



Time domain, fast timescales, and multi-messenger

Laura Driessen
Keith Bannister





Time domain science with ATNF facilities

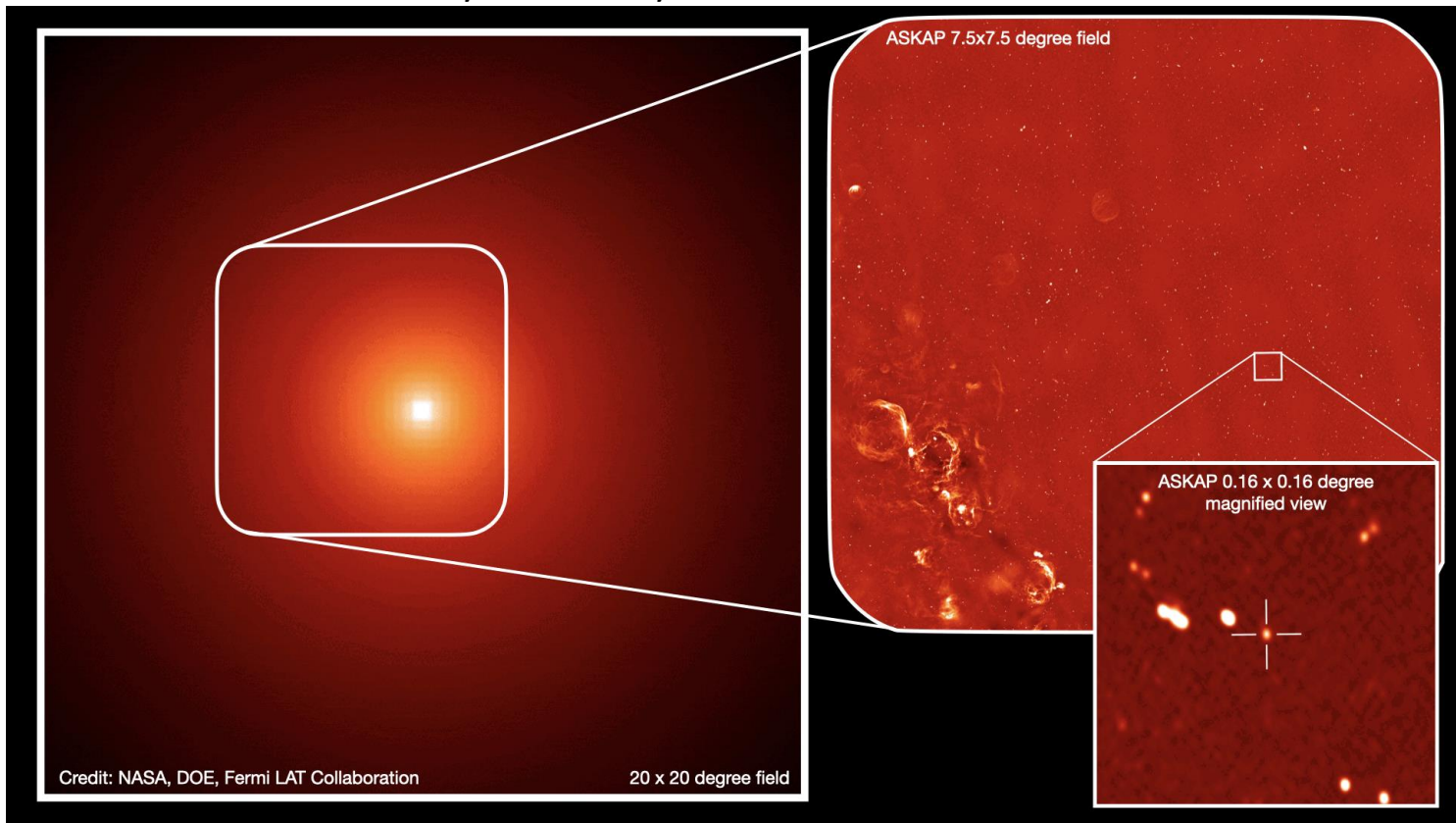
- Transients uses all of the ATNF facilities and instrumentation.
- ASKAP/VAST: Stellar flares, general transients, CP pulsar in LMC, GC transient, GW170817 follow-up, intraday variability along a line
- ASKAP/CRAFT - Lots of FRBs, localisations, high Z FRBs, Macquart Relation.
- Parkes – the original FRB, pulsars, UWB observations of magnetars. FRB follow-up
- ATCA rapid response / GRBs (See Gemma's talk), QSO/AGN variability
- LBA – Supernova shells, astrometry
- And ...



