Fast Radio Bursts
(facts and speculations)

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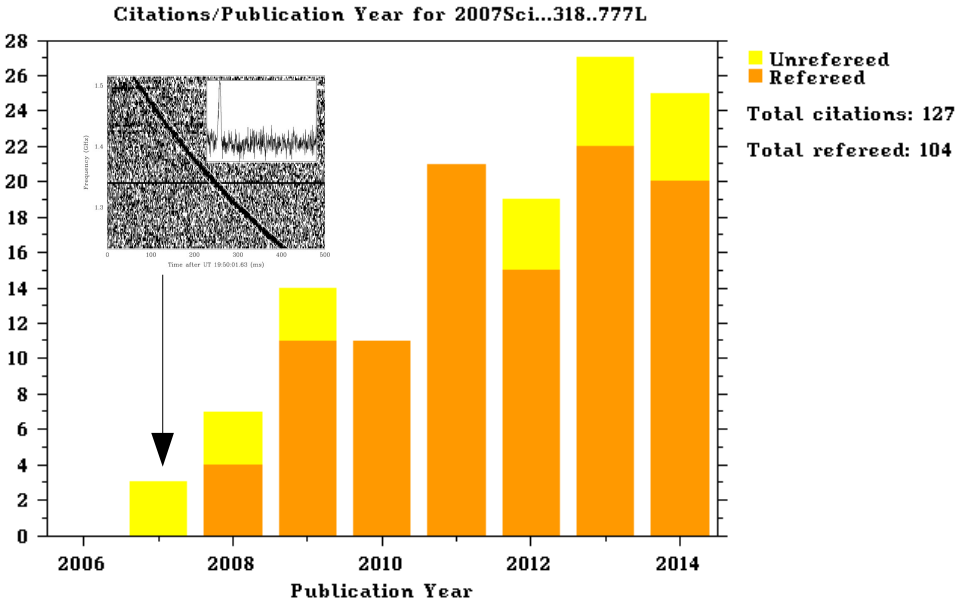
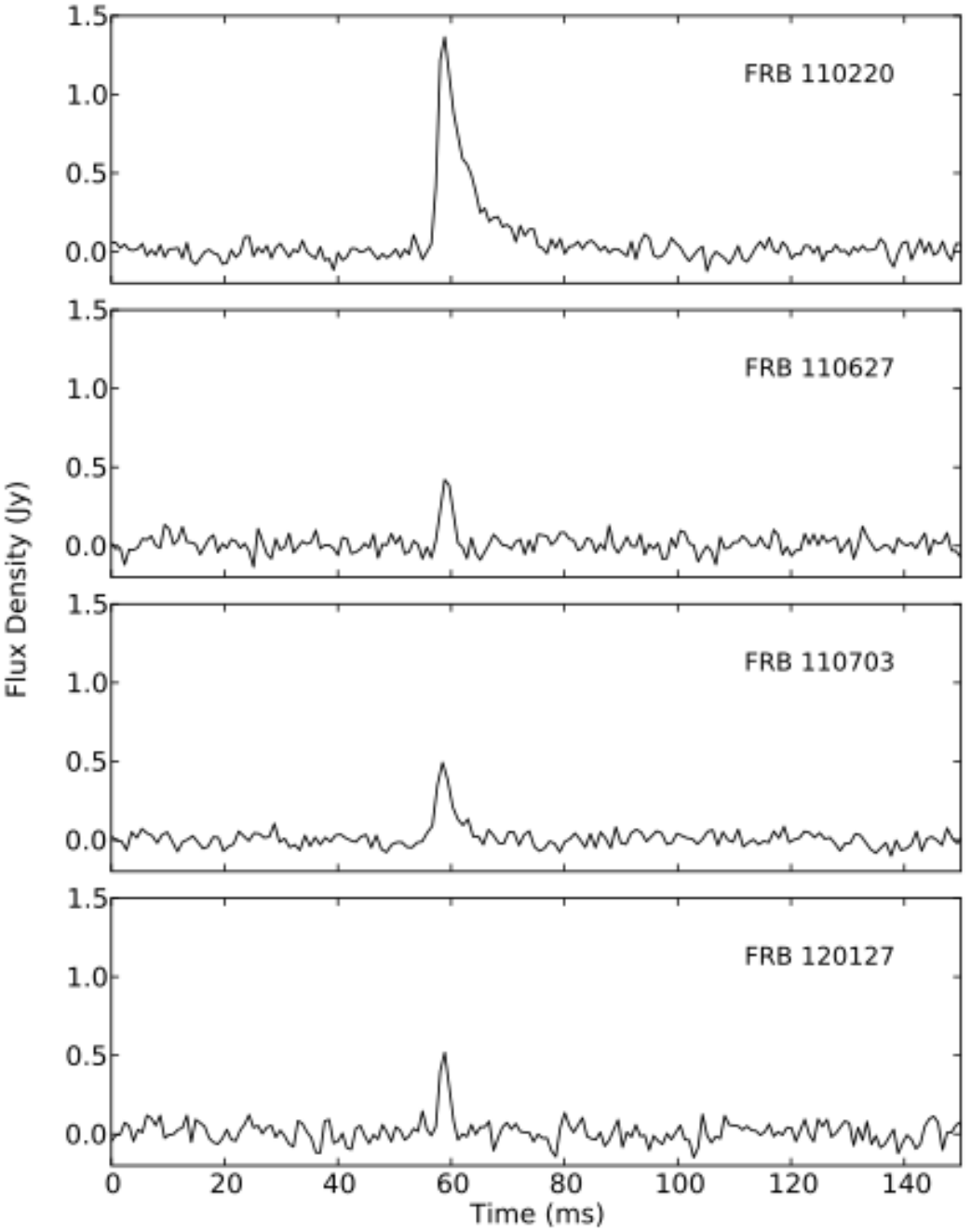
Credit: Swinburne

