

Fast radio bursts

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CSIRO/ATNF



Dynamic Universe



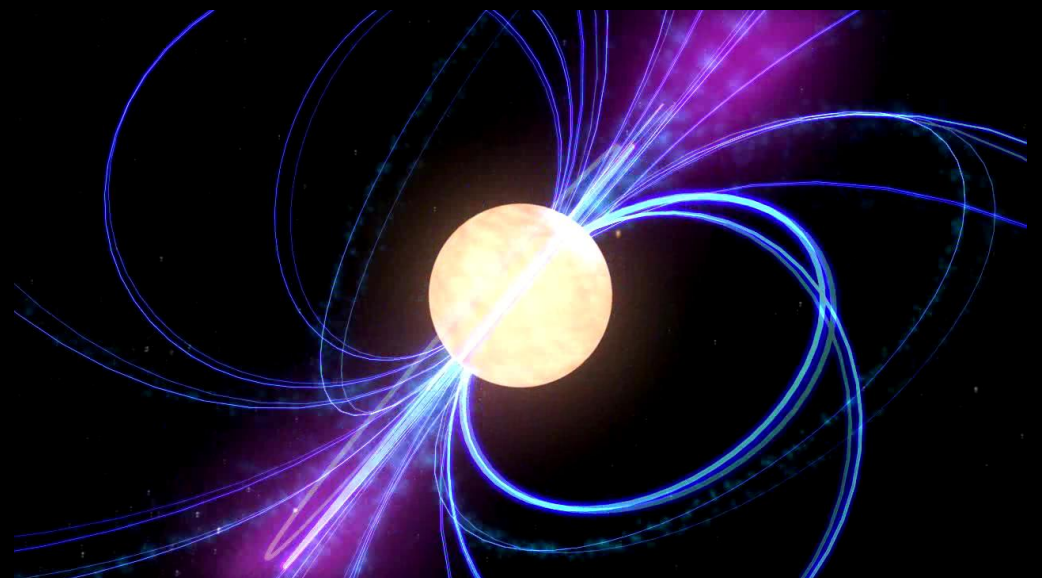
Supernova



Fast radio bursts



Pulsars



FRBs are intensely energetic events that flare for just milliseconds,
seemingly all over the sky and from outside the galaxy.
-ScientificAmerican

Fast radio bursts from space are a uniquely 21st-century mystery.
-Cnet

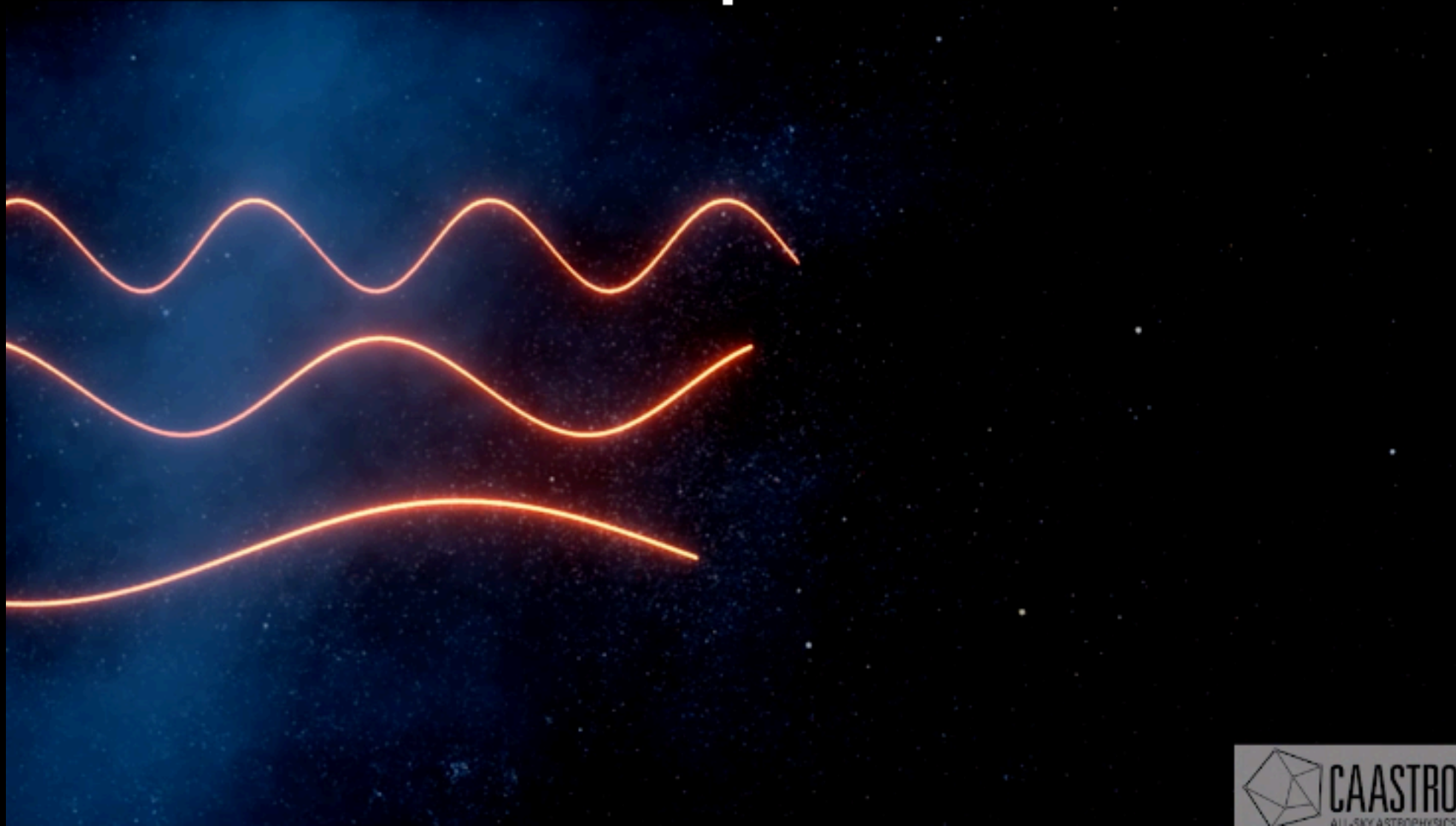
What are Fast Radio Bursts?

Fast radio bursts are fast and hard to catch.
-SciencAlert

Fast radio bursts (FRBs) are among the most enigmatic and
powerful events in the cosmos.
-DailyGalaxy

They could be natural. They could be ET (or several ETs) phoning home
or swiping right on some intergalactic Tinder app using a
not-so-local area network (INSLAN).
-eejournal

Dispersion Measure (DM)



$$t_2 - t_1 = 4.15 \text{ ms } \mathbf{DM} [(\nu_1 / \text{GHz})^{-2} - (\nu_2 / \text{GHz})^{-2}]$$

