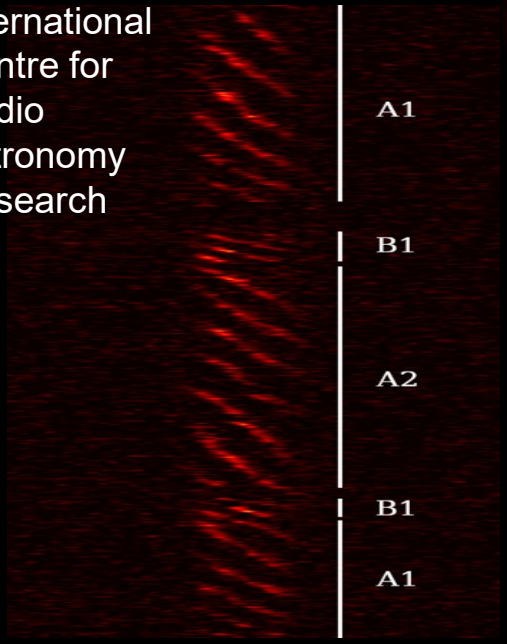
SMART discovery* of an unusual nulling, subpulse drifting pulsar

Sam McSweeney + SMART team

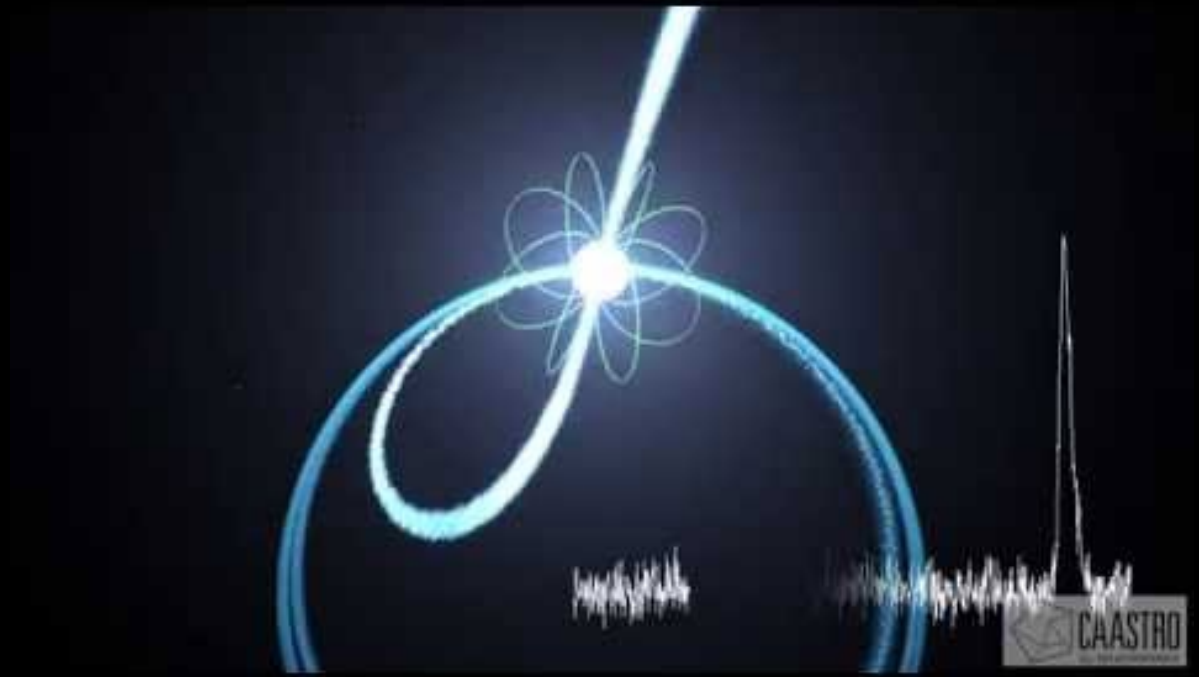
International Centre for Radio Astronomy Research

