Tenth International Fermi Symposium

9th-15th October 2022

Joint Pulsar Studies with the FAST radio telescope and the *Fermi* LAT

Pablo Saz Parkinson*

Di Li, Pei Wang, Xian Hou, Colin Clark, David Smith, Matthew Kerr, and Massimiliano Razzano

on behalf of the FAST team and the *Fermi*-LAT Collaboration

*sazpark@ucsc.edu

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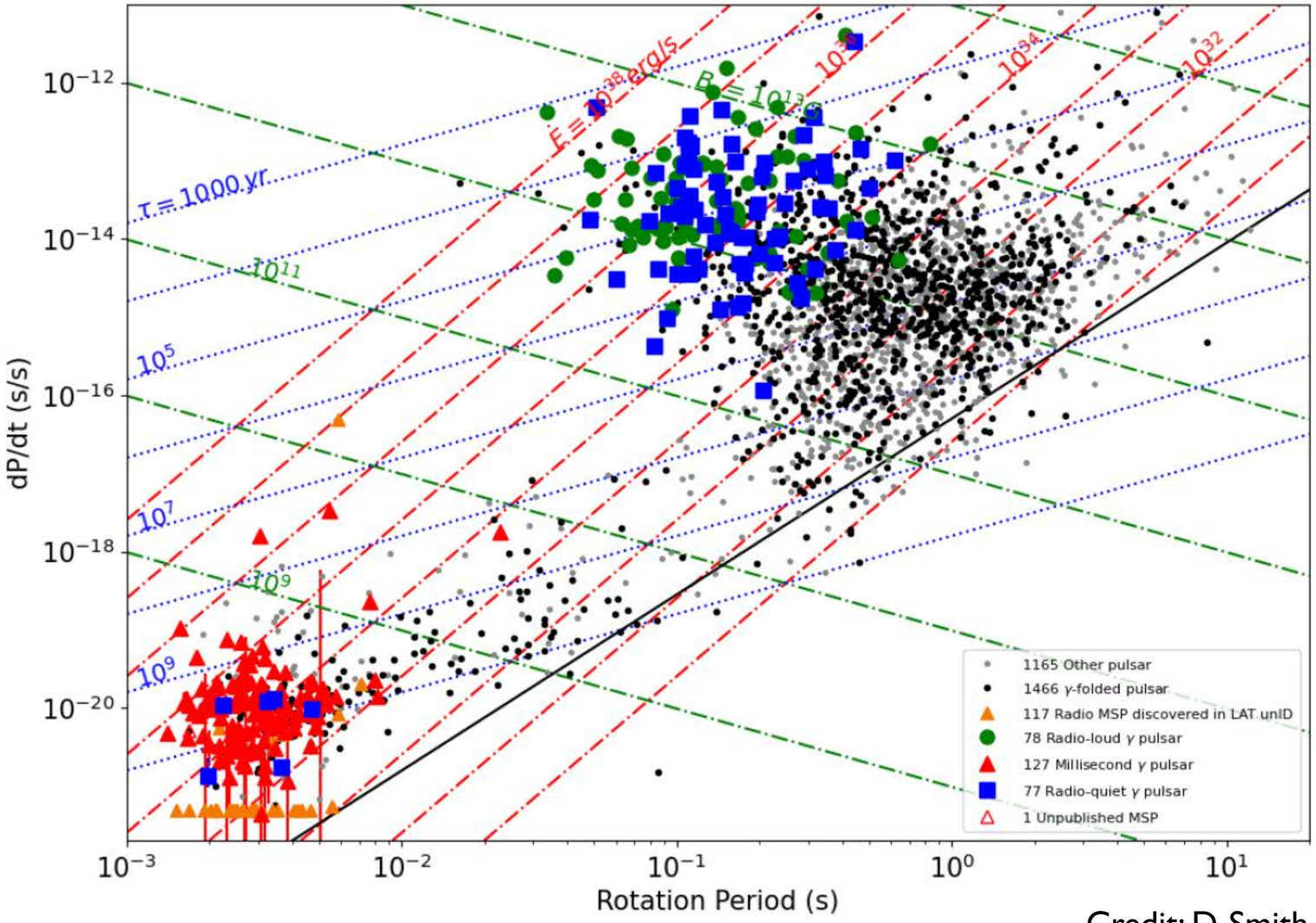
Fermi LAT gamma-ray pulsars



Credit: D. Smith

Summary Statistics

Total number of pulsars: 278

- Young, radio + X-ray selected: 73
- Young, gamma selected: 71
- MSP, radio selected : 118
- MSP, gamma selected : 10
- Found in searches of LAT unassociated sources : 145
- EGRET/COMPTEL pulsars: 7