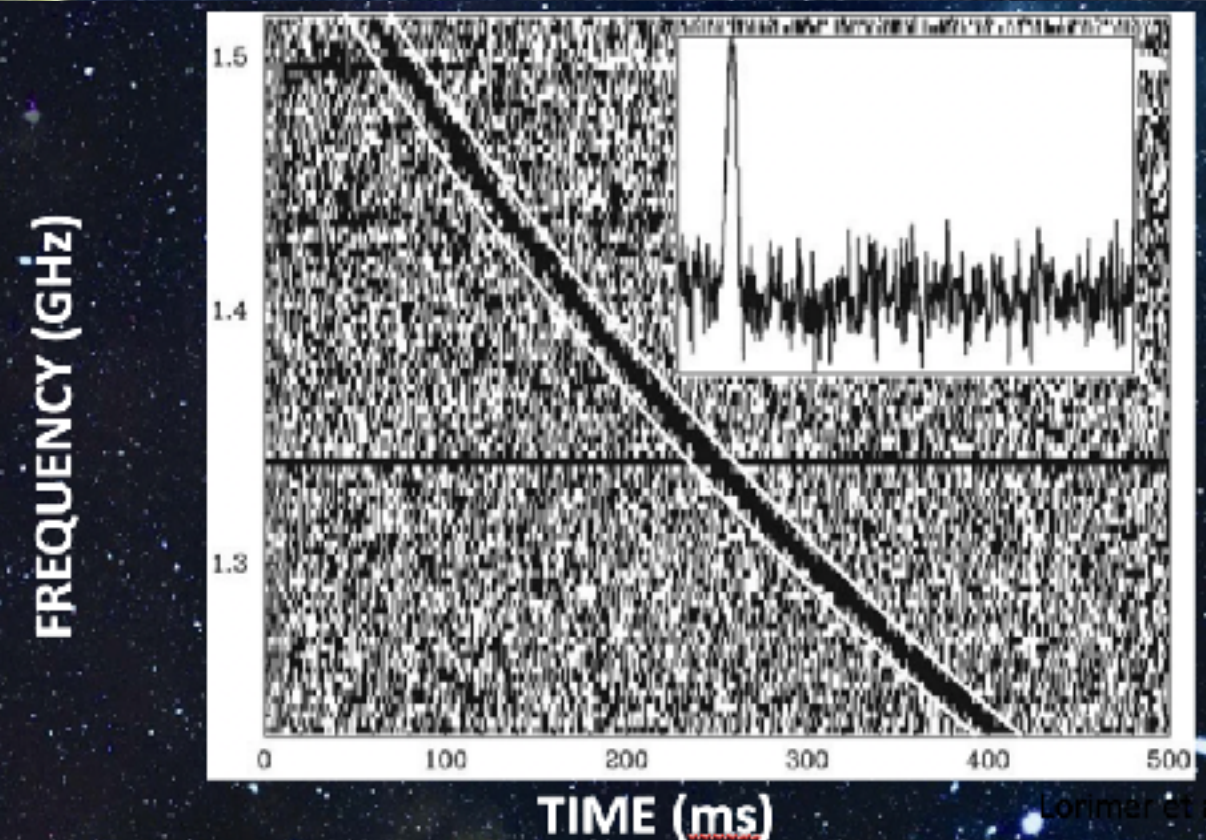
$$\mathcal{DM} \equiv \int_0^d n_e dl$$



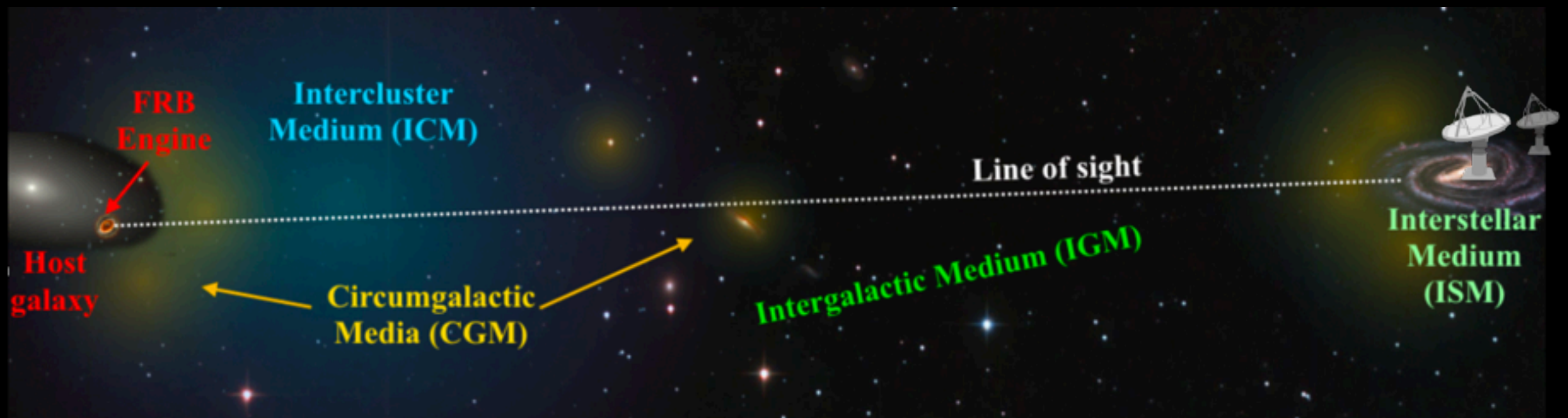
Fast Radio Bursts (FRBs)

- Bright energetic explosions
- Last for couple of milliseconds
- Dispersion measure > what we expect from our Galaxy

The Lorimer Burst (Lorimer+07)



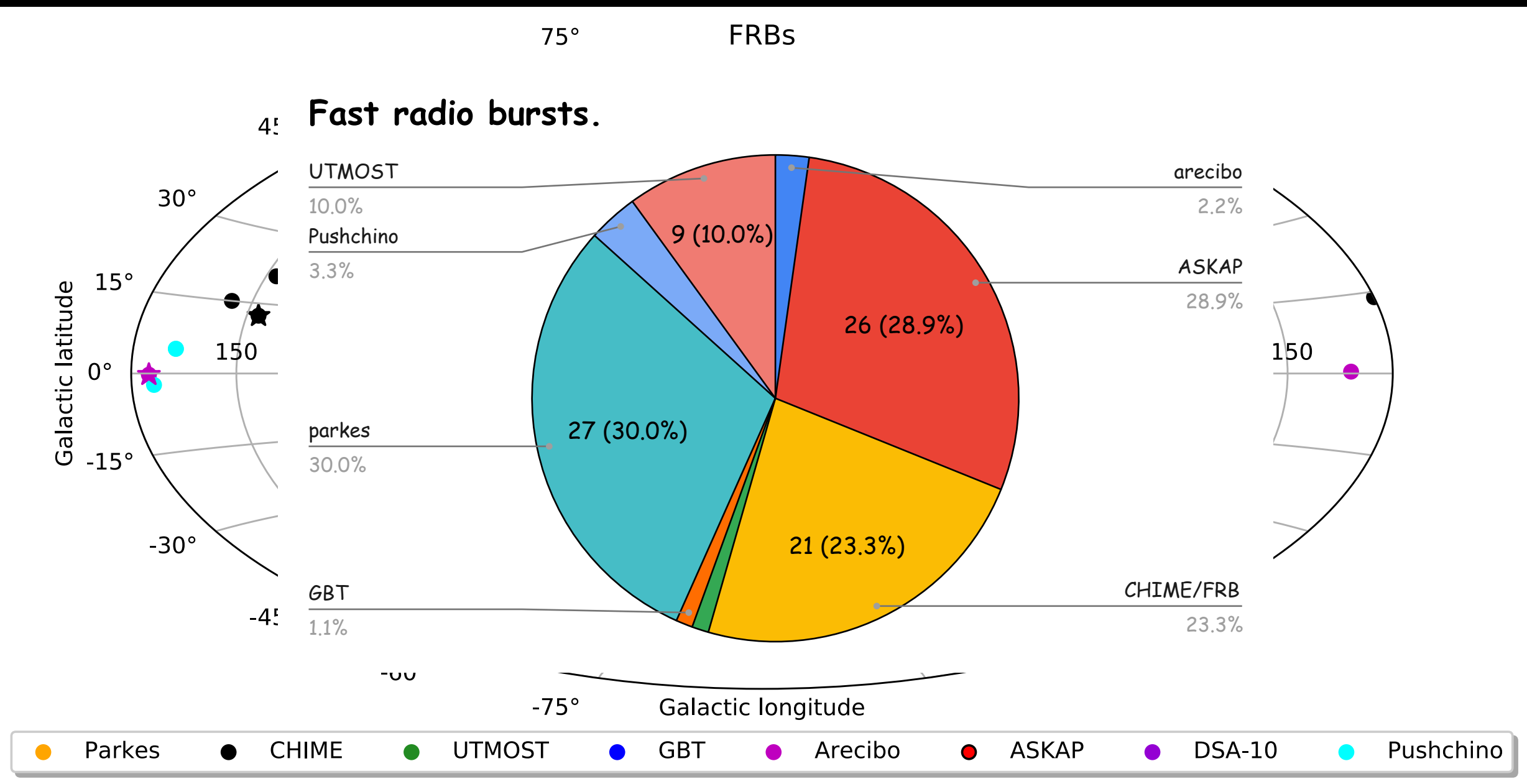
Journey through the Universe



Ravi+19

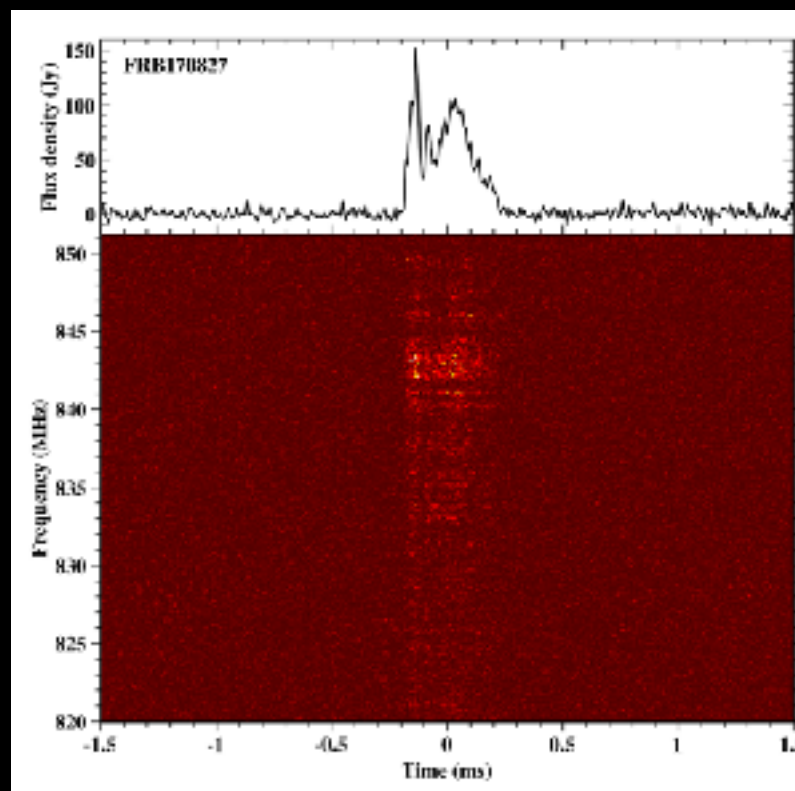
Excess DM thought to come from intergalactic space between the galaxies

How many FRBs?

