Long Period Radio Transit

Tom Throwe

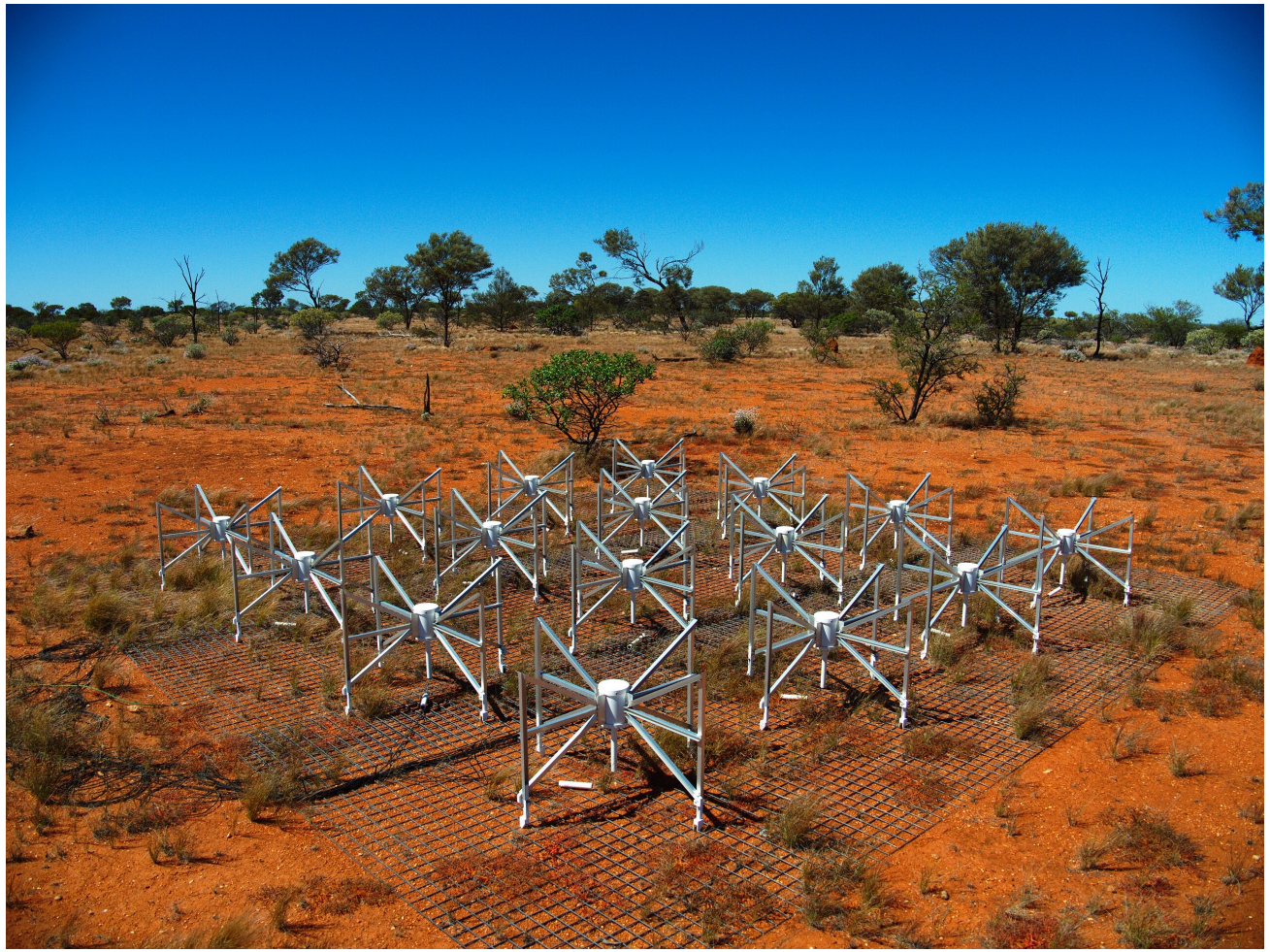
2 November 2023

Hurley-Walker search for Long Period Radio Objects

- Pulsars generally have periods from milliseconds to seconds
- With a new grant and access to Austrailia's Murchison Widefield Array (MWA) Hurley-Walker and students produced an algorithm to look for long period transits
- People searching for pulsars would not find these
- Hurley-Walker, et.al. soon found two objects
  - GLEAM-X J1627-52, period of 18 minutes
  - GPM J1839-10, period of 22 minutes

Tile of Murchison Widefield Array

- Telescope is made up of 256 tiles or 4096 antennas.
- Frequency range 70 and 300MHz
- Photo credit: By Natasha Hurley-Walker - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=18366320



