

FAST RADIO BURSTS at the Molonglo Radio Telescope



CENTRE FOR ASTROPHYSICS AND SUPERCOMPUTING

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Fast Radio Bursts

Bright, millisecond-wide flashes observed in the radio spectrum, the origins of which are yet to be discovered



UTMOST

- UTMOST (Bailes et al. 2017) is the ongoing project that is transforming the Molonglo Observatory Synthesis **Telescope** into an FRB finding machine One of the global leaders in FRB science, achieved the first detection of FRBs with an array (Caleb et al. 2017) The Molonglo telescope operates with 30 MHz frequency range centered at 835 MHz
- 8 square degrees field of view, ideal for FRB searches

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- Likely to be of extra-galactic or even **cosmological** origin
- More proposed theories to explain their origins than FRB detections
- Promising probes of the intergalactic baryons and intergalactic magnetic field



the Parkes Radio Telescope. (Lorimer et al. 2007)

Localisation to host galaxies is a major current goal

Real-time Detection Pipeline

- Real-time searching is **GPU**-accelerated
- Harsh interference environment on site, meant thousands of candidates had to be analysed by eye
- Pipeline extended by machine-learning algorithm, based on Random Forest
- Pipeline has discovered 3 new FRBs, observers were notified via email within only a few seconds





FRB170827

- Real-time discovery enabled detailed study of the FRB's temporal profile and frequency structure
- Width of only **400 µs**
- Temporal features as narrow as **30 µs**
- 2 spectral modulation scales:
 - One caused by the Milky Way ISM

20 Signal to Noise Farah et al. 2018a

Milky Way

Screen #1: ISM

Screen #2: IGM? Screen #2: FRB Vicinity?

FRB170827 source

The other might be caused by IGM or even the **immediate vicinity** of the FRB source • FRB field was followed up by SkyMapper, **ASKAP*** and the **Parkes** radio telescope, with no signs of counterparts or repetition

FRB170922

This FRB is the 5th of the Molonglo FRBs. It exhibits large scattering, evident as an exponential tail (figure on right). Scattering is an effect experienced by radio signals traversing turbulent media. FRB170922 is the most scattered FRB discovered to date.



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Farah et al. 2017

FRB180528

Discovered recently, the burst is ~2 ms wide, typical for FRBs. Its dispersion measure implies that the source might be located at a redshift of 0.8. This FRB was discovered in real time, and hence the native time and frequency resolution data/

Host Galaxy

Farah et al. 2018

product of the telescope was saved.

References:

Scan this QR code for link to ADS library S. 10

Bailes M. et al., 2017, Publications of the Astronomical Society of Australia, 34, e045 Caleb M. et al., 2016, Monthly Notices of the Royal Astronomical Society, 458, 718 Farah W. et al., 2017, Astronomer's Telegram, 10867 Farah W. et al., 2018a, Monthly Notices of the Royal Astronomical Society, 478, 1209 Farah W. et al., 2018b, Astronomer's Telegram, 11675 Lorimer D. R. et al., 2007, *Science*, 318, 777

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* Australian Square Kilometer Array Pathfinder

Background image







