsars that have been observed by this survey and the likelihood that they are associated with the EGRET sources.

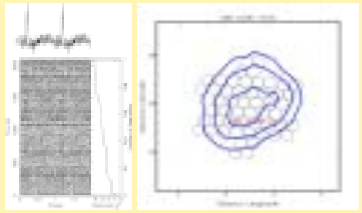
Observations / Analysis

- Data taken using the Parkes Multibeam System (e.g. Manchester et al., 2001, MNRAS, 328, 17)
- 35 min duration, 0.125 ms sampling
- 96 x 3 MHz Channels at 20cm (i.e. 1.4 GHz)
- Sensitivity is ~0.2 mJy
- 52 node Beowulf cluster dedicated for the McGill Pulsar group is being used for all data analysis
- Analysis includes full coherent acceleration search for binary pulsars
- Analysis is approximately 2/3 complete
- All known pulsars in the data analyzed so far (7) except for PSR J1636-1509 have been detected
- A re-analysis of all data for slow pulsars using improved interference rejection is planned

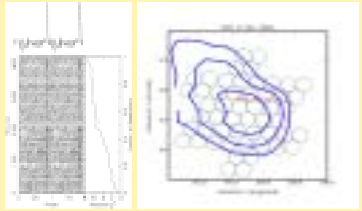
New Pulsars



PSR J1614-22 (3.15 ms, binary)



PSR J1632-10 (717 ms, isolated)



PSR J1744-39 (172 ms, binary)

These plots show the three confirmed new pulsars from the survey to date. The plots on the left show 2 full pulse profiles and a grayscale image displaying the pulse intensity as a function of time along with effects caused from scintillation and/or interference (and in the case of PSR J1614-22, 35 min when the telescope was off source). The maps on the right show the tessellation pattern of the 4x13 beam pointings using the Parkes telescope as well as the 68%, 95%, and 99% EGRET confidence limits on the source position. PSR J1632-10 seems to be a "normal" radio pulsar, but both PSR J1614-22 (a binary millisecond pulsar) and PSR J1744-39 (a rare non- or mildly-recycled binary pulsar in a relatively compact (P_{orb} of order 1 day) appear to be particularly interesting. Timing observations of these pulsars will begin soon. Measurement of the spin-down rates and positions(i.e. to look for X-ray counterparts) will help us determine if the pulsars could reasonably be *EGRET* counterparts.

Candidates

The five candidates shown here were found during the processing of the first 2/3 of our data. Several of these candidates have millisecond periods and/or display a significant period derivative implying binarity. Confirmation observations will occur within the next few months at Parkes and/or Arecibo.

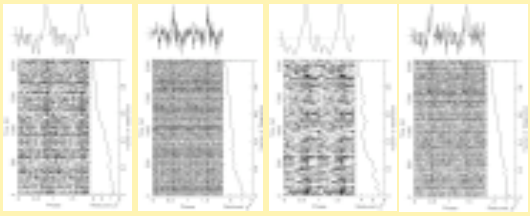


Table 1: Observed EGRET sources

Name	l	b	d	γ
3EG J0038−0949	112.69	−72.44	0	2.76 ± 0.44
3EG J0159−3603	248.89	−73.04	0	3.88 ± 0.66
3EG J0240+1758	157.62	−37.11	1.14	2.61±0.37
3EG J0348−5706	269.35	−46.79	1.89	2.18±0.27
3EG J0404+0700	184.60	−32.15	0.37	2.65±0.26
3EG J0437+1719	175.63	−25.06	0.93	2.93±0.37
3EG J0426+1333	161.58	−23.82	0.26	2.17±0.25
3EG J0429+0337	191.44	−29.08	0	3.02±0.27
3EG J0530−3626	240.60	−31.29	0.56	2.48±0.84
3EG J0556+0409	202.868	−20.48		2.45±0.16
3EG J0616−3310	240.35	−21.24	0.17	2.11±0.24
3EG J0812−0646	226.64	14.62	0	2.34±0.29
3EG J0903−3531	259.49	7.40	0.52	2.68±0.34
3EG J1134−1530	277.64	43.48	1.20	2.78±0.31
3EG J1219−1520	291.56	46.82	1.81	2.52±0.5
3EG J1234−1318	296.43	49.34	0.42	2.08±0.24
3EG J1239+0233	285.28	65.13	0.24	2.38±0.35
3EG J1310−0517	311.79	57.35		2.34±0.22
3EG J1314−3431	308.21	38.12	0	2.28±0.19
3EG J1316−5244	305.85	9.93	0.42	2.54±0.18
3EG J1457−1903	339.68	34.68	0.49	2.67±0.43
3EG J1504−1537	344.04	36.58	1.25	—
3EG J1616−2221	353.60	20.03	0	2.42±0.24
3EG J1627−2419	353.36	16.71	0	2.26±0.27
3EG J1631−1818	5.55	24.94	0.36	2.28±0.27
3EG J1634−1434	3.33	21.78	0	2.15±0.23
3EG J1636−2749	352.35	12.59	0.46	2.47±0.15
3EG J1646−0704	10.85	23.69	0.85	2.38±0.36
3EG J1649−1611	3.35	17.86	0.51	2.31±0.27
3EG J1652−0223	15.99	25.05	0	2.53±0.24
3EG J1717−2737	357.67	5.95	0.80	2.23±0.15
3EG J1719−0439	17.80	18.17	0	2.28±0.24
3EG J1720−7828	314.56	−22.17	0	2.74±0.38
3EG J1726−0807	15.52	14.77	0.27	2.34±0.19
3EG J1735−1508	16.73	9.22	0	3.24±0.47
3EG J1741−2958	6.44	5.00	0.40	2.25±0.12
3EG J1744−3834	350.81	−5.36	0.61	2.42±0.17
3EG J1746−1806	16.34	9.64	0.31	2.59±0.18
3EG J1800−0646	25.49	10.39	0	2.79±0.22
3EG J1822+1641	44.84	13.84	1.89	3.06±0.68
3EG J1825−7928	314.56	−25.44	0.76	2.47±0.31
3EG J1828+0142	31.80	5.76	1.64	2.76±0.39
3EG J1834−2803	5.92	−8.87	0	2.62±0.20
3EG J1836−4933	345.53	−16.26	0	2.14±0.25
3EG J1847−0219	3.21	−13.37	0.79	2.67±0.42
3EG J1858−2537	14.21	−11.15	0	2.48±0.36
3EG J1904−1124	24.22	−8.32	0.26	2.68±0.21
3EG J1949−0626	37.41	−11.62	1.23	3.15±0.39
3EG J1949−3456	5.25	−26.29	1.17	—
3EG J2004−3611	12.25	−34.64	1.12	3.43±0.78
3EG J2219−7941	310.64	−35.06	0	2.58±0.29
3EG J2243+1508	82.89	−37.49	1.11	—
3EG J2251−1341	52.48	−58.91	1.30	2.43±0.46

Table 1: The Sources

The names, Galactic coords (l,b), variability parameter (d, Thompkins 2001, PhD Thesis, Stanford), and spectral indices (g) of the mid-latitude *EGRET* sources observed (see Hartman et al., ApJS, 123, 79). The positions of these sources are consistent with either a Galactic Halo + Gould Belt distribution or the MSP distribution. g-ray pulsars are expected to show little variability. Sources with probable blazar counterparts were not observed.