https://confluence.slac.stanford.edu/x/5JI6Bg

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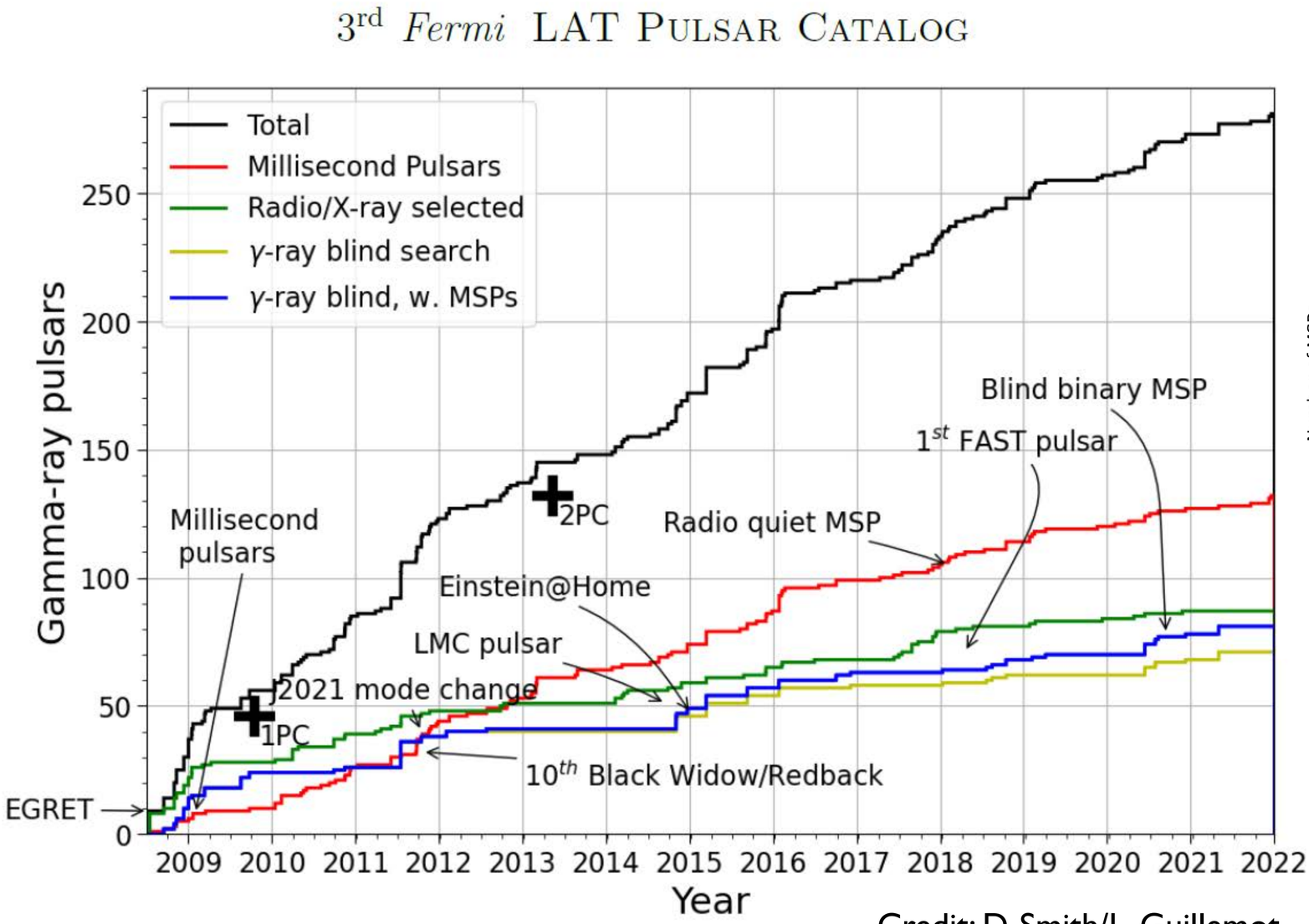
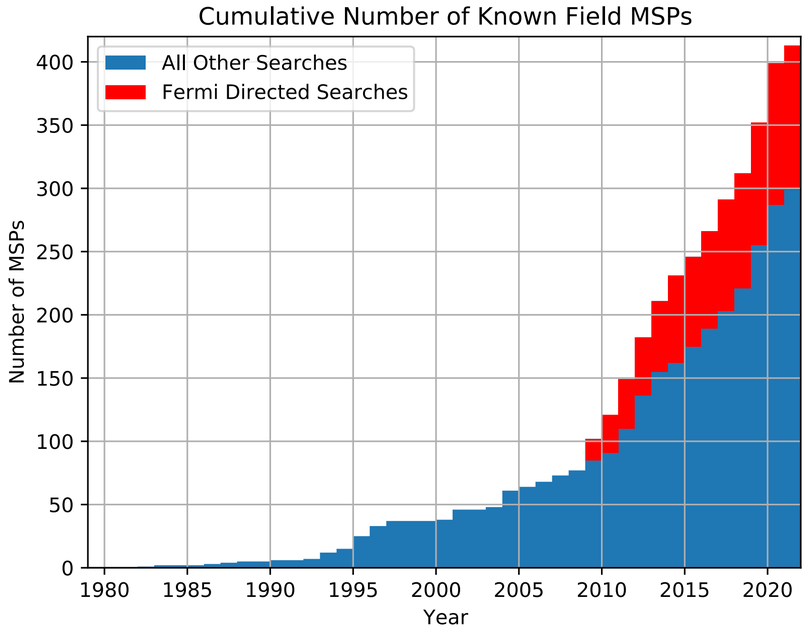
Fermi LAT gamma-ray pulsars



Credit: D. Smith/L. Guillemot



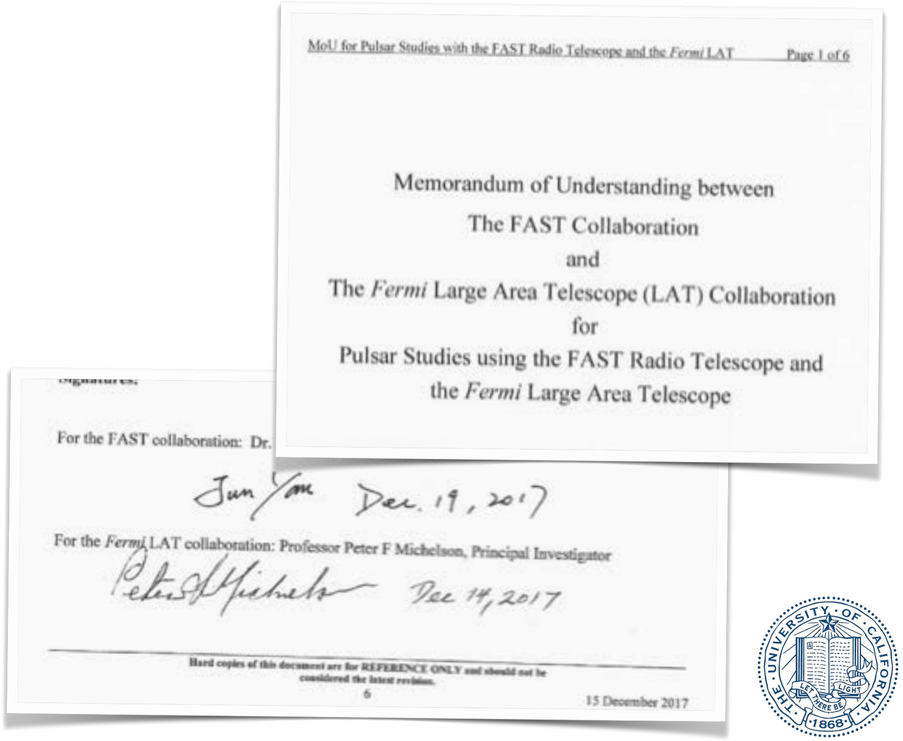
Credit: P. Ray

FAST-Fermi-LAT Collaboration

1. LAT Team provides source candidates and ephemerides of known pulsars, and FAST conducts deep searches for pulsars (or radio pulsations, for known pulsars)

2. FAST team provides details on newly discovered pulsars, and the Fermi group searches for their high-energy counterparts

NAOC – SHAO – XAO – FermiLAT
signed MoU 2017.12


MoU for Pulsar Studies with the FAST Radio Telescope and the *Fermi* LAT Page 1 of 6

Memorandum of Understanding between
The FAST Collaboration
and
The *Fermi* Large Area Telescope (LAT) Collaboration
for
Pulsar Studies using the FAST Radio Telescope and
the *Fermi* Large Area Telescope

For the FAST collaboration: Dr.

Dec. 19, 2017

For the *Fermi* LAT collaboration: Professor Peter F Michelson, Principal Investigator

Dec 14, 2017

Hard copies of this document are for REFERENCE ONLY and should not be considered the latest revision.

