

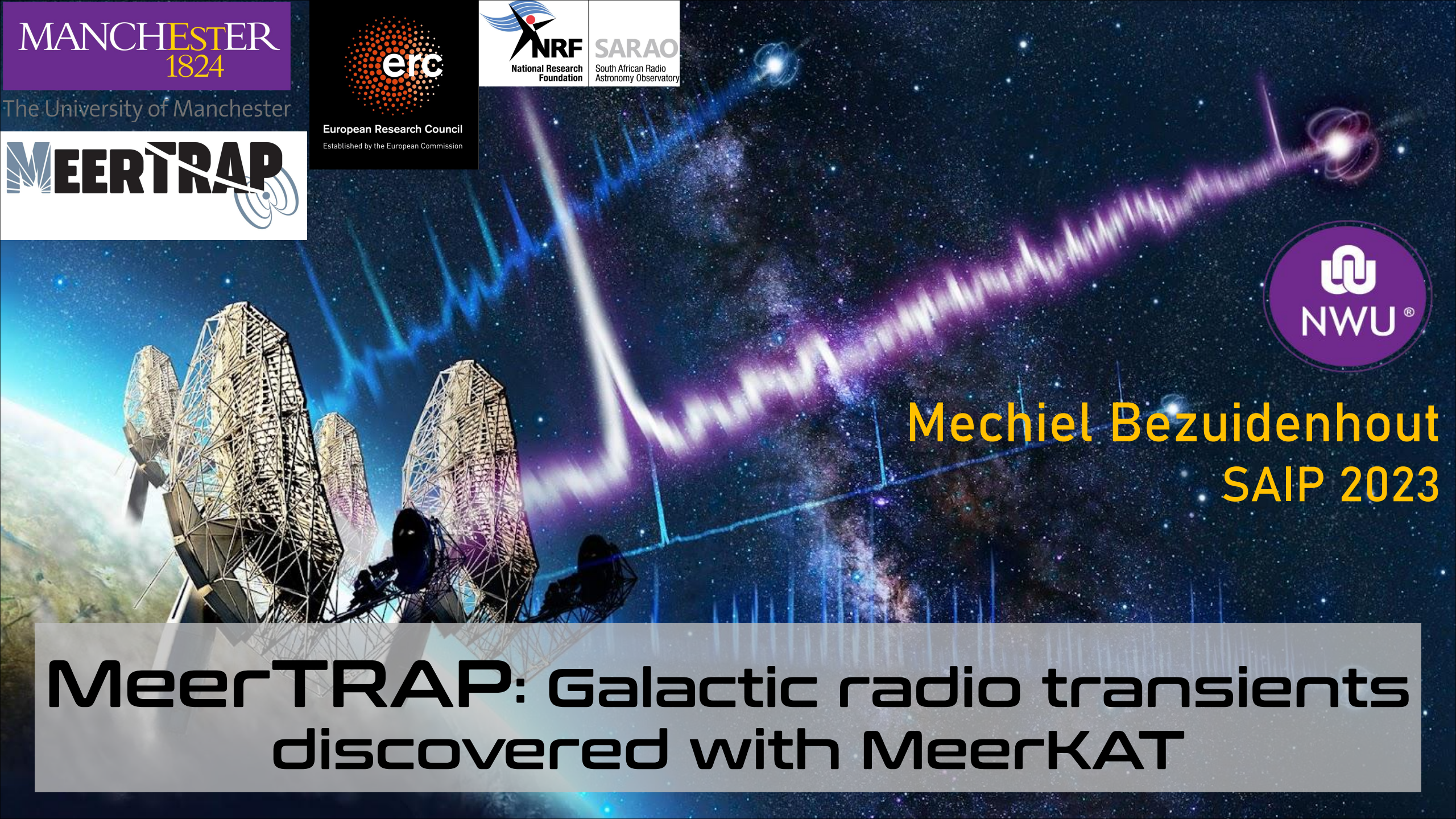


The University of Manchester



Mechiel Bezuidenhout
SAIP 2023

MeerTRAP: Galactic radio transients discovered with MeerKAT



MeerTRAP (More TRANSients and Pulsars)



Prof. Benjamin Stappers (PI)