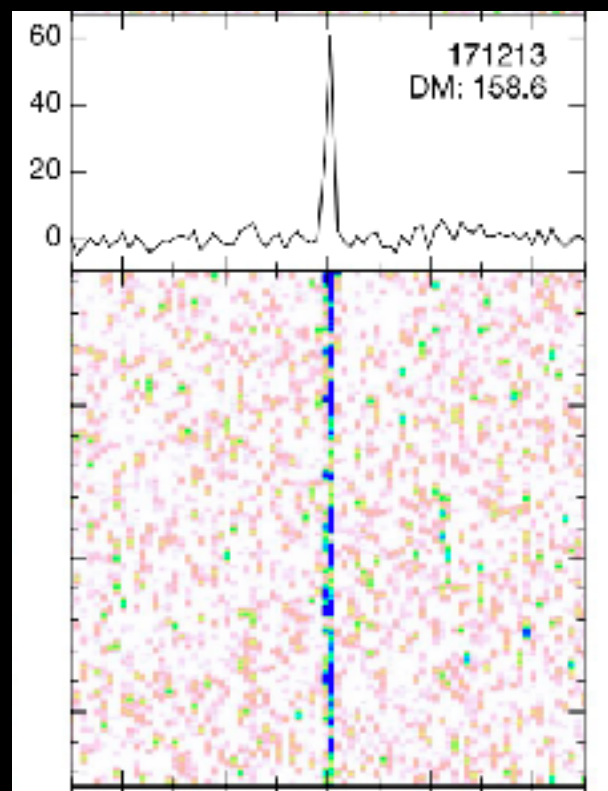


90 FRBs (published)

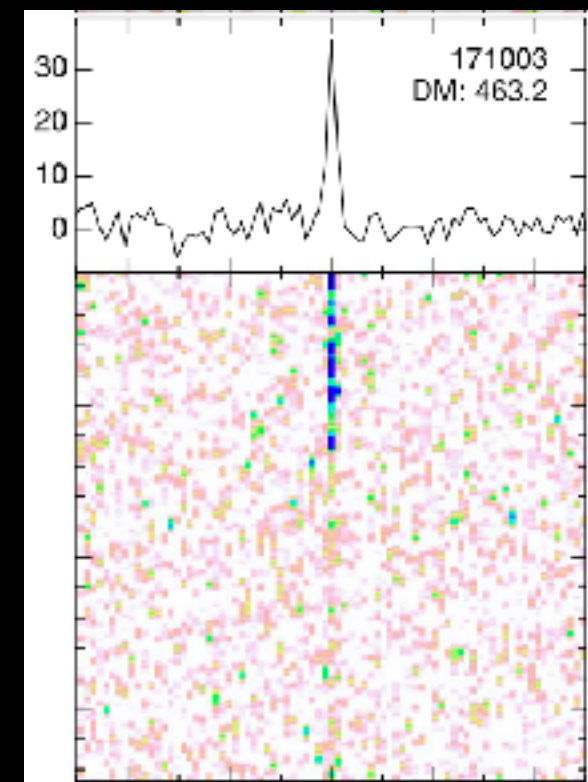
FRBCatalog
(Petroff+16)