6 15 December 2017

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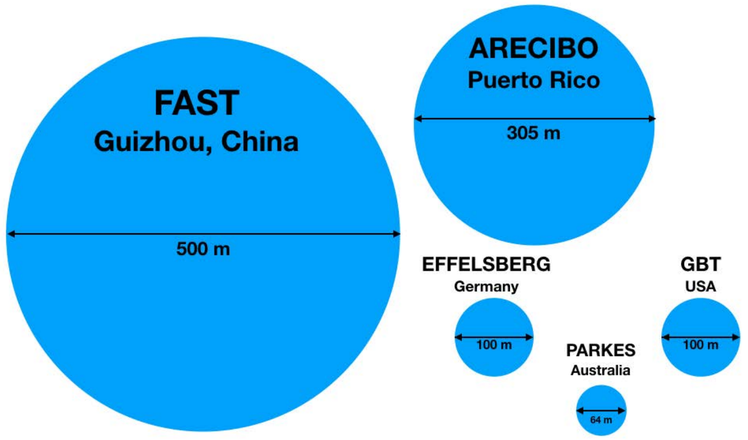
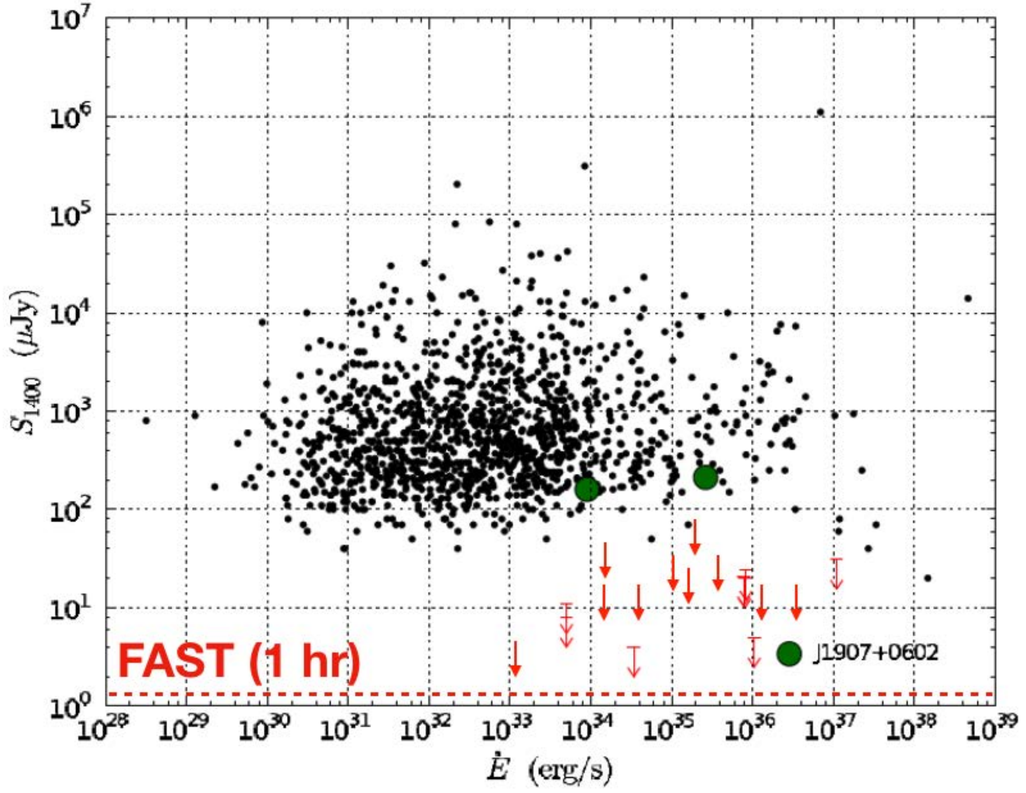
Radio follow-up searches



Comparison of the world's largest single-dish radio telescopes
(All members of the Fermi LAT Pulsar Search Consortium)

The Pulsar Search Consortium (PSC) was set up to search for radio pulsars in LAT sources/pulsars (Ray et al. 2012)



Adapted from Saz Parkinson et al. 2010

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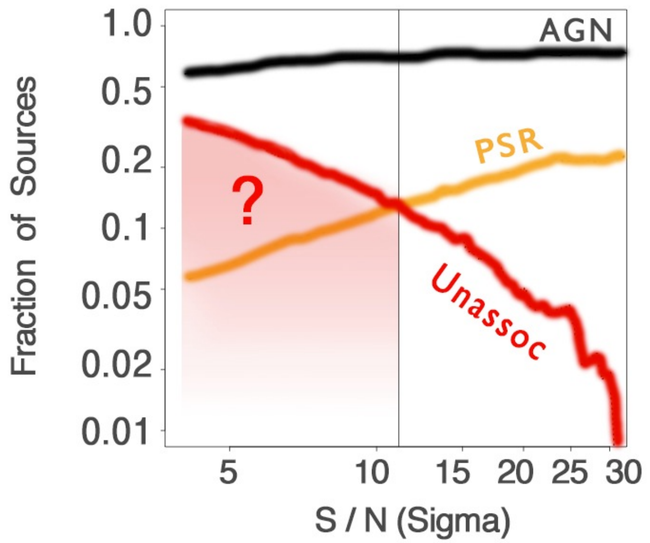
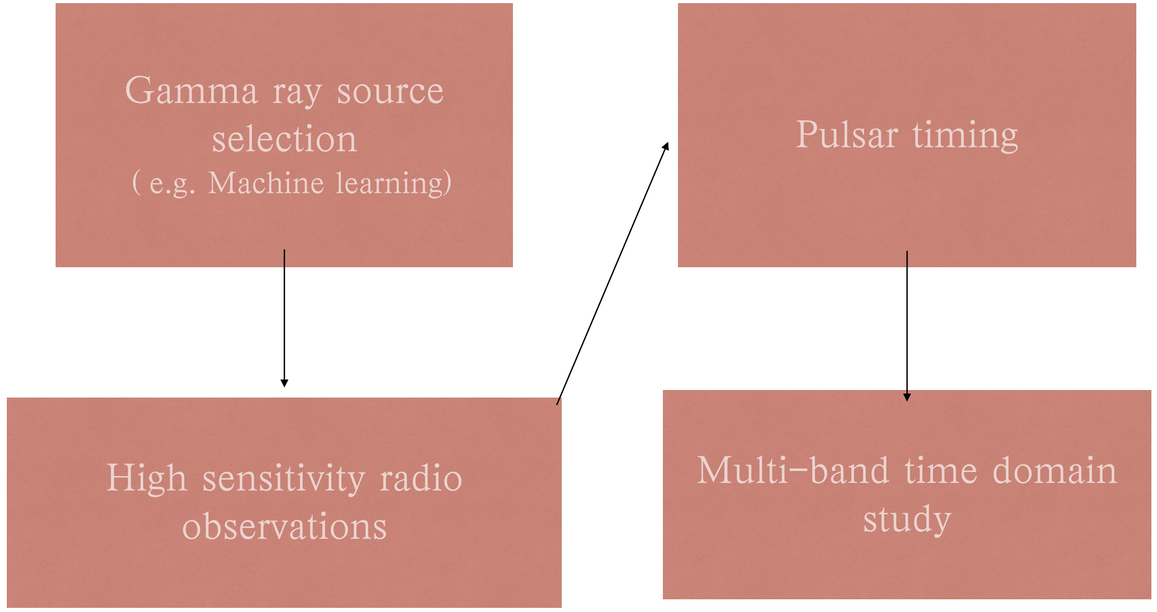
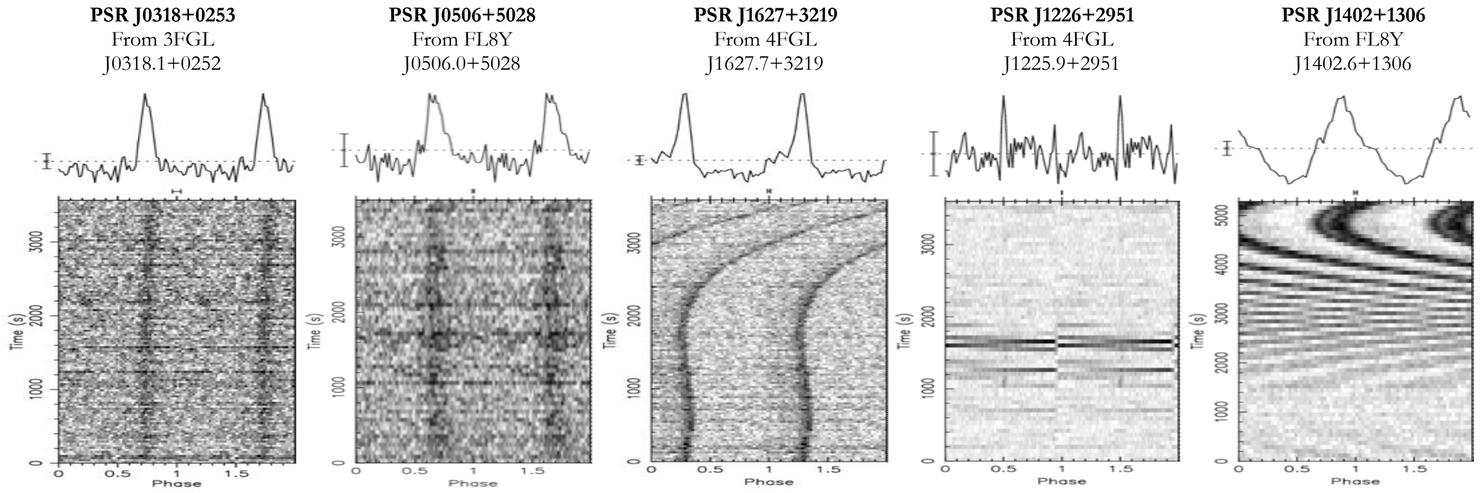
The Fast-Fermi pipeline

