



Extended MWA capabilities for transients and variability

Tara Murphy
on behalf of the Transients collaboration

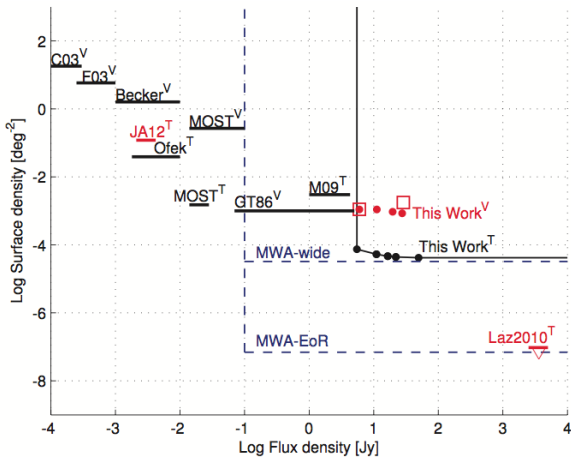
16th October 2014



- ▶ **Low mass stars and brown dwarfs**
Physical origin; incident rates; spectral characteristics
- ▶ **Magnetars**
Flare properties; energetics; duty cycles of radio bright phases
- ▶ **X-ray binaries**
Understanding the disc-jet connection; outburst statistics; burst luminosity function
- ▶ **Extra-solar planets**
Independent radio detections?
- ▶ **Gamma Ray Bursts**
Prompt emission; long term follow-up
- ▶ **New discoveries**



Transient snapshot rates (c. 2013)



Bell et al. 2014, MNRAS, 438, 352



MWA 128T transients surveys

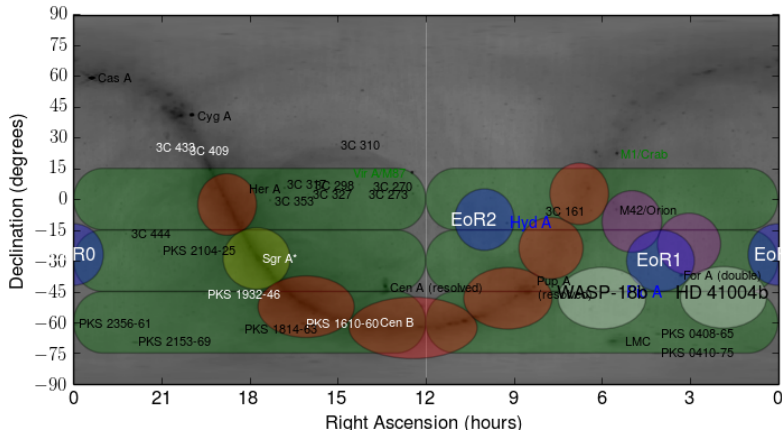
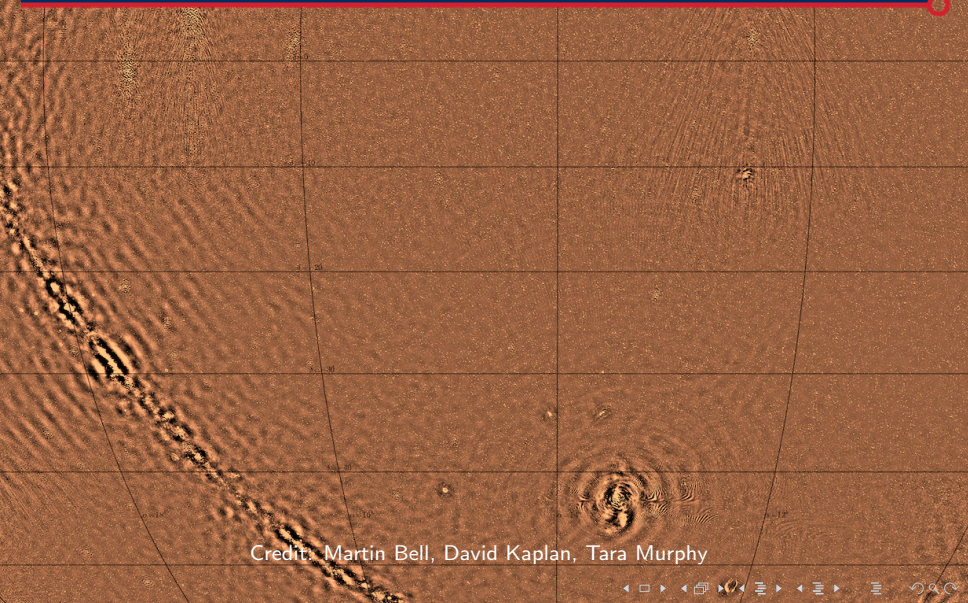