Curtin University

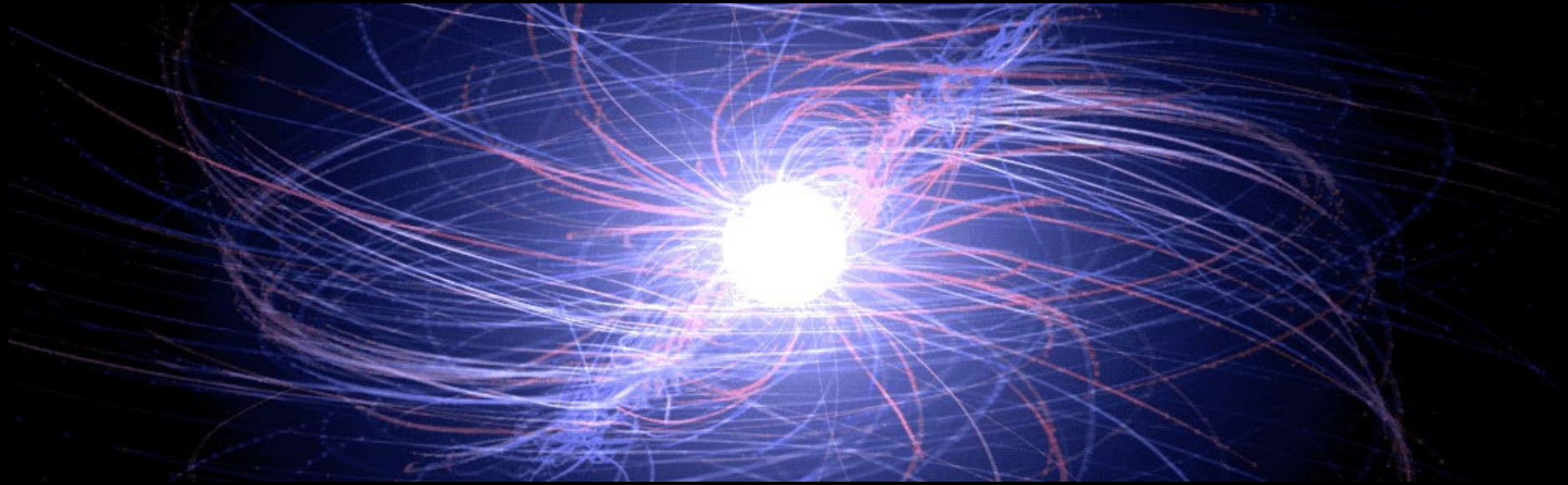
The University of Western Australia



The pulsar emission mechanism

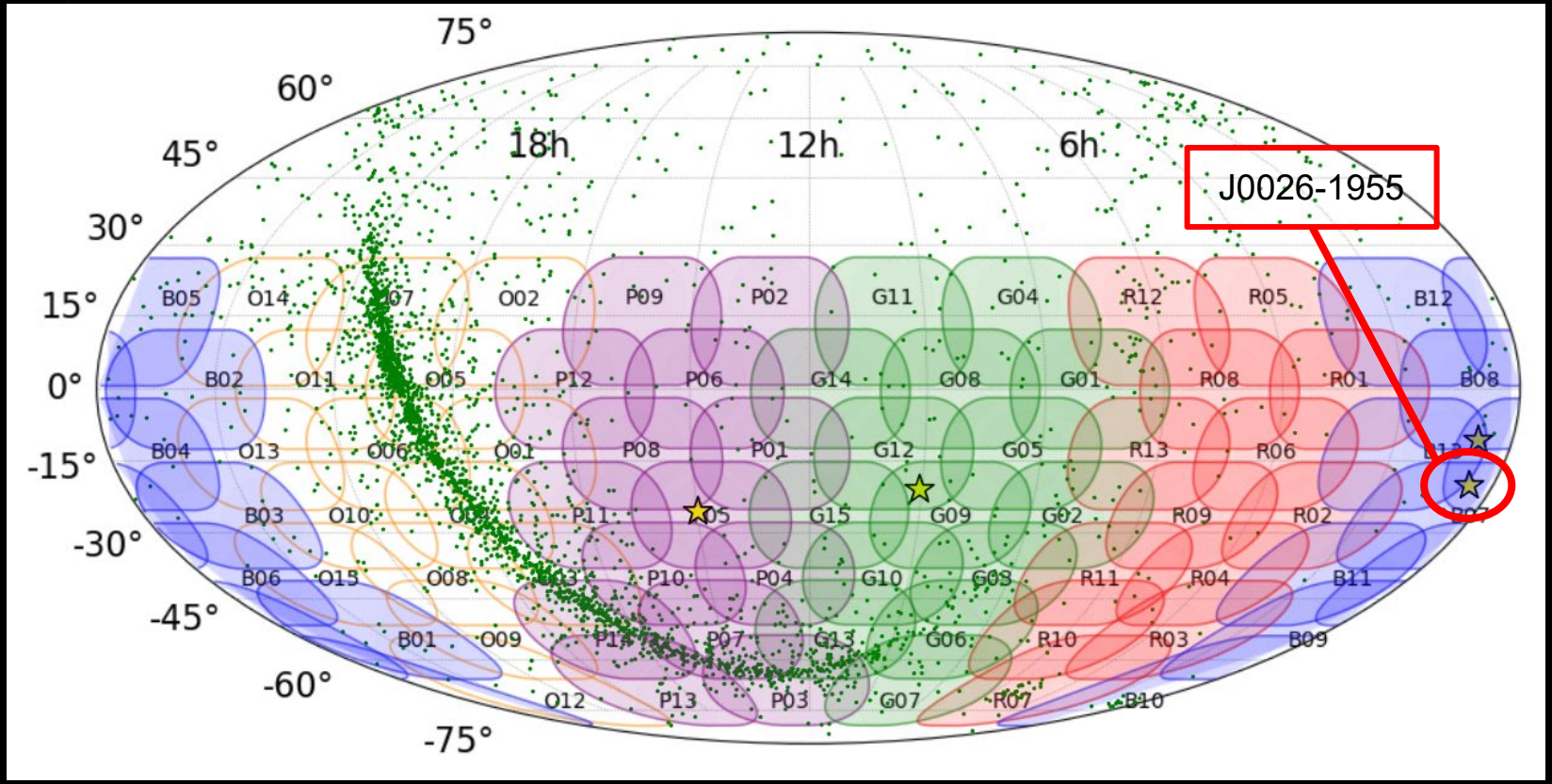


Why single pulse studies matter

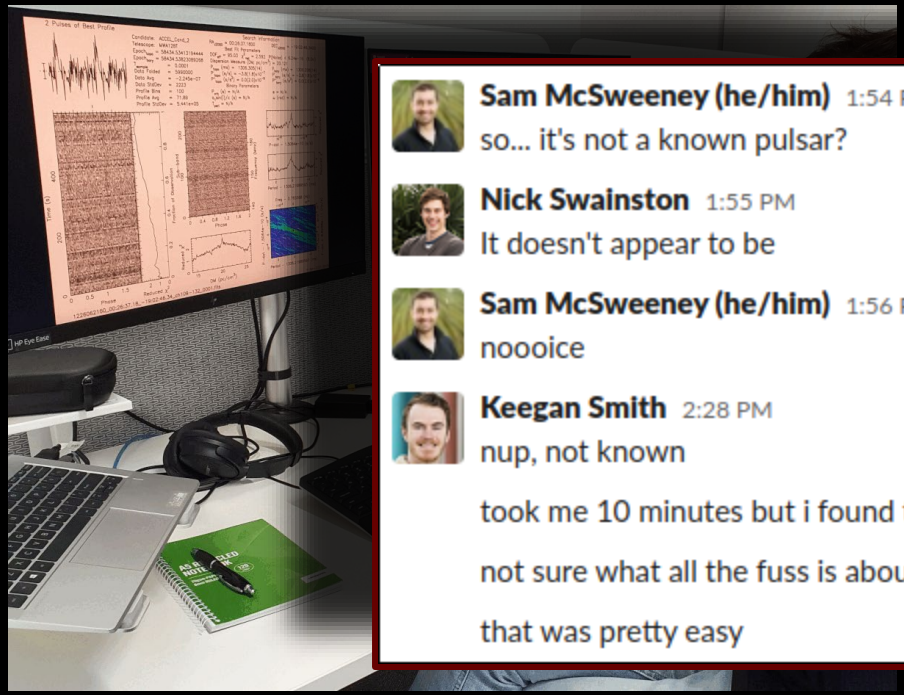


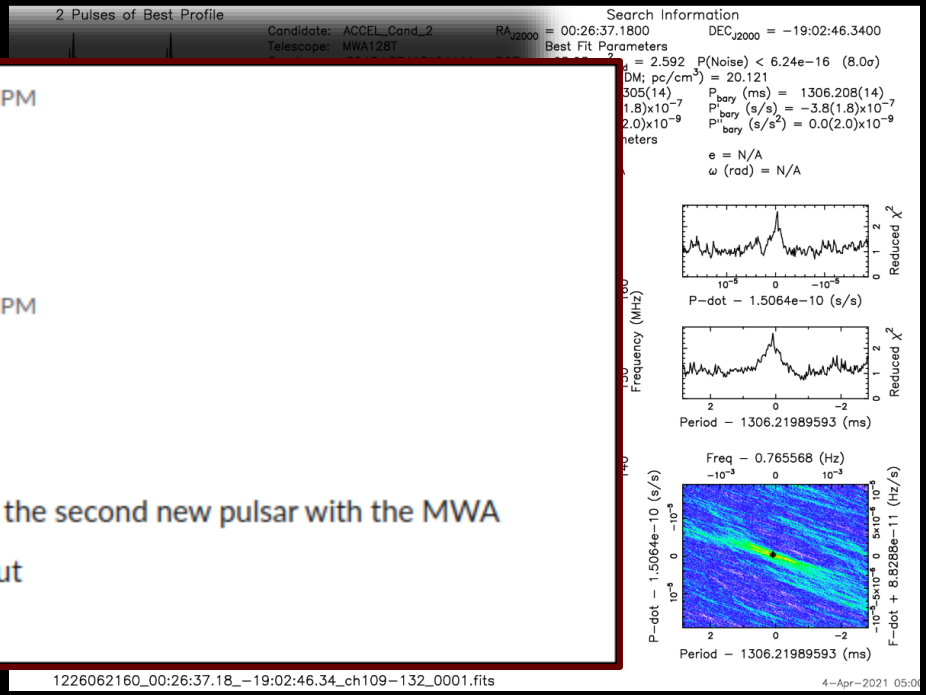
Paper: Brambilla et al. (2018)
Animation: NASA Astrophysics / Goddard Space Flight Centre
https://www.nasa.gov/sites/default/files/thumbnails/image/pulsar_banner.gif