- What do we observe?
- How are they found?
- What could they be?
- Why are they important?
- What are we doing?
- My bold predictions!



What is observed?

- 1+1+4+1+1=8 published
- Peak flux > 0.5 Jy
- L-band (1.4 GHz)
- Highly dispersed
- Pulse widths > few ms
- Evidence for scattering
- Singular events?
- Different sky locations
- No counterparts so far

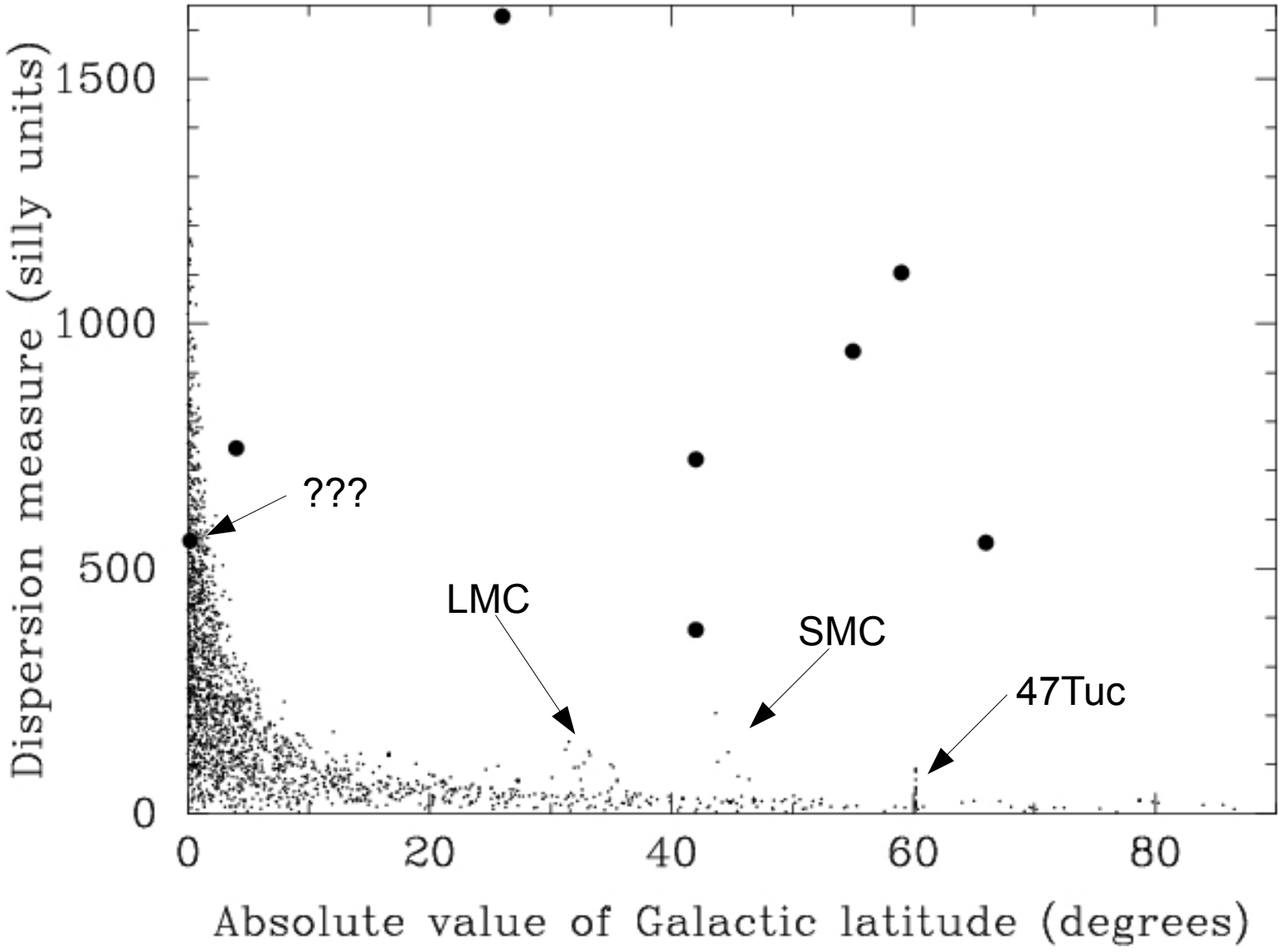


From Thornton et al. (2013)

