

Recent Cluster Pulsar Results from Caltech

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Search Effort

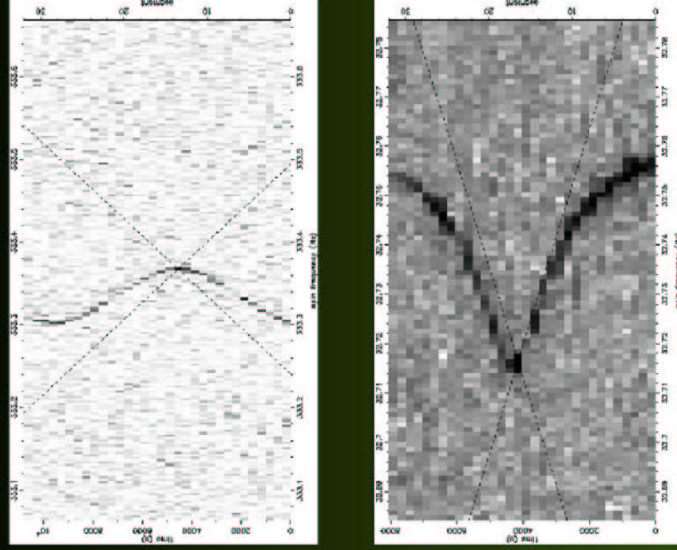
Goal: Find new pulsars in rich galactic bulge globular clusters using 100 m Green Bank Telescope.

- Installed and integrated Berkeley-Caltech Pulsar Machine (96 channel digital filterbank) at GBT for search backend.
- Observed seven clusters at 1.4 GHz for about 6 hours each: NGC 6642, NGC 6266 (M62), NGC 6624, NGC 6544, NGC 6522, NGC 6440, NGC 6293.
- Developed Dynamic Power Spectrum pulsar search technique (A. Chandler, Ph. D. Thesis, 2003) for data analysis.

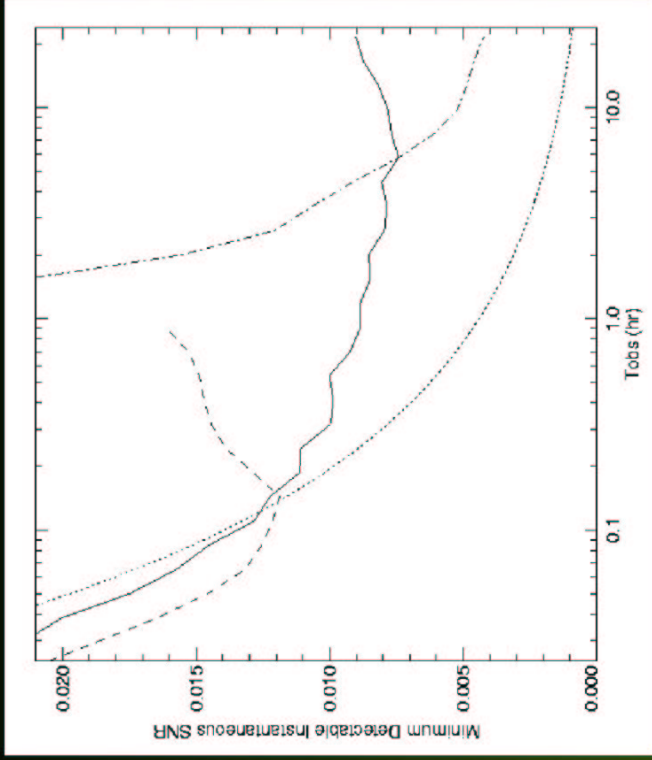
Dynamic Power Spectrum Technique

- Divide observation into several sub-integrations and compute power spectrum for each.
- Find bins with locally significant excess power.
- Search adjacent power spectra for excess power in bins within some pre-determined acceleration range.
- Allows candidates to be identified even when excess power in a given bin is not globally significant.
- Sensitive and efficient for orbital periods comparable to the observation length.