Pulsars

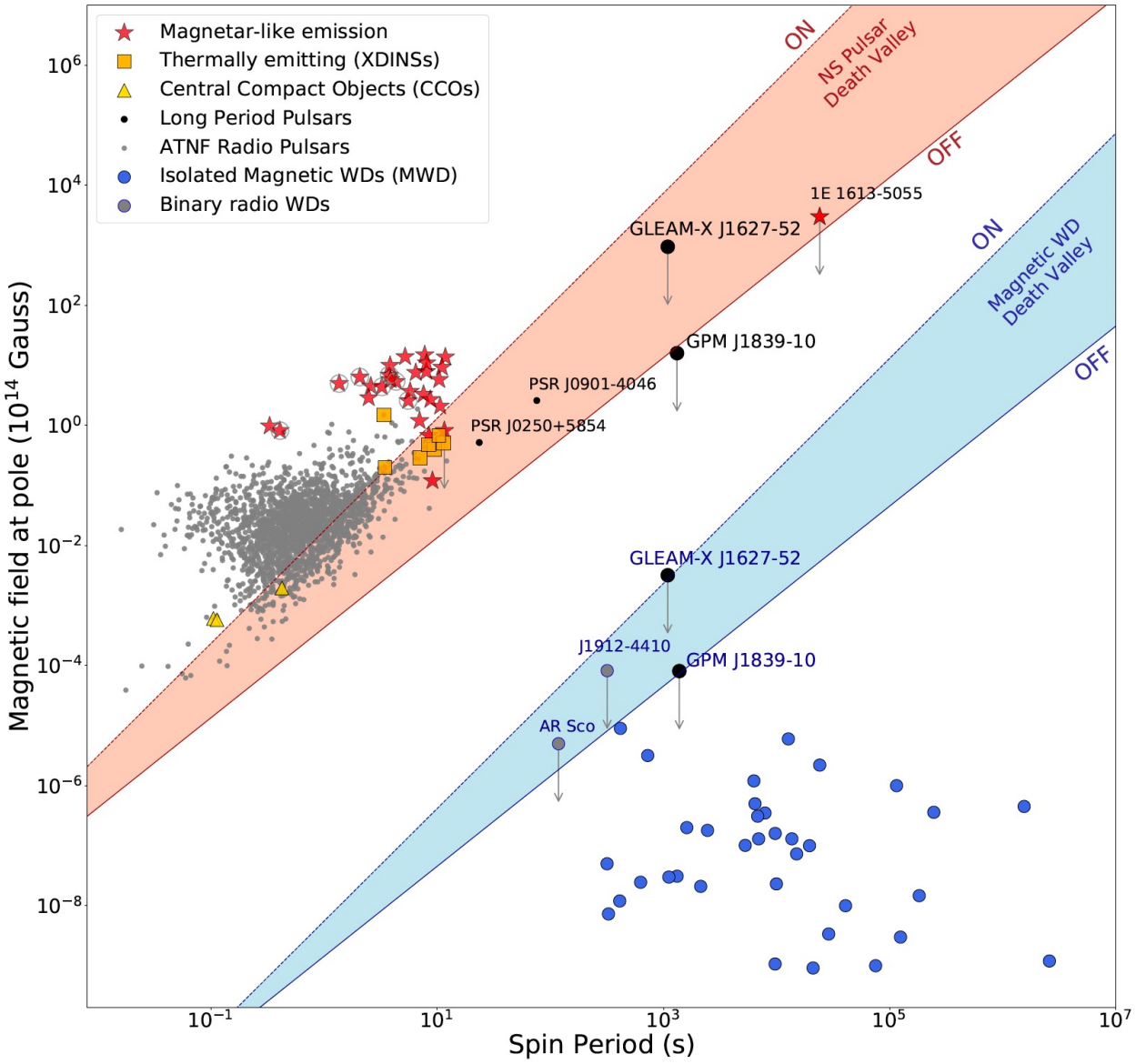
- Radio emissions from pulsars are believed to be created by pair production in the magnetic field of the spinning neutron start
- If the magnetic field is too weak, there is no pair production
- Where pair production ceases depends on:
  - Configuration of the magnetic field – i.e., dipolar, multi-polar, twisted
  - Seed gamma-ray photons – i.e., inverse Compton, curvature
  - Pulsar obliquity
  - Radius
  - Moment of inertia
- Where quenched called the “death valley”

White Dwarf

- In theory, a spinning white dwarf (WD) with a magnetic field (MWD) could produce radio emissions
- No radio emission for an isolated magnetic WD have been observed
  - Radio emission observed in two WDs in binary systems
- All observed MWDs are below the “death valley” for WDs
- Slow spin periods are common for MWDs

What are GLEAM-X J1627-52 and GPM J1839-10

- Plotted as NS and WD
- Plotted at upper B-field limit
- Do not fit current NS and MWD models
- GLEAM-X J1627-52
  - From reanalysis of 2018 data
  - Radio emissions lasted only few months
  - Very bright
  - No optical/infrared signal
  - Period similar to MWD, but radio emission only seen in binary
- GPM J1839-10
  - Long history > 33 years
  - Falls below NS death valley
  - Radio emission high for MWD



More data

- More long period object have been found and another paper is being worked on.

Simulating NS and WD Populations

- The remaining section of the paper discusses generating populations of NS and WD using the Graber et al. framework with parameters adjusted accordingly for isolated NS and WD.
- For NS, the synthesis does not produce sufficient energetic pulsars with periods > 1000s
- The WD population synthesis shows that long period MWDs are more common than NS pulsars