The Einstein@Home Survey for Gamma-ray Pulsars

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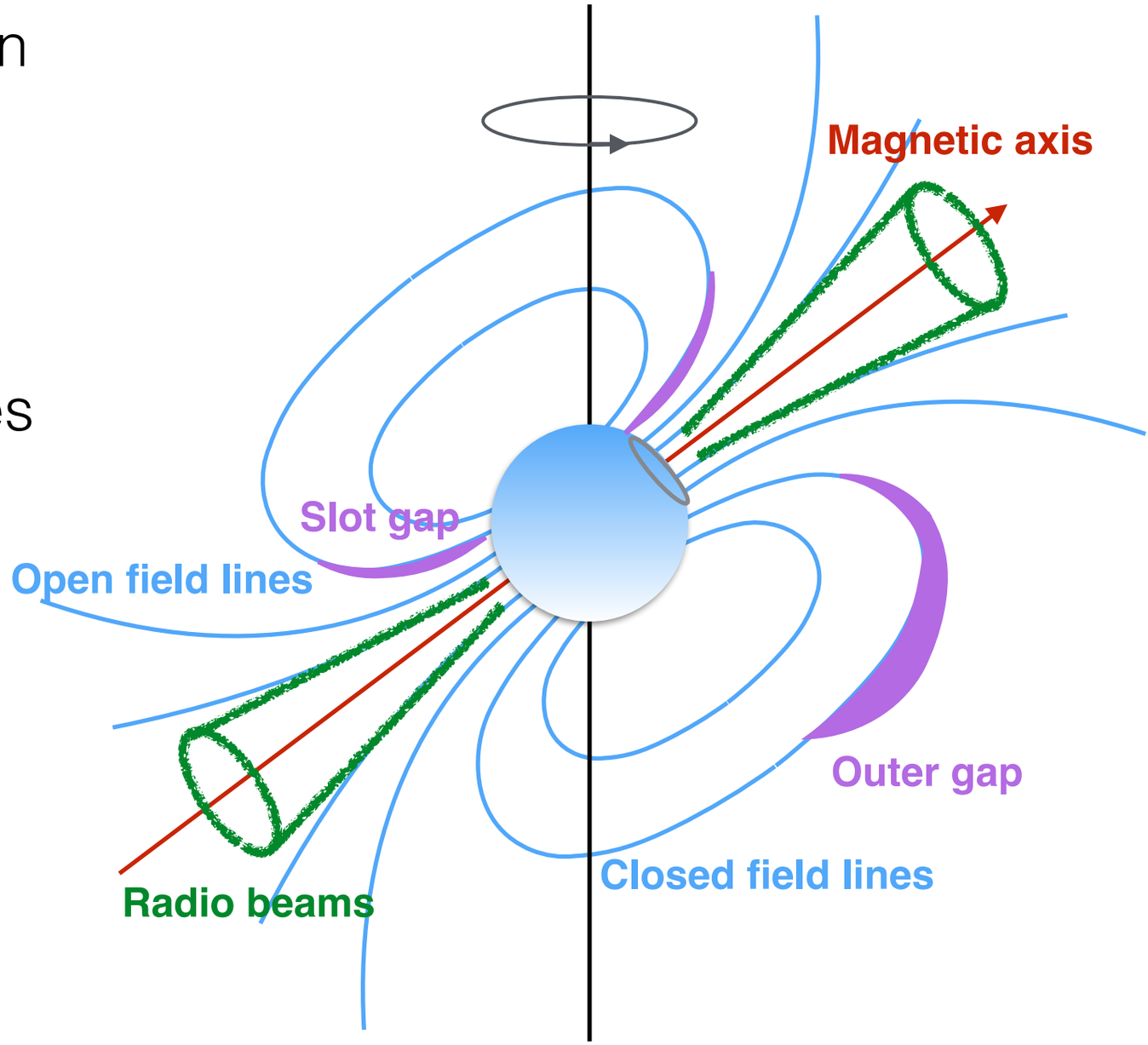
Gamma-ray Pulsars

GeV gamma-ray beams produced in "gaps" high above pulsar's surface

Gamma-ray vs. radio beams:
— Typically unaligned in phase
— Visible from wider range of angles

Unaffected by interstellar medium
— no dispersion, scattering, scintillation, absorption

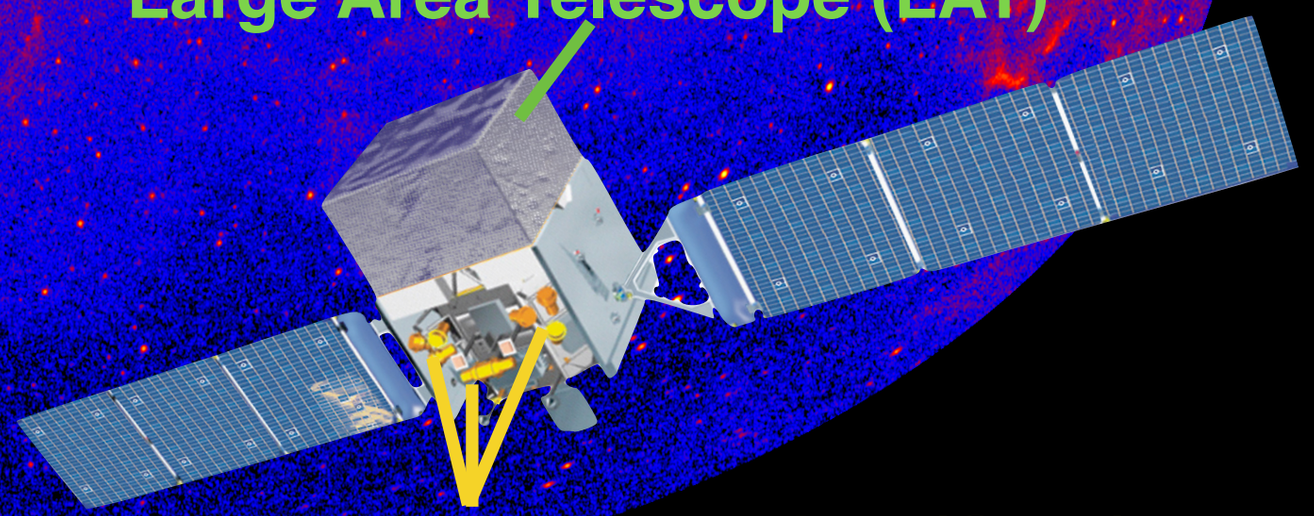
Gamma-ray pulsar population complementary to radio pulsar population



Emission model from Lorimer, D., & Kramer, M. 2005, Handbook of Pulsar Astronomy

Fermi Gamma-ray Space Telescope

Energy range: 20 MeV to 300 GeV
Field-of-view: 2.4 sr (~20% of sky)
Effective area: ~8,000 cm^2 at 1 GeV
Average source localisation: 6’