Dr. Kaustubh Rajwade

Dr. Manisha Caleb

Dr. Fabian Jankowski

Dr. Mayuresh Surnis

Dr. Vincent Morello

Dr. Laura Driessen

Dr. Mechel Bezuidenhout

Dr. Sotiris Sanidas



MAX-PLANCK-GESELLSCHAFT

Prof. Michael Kramer

Dr. Ewan Barr

Dr. Jason Wu



Prof. Wes Armour

Dr. Karel Adamek

Dr. Jan Novotny

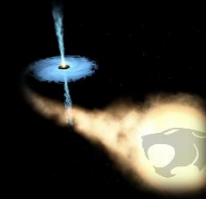
Prof. Aris Karastergiou

Dr. Christopher Williams



Fernando Camilo, Sharmila Goedhart,

Dave Horn, Sarah Buchner, etc



A real-time survey of the Southern Sky *commensal* with MeerKAT LSPs.

- Custom back-end continually sifts for single pulses in real time.
- Thousands of hours on-sky

All LSP pointings

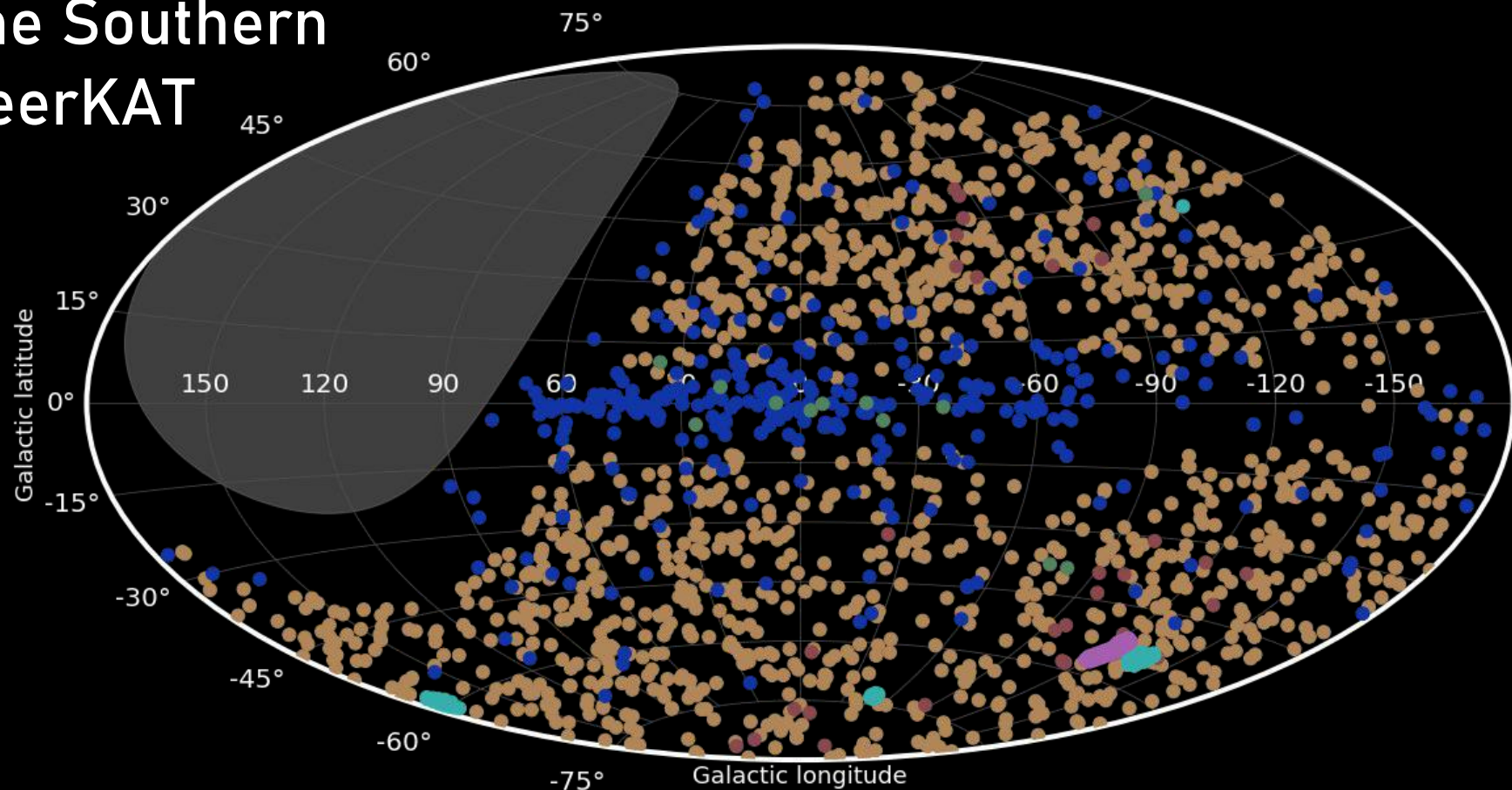
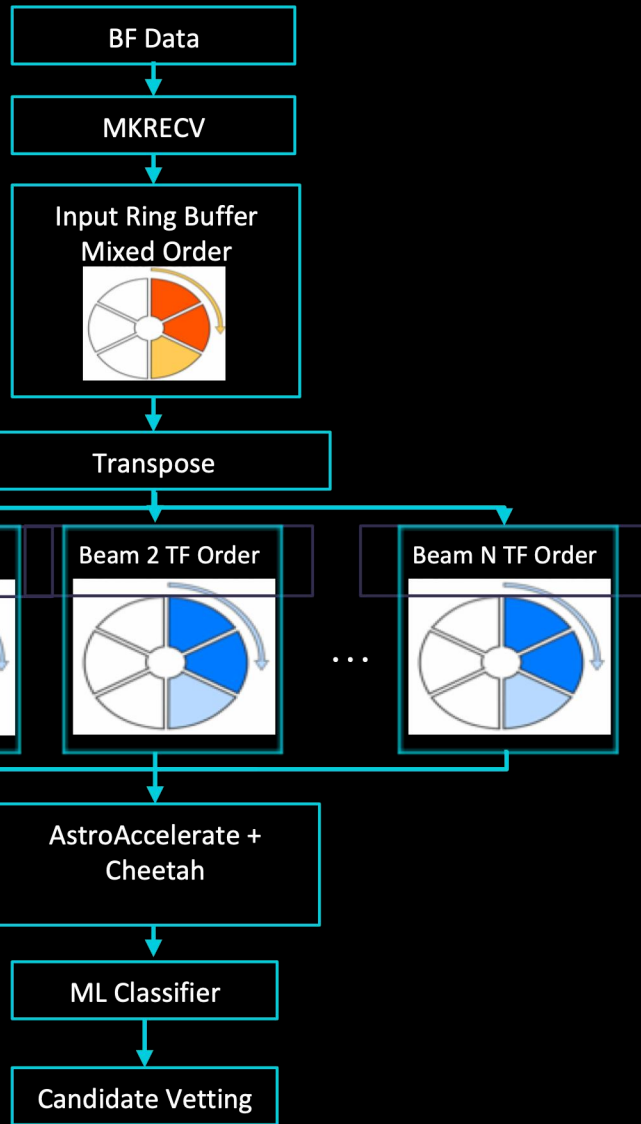