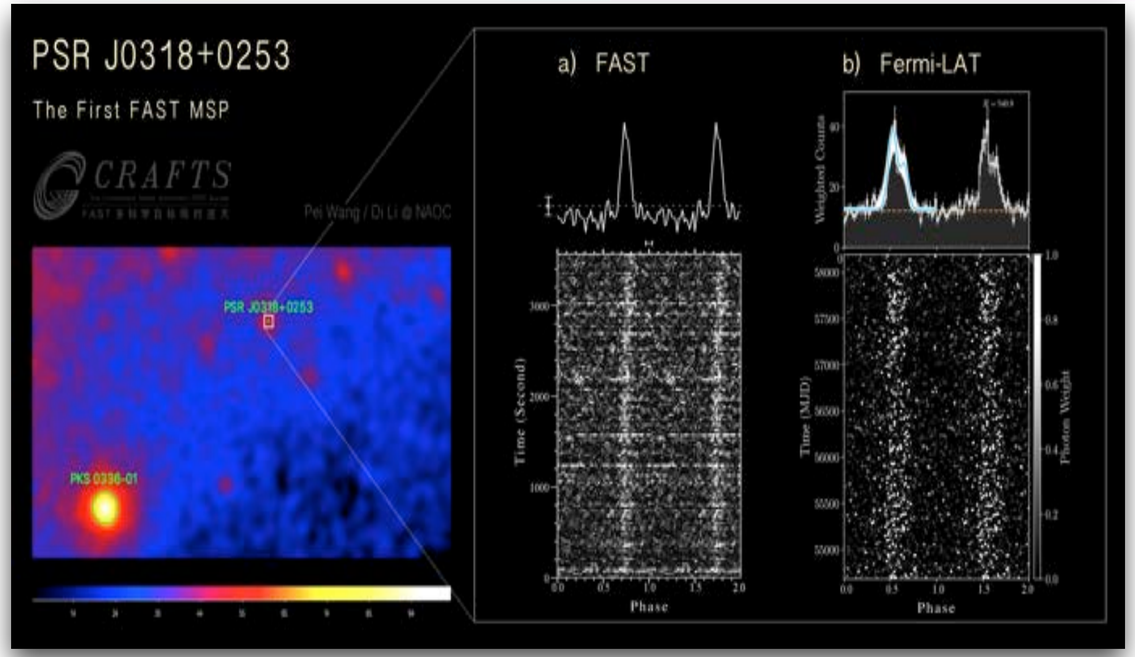


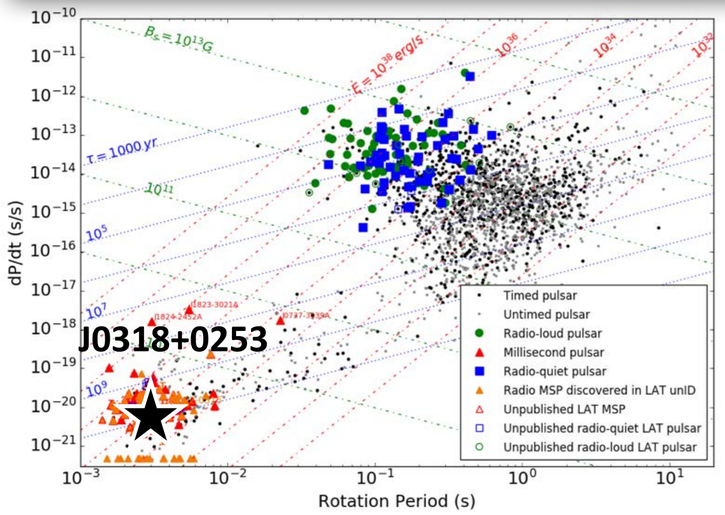
See 4FGL-DR3 (2022)