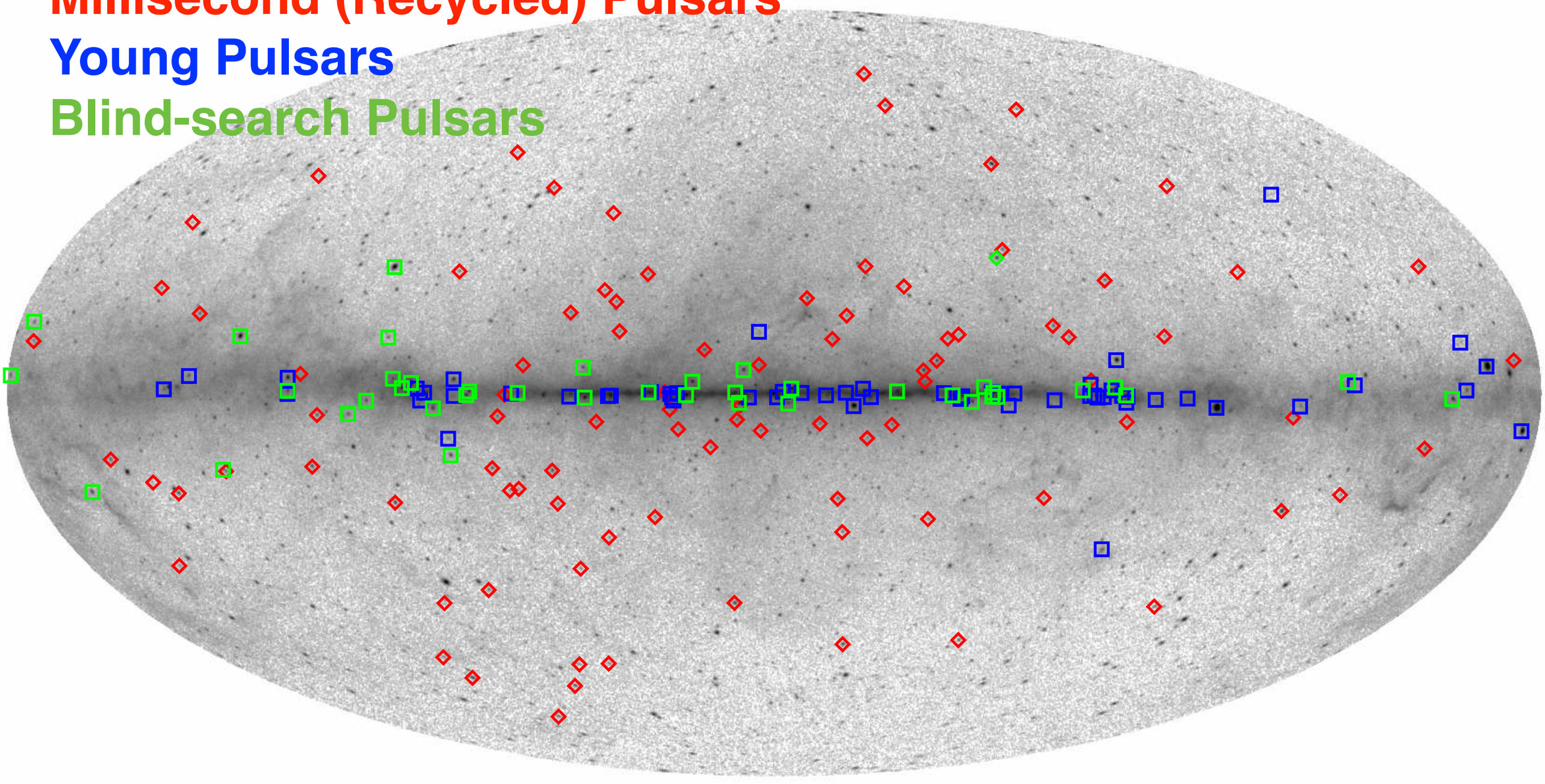
Fermi Image credit: NASA/Sonoma State University/Aurore Simonnet, LAT data courtesy of the Fermi-LAT collaboration