The SMART pulsar survey



How it was found





Sam McSweeney (he/him) 1:54 PM
so... it's not a known pulsar?

Nick Swainston 1:55 PM
It doesn't appear to be

Sam McSweeney (he/him) 1:56 PM
noooice

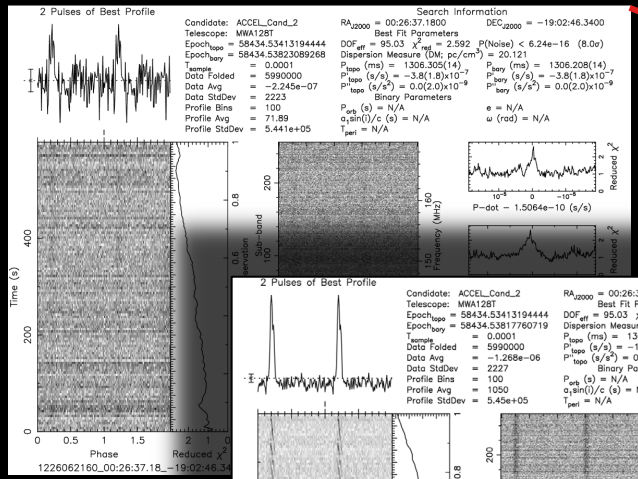
Keegan Smith 2:28 PM
nup, not known

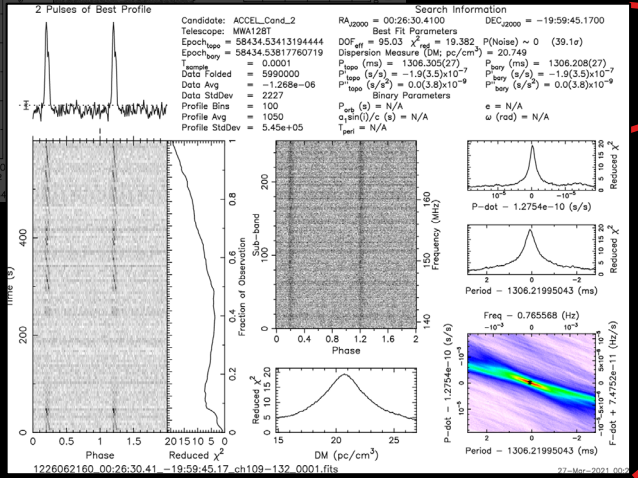
took me 10 minutes but i found the second new pulsar with the MWA