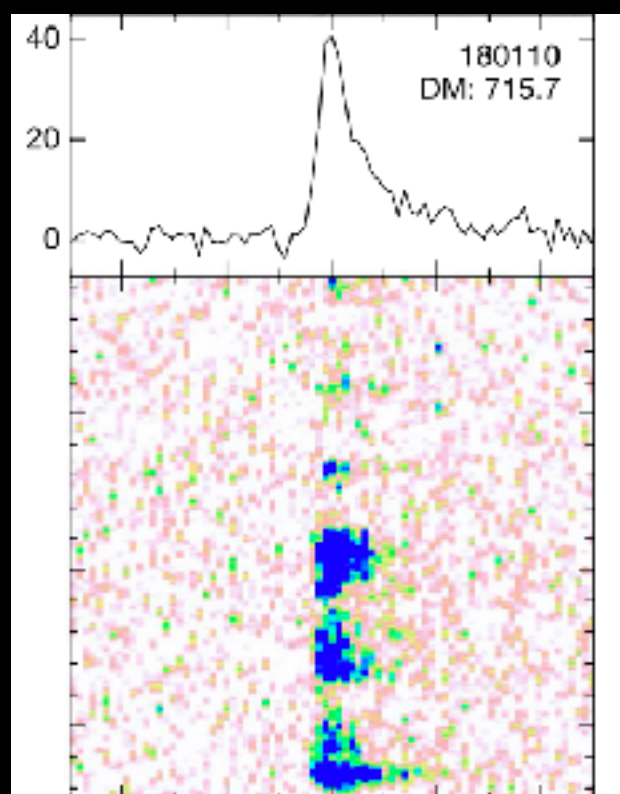
Multiple peaks



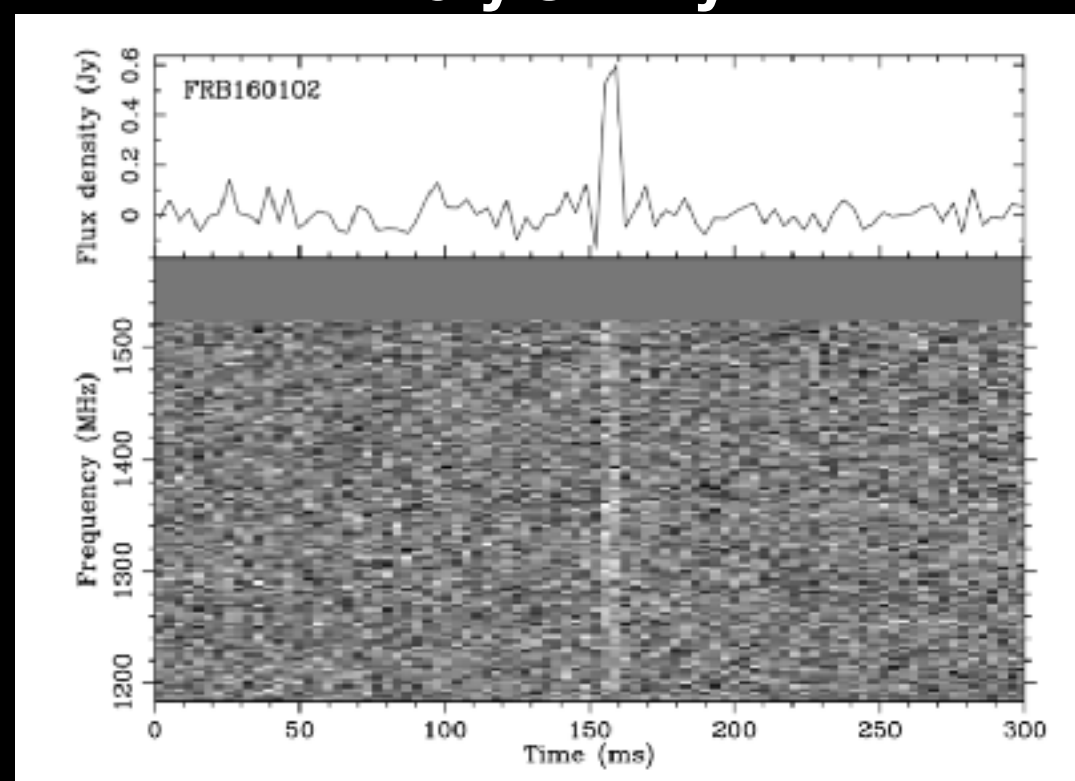
Very skinny



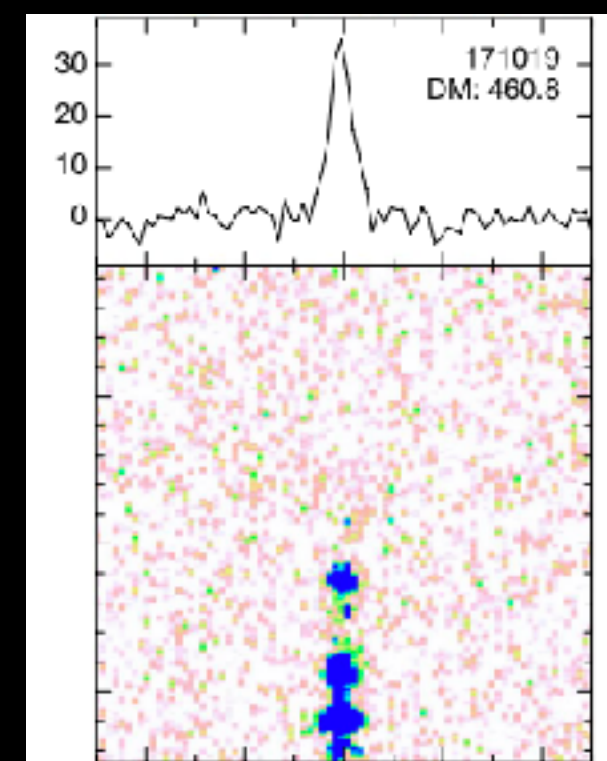
Sub-band emission



Highly scattered



**High DM ~ 2600 pc/cc
Brightness ~ 2 Jy ms**



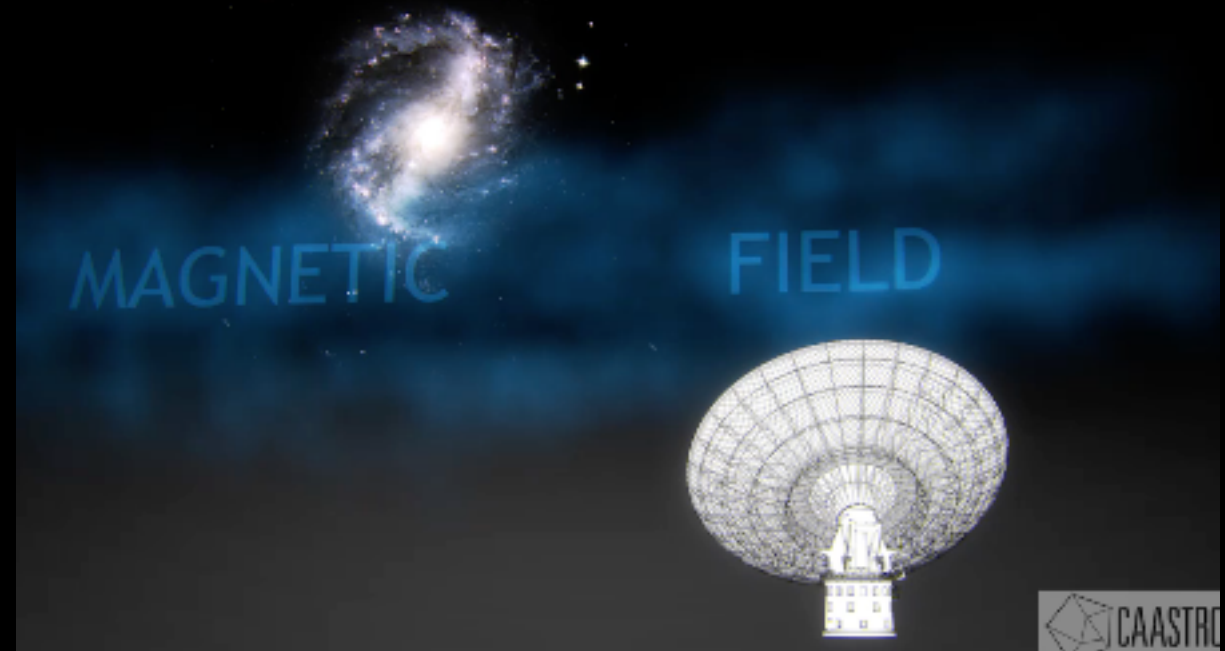
Bright ~200 Jy ms

Cosmic Applications

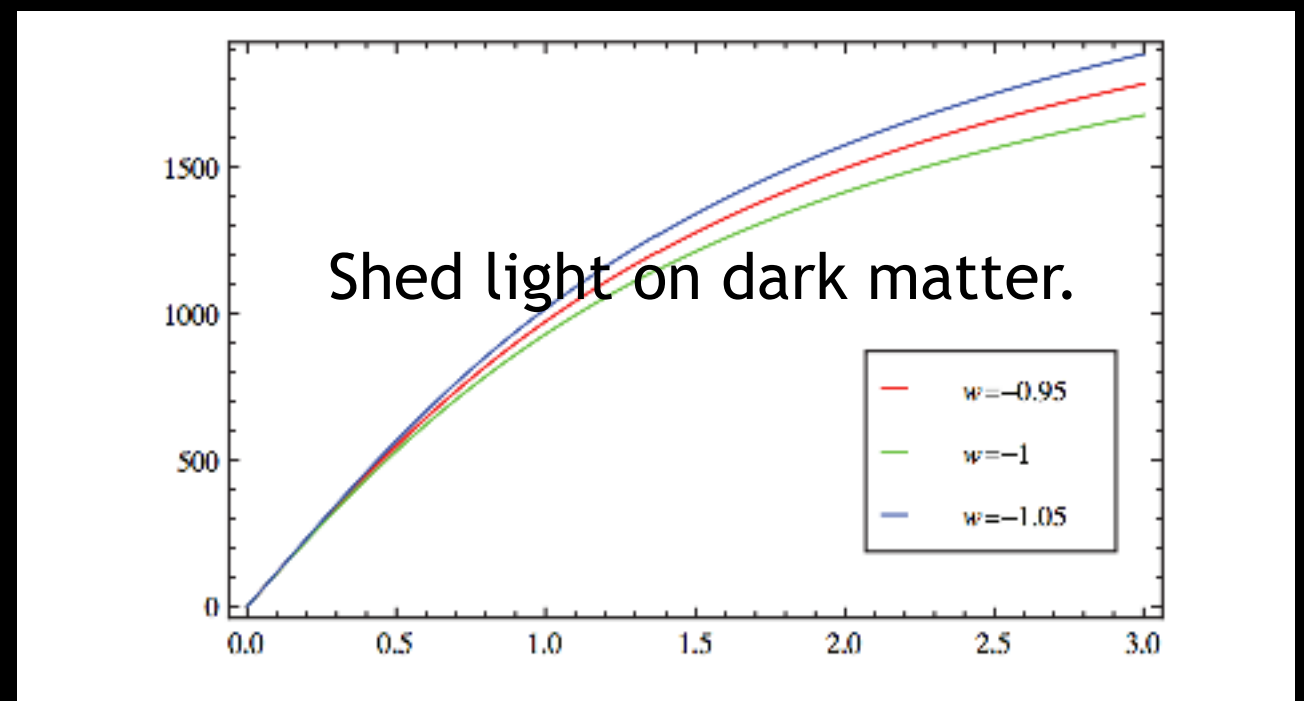
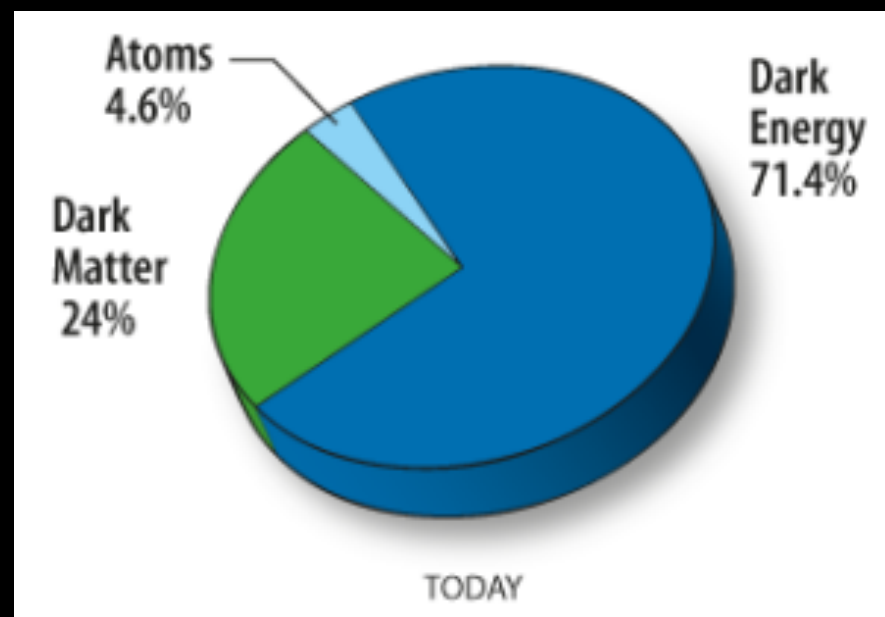
Macquart et al. 2015



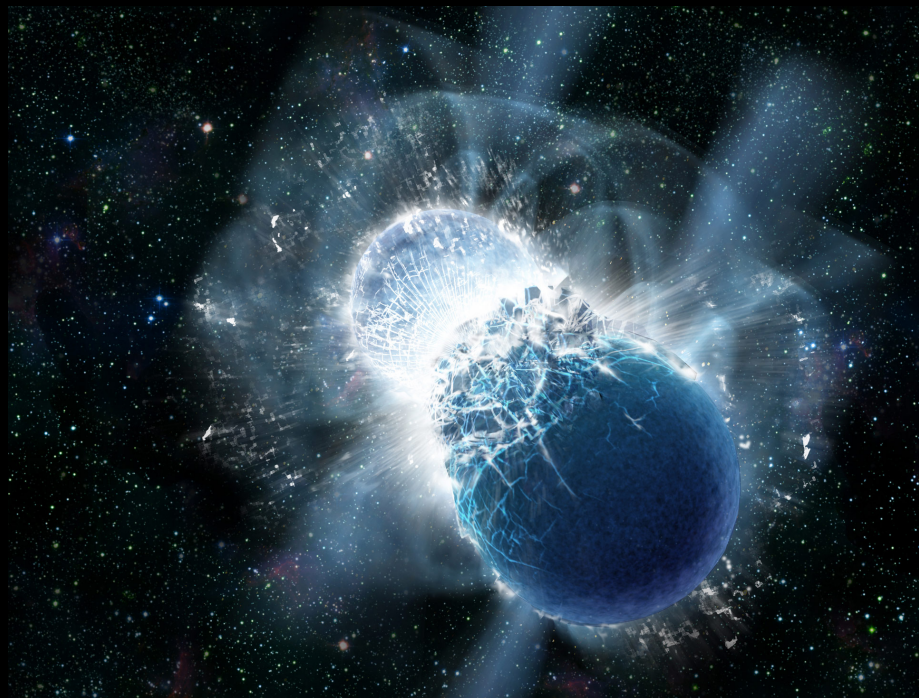
Credits: Illustris



First measurements of
extragalactic magnetic fields



What produces an FRB?

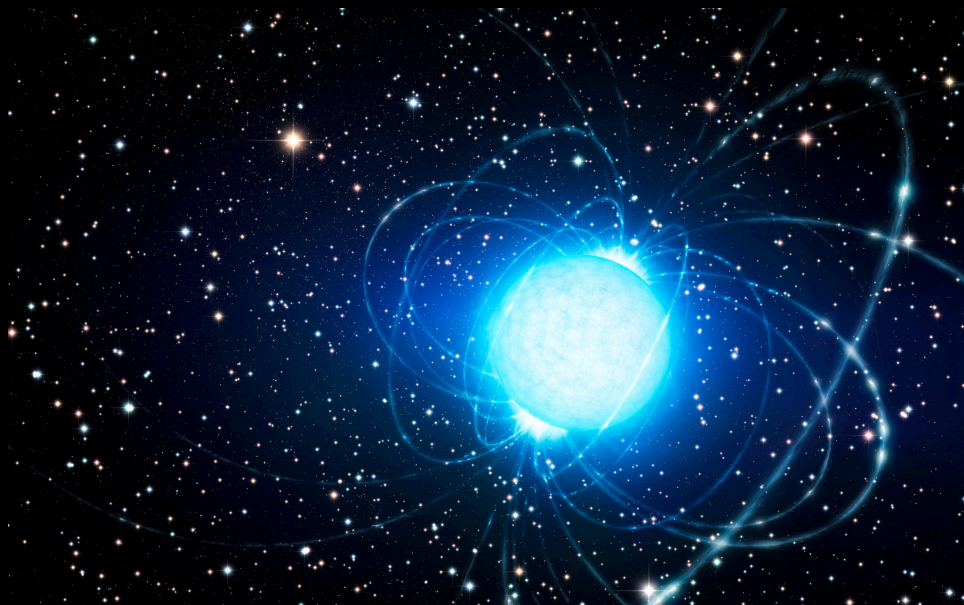


Merging compact objects

?