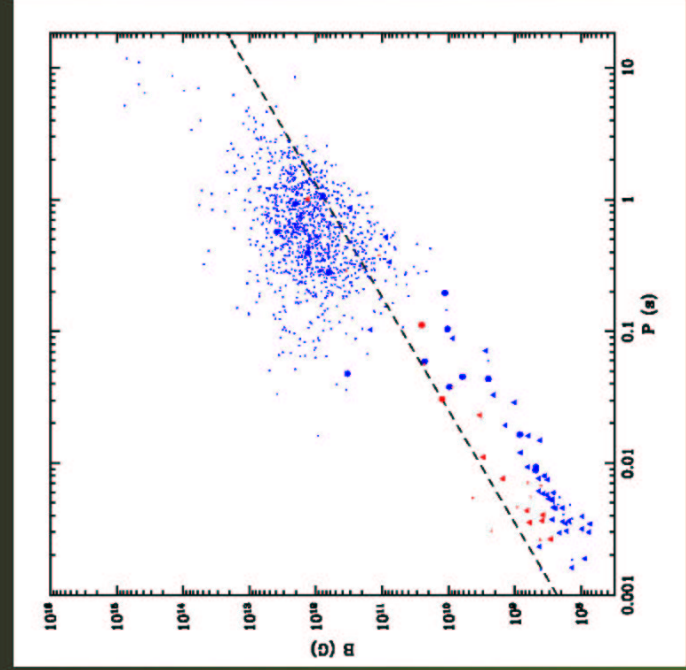
Dynamic Power Spectrum Examples



Search Technique Comparison



Pulsar Population



Three New Pulsars in M62

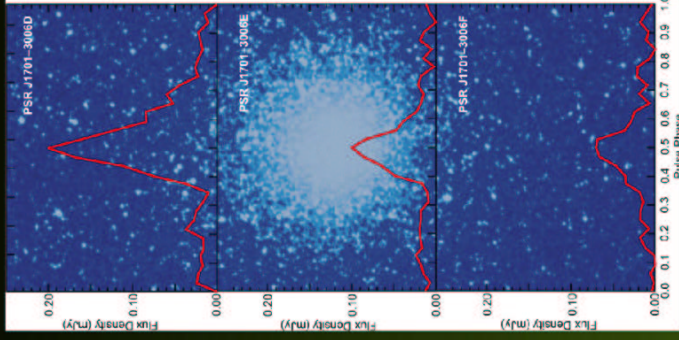
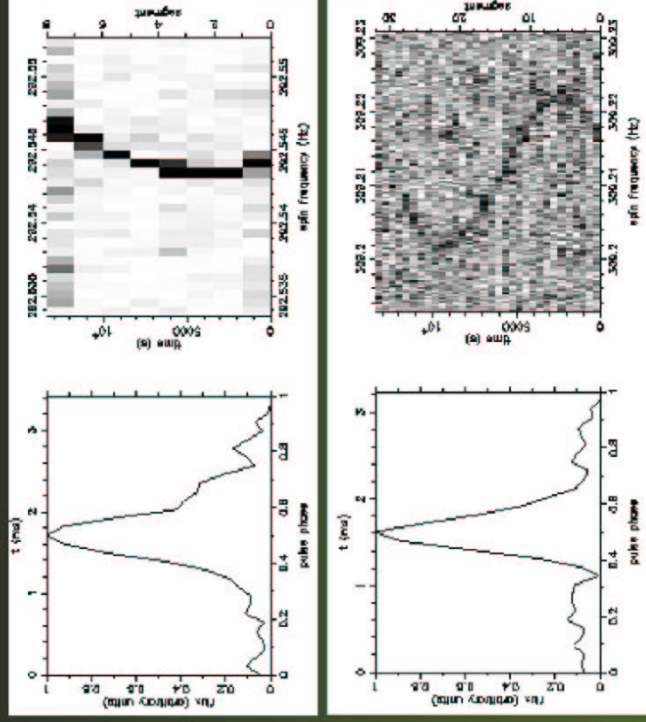