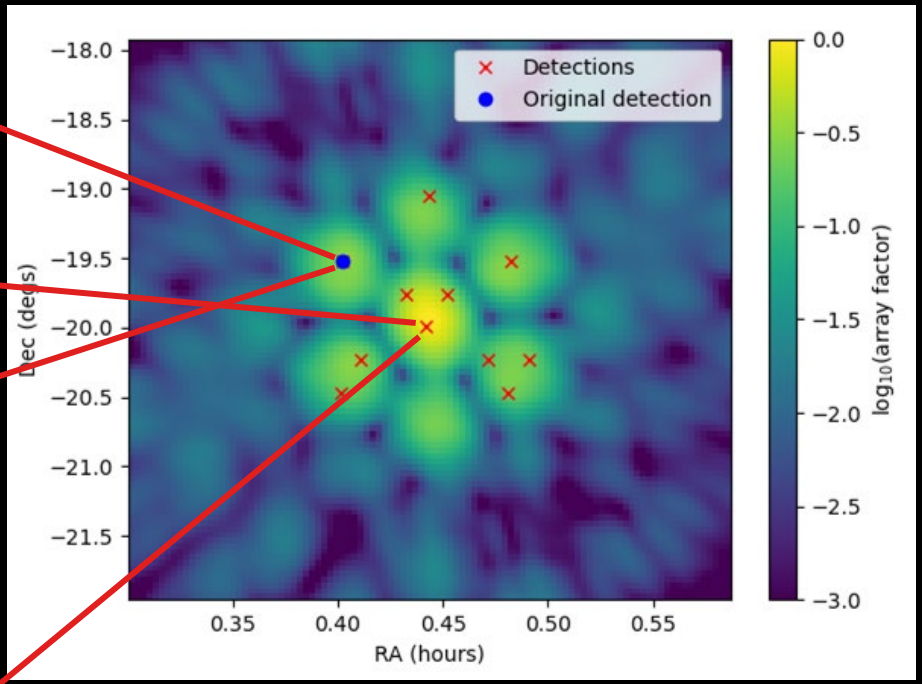
not sure what all the fuss is about

that was pretty easy

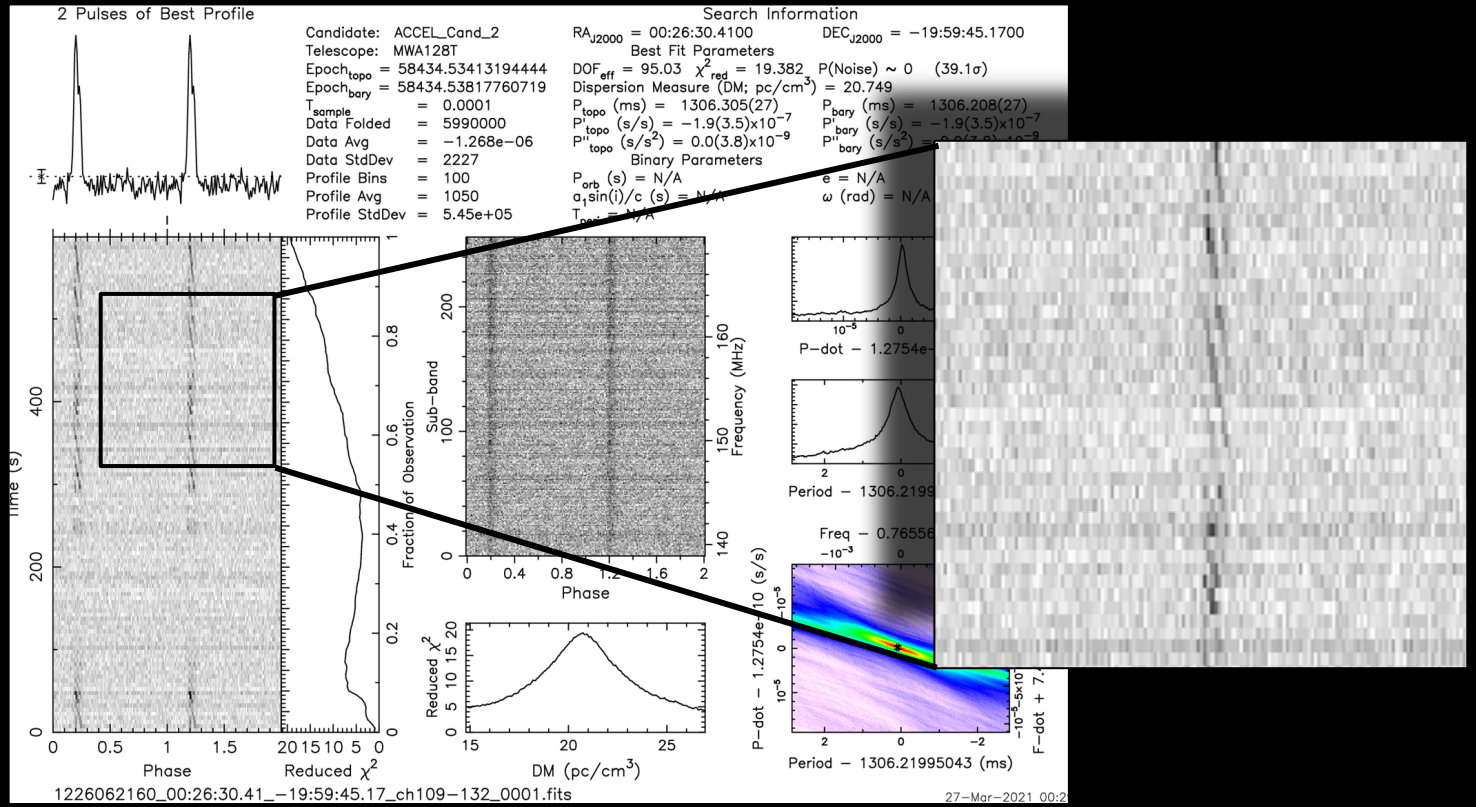
How it was found



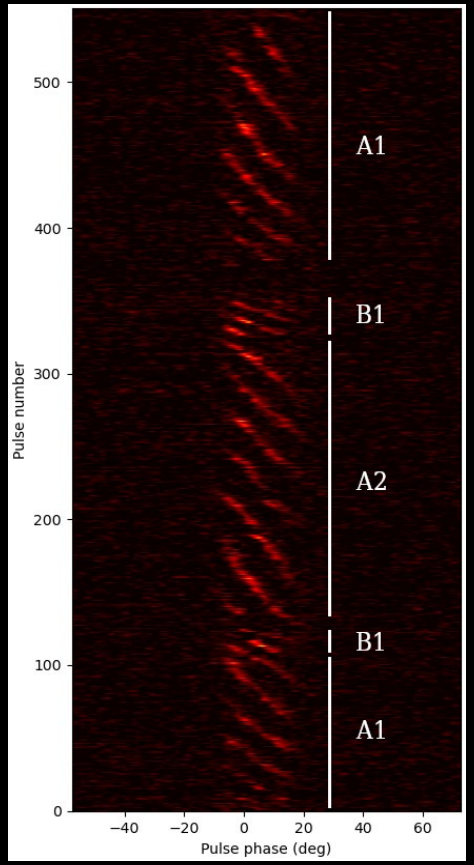