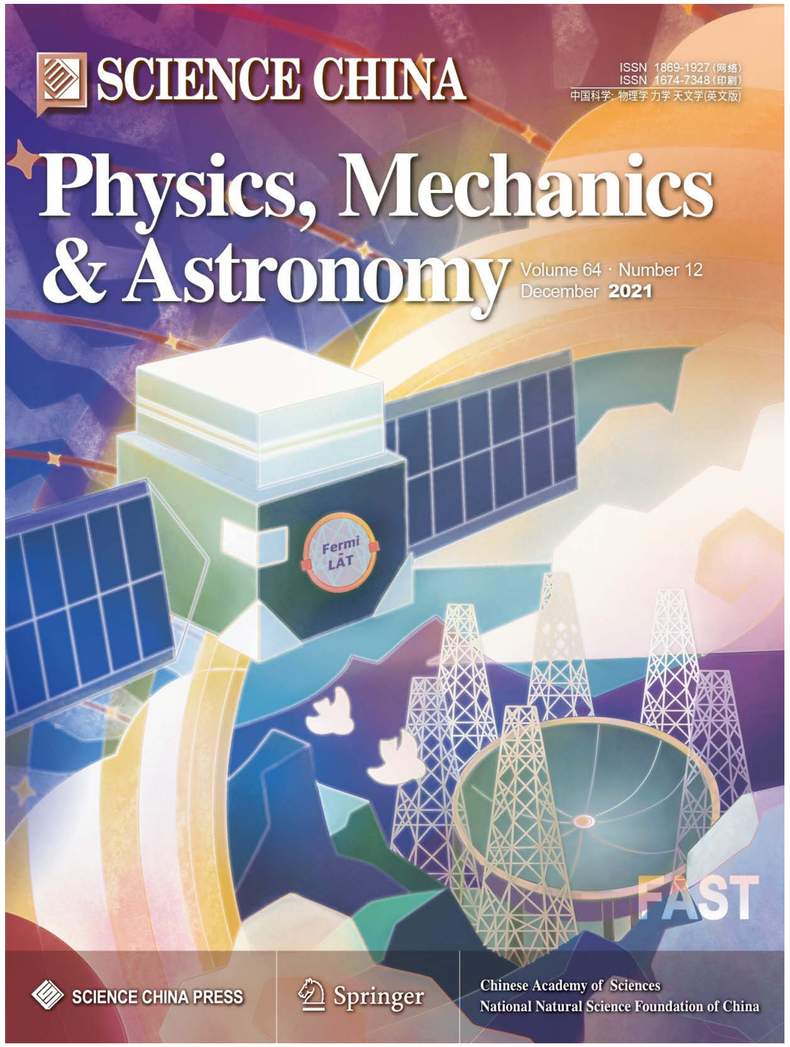




A Fermi/FAST radio-faint MSP







Wang et al., Science China Physics, Mechanics & Astronomy, Volume 64, Issue 12, article id.129562 (December 2021)

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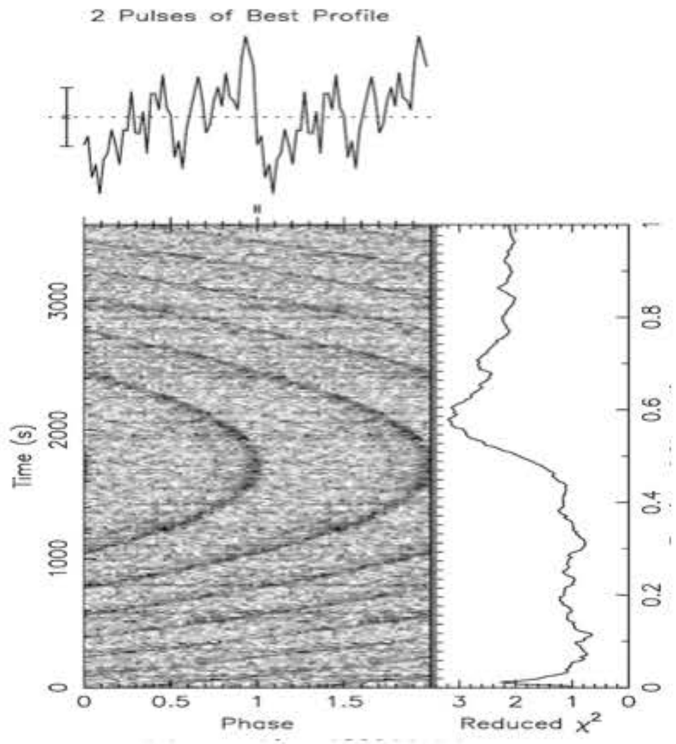
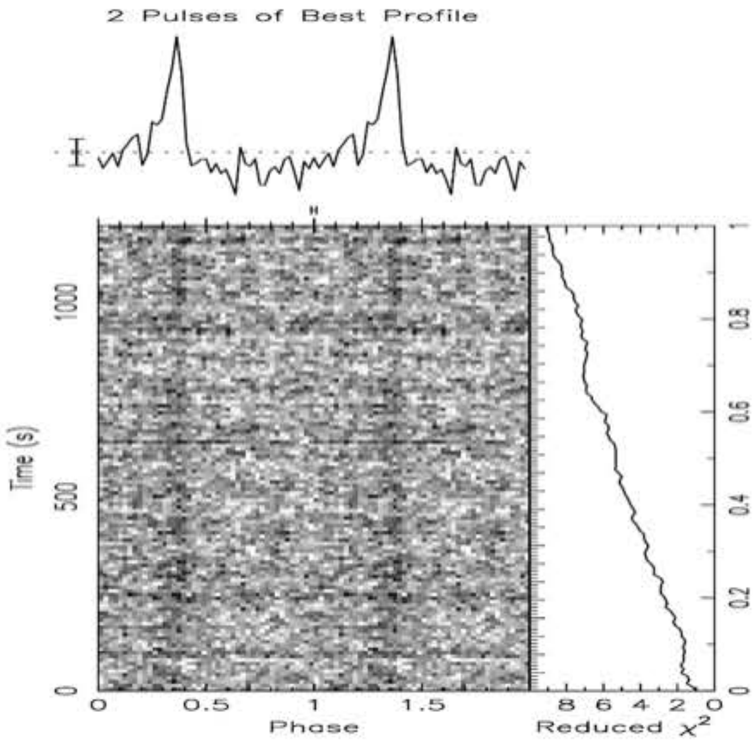
4FGL J1627.7+3219 aka PSR J1627+3219

Spin period is **2.2 milliseconds**, an estimated distance of about **4.4 kpc**, and as potentially one of the shortest orbital period binary systems (**4.2 hours**).



Orbital modulation



Elimination of orbital effects

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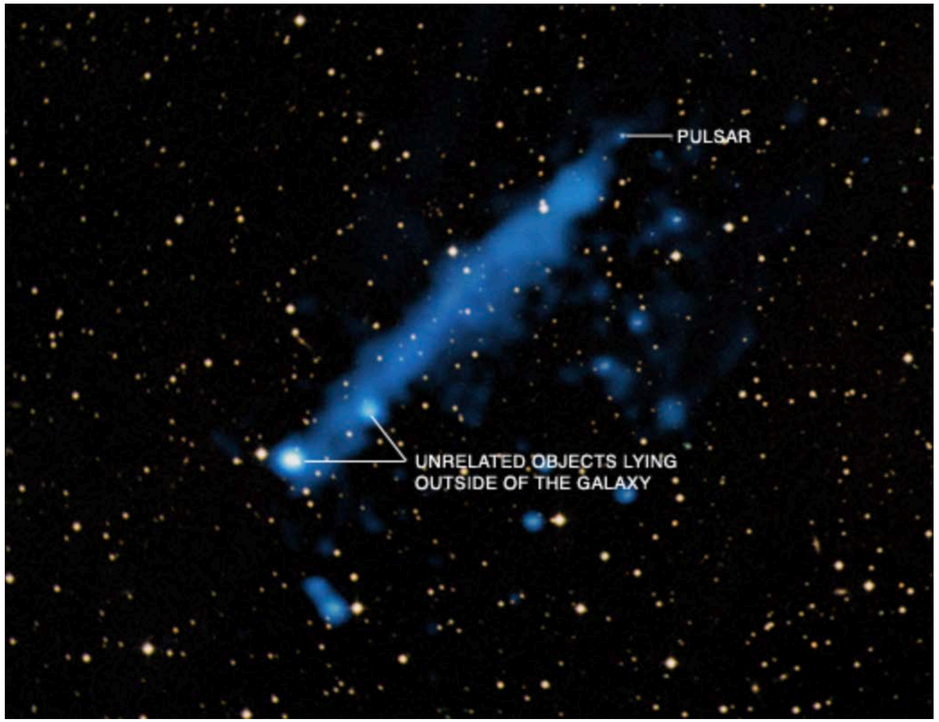
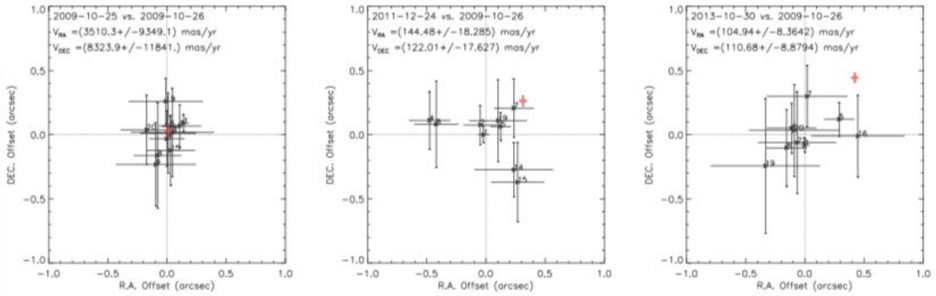
PSR J0357+3205: Nearest or fastest?