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M62 D, E

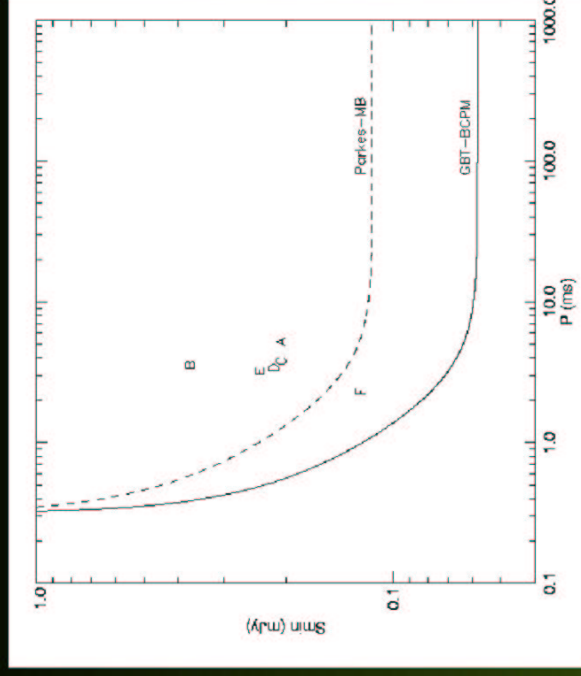


M62 Pulsars

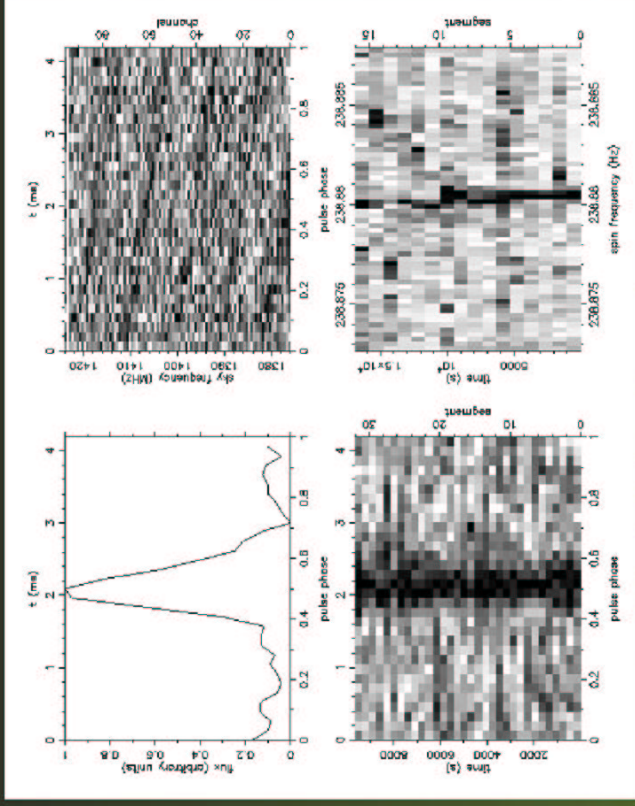
Name	Period (ms)	P_b (days)	$a \sin i$ (ls)	M_C^{\min} (M_\odot)
J1701-3006A	5.241	3.80	3.48	0.19
J1701-3006B	3.593	0.14	0.25	0.12
J1701-3006C	3.806	0.21	0.19	0.07
J1701-3006D	3.418	1.12	0.98	0.12
J1701-3006E	3.234	0.16	0.07	0.03
J1701-3006F	2.295	0.20	0.06	0.02

A, B, C: Possenti et al. 2001. D, E, F: Jacoby et al. 2002, Chandler 2003.