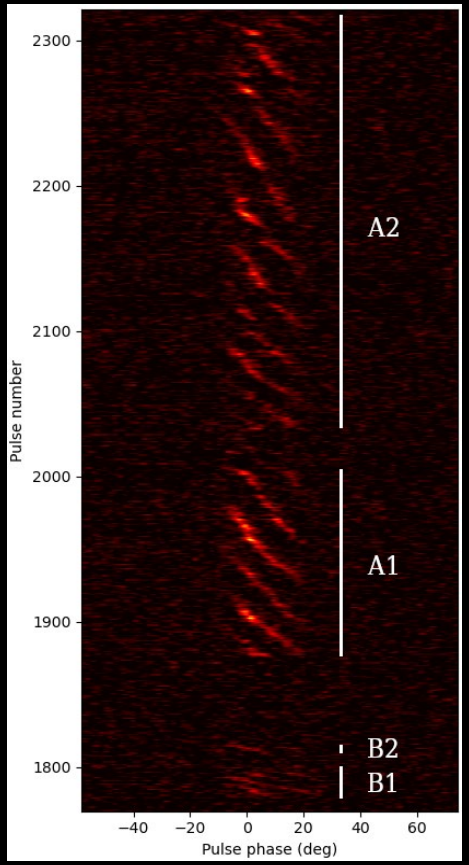


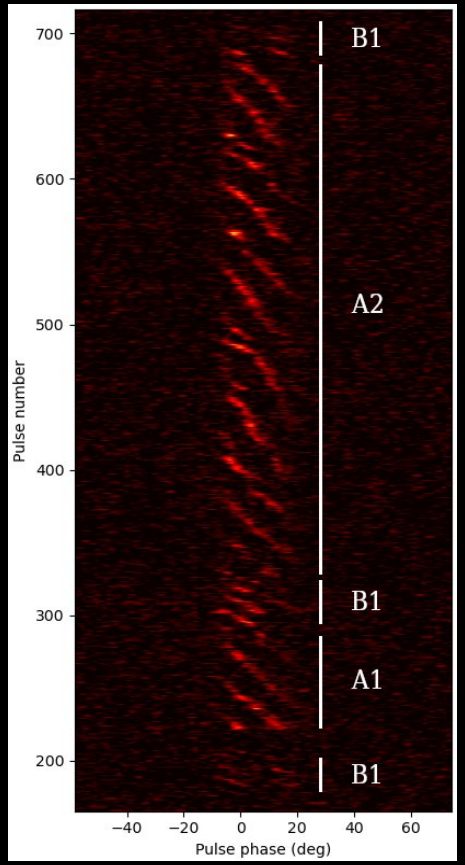
Subpulse drifting!



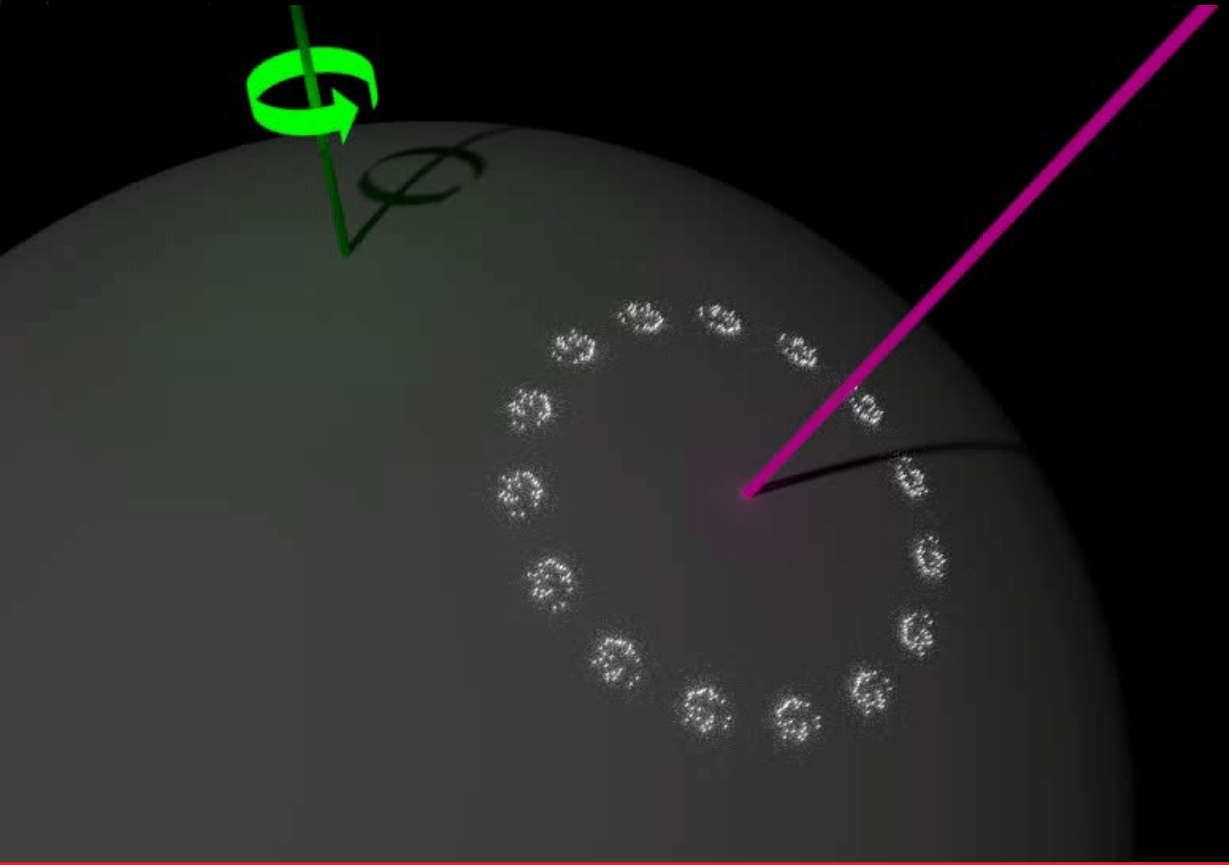
INTERESTING subpulse drifting!