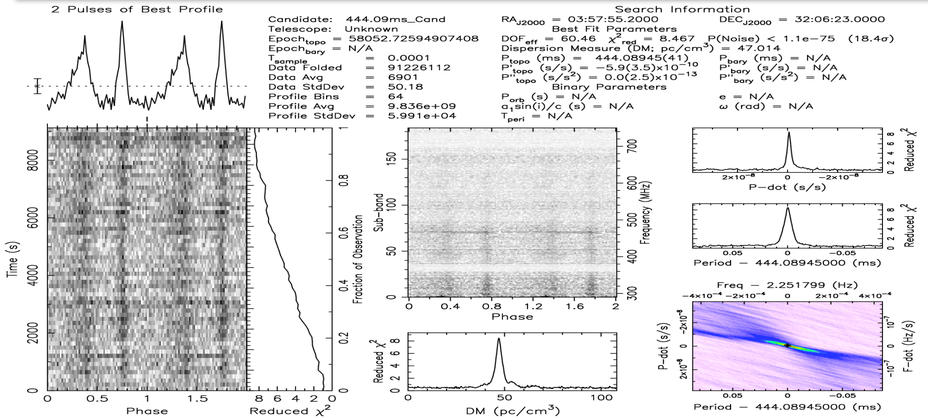


Credit: X-ray: NASA/CXC/IUSS/A.De Luca et al; Optical: DSS

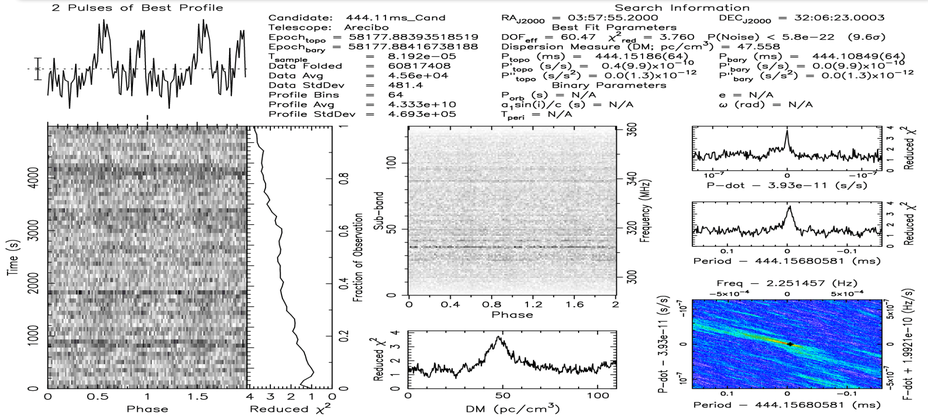


De Luca, A. et al. 2013

2017.10 Discovered by FAST



2018.3.1 Confirmed by Arecibo DDT



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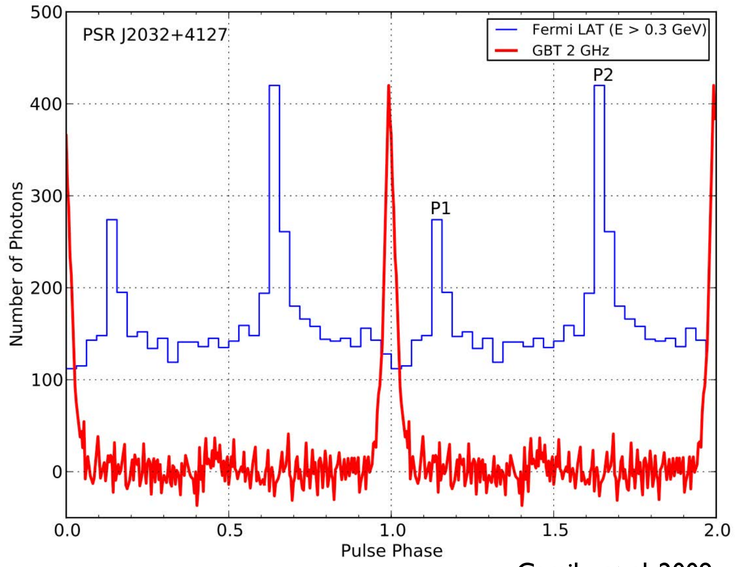
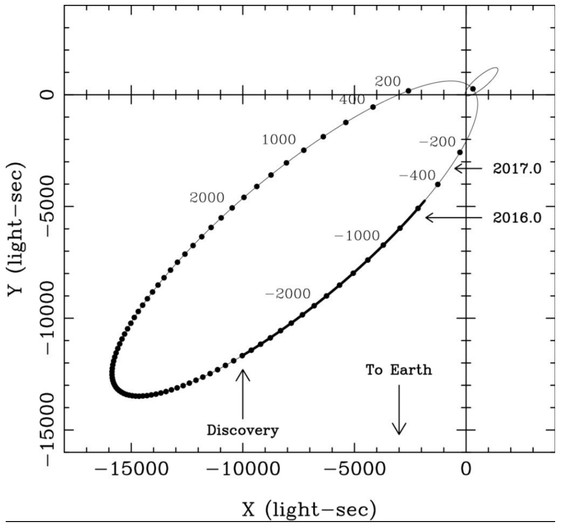
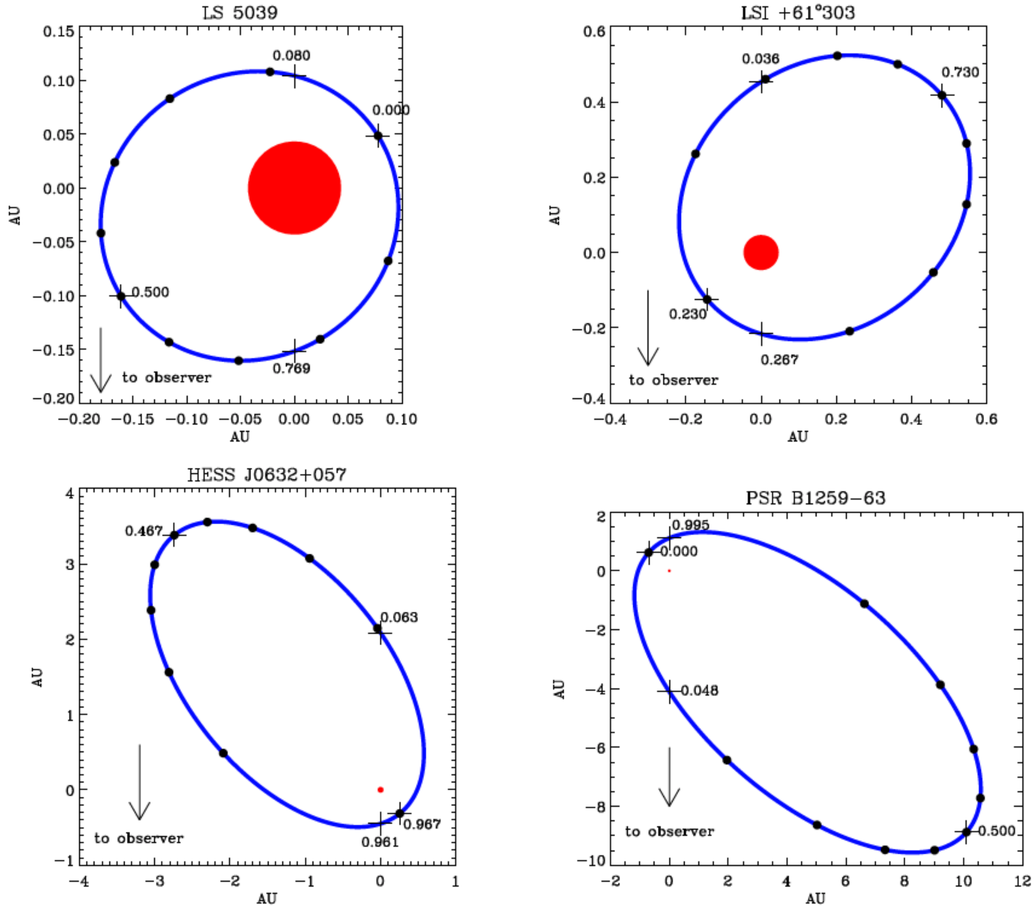
Young pulsars in gamma-ray binaries?