>200 Fermi-LAT Detected Pulsars

Millisecond (Recycled) Pulsars

Young Pulsars

Blind-search Pulsars

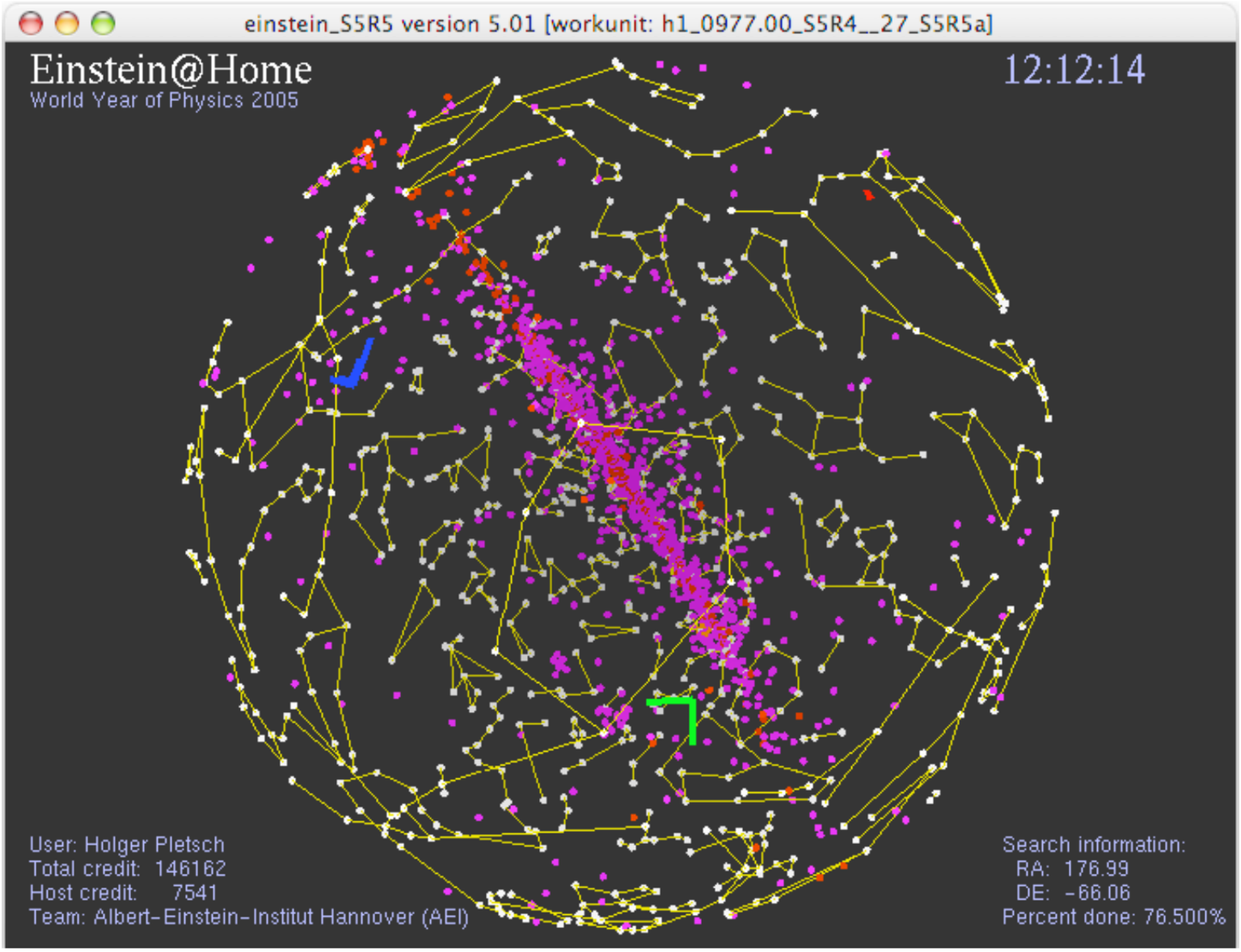


LAT data courtesy of the Fermi-LAT collaboration

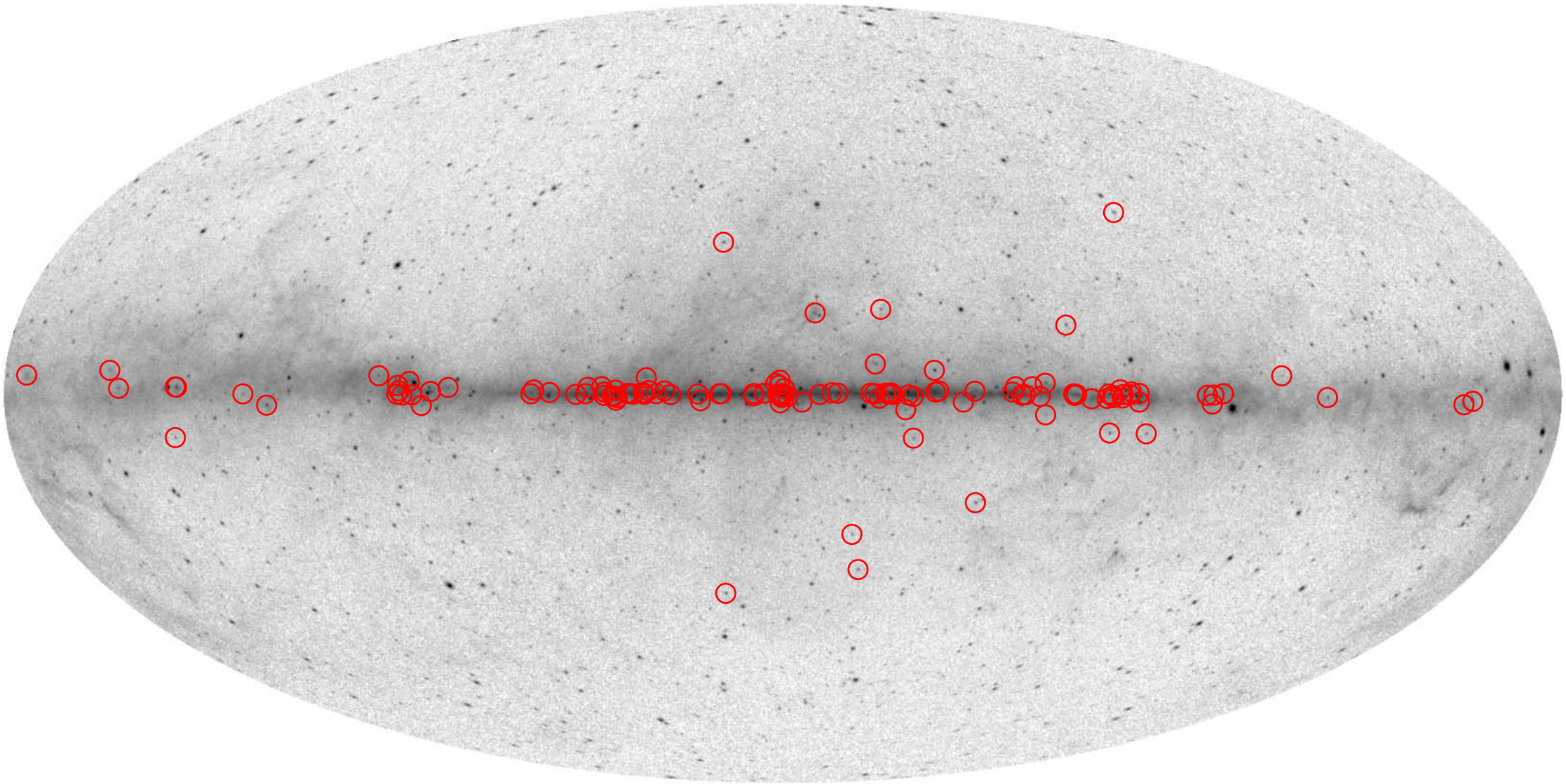
http://tinyurl.com/fermipulsars

Einstein@Home

- Unused computing cycles from 75,000 active computers
- **>2 PFlop/s** sustained computing power
- Lowest constraints on GWs from unknown neutron stars
- >50 new radio pulsars, 4 gamma-ray pulsars in previous surveys



The Latest Gamma-ray Pulsar Survey



- 152 pulsar-like sources from latest 3rd Fermi-LAT source catalog (3FGL)
- 5.5 to 6 years of the latest “Pass 8” LAT data
- O(10,000) yrs of total CPU time

Clark, C. J., Wu, J., Pletsch, H. J., et al. 2017, ApJ, 834, 106

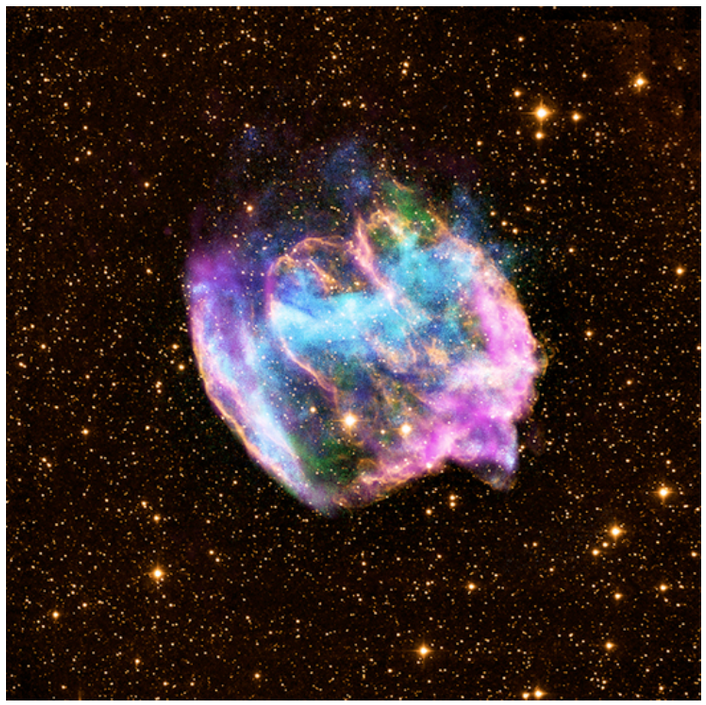
Upper limits from Interesting Sources

p = upper limit on fraction of **pulsed** gamma-ray flux from a source

W49B

Core-collapse supernova remnant, but strong limits on presence of neutron star from X-ray observations