Exploding stars

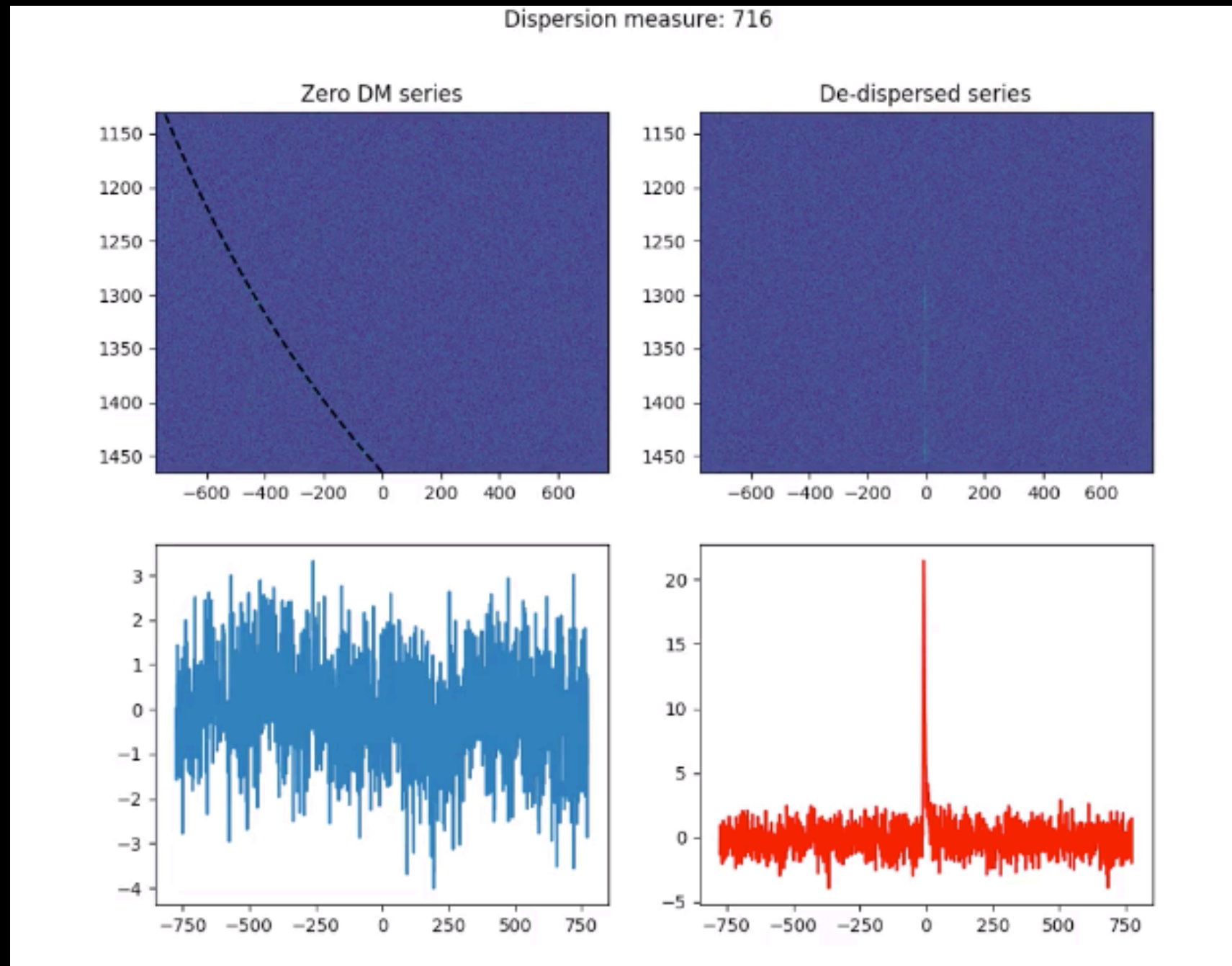


Exotic neutron stars



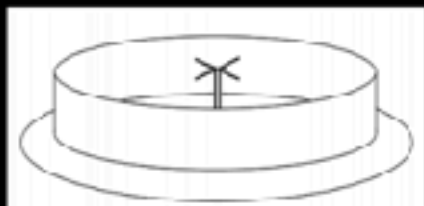
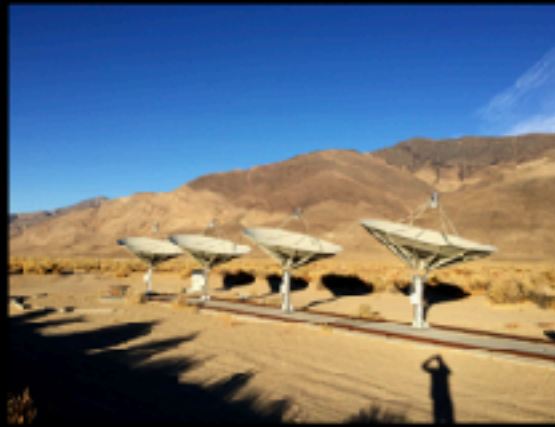
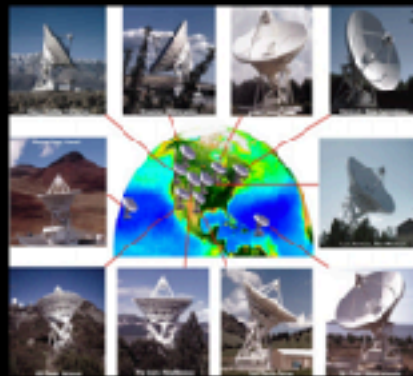
Flaring objects

How to search for an FRB?



$$t_2 - t_1 = 4.15 \text{ ms } \mathbf{DM} [(\nu_1 / \text{GHz})^{-2} - (\nu_2 / \text{GHz})^{-2}]$$

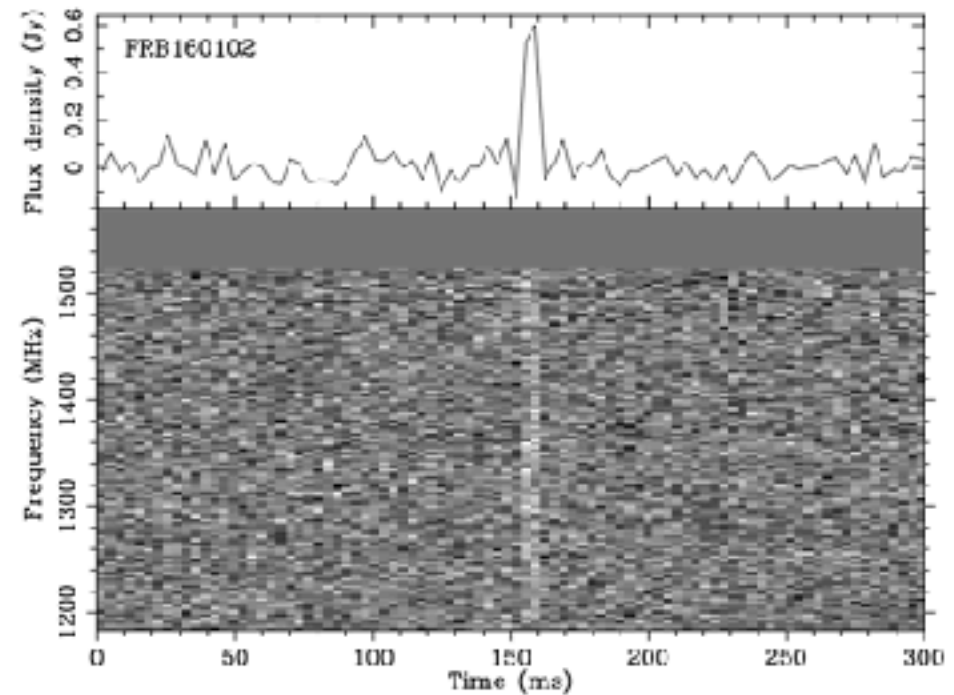
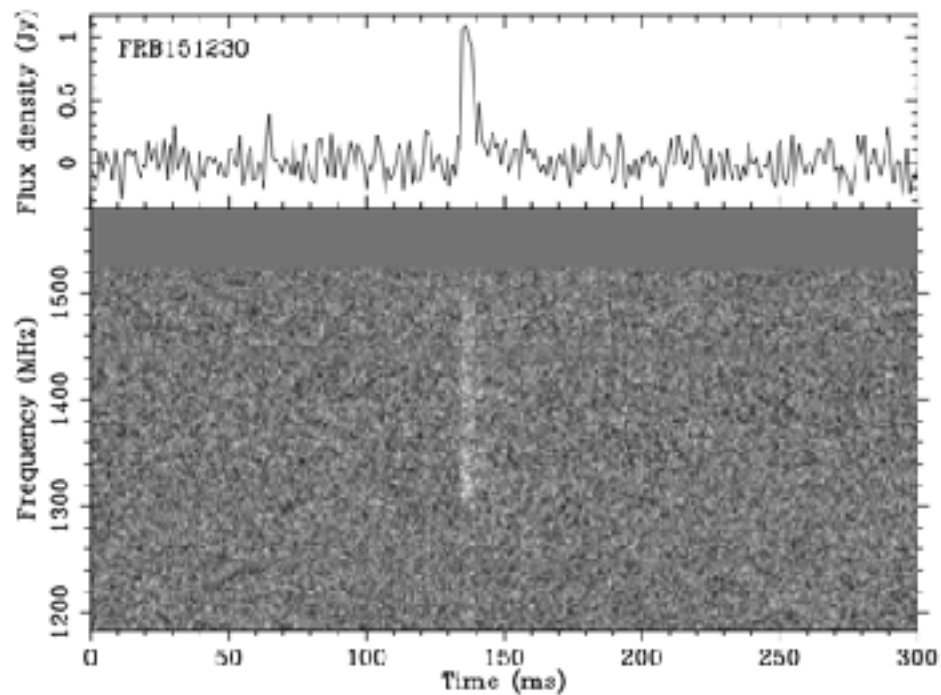
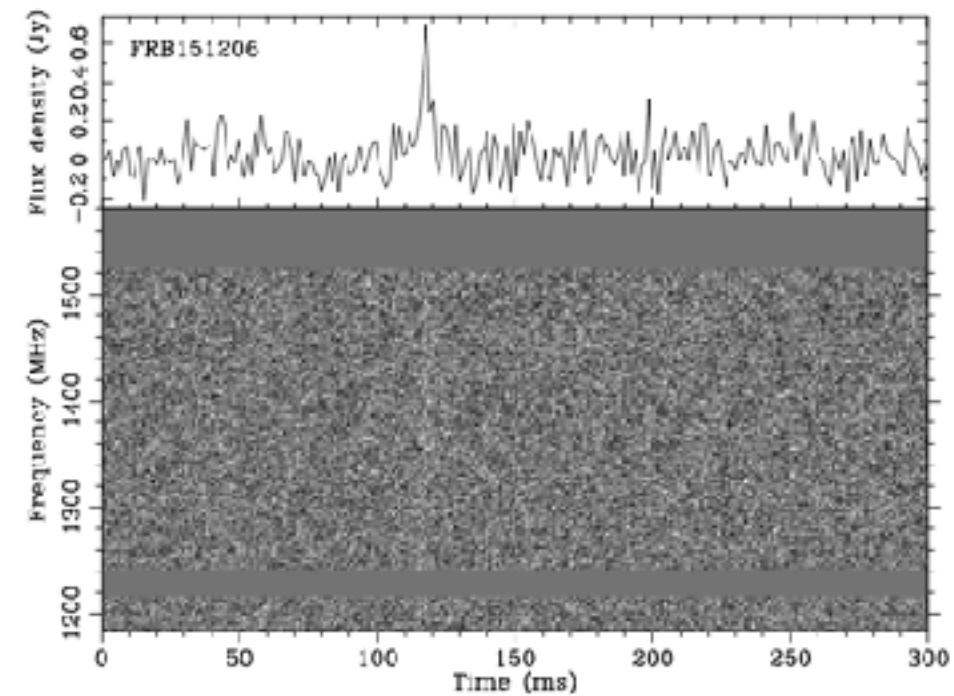
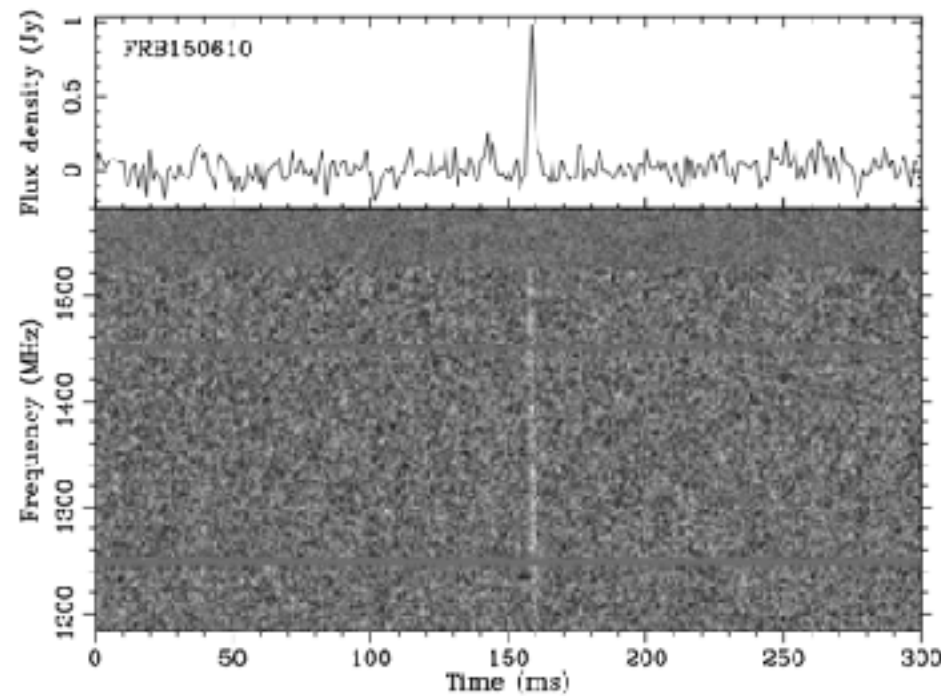
The hunt is ON!