Image credit: David Kaplan



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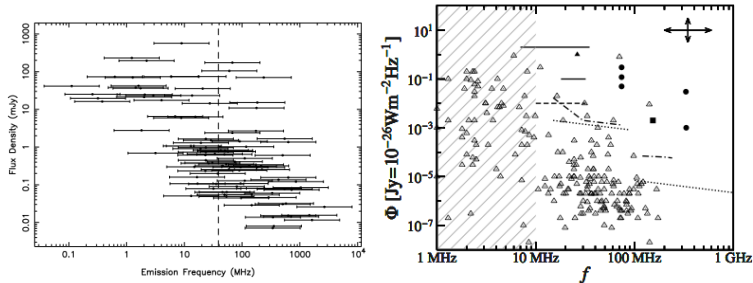
The MWA Transients Survey



Credit: Martin Bell, David Kaplan, Tara Murphy

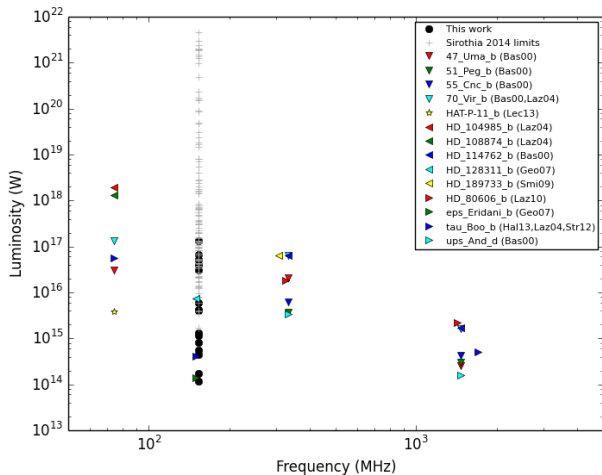


- ▶ Models predict $\mu\text{Jy} - \text{mJy}$ emission at MWA frequencies
- ▶ Emission is likely to be sporadic and bursty
- ▶ No radio detections to date



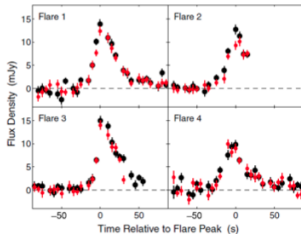
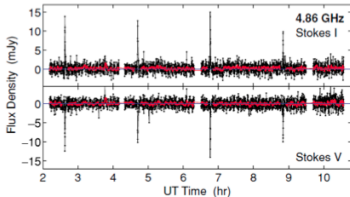
Lazio et al. 2004, ApJ, 612, 511

Greibmeier, Zarka & Spreew 2007, A&A, 475, 359





Results: Ultracool dwarf stars

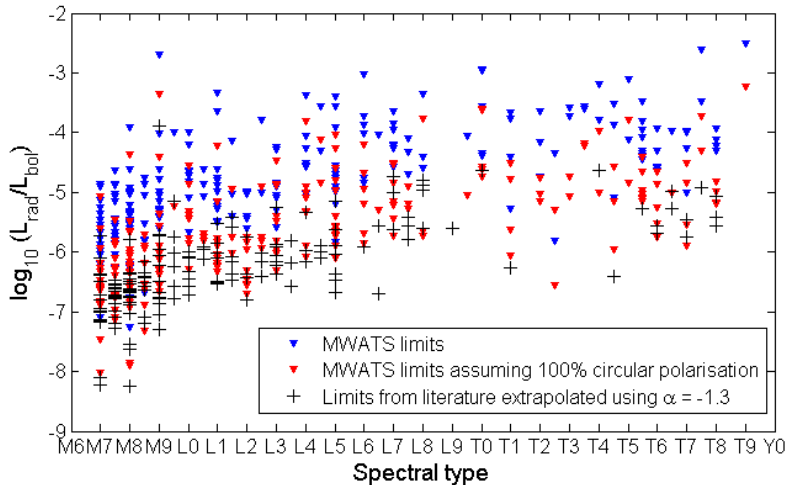


Light curves of 2MASSW J0746425+200032
Source: Berger et al. (2009)

- Discovery of **first radio-emitting UCD** by Berger et al. (2001)
- **Largest radio surveys** by McLean et al. (2012) and Antonova et al. (2013) at 4 and 8 GHz
- **Lowest-frequency** study by Jaeger et al. (2011) at 325 MHz
- **13 out of 181** studied systems possess detectable radio emission
- Two types of emission observed:
 - Quiescent
 - Flaring

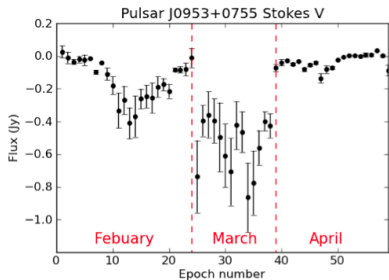
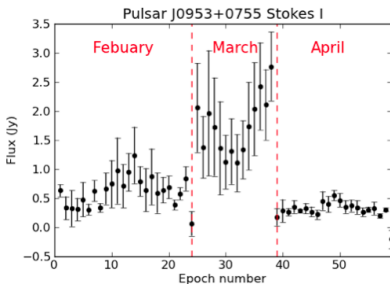