$$p < 38\%$$

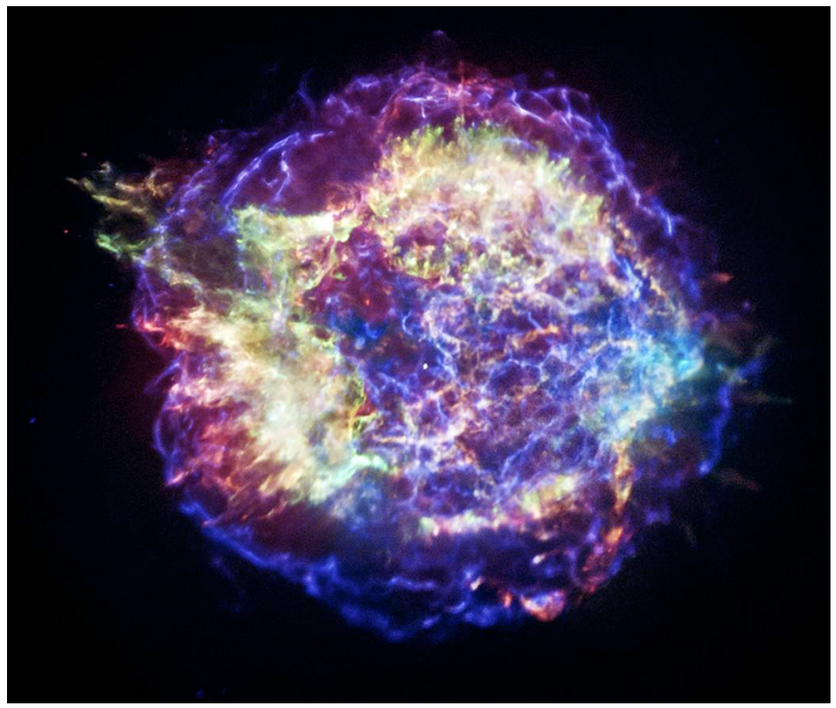


http://chandra.harvard.edu/photo/2013/w49b/w49b_w11.jpg X-ray: NASA/CXC/MIT/L.Lopez et al.; Infrared: Palomar; Radio: NSF/NRAO/VLA

Cassiopeia A

Contains the youngest known neutron star, but rotation rate unknown

$$p < 57\%$$



http://www.nasa.gov/sites/default/files/styles/full_width_feature/public/casa.jpg?itok=V4ggt5Ei
X-ray: NASA/CXC/SAO

Galactic Centre

Gamma-ray excess towards GC is of unknown origin

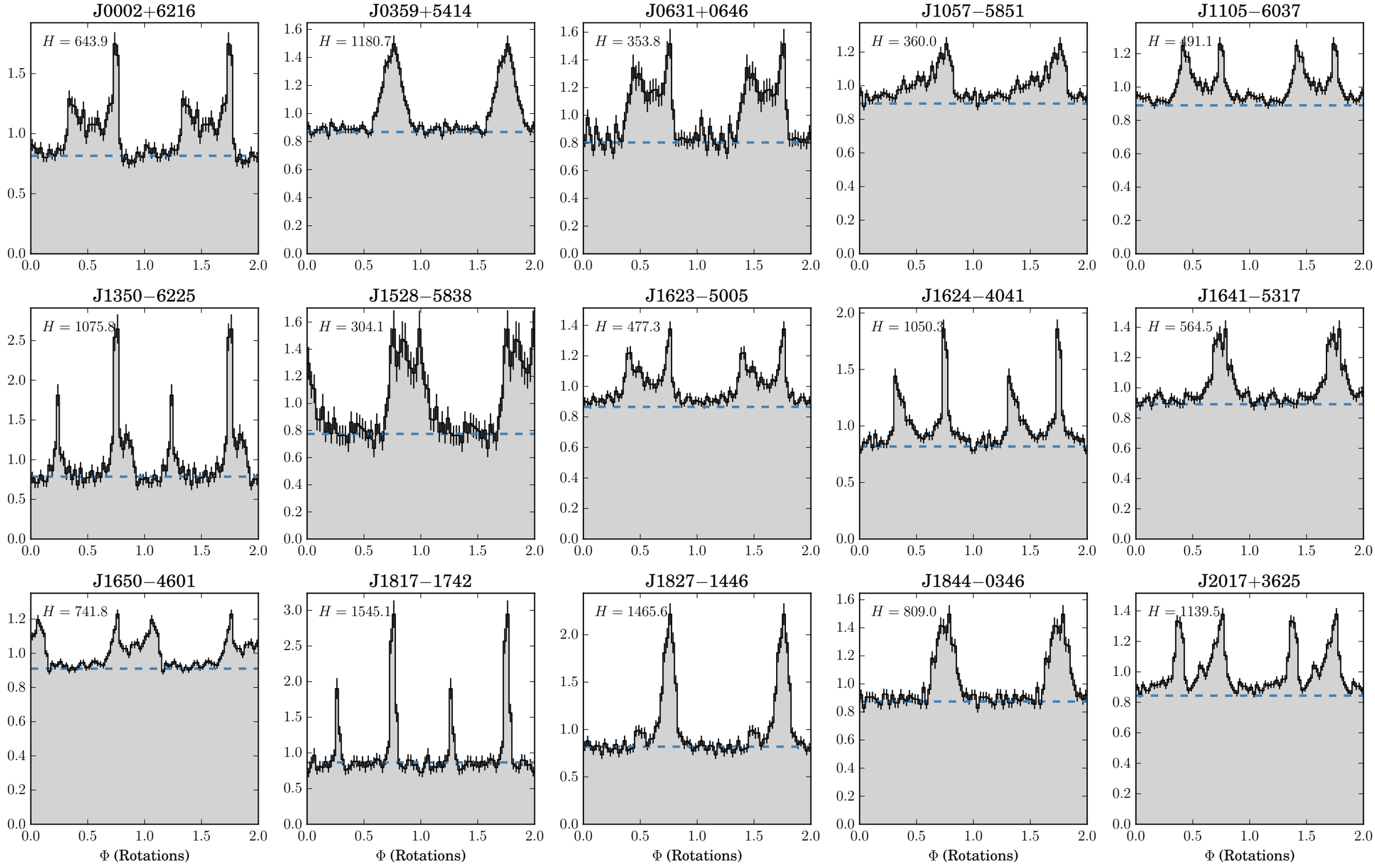
Pulsars? Dark matter?

$$p < 40\%$$

http://chandra.harvard.edu/photo/2003/0203long/0203long_xray_420.jpg
Credit: NASA/CXC/MIT/F.K.Baganoff et al.