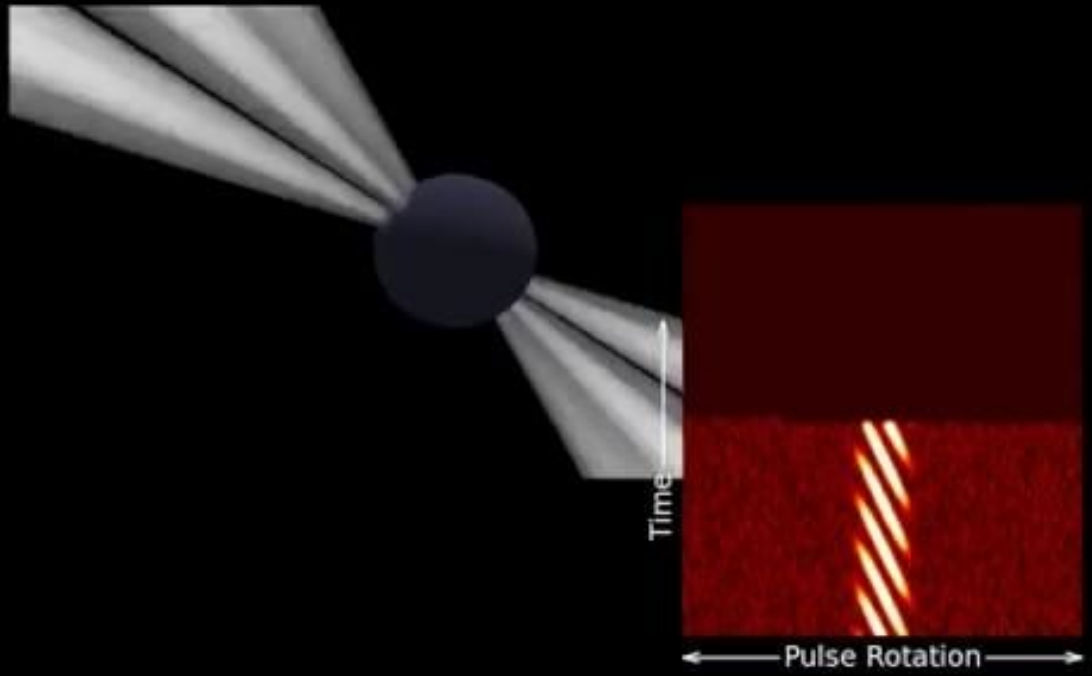


“Boring” subpulse drifting



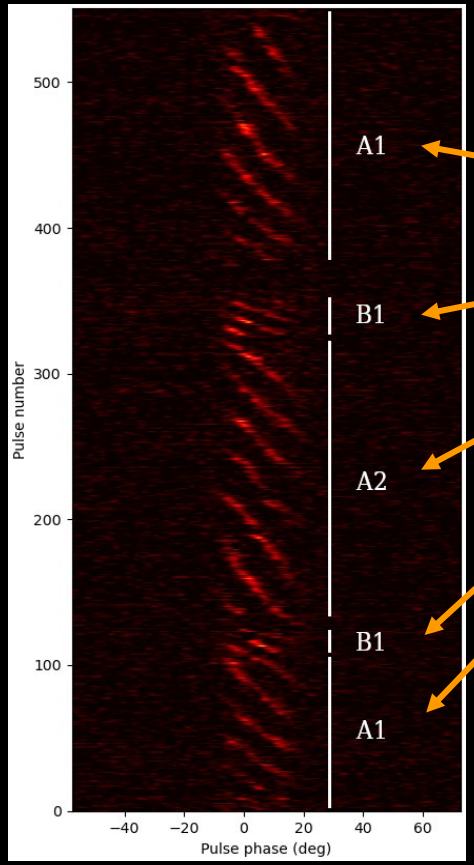
1975

“Boring” subpulse drifting



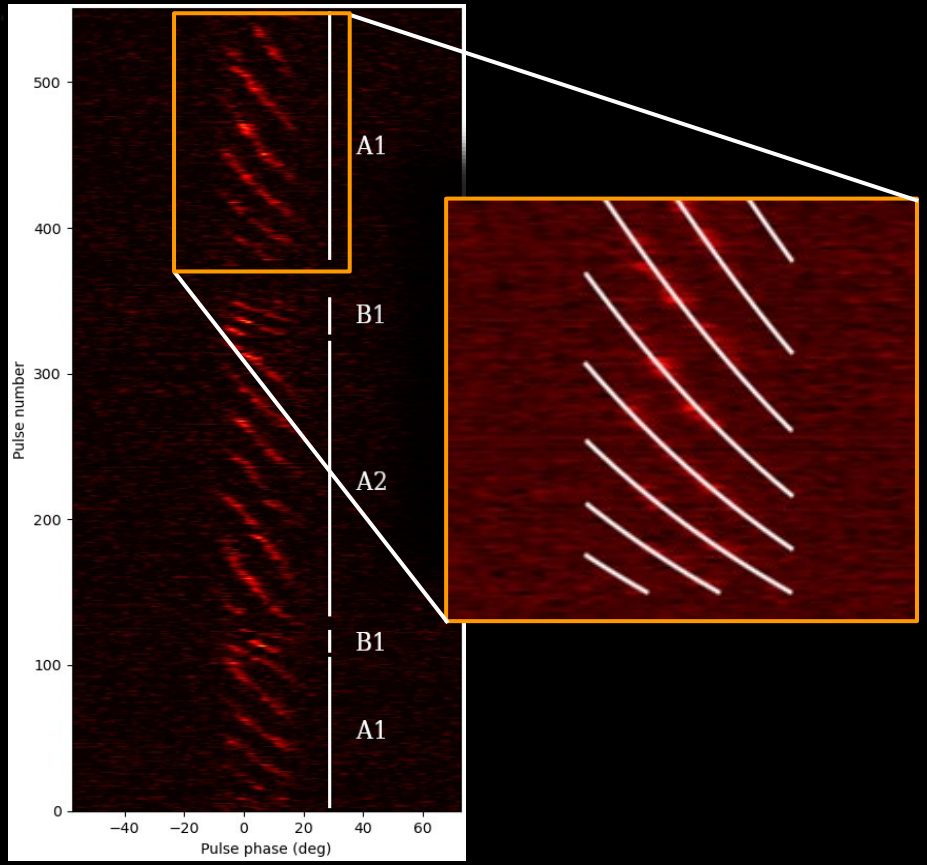
1975

