ICRAR

International Centre for Radio Astronomy Research

Fast Transients science in Australia

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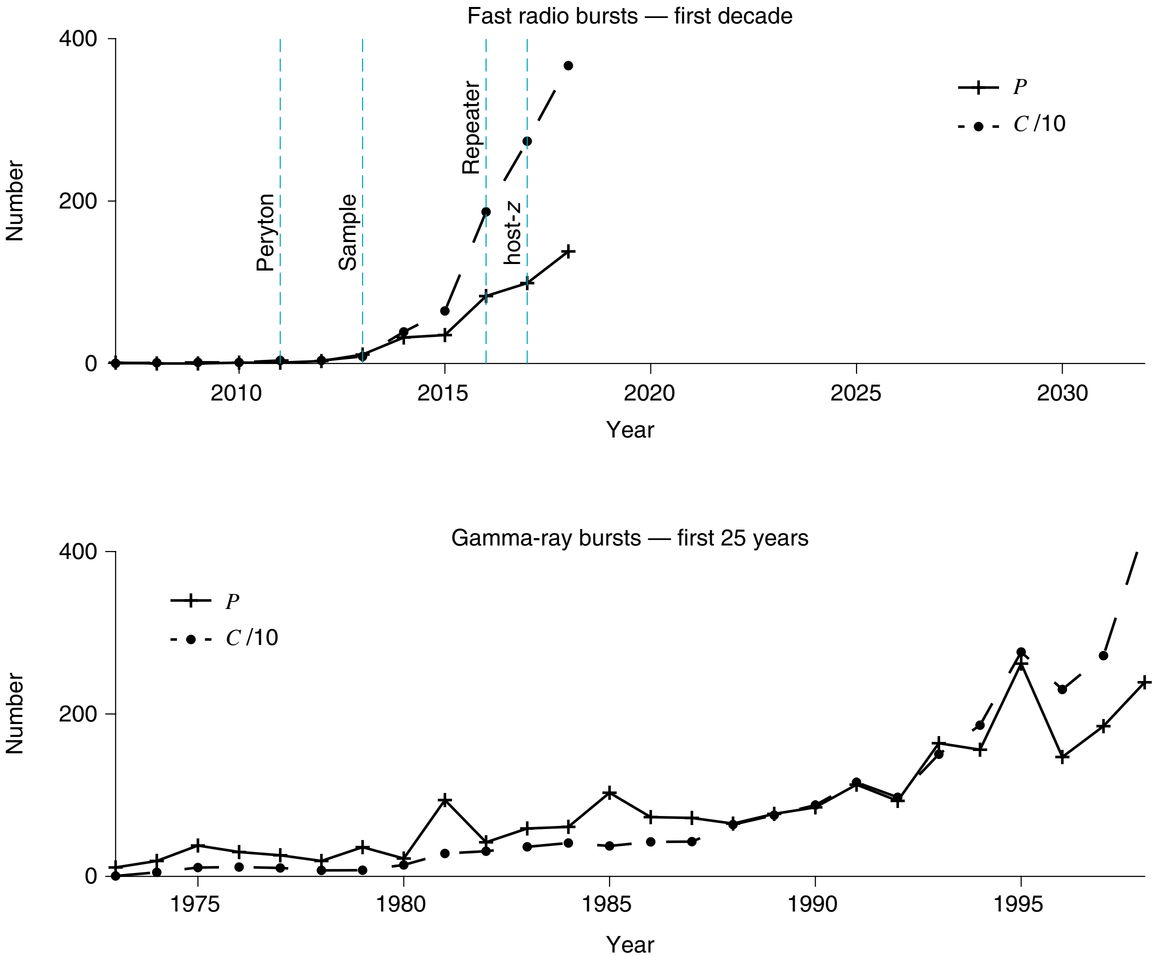
Achieve International Excellence

FRB research: engagement & impact

FRB publications (P) and citations (C) wildly outperforming GRBs

Kulkarni 2018



Combines the interest of five disparate communities:

i) **Radio** Pulsar and scintillation community
ii) **Optical** community for host IDs
iii) Stellar evolution: what are the progenitors of FRBs?
iv) Cosmology:
   1. “missing” baryons,
   2. baryonic feedback,
   3. gravitational microlensing by dark matter (due to extremely short timescale)
v) Theory – how is their outrageously luminous emission generated?