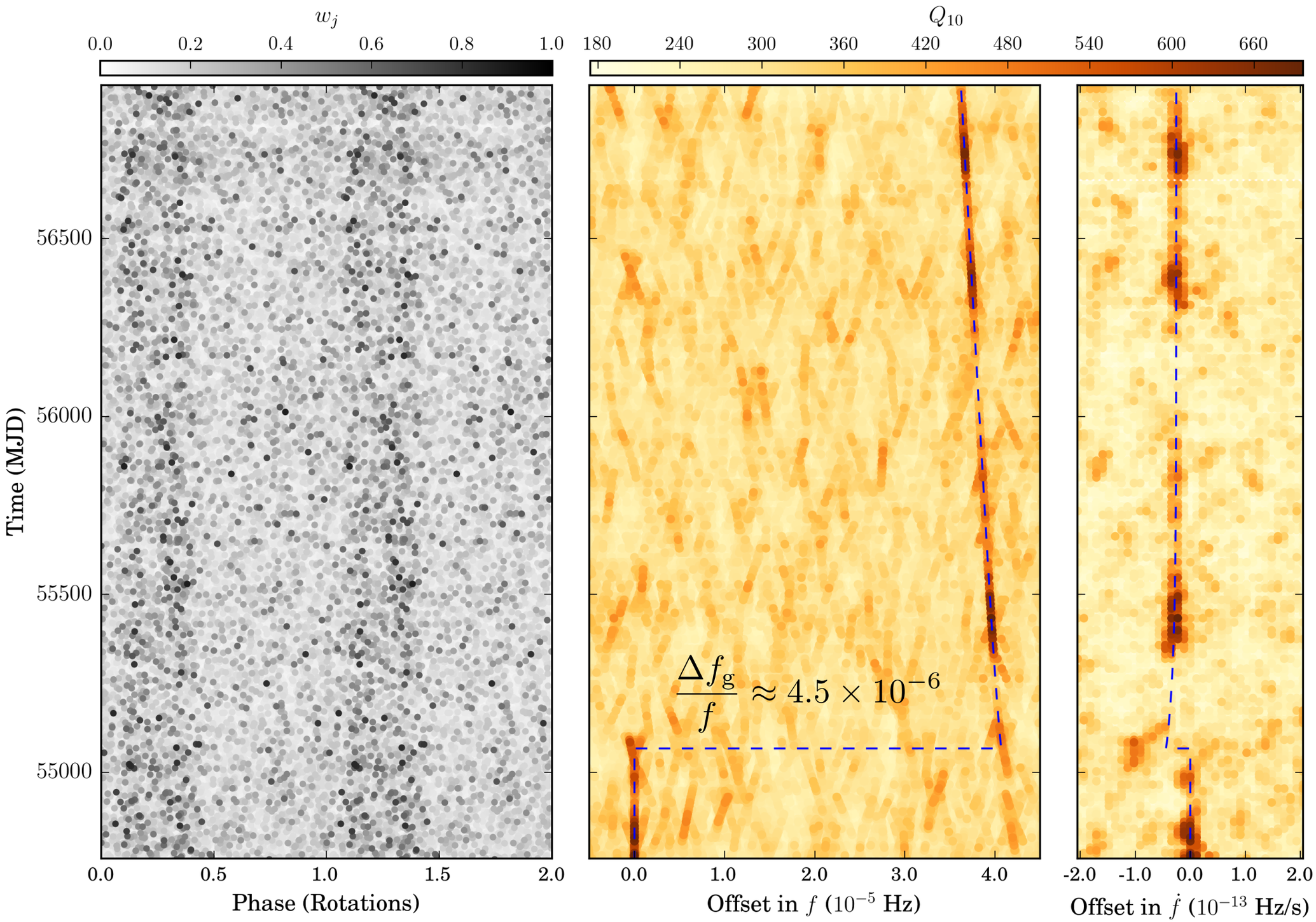
New Young Pulsars from E@H

Clark, C. J., Wu, J., Pletsch, H. J., et al. 2017, ApJ, 834, 106



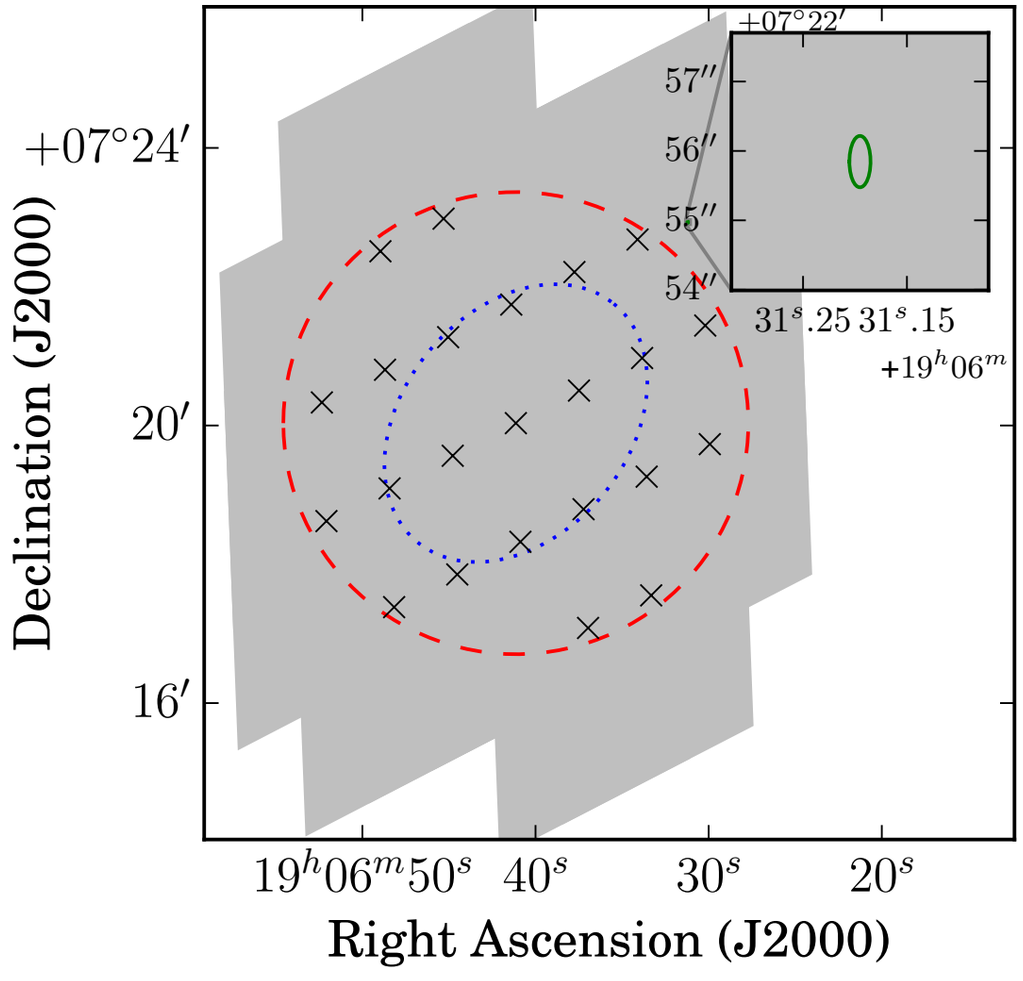
PSR J1906+0722 — Glitch

Clark, C. J., Pletsch, H. J., Wu, J., et al. 2015, ApJL, 809, L2