Image credit:
L. Driessen



PIPELINE



TUSE (Transients User Supplied equipment) back-end

66 compute nodes +
Head node
Per node:
2x Xeon E5-2620 CPUs
256 GB RAM
2x NVidia 1080Ti GPUs
480 GB SSD

DM range	0-5000
Widths	0.3-300ms
Beams	12 beams per node

Each node processes 12 coherent beams

Figure credit: Vincent Morello

OBSERVING MODES

Incoherent mode

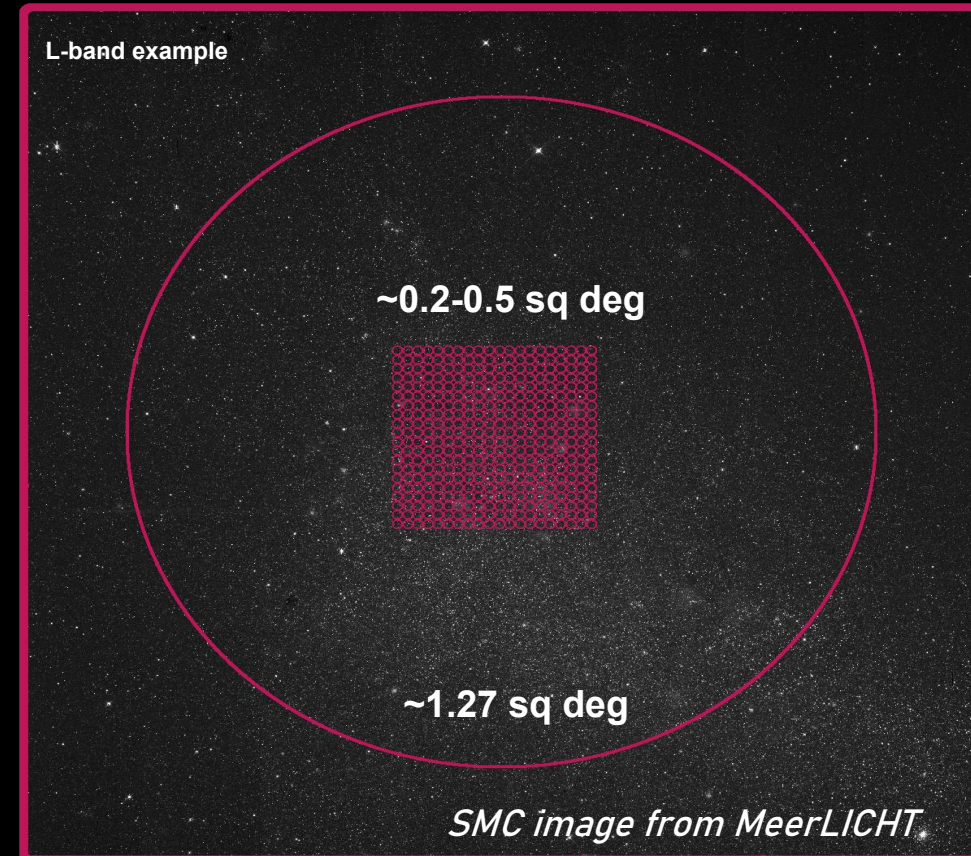
- All 64 dishes => 0.7 Jy Sensitivity (~Murriyang)
- FoV: 1.27 sq.deg

Coherent mode

- Use 40 core dishes => 5-7x IB sensitivity (0.1 Jy; ~GBT)
- Up to 768 tied-array beams, each ~45 arcsec FWHM
- Total FoV: 0.2-0.5 sq.deg