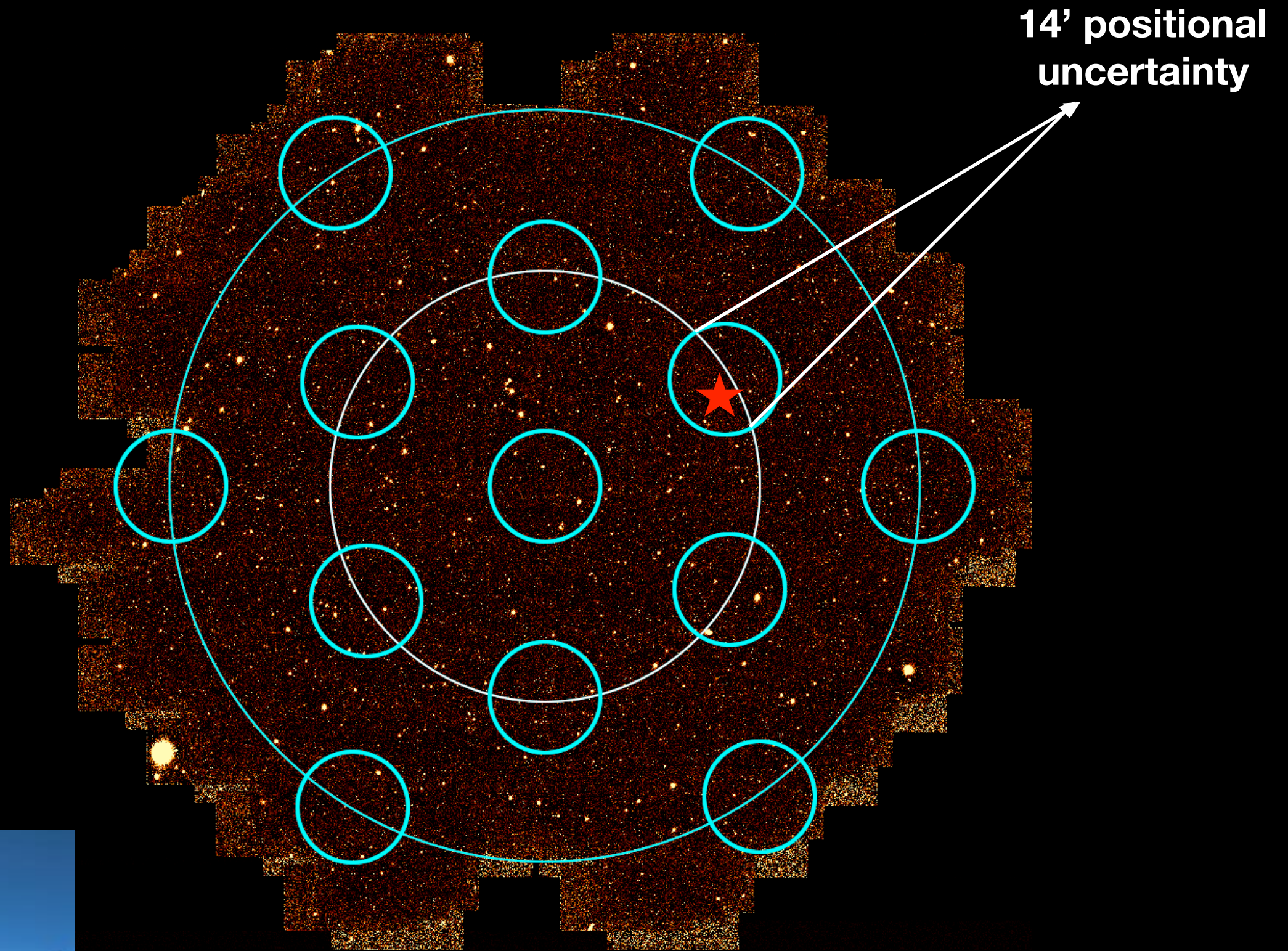
FRBs with Parkes

Bhandari+18



27 FRBs detected with Parkes to date

Localisation with Parkes



Parkes beam overlaid on DECAM image.

Credits: Igor Andreoni

FRBs with the Australian SKA Pathfinder (ASKAP)

33 FRBs detected with ASKAP to date

CRAFT



Find an FRB real-time

Localise using interferometry

Do amazing Science

CRAFT candidates APP Sep 25th at 2:20 AM
Real time ICS FRB closepack36

SBID 66035	alias CRAFT/lat50/south
Scan ID 20180924155217	Capture ID C001
Antenna 01,02,03,04,05,06,08,10,11,12,13,14,15,16,18,25,26,27,28,30,31,32,33,34	Beam 18
S/N 21.08	Latency (ms) 280.54
DM 361.53 (200 KB) ▶	width 2

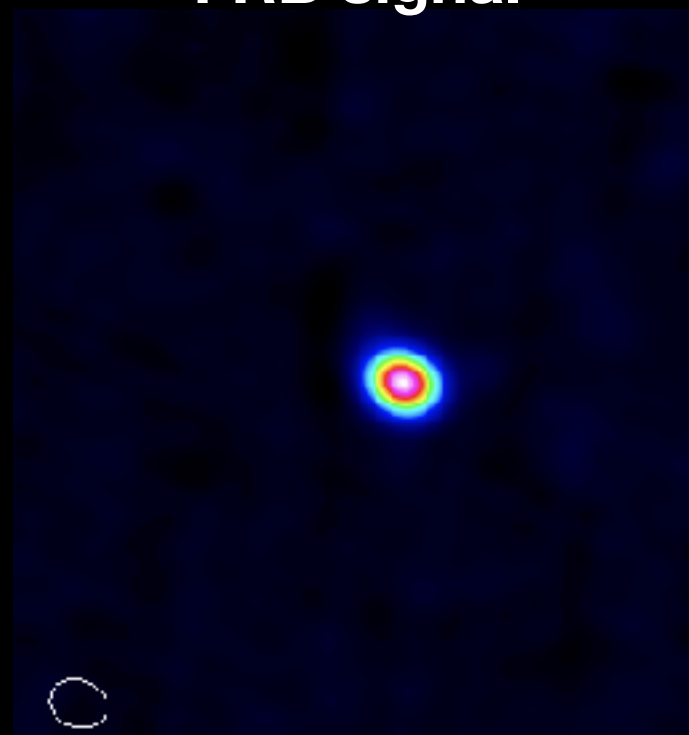
3 replies

ryan 2 months ago
This one looks promising @shivani @keith ?