PSR J1906+0722 — Position Offset

Clark, C. J., Pletsch, H. J., Wu, J., et al. 2015, ApJL, 809, L2



PSR J1906+0722 lies far outside its 3FGL source localisation region

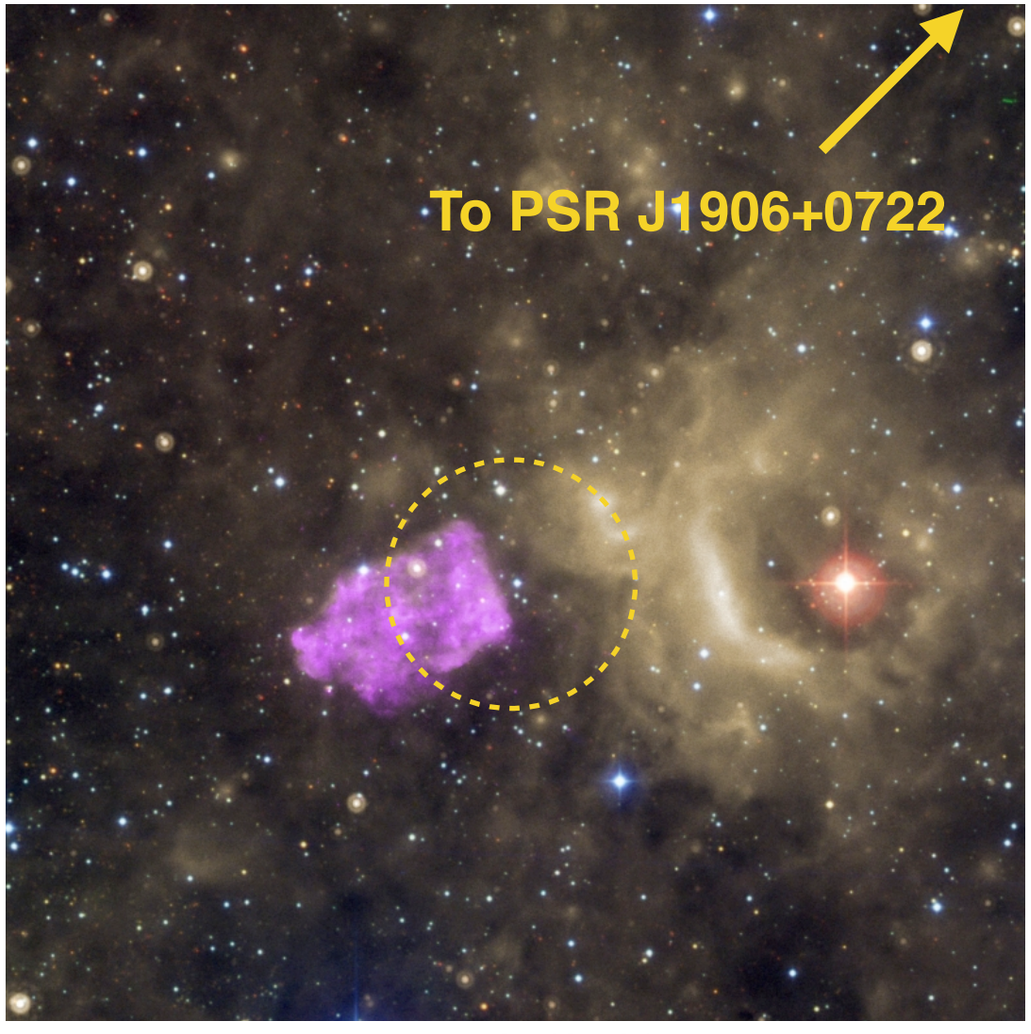
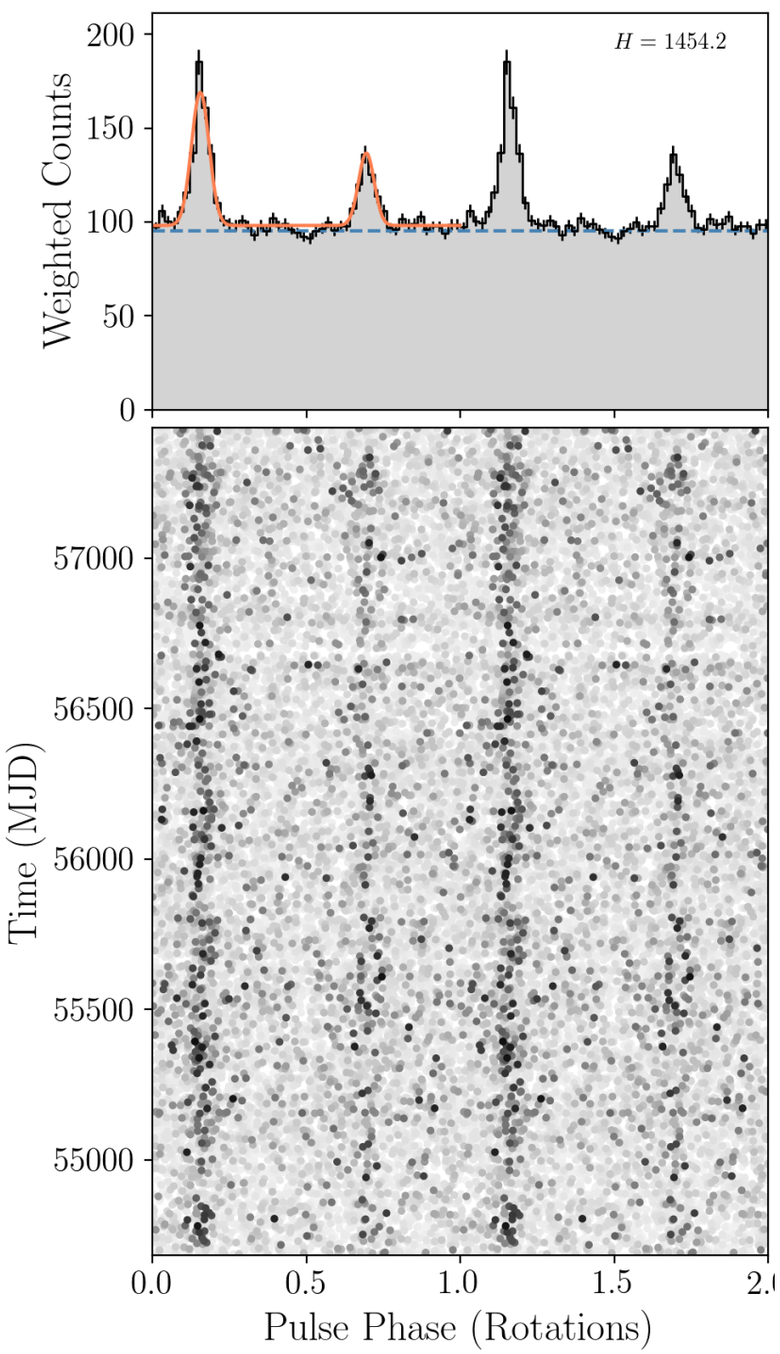