ASKAP detection of the super bright GRB

GRB 221009A – image credit Emil Lenc, James Leung, Tara Murphy

21st of October 2022 ATNF Daily Astronomy Picture

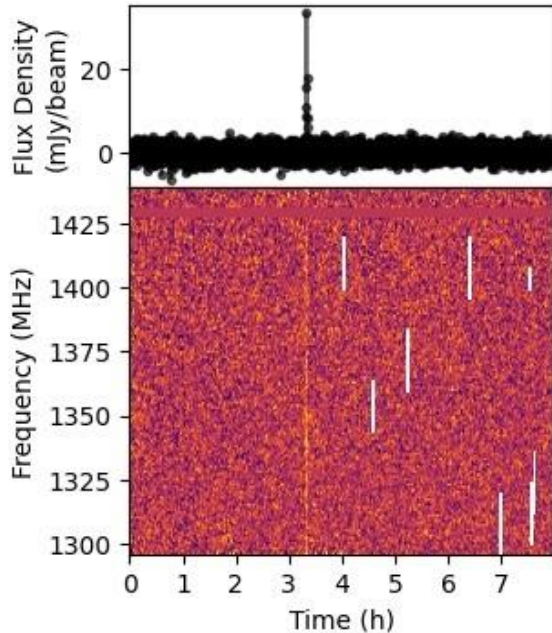




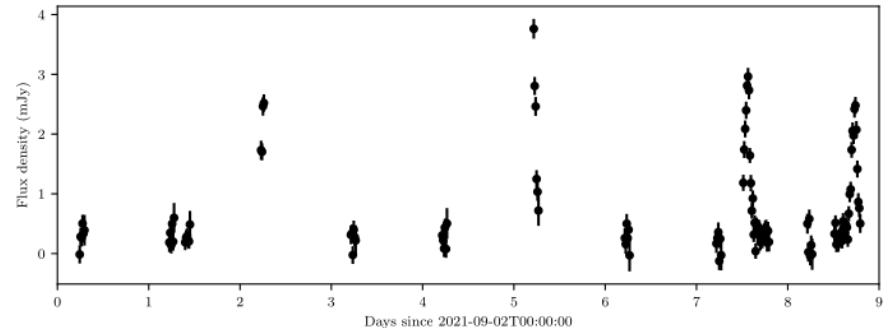
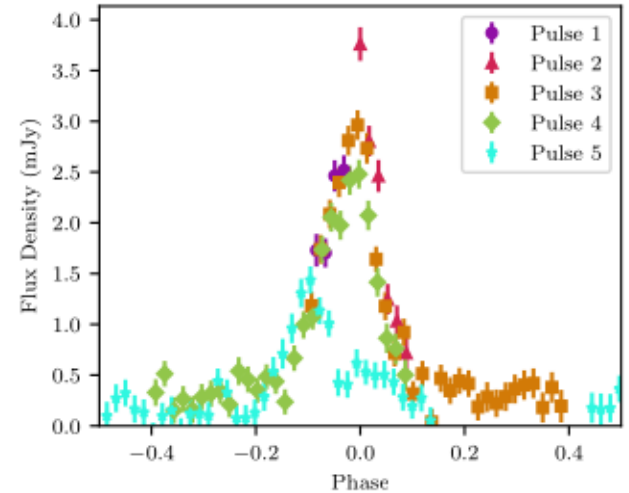
Radio stars with ASKAP