Instrumentation — ASKAP

36x 12m dishes each equipped with a 30 sq.deg. field of view phased array feed (PAF)

Baselines up to 6km

Can operate in an
— ultra widefield fly’s-eye non-localisation mode
— 30 sq.deg. interferometric mode + 3.2 second voltage buffer
    — localisations good to 0.1-0.2”
    — search mode is **incoherent** with ~1ms, 1 MHz resolution

Instrumentation — Parkes

The workhorse of Australian pulsar and fast transients astronomy

>6x the sensitivity of incoherent ASKAP
64 microsecond searches

CryoPAF upgrade planned will enable filled focal plane searches

Instrumentation — UTMOST-2D

Upgrade of the existing Molonglo telescope @ 843 MHz

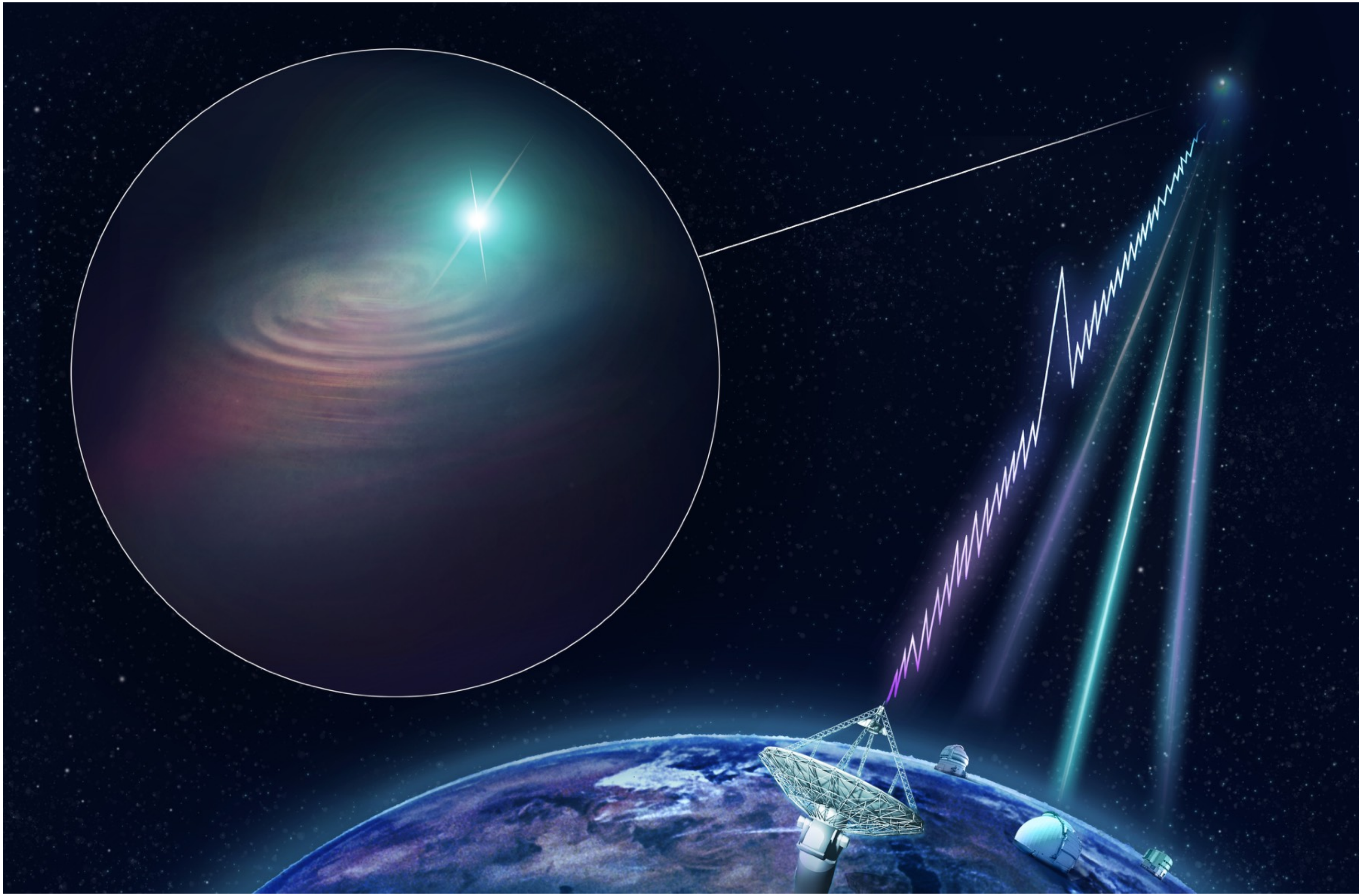
Addition of N-S baselines to the existing E-W arm will give a 60”x45” synthesised beam