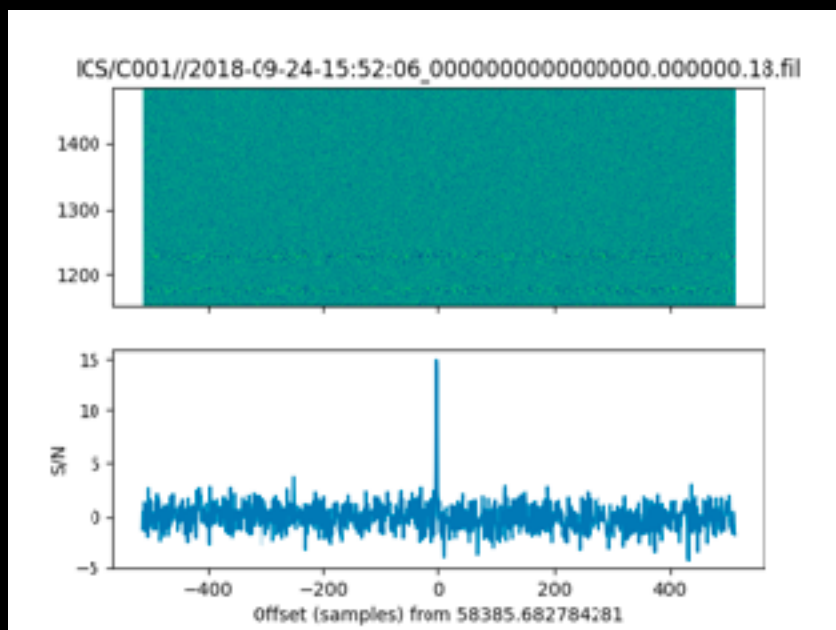
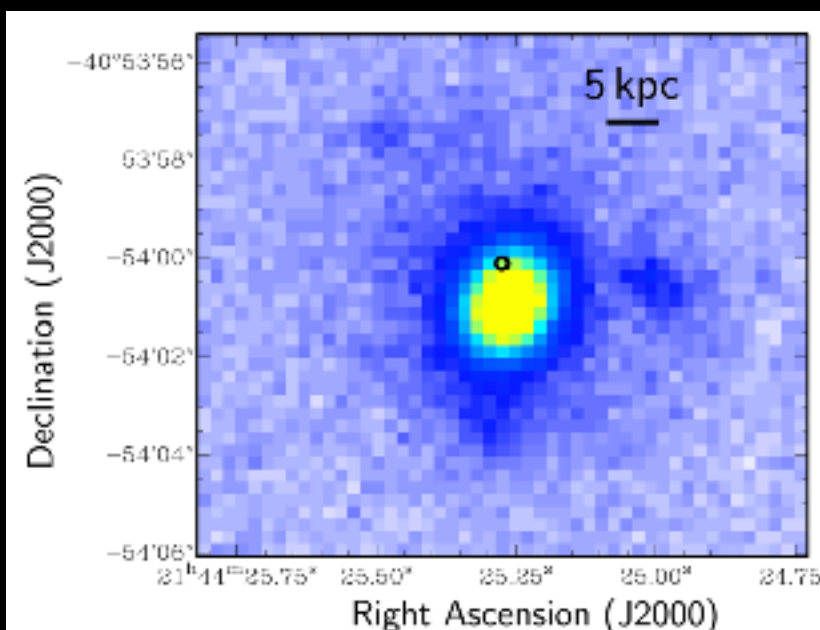
keith 2 months ago
heck yes

shivani 2 months ago
Wohoo!! Just saw this

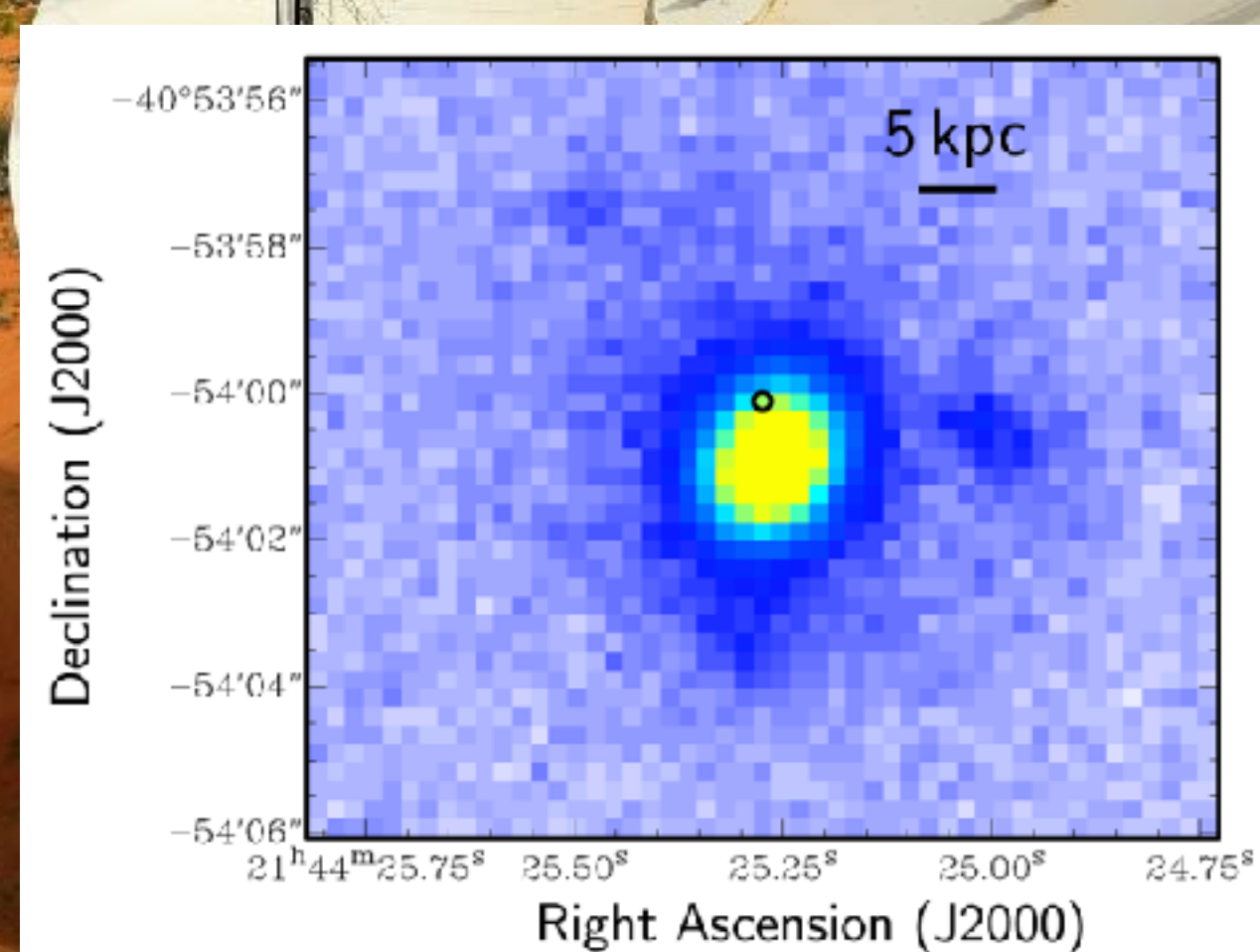
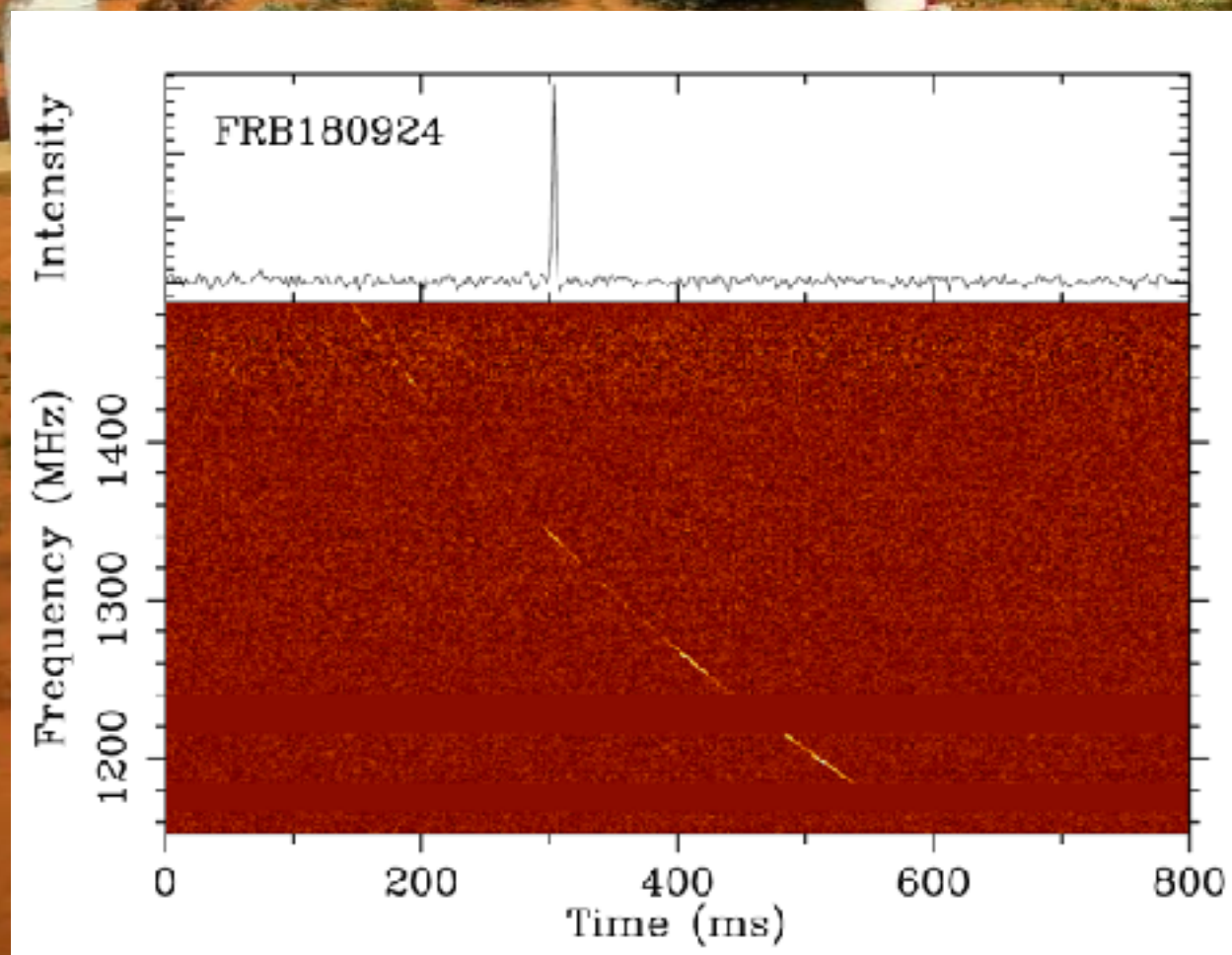
FRB signal