~ minute long stellar radio flares

Credit: Yuanming Wang



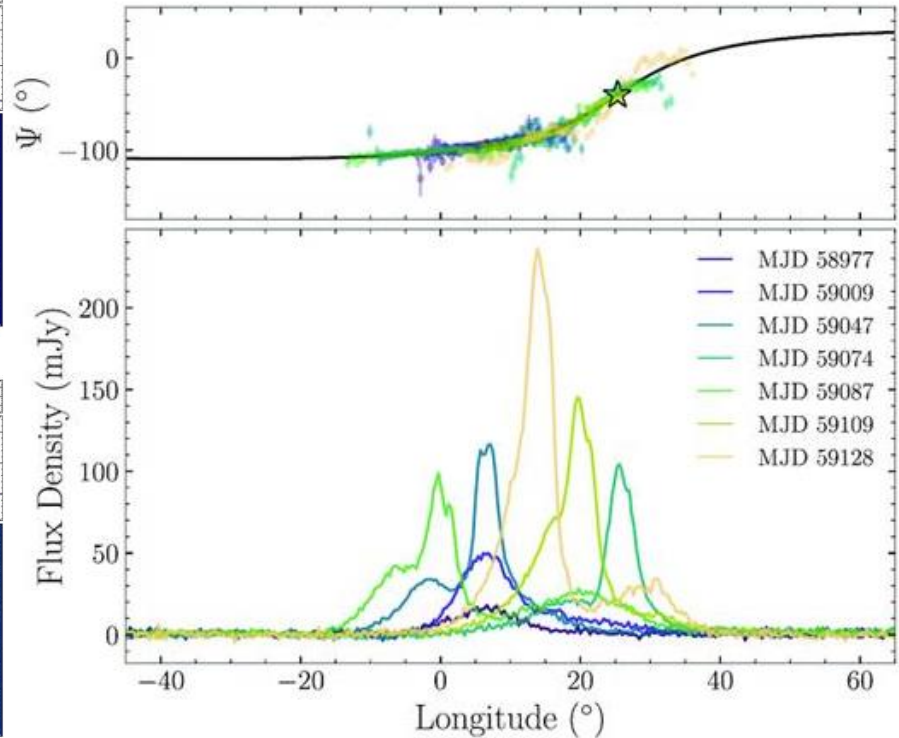
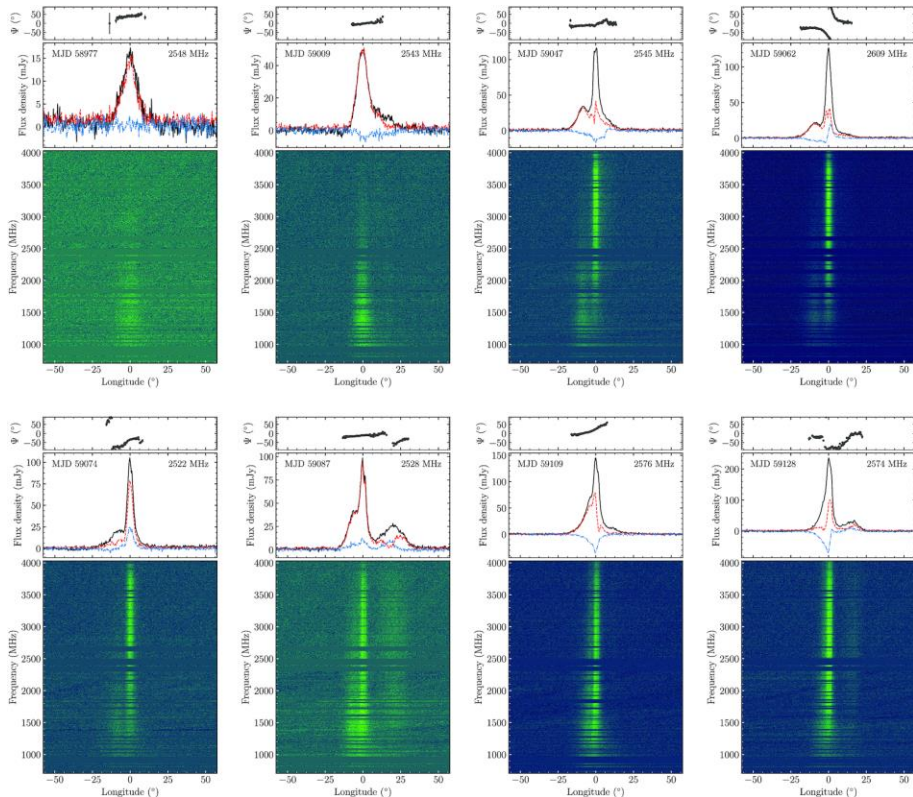
Slowest rotating
radio-loud ultra-
cool dwarf (UCD)
- 14.1 hour
period
Dobie et al.
submitted





Magnetars with Parkes

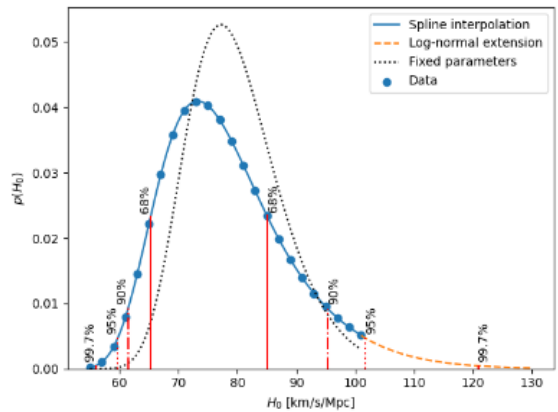
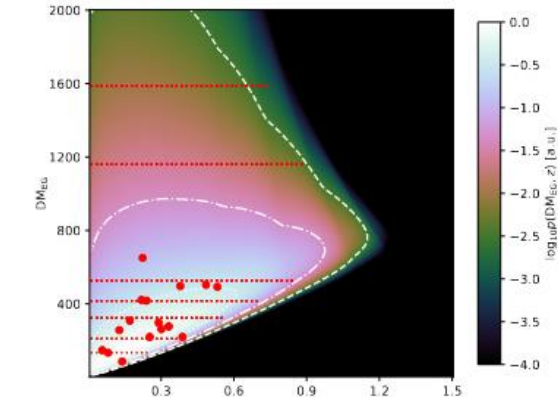
Spectropolarimetry of Swift J1818.0-1607 – Lower et al. 2021