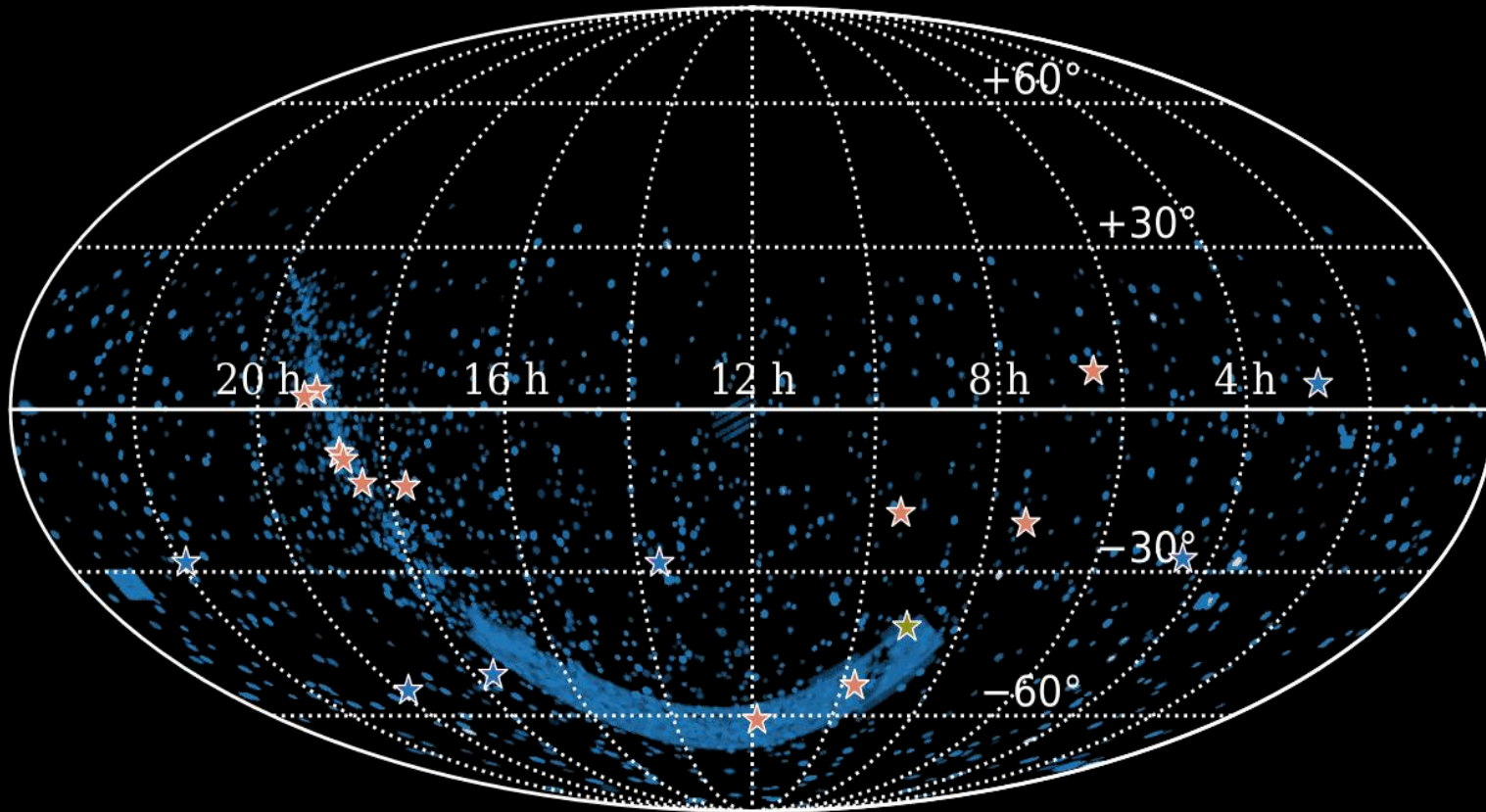
Transient buffer

- Store 300 ms of voltage data around the detected burst to perform fast imaging
- Sub-arc second localisation (combined with beamforming post-facto).