Estimated median position errors 1.5” (RA), 3” (dec)

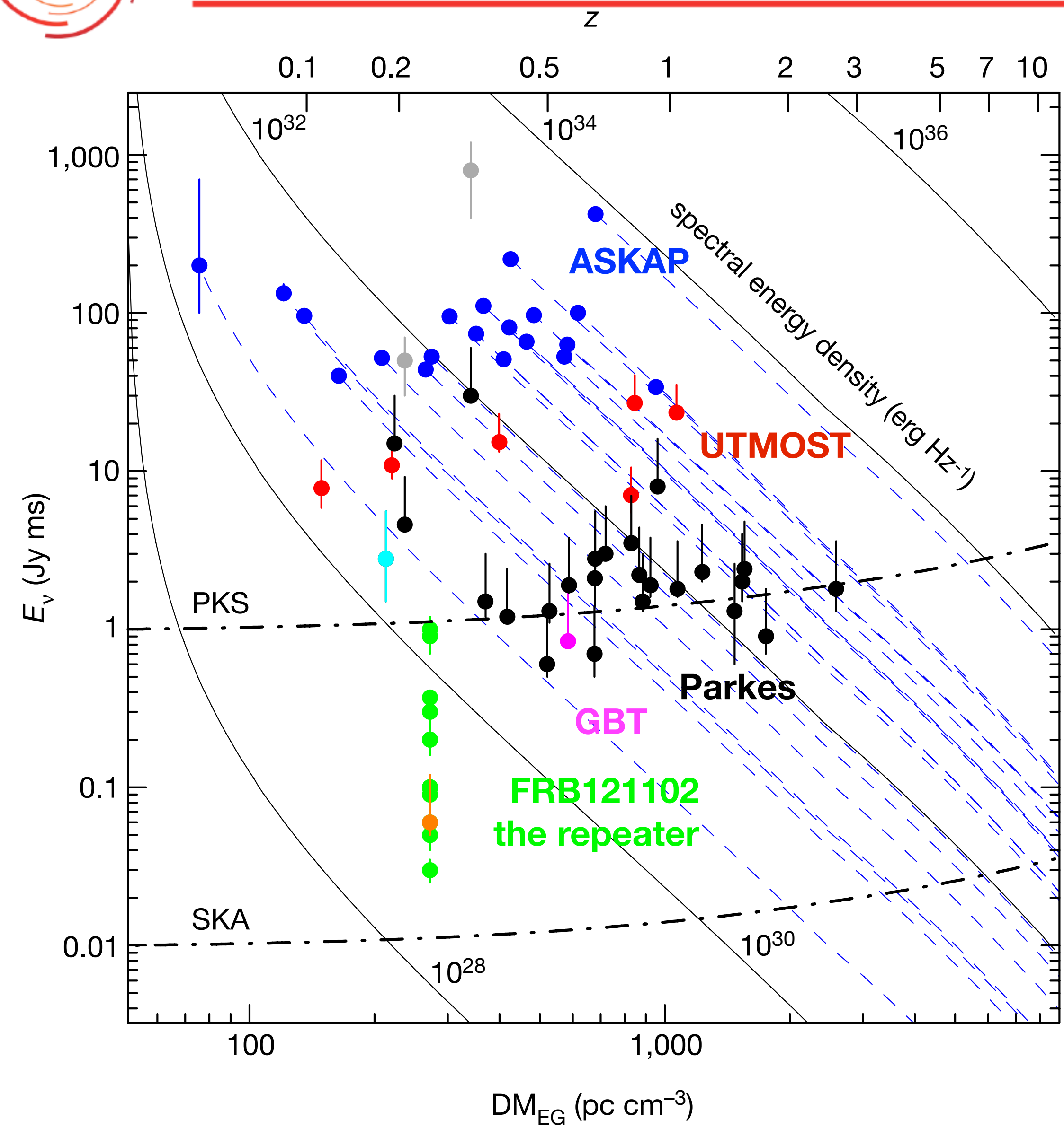
z=0.321

VLT/FORS2 g’-band

Recent FRB results



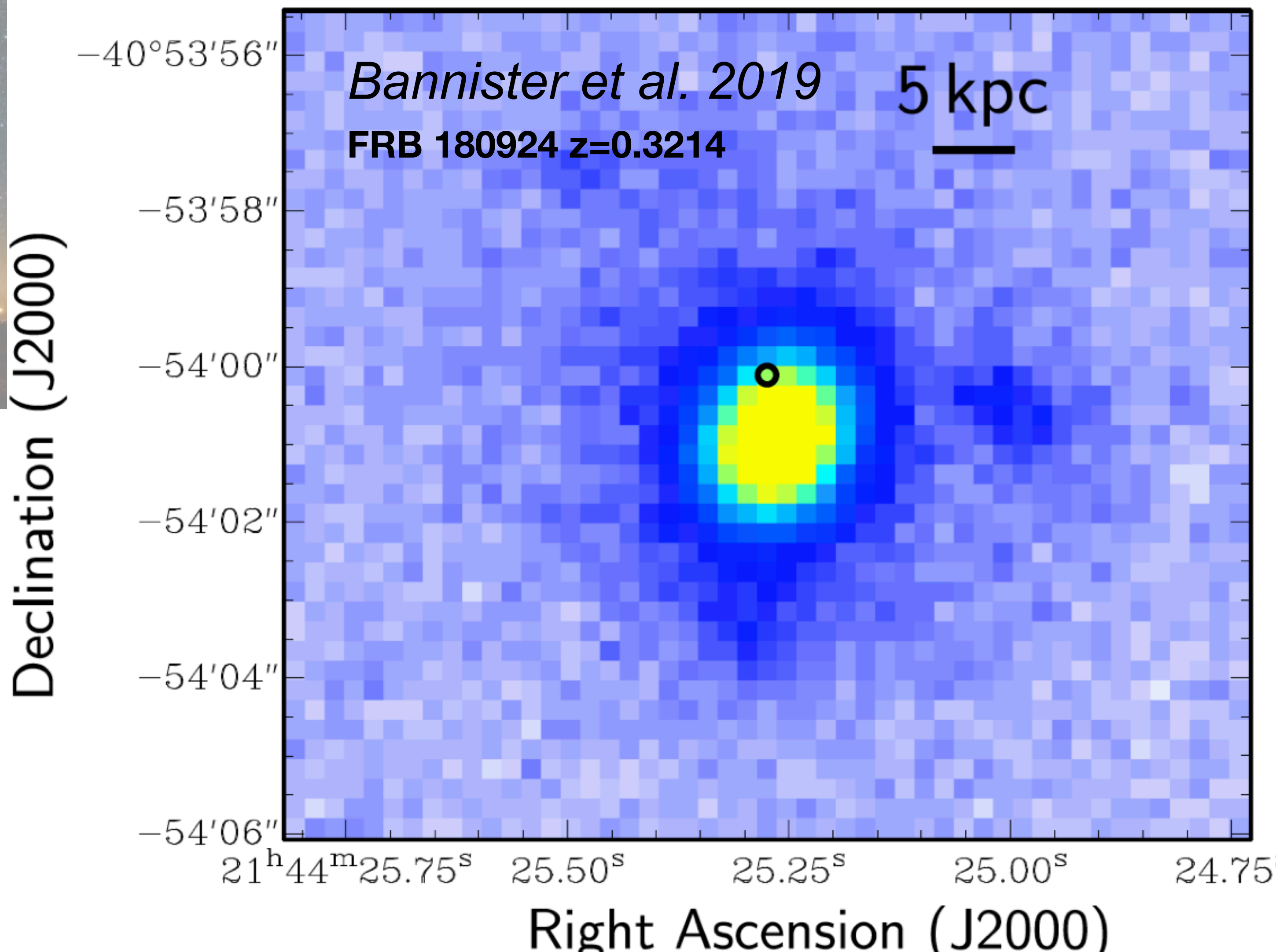
The FRB landscape



ASKAP population statistics confirm both that there is both a correlation between DM and fluence, and that DM can be used as a proxy for distance.