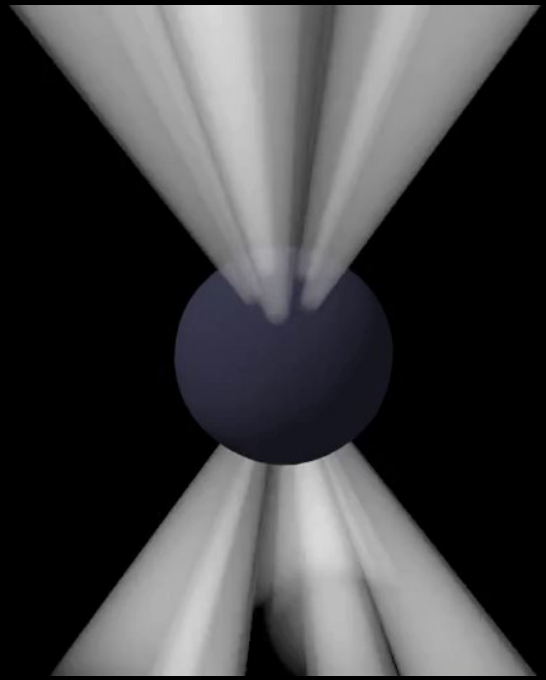
Modelling the drifting behaviour



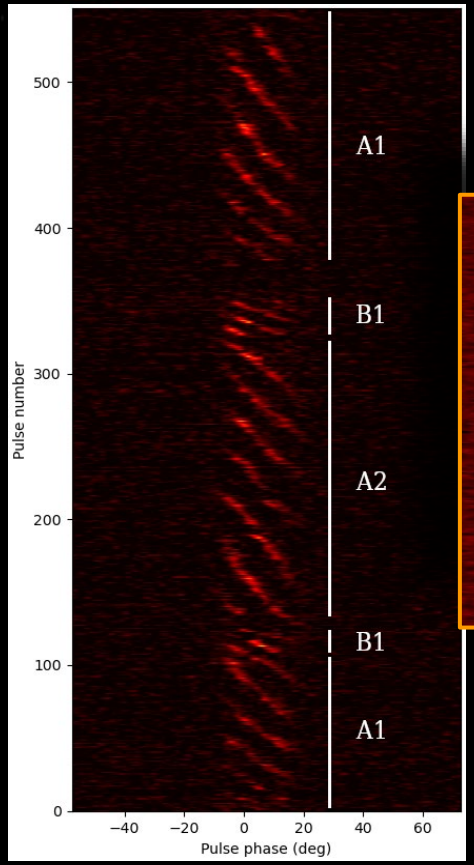
Classification based on how "spread out" the drift bands are (i.e. vertical separation, "P_3")