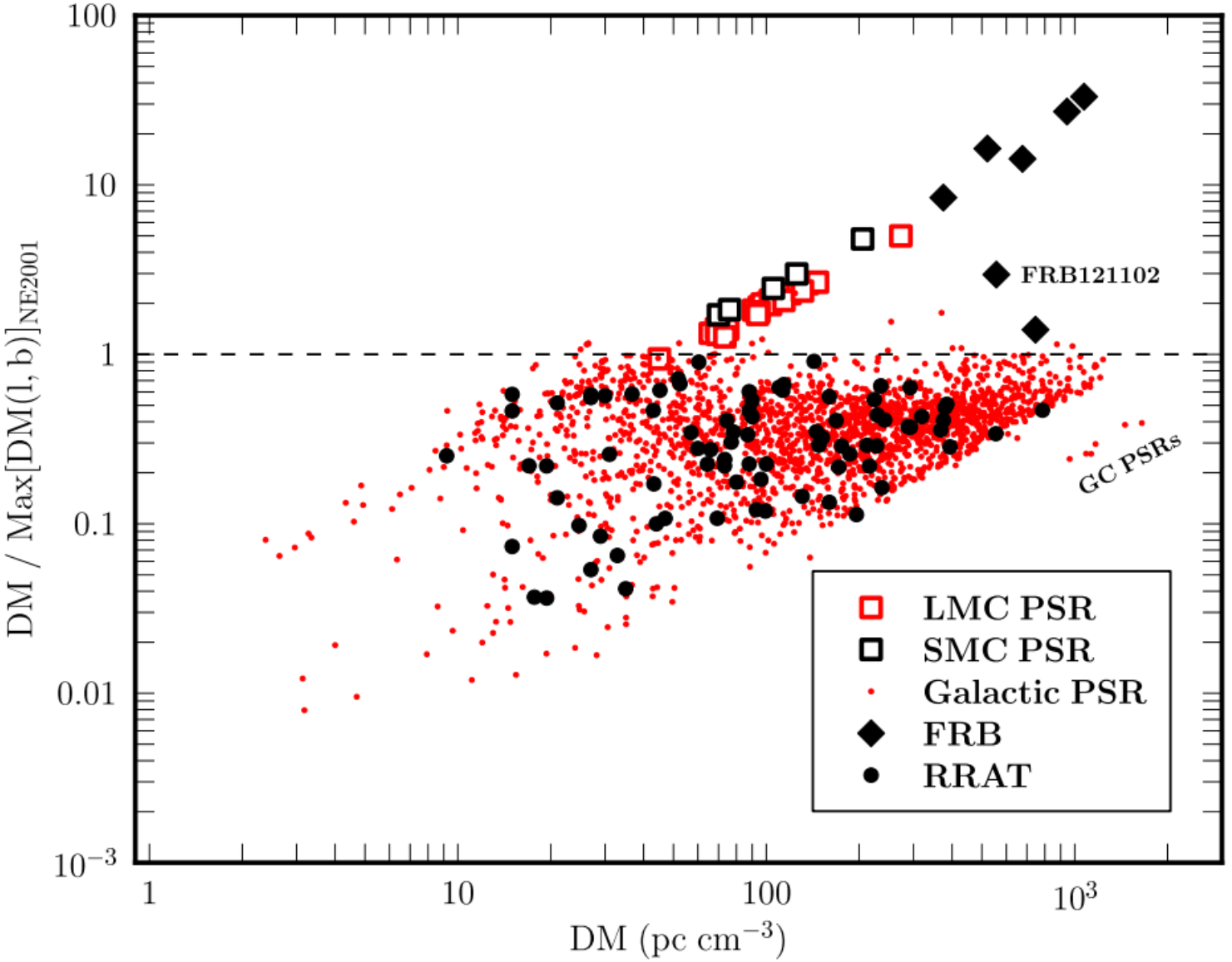
Obligatory table of numbers

FRB	l	b	DM	Width	Flux
010724	300	-42	375	4.6	30
010621	25	-4	746	8.3	0.4
110220	51	-55	944	5.6	1.3
110703	81	-59	1104	1.4	0.5
110627	356	-42	723	4.3	0.4
120127	49	-66	553	1.1	0.5
121002	308	-26	1628	2 / 4	0.4
121102	175	-0.2	557	3	0.4

Compared to pulsar DMs

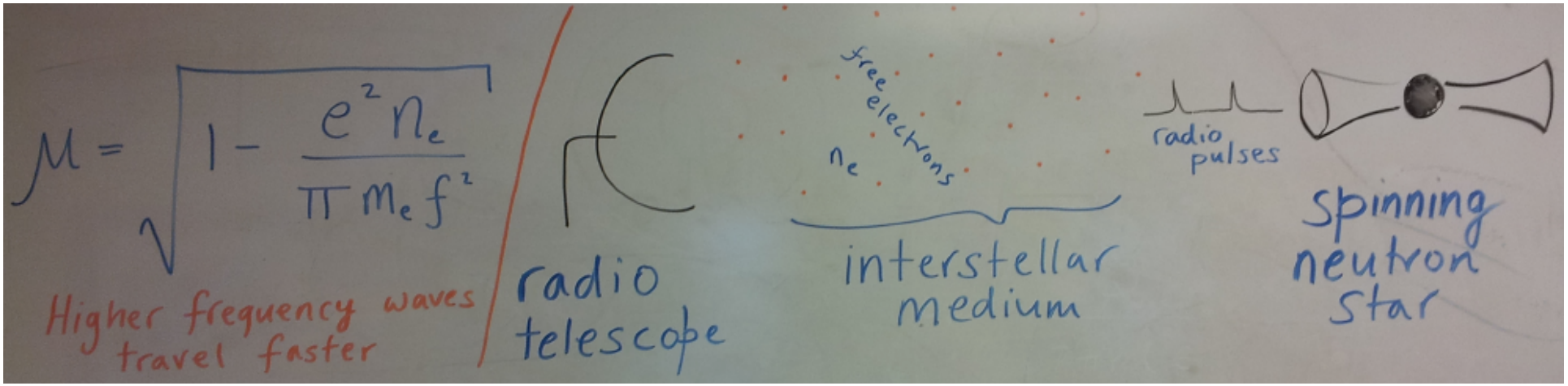


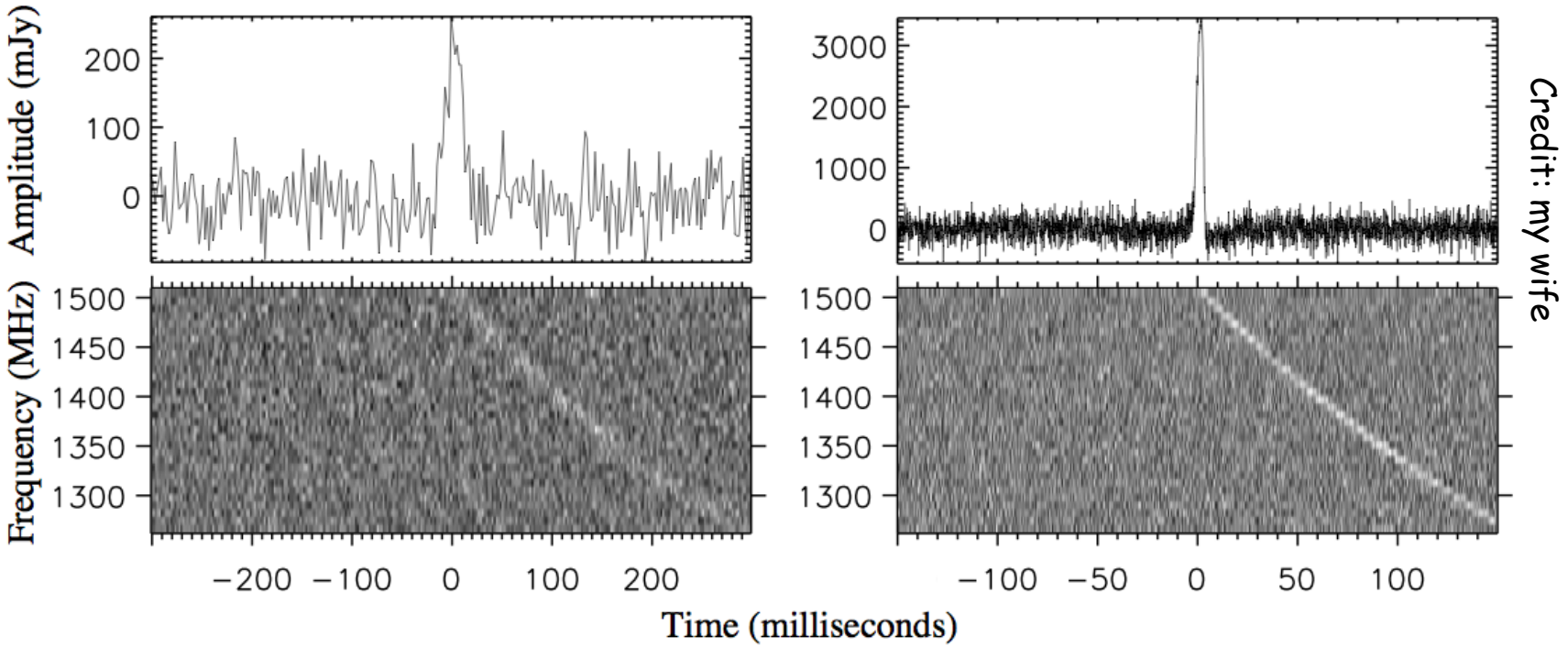
Compared to pulsar DMs



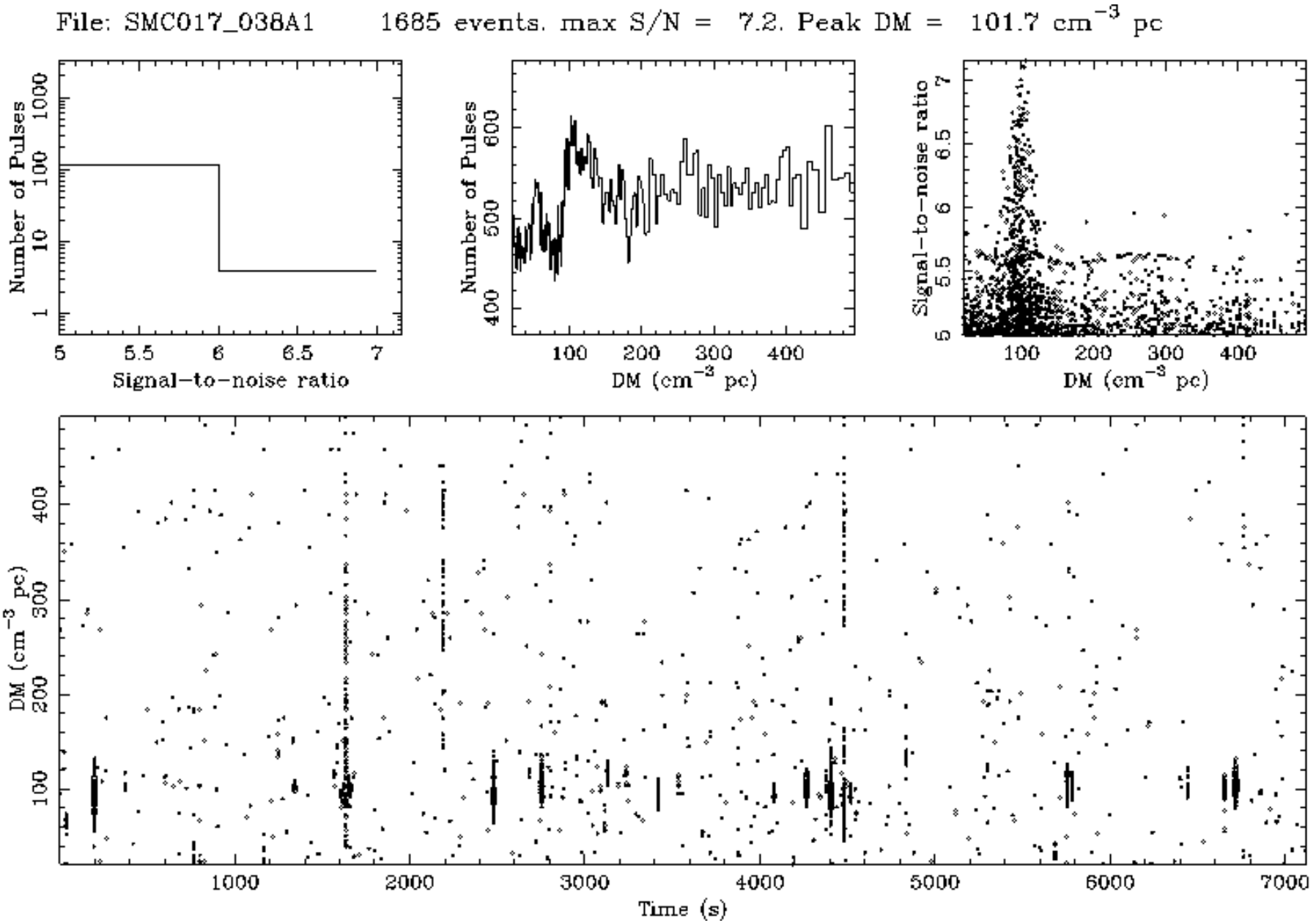
Credit: Jim Cordes

How are they found?