Results: Ultracool dwarf stars





- ▶ Search for emission from all known pulsars
- ▶ Blind survey for all circularly polarised sources
- ▶ Scintillation properties
- ▶ Giga-hertz peaked spectrum pulsars

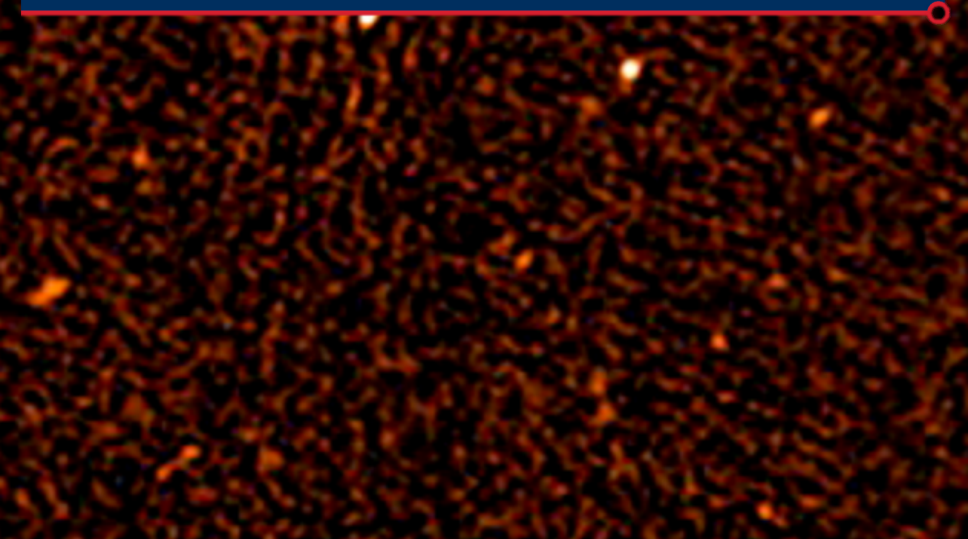


Martin Bell, Simon Johnston, David Kaplan, Tara Murphy, Andrew Zic, Dougal Dobie

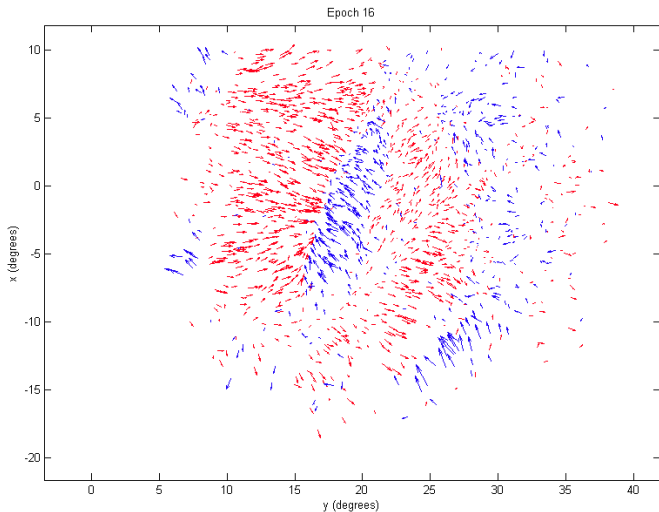


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Results: Ionospheric variability



Credit: Natasha Hurley-Walker



Loi, Murphy, Trott, Cairns, Hurley-Walker et al. in prep



- ▶ Circular polarisation survey
(Murphy, Bell)
- ▶ Full MWATS transients and variability survey
(Bell, Murphy)
- ▶ Full EoR transients and variability survey
(Hancock, Feng, Rowlinson)
- ▶ Galactic centre monitoring
(Miller-Jones, Kaplan)
- ▶ AGN variability
(Croft, Kaplan, Murphy)
- ▶ Low frequency scintillation
(Hancock)
- ▶ Targeted exoplanet observations
(Murphy, Kaplan)



- ▶ Confusion limited
→ longer baselines
- ▶ Higher resolution = better follow-up
→ longer baselines
- ▶ Limited sensitivity on short timescales
→ more tiles, increased sensitivity
- ▶ Lower frequency
→ emission from exoplanets more likely at lower frequency
(this is not important for our other science goals)



- ▶ Better instantaneous bandwidth to characterise sources
→ increase bandwidth/tile at the expense of number of tiles
(helpful in continuum surveys where we are not S/N limited)
- ▶ Sacrifice polarisation for more tiles used instantaneously
→ don't compute cross-polarisations in the correlator
(full polarisation is often not necessary)
- ▶ Limited cadence
→ would like daily/weekly observations
- ▶ Processing time is too long
→ need to improve/speed up imaging pipeline



- ▶ Transients and variability has been a productive area of research so far
- ▶ However we are just starting to reach interesting levels of sensitivity for many science goals
- ▶ Overall message: keep MWA operating!
- ▶ We are generally happy with the Phase 1 and Phase 2 plans
- ▶ Most important: longer baselines, more sensitivity
- ▶ Worth making wider connections with ionospheric community