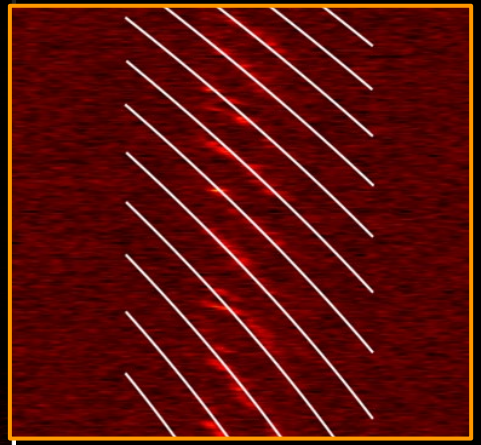
Modelling the drifting behaviour

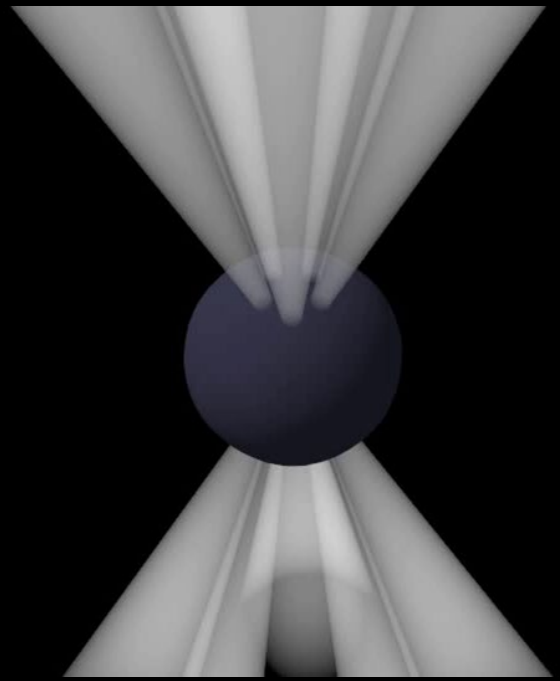




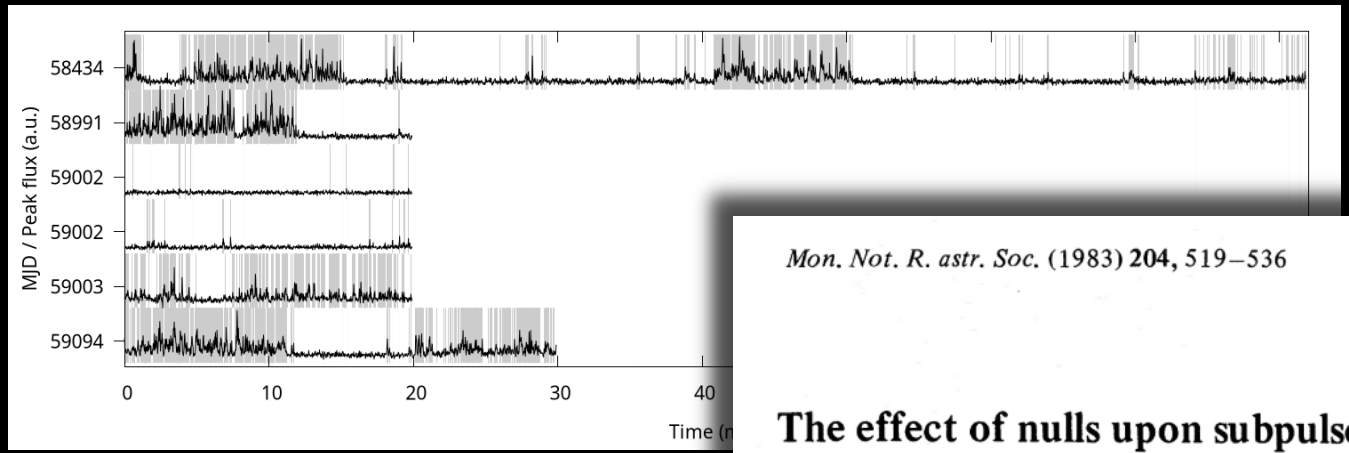
Modelling the drifting behaviour







Connection with nulling?



Mon. Not. R. astr. Soc. (1983) **204**, 519–536

The effect of nulls upon subpulse drift in PSRs 0809 + 74 and 0818 – 13

A. G. Lyne and M. Ashworth *University of Manchester, Nuffield Radio Astronomy Laboratories, Jodrell Bank, Macclesfield, Cheshire SK11 9DL*

Conclusions and follow-up

- Paper has just been published:
  - DOI: 10.3847/1538-4357/ac75bc

The Astrophysical Journal, 933:210 (12pp), 2022 July 10 https://doi.org/10.3847/1538-4357/ac75bc

Independent Discovery of a Nulling Pulsar with Unusual Subpulse Drifting Properties with the Murchison Widefield Array

Samuel J. McSweeney[1], N. D. Ramesh Bhat[1], Nicholas A. Swainston[1], Keegan R. Smith[1], Sanjay Kudale[2], Paul Hancock[3], Willem van Straten[4], Shi Dai[5], Ryan M. Shannon[6,7], Steven J. Tingay[1], Melanie Johnston-Hollitt[3], David L. Kaplan[8], and Mia Walker[1]

[1] International Centre for Radio Astronomy Research, Curtin University, Bentley, WA 6102, Australia; sammy.mcsweeney@gmail.com
[2] National Centre for Radio Astrophysics, Tata Institute of Fundamental Research, Pune 411 007, India
[3] Curtin Institute for Computation, Curtin University, GPO Box U1987, Perth, 6845, WA, Australia
[4] Institute for Radio Astronomy & Space Research, Auckland University of Technology, Private Bag 92006, Auckland 1142, New Zealand
[5] Western Sydney University, Locked Bag 1797, Penrith South DC, NSW 1797, Australia
[6] Centre for Astrophysics and Supercomputing, Swinburne University of Technology, Hawthorn, VIC, 3122, Australia
[7] ARC Centre of Excellence for Gravitational Wave Discovery (OzGrav), Australia
[8] Center for Gravitation, Cosmology, and Astrophysics, Department of Physics, University of Wisconsin-Milwaukee, P.O. Box 413, Milwaukee, WI 53201, USA
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Conclusions and follow-up

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- Can we keep *adapting* the carousel model? (“epicycles”)
  - In-depth studies of pulsars like this really test the limits…
- SMART is primed to uncover many similar nulling/intermittent pulsars

- More MWA archival data to be studied
- GMRT and Parkes observations have been taken
  - Follow-up paper will focus on frequency-dependent effects + polarisation

THANK YOU