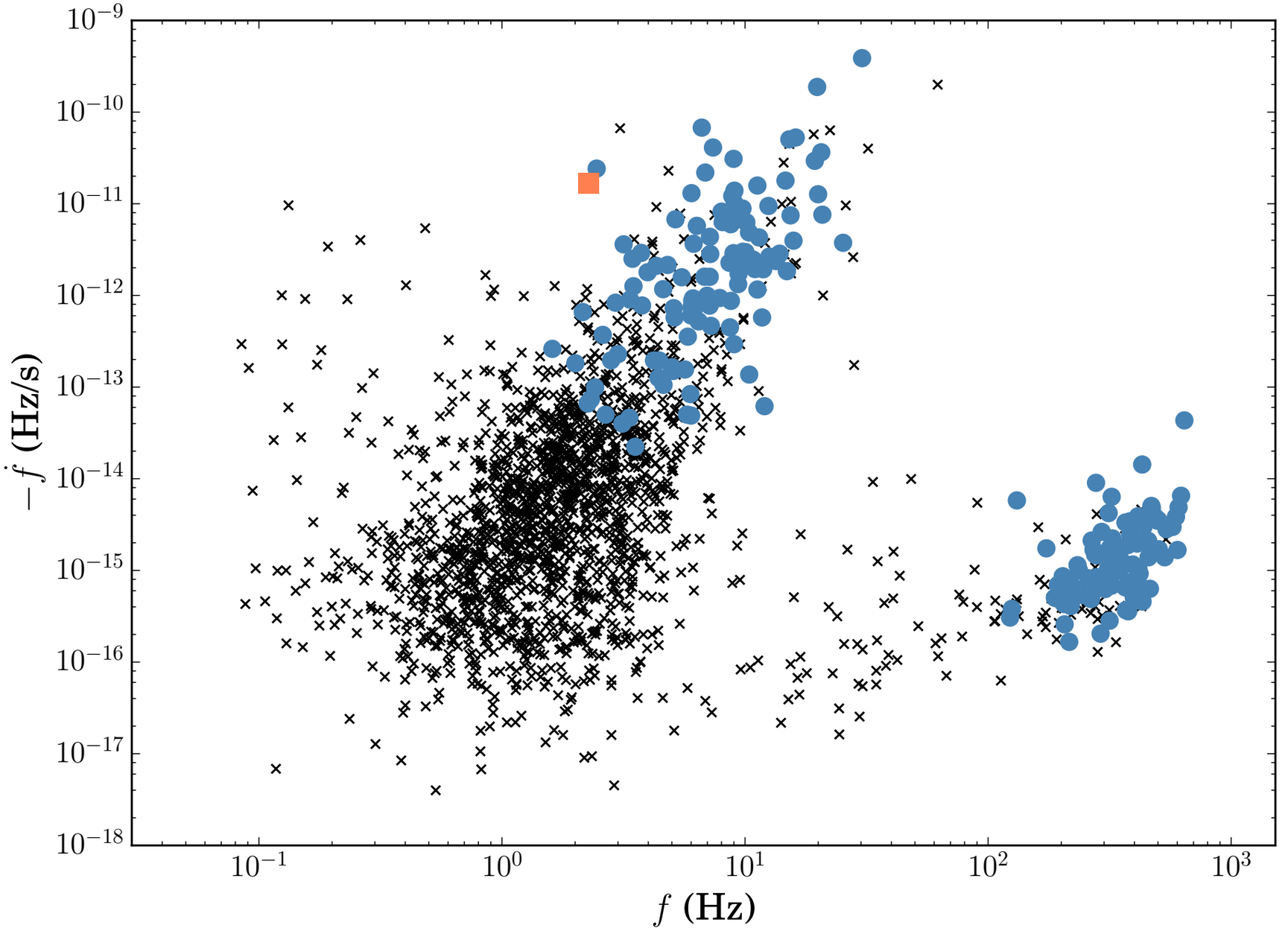
Image credit: X-ray: NASA/CXC/Univ of Manitoba/ S.Safi-Harb et al, Optical: DSS, Infrared: NASA/JPL-Caltech

Off-pulse data revealed possible interaction between SNR (3C 397) and molecular cloud