Shannon et al., Nature 2018

Location, Location, Location

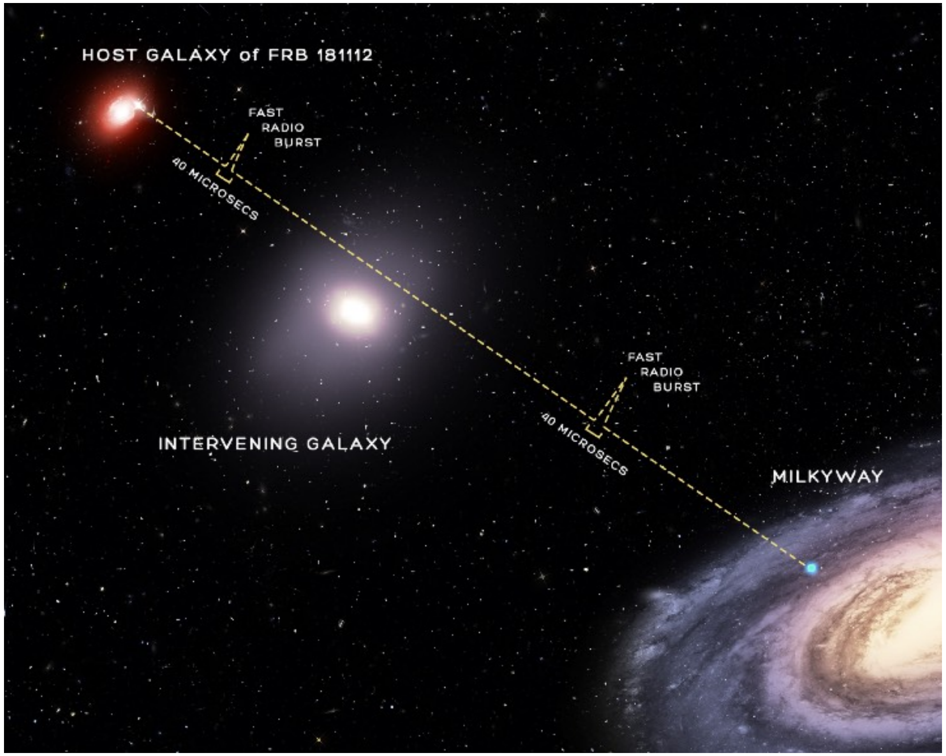


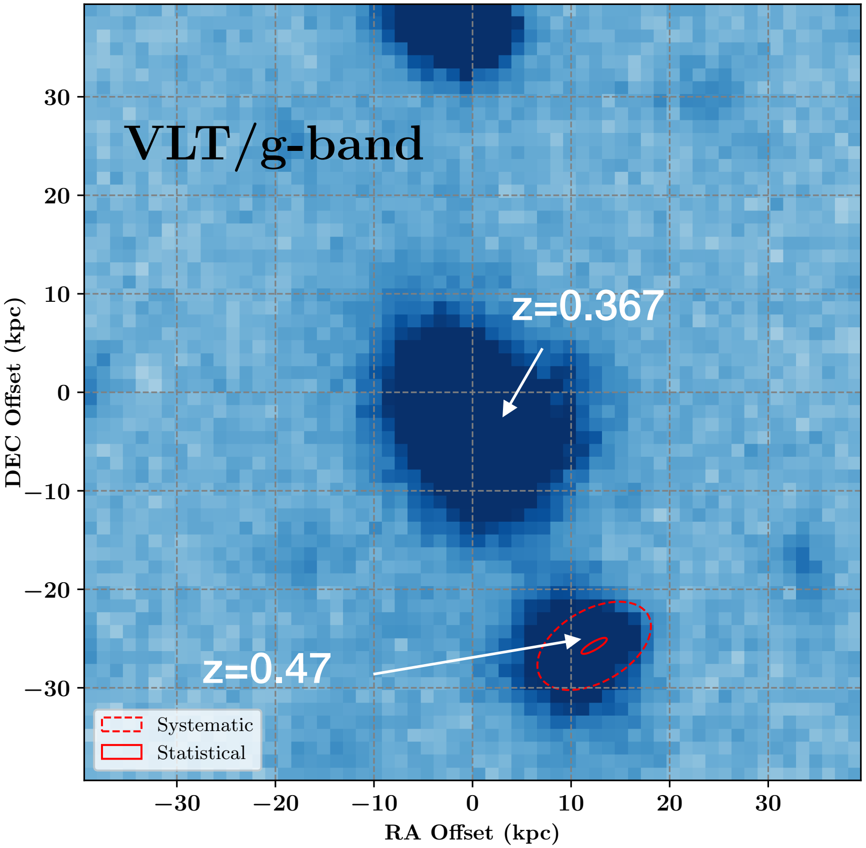
Halo! What halo?

Using FRBs as astrophysical tools

Prochaska, Macquart et al.
Science, 2019

FRB 181112

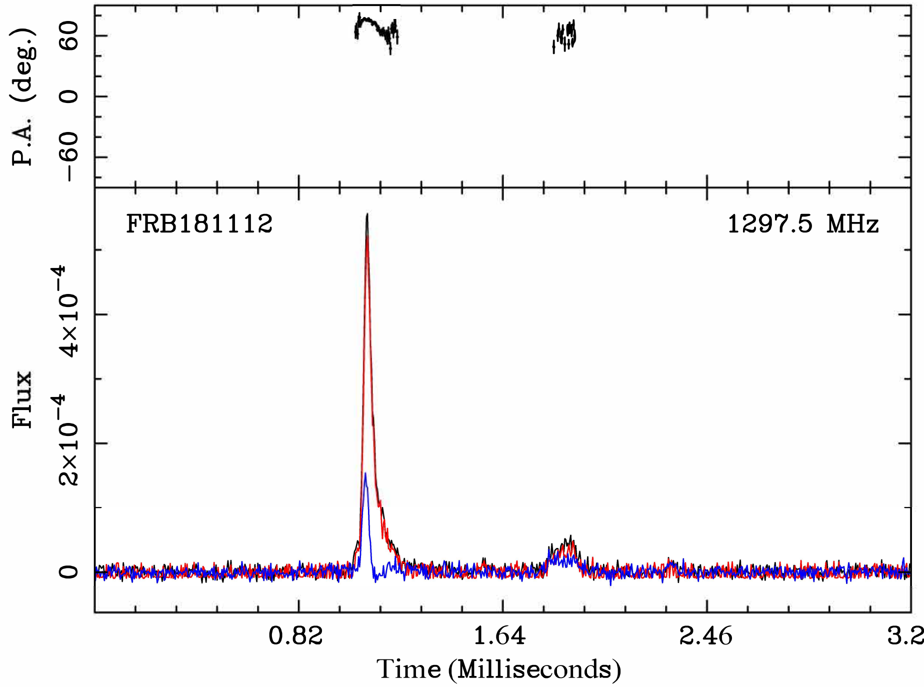




The next 3-5 years

- ASKAP's phased array feeds and localisation capabilities are a game-changer
    - Opportunity to clean up a number of front-line cosmology problems
        - Solve baryonic feedback
        - Probe He EoR (maybe H EoR)
        - Solve the riddle of FRB emission using ultra-high time resolution data
- Coherent upgrade to ASKAP would increase detection rate by a factor >20
- Parkes PAF – explore the fainter FRB population

FRB 181112 at 3 ns time resolution



A coherent ASKAP would dominate FRB science

Telescope & Mode	FoV (deg^2)	1 ms 10-σ sensitivity (mJy)	Relative Detection rate
	~ 1 GHz with $\sim 1''$ localisation		
ASKAP-8 ICS	30	8626	1.1
ASKAP-36 ICS	30	4066	5.4
ASKAP-30 Coherent	**30**	**813**	**58.7**
DSA-110 Coherent	9	853	16.8
MeerKAT Coherent	0.32	46	11.1
VLA	0.283	224	2.0
	~ 1 GHz with $> 40''$ localisation		
ASKAP-8 Flyseye	**240**	**24398**	**1.0**
ASKAP-36 Flyseye	1080	24398	4.5
CHIME	134	405	526.8
MeerKAT Flyseye	40.96	2936	14.6
PARKES	0.559	436	2.0

Table 1: A comparison of the relative detection rates of the various facilities. The detection rate, referenced to the ASKAP-8 fly's eye mode, is based on the measured integral source counts slope of $N(>F_\nu) \propto F_\nu^{-2.1}$ down to a fluence of 2 Jy ms (see C. W. James et al. MNRAS, submitted) and a slope $N(>F_\nu) \propto F_\nu^{-1}$ for $F_\nu < 2$ Jy ms. This shallow slope is implied by the observed Arecibo detection rate.