Camilo et al. 2009



Lyne et al. 2015



Gamma-ray binaries: typically consist of a massive star in orbit with a compact object, often a pulsar.

See: Nieder et al. 2020

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FAST discovery of a pulsar in LS I + 61 303

nature astronomy

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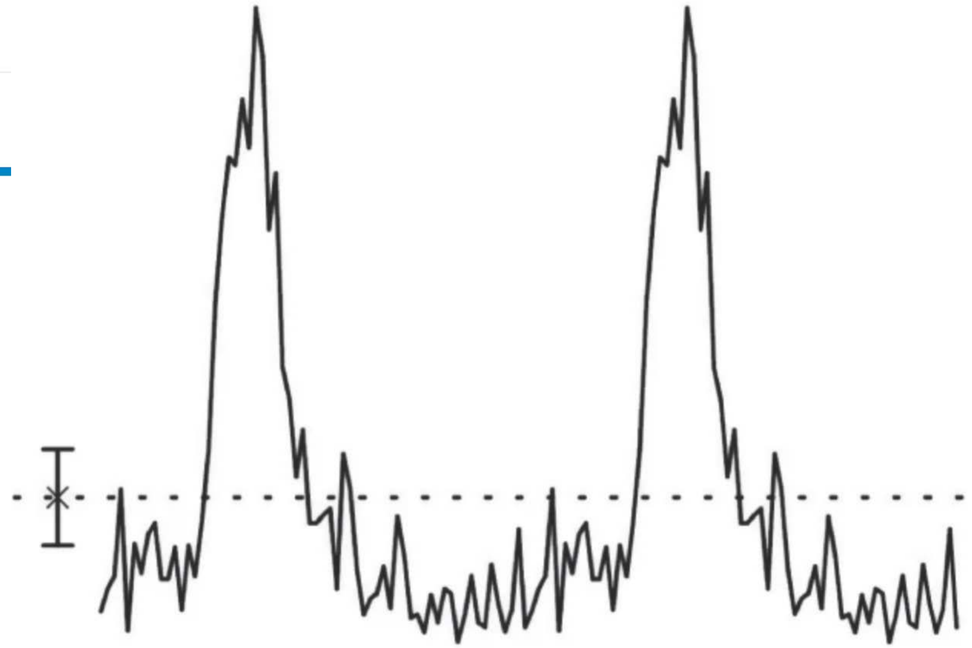
Letter | Published: 17 March 2022

Radio pulsations from a neutron star within the gamma-ray binary LS I +61° 303

Shan-Shan Weng, Lei Qian, Bo-Jun Wang, D. F. Torres, A. Papitto, Peng Jiang, Renxin Xu, Jian Li, Jing-Zhi Yan, Qing-Zhong Liu, Ming-Yu Ge & Qi-Rong Yuan

Nature Astronomy **6**, 698–702 (2022) | Cite this article

747 Accesses | **5** Citations | **16** Altmetric | Metrics



Two cycles of integrated pulse profile with the best-fitted spin period (P=269.15508 ms). The dotted line and the asterisk mark the mean flux level of pulsed emission, and the standard deviation of the pulse profile is plotted with the error bar.