Results in numbers

~4 years of continuous observing



41 FRBs

~ 1 / month

84 Galactic transients

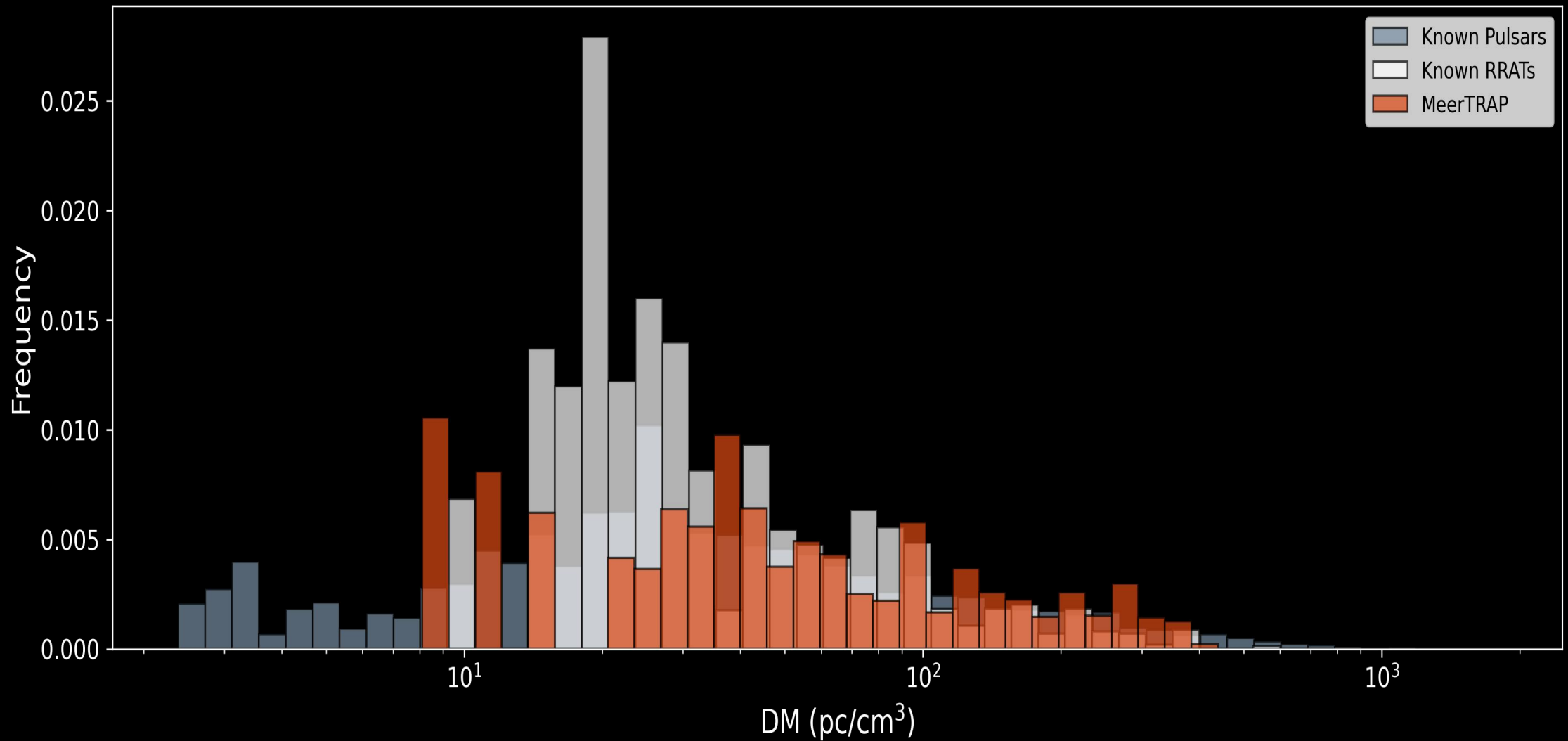
19 in IB

65 in CB

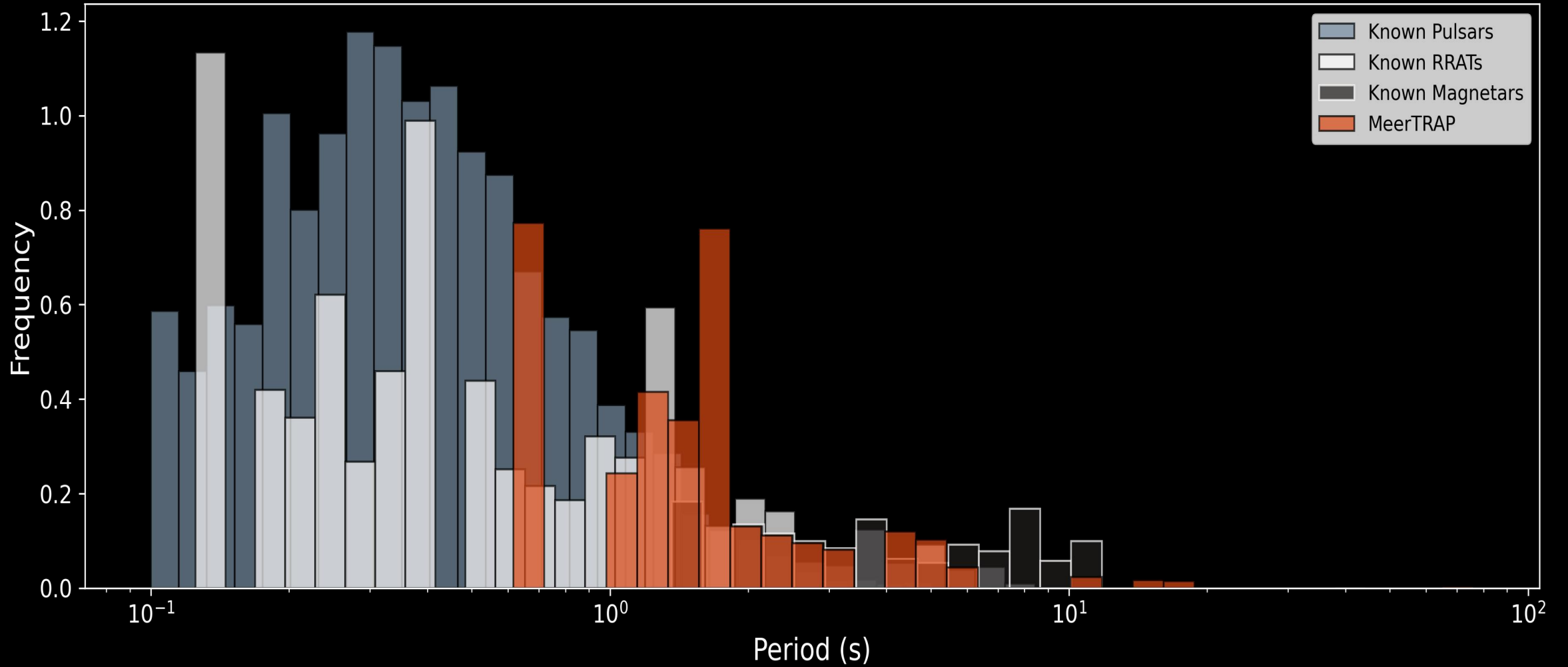
~ 2 / month!