M62 Search Sensitivity



New Millisecond Pulsar in NGC 6544



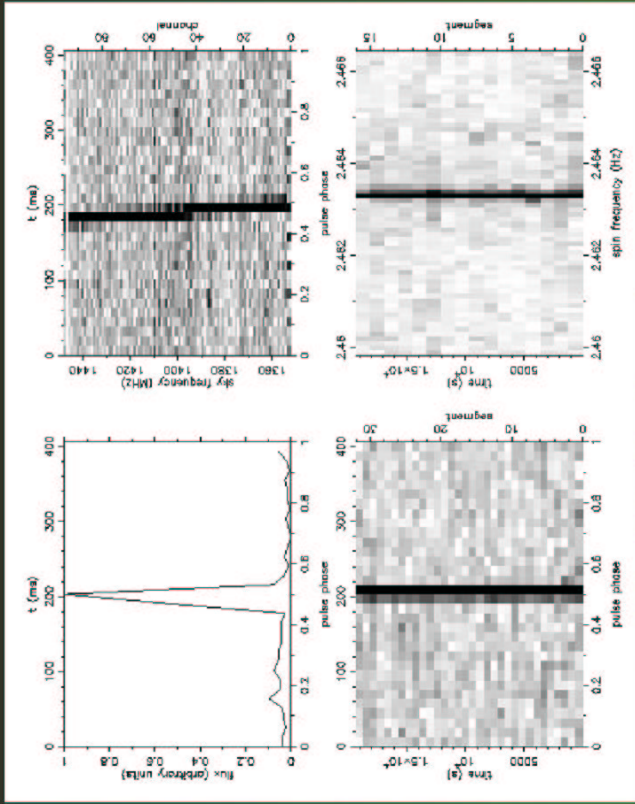
NGC 6544B, $P = 4.186$ ms

NGC 6544 Pulsars

Name	Period (ms)	DM (pc cm^{-3})	P_b (days)	$a \sin i$ (ls)
J1807-2459A	3.059	134	0.071	0.012
J1807-2459B	4.186	134	-	-

A: D'Amico et al. 2001

New Slow Pulsar in NGC 6624



NGC 6624C, $P = 405.9$ ms

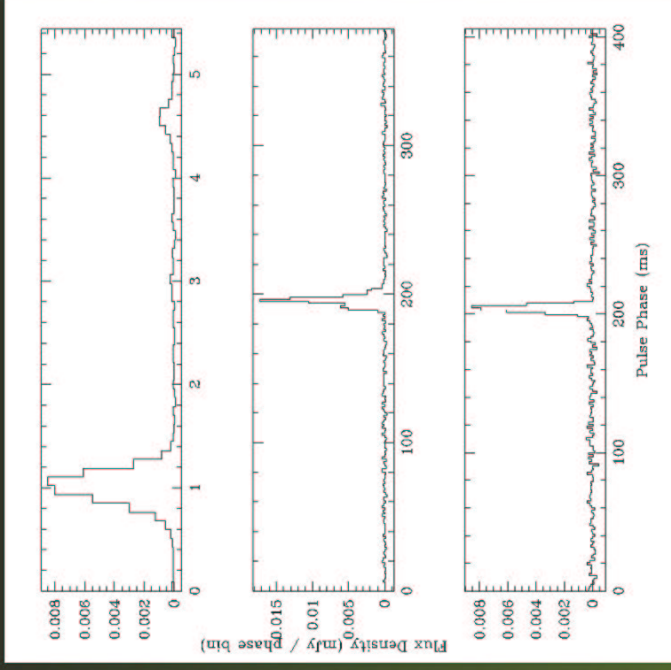
NGC 6624 Pulsars

Name	Period (ms)	DM (pc cm^{-3})	P_b (days)	$a \sin i$ (ls)
B1820-30A	5.440	87	-	-
B1820-30B	378.6	87	-	-
B1820-30C	405.9	87	-	-

A, B: Biggs et al. 1994

Also contains LMXB 4U 1820-30.

NGC 6624 A, B, C Pulse Profiles



Slow Pulsars in Globular Clusters?

There are only 4 known cluster pulsars with $P > 200$ ms, and two of them are in NGC 6624! (See Lyne et al. 1996 and references therein for discussion of origin.)

- Could be from AIC or old pulsars with newly captured companions, but where did the companions go?
- More likely scenario is collision between old neutron star and non-degenerate star.
- Brief common envelope phase, then companion is disrupted.
- Accretion disk results, pulsar is mildly recycled.

In the near future...

- Complete timing analysis of new M62 pulsars (positions, cluster dynamics, etc).
- Completion of search analysis for remaining clusters.
- Hopefully more new pulsar discoveries!

References

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