PSR J1208-6238

Clark, C. J., Pletsch, H. J., Wu, J. et al. 2016, ApJL, 832, L15





Youngest radio-quiet gamma-ray pulsar

Age ~ 2,700 yrs

PSR J1208-6238 — Braking Index

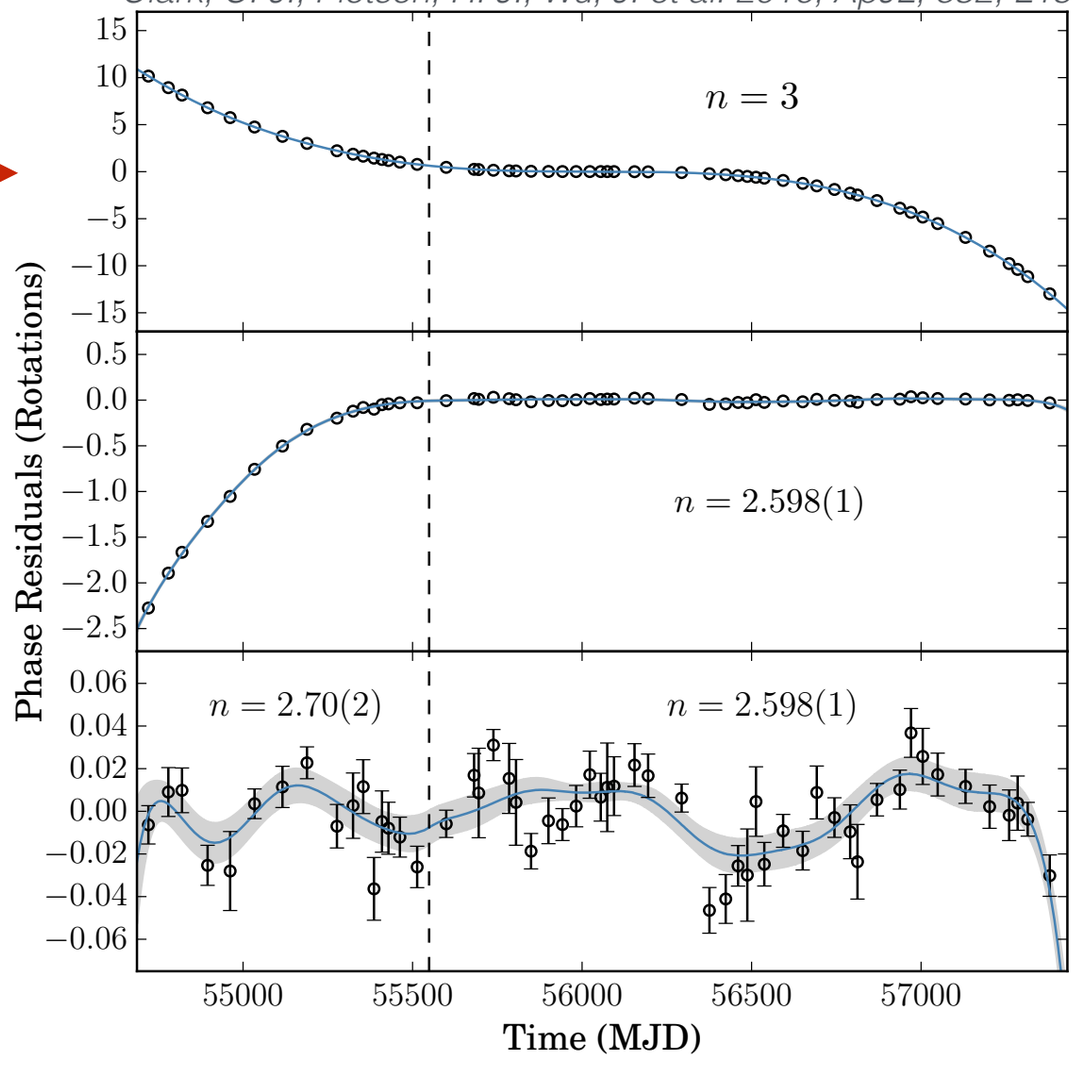
$$\dot{f} \propto -f^n$$

Braking index fixed at dipole value

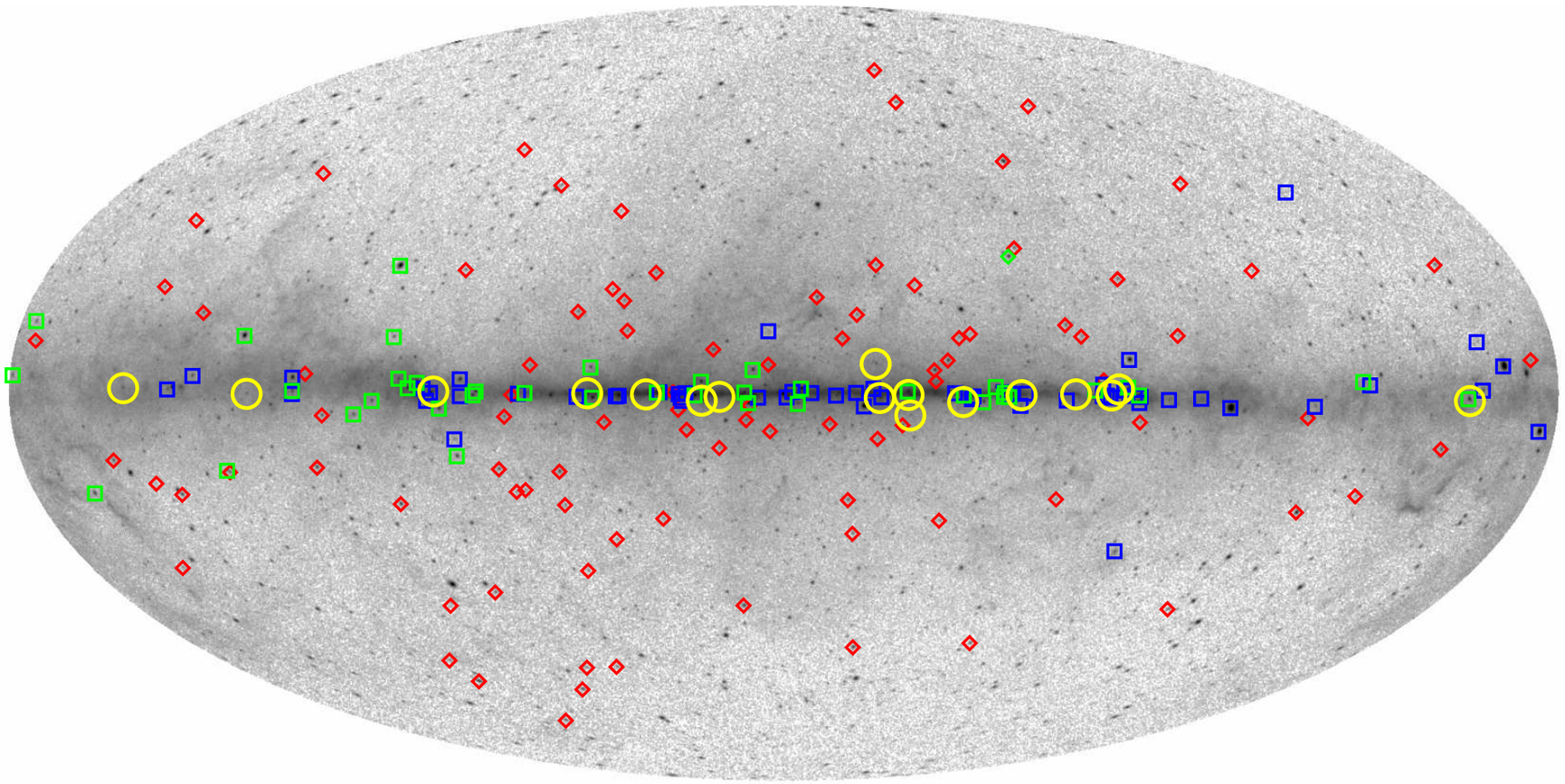
Fit for constant braking index

Allow a change in braking index

Clark, C. J., Pletsch, H. J., Wu, J. et al. 2016, ApJL, 832, L15



Summary/Outlook



- 17 new young gamma-ray pulsars, including:
  — 2 glitching pulsars,
  — 2 slowest gamma-ray pulsars
  — Youngest radio-quiet gamma-ray pulsar
- Upper limits on pulsations from unidentified gamma-ray sources
- Blind searches for *binary* gamma-ray pulsars currently running on E@H

Thank you for listening!