Galactic population statistics



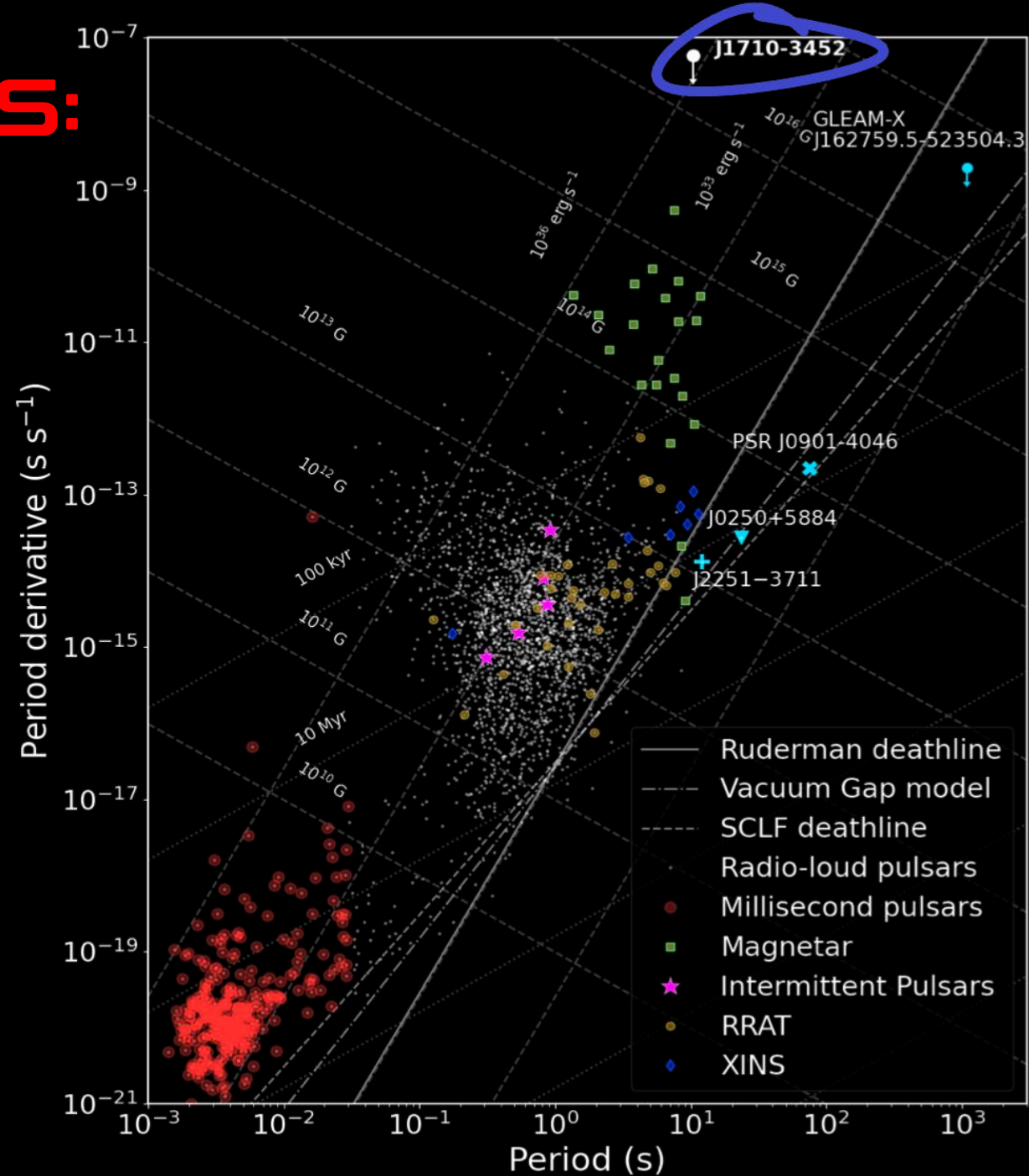
Galactic population statistics



MAJOR DISCOVERIES:

1. PSR J1710-3452

- An extremely intermittent pulsar— 97 pulses in 21 minutes, then disappeared for over 3.5 years.
- Super strong magnetic field ($<10^{16}$ G) suggests magnetar, but no X-ray emission...
- High Galactic latitude (2.9°)
=> very old (184 kyr - 6.6 Myr)