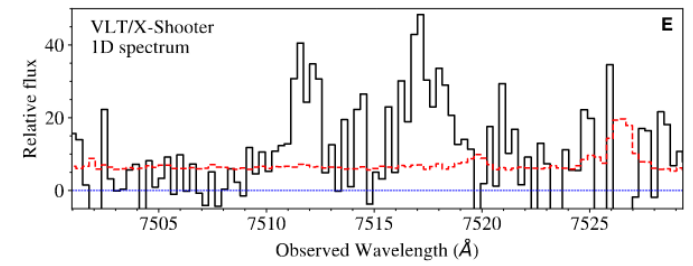
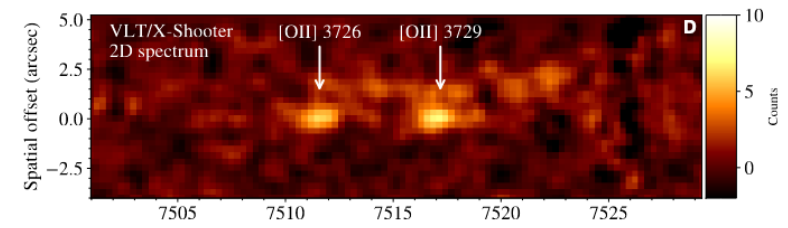
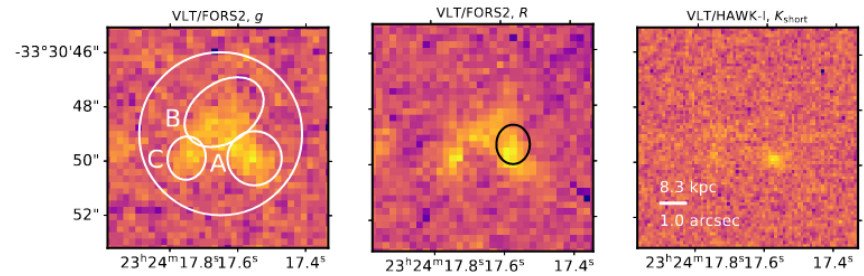


Fast Radio Bursts

Measuring the Hubble constant using
ASKAP and Parkes FRBs – James et al. 2022



ASKAP detected FRB20220610A
Localised to a host galaxy system at $z=1.016 \pm 0.002$
- Ryder et al. submitted





Progress

- The fast/slow dichotomy ... isn't - The line between "Fast" "slow" is blurring. We need to attack the problem from both sides
- Follow-up of known objects suggests transient emission is lurking in un-explored parts of parameter spaces:
 - Very wide FoV (l.e. all-sky) FRBs
 - Timescales 100ms-10s – galactic plane
 - Timescales \ll 1ms
 - Frequencies $>$ 2 GHz



Future Science

- Ultra-long period objects
- More FRBs (localised too!)
- VAST full survey coming soon
- Unknown new things?



Current & future instrumentation



Current instrumentation

- Dispersed transients
 - Parkes – UWB, CryoPAF
 - ASKAP – CRACO, CRAFT
- Un-dispersed transients
 - ASKAP – VAST
 - ATCA – rapid response



Future instrumentation / experiments

- CryoPAF in aperture array – Nearest & brightest FRBs and Galactic events
- Parkes CryoPAF \leftrightarrow ASKAP FRB searching & Localisation
- Pulsar searching with ASKAP
- Probing the microsecond sky -- wide FoV instruments above 2 GHz?
- Probing intermediate timescales (10ms to 1s)



Summary

- ATNF facilities are producing lots of cool time domain science results
 - Searching for (and finding) new objects
 - Investigating time domain objects
 - Follow-up and host identification
- Instrumentation
 - Currently have instruments looking for dispersed and non-dispersed signals
 - Looking forward to CryoPAF results
 - How do we probe "intermediate" time scales and higher frequencies?