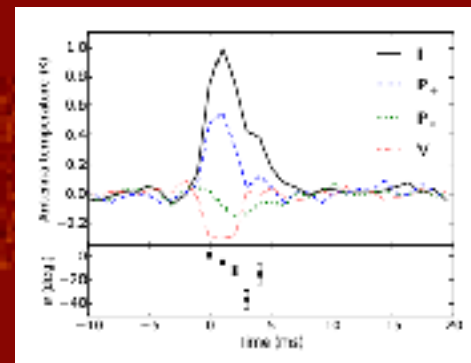
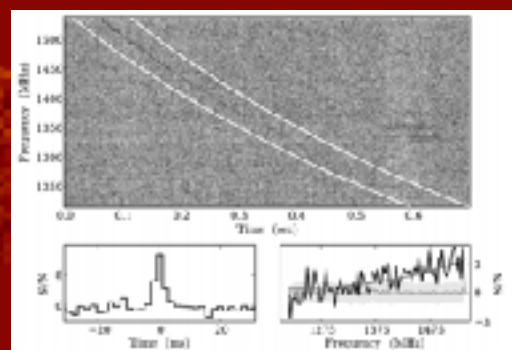
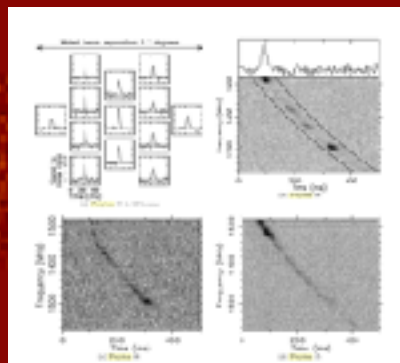
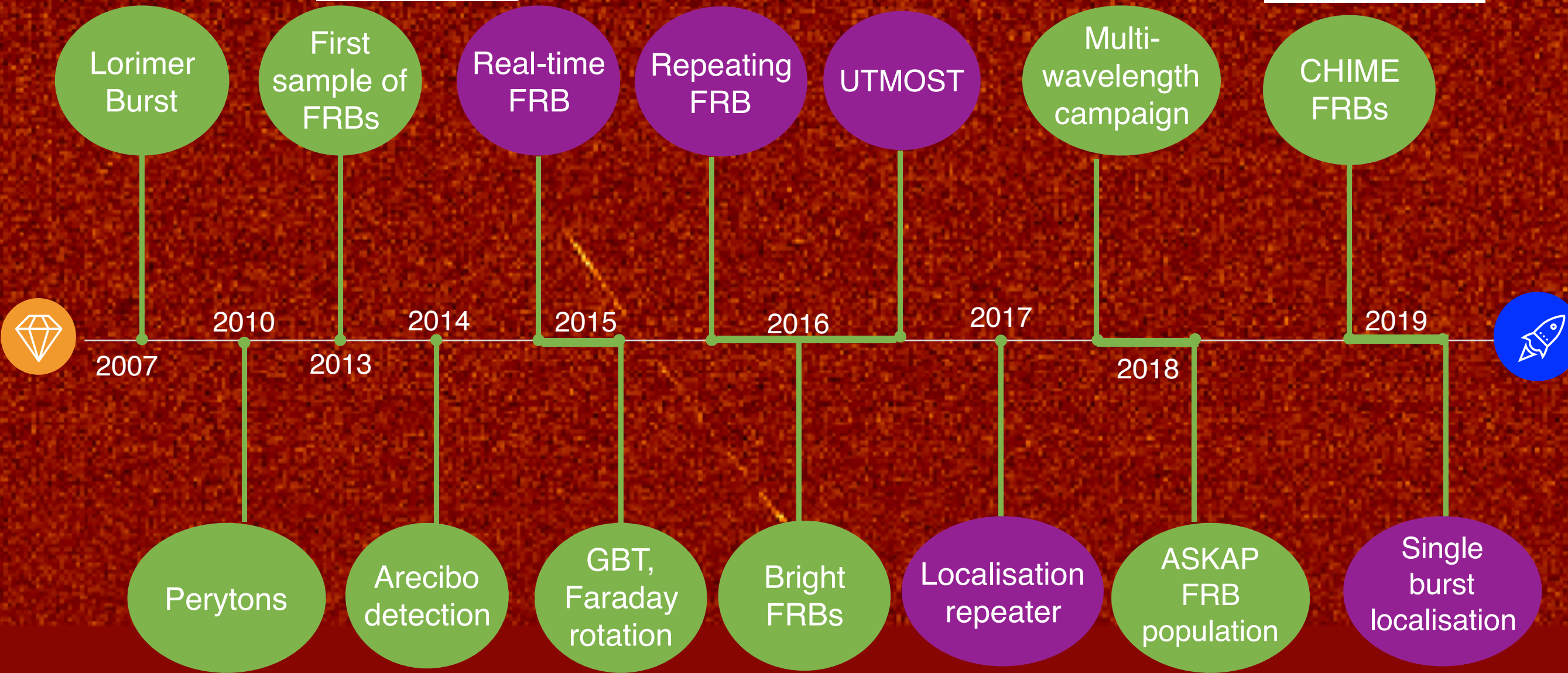
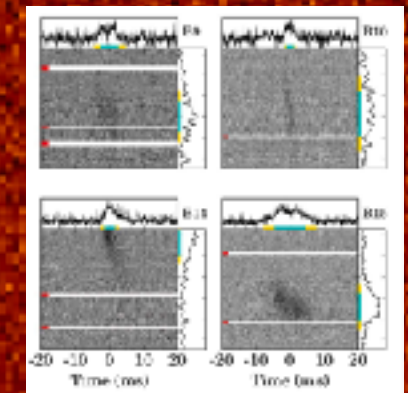
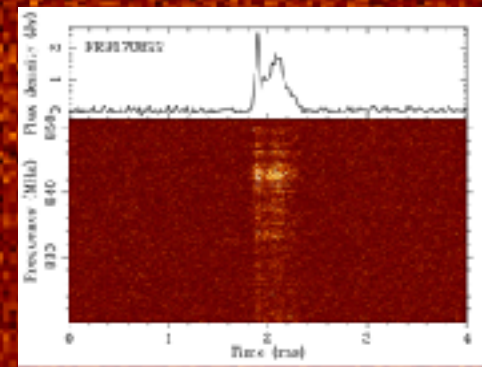
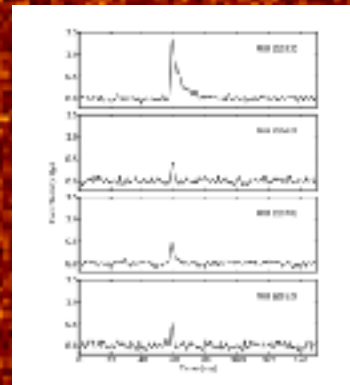
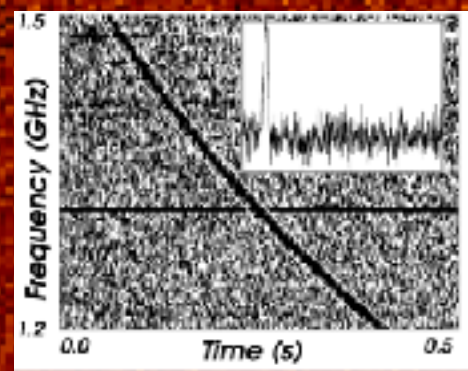
FRB host galaxy



A single fast radio burst localized to a massive galaxy at cosmological distance



Bannister+19 (The CRAFT collaboration), Science



Lorimer+07, Burke-Spolaor+11, Thornton+13, Spitler+14, Petroff+15, Spitler+16, Ravi+16, Caleb+17, Farah+18, Chatterjee+17, Bhandari+18, Shannon+18, CHIME+19, Bannister+19, Ravi+19

THANKS!

THE CONVERSATION
Academic rigour, journalistic flair

How we closed in on the location of a fast radio burst
in a galaxy far, far away

June 28, 2019 8:54am AEST

[https://www.csiro.au/en/News/News-releases/2019/
Astronomers-make-history-in-a-split-second](https://www.csiro.au/en/News/News-releases/2019/Astronomers-make-history-in-a-split-second)