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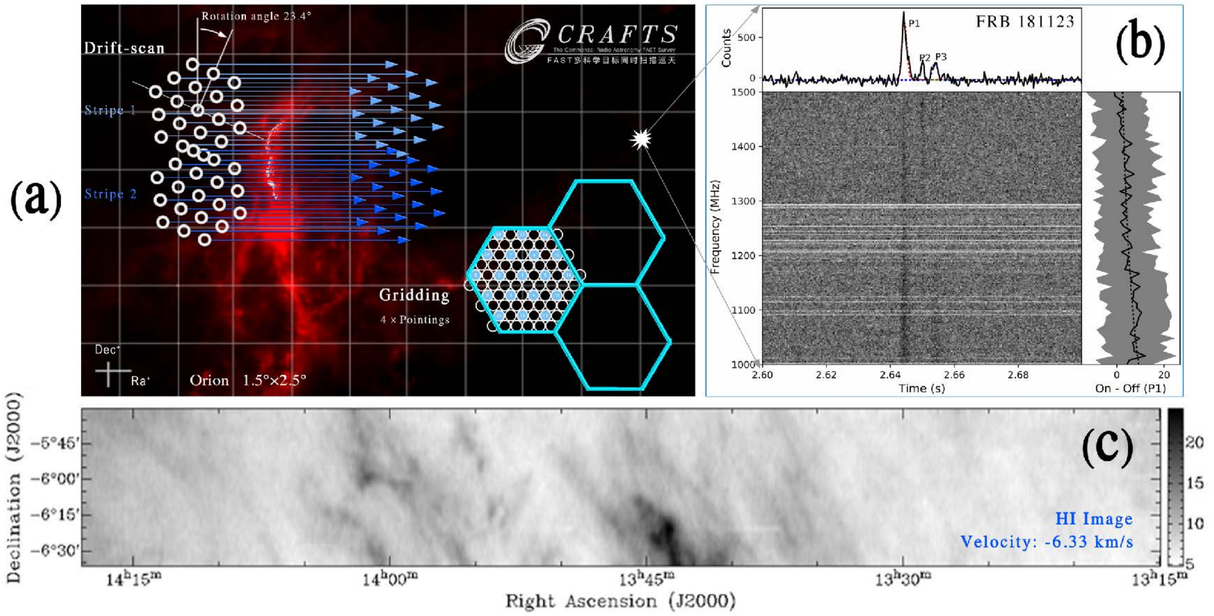
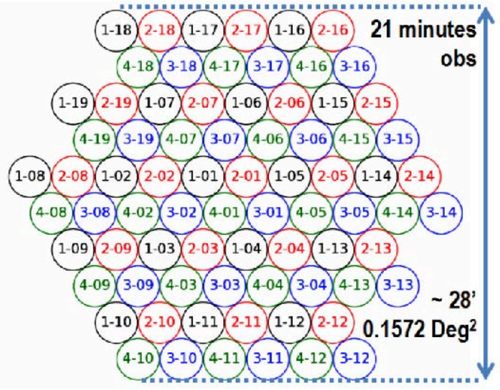
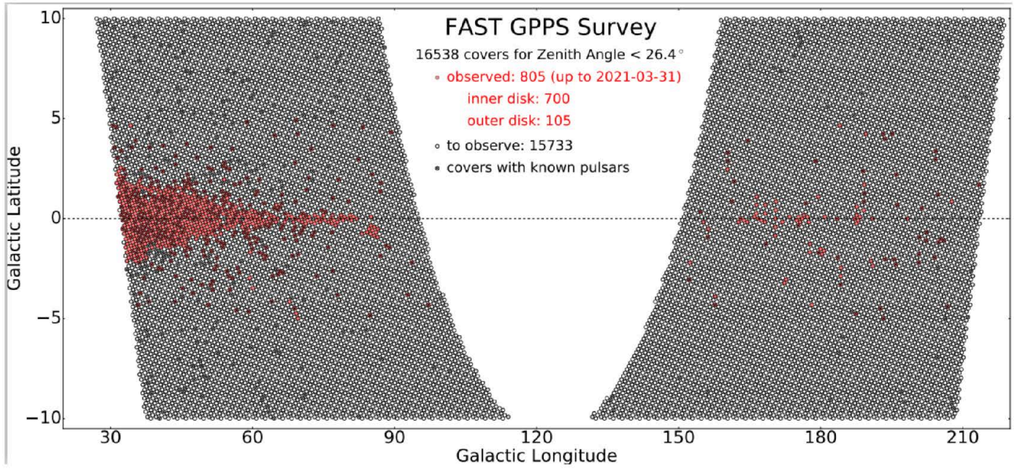
FAST surveys

CRAFTS
The Commensal Radio Astronomy FAST Survey
FAST多科学目标同时扫描巡天

http://groups.bao.ac.cn/ism/CRAFTS/







GPPS http://zmtt.bao.ac.cn/GPPS/

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FAST-CRAFTS Pulsar Survey

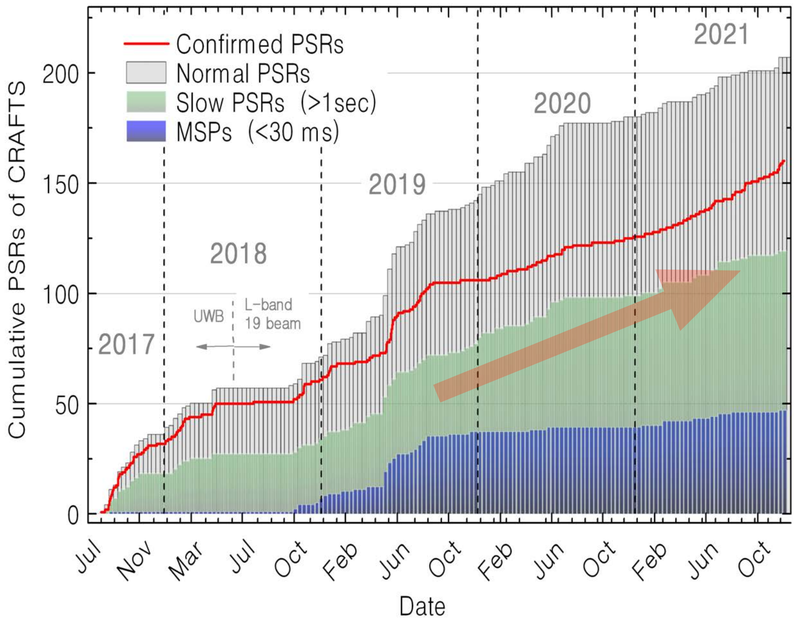
- Only 15% of FAST sky coverage completed
- A large number of high-value sources need to be followed up with observations
- FAST-based, combined with international multi-equipment to accelerate the pulsar timing process

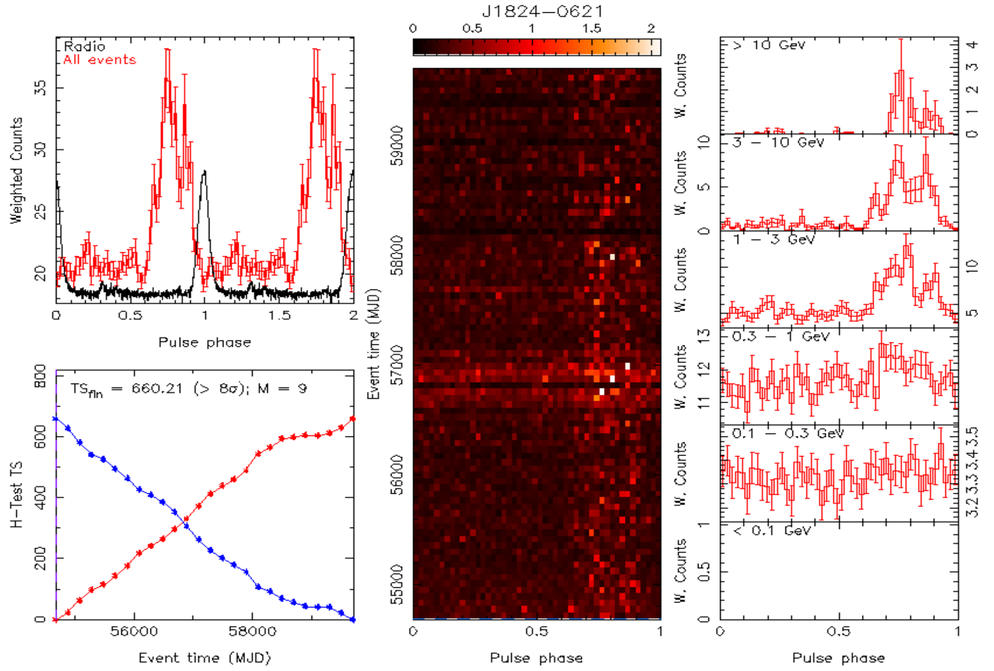
>40 MSPs

>20 Binary systems (including 1 DNS)

~30 RRATs

Confirmed 170 pulsar discoveries!





Successful detection of gamma-ray counterparts

PSR J1824−0621

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Thank you for your attention!

Pablo Saz Parkinson*

*sazpark@ucsc.edu

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