MAJOR DISCOVERIES:

2. PSR J1901-4046

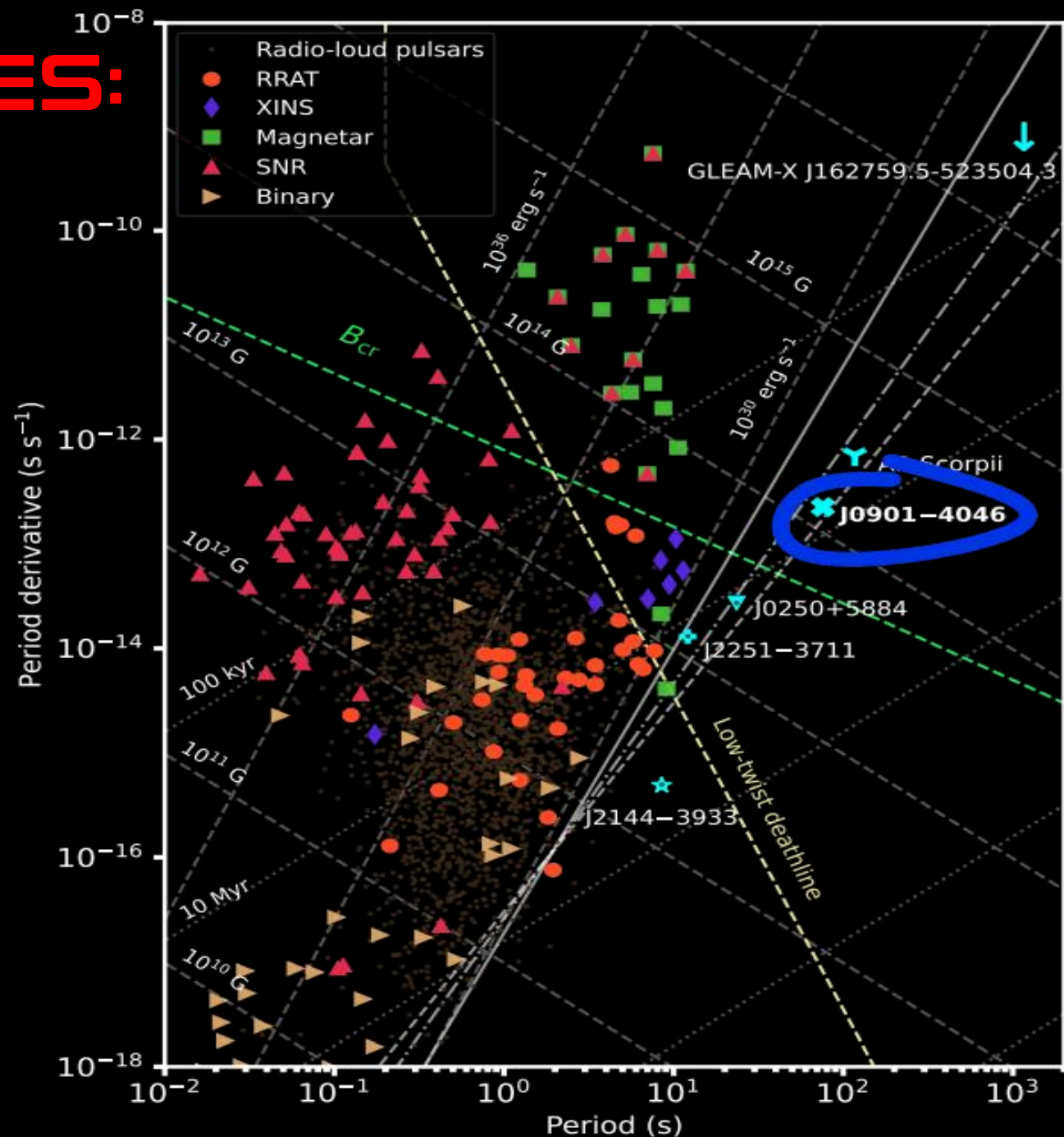
The slowest pulsar ever! (76s)

DM = 52.6 pc cm⁻³

Distance ~327 pc

L-band ~ 90 mJy

UHF-band ~ 170 mJy



Summary

- Commensal observing for ~4 years
- Found 125 new transients to date
(41 extragalactic, 84 Galactic)
- Discovered a strange, old (dying?) pulsar/magnetar
- Discovered the slowest pulsar ever
(new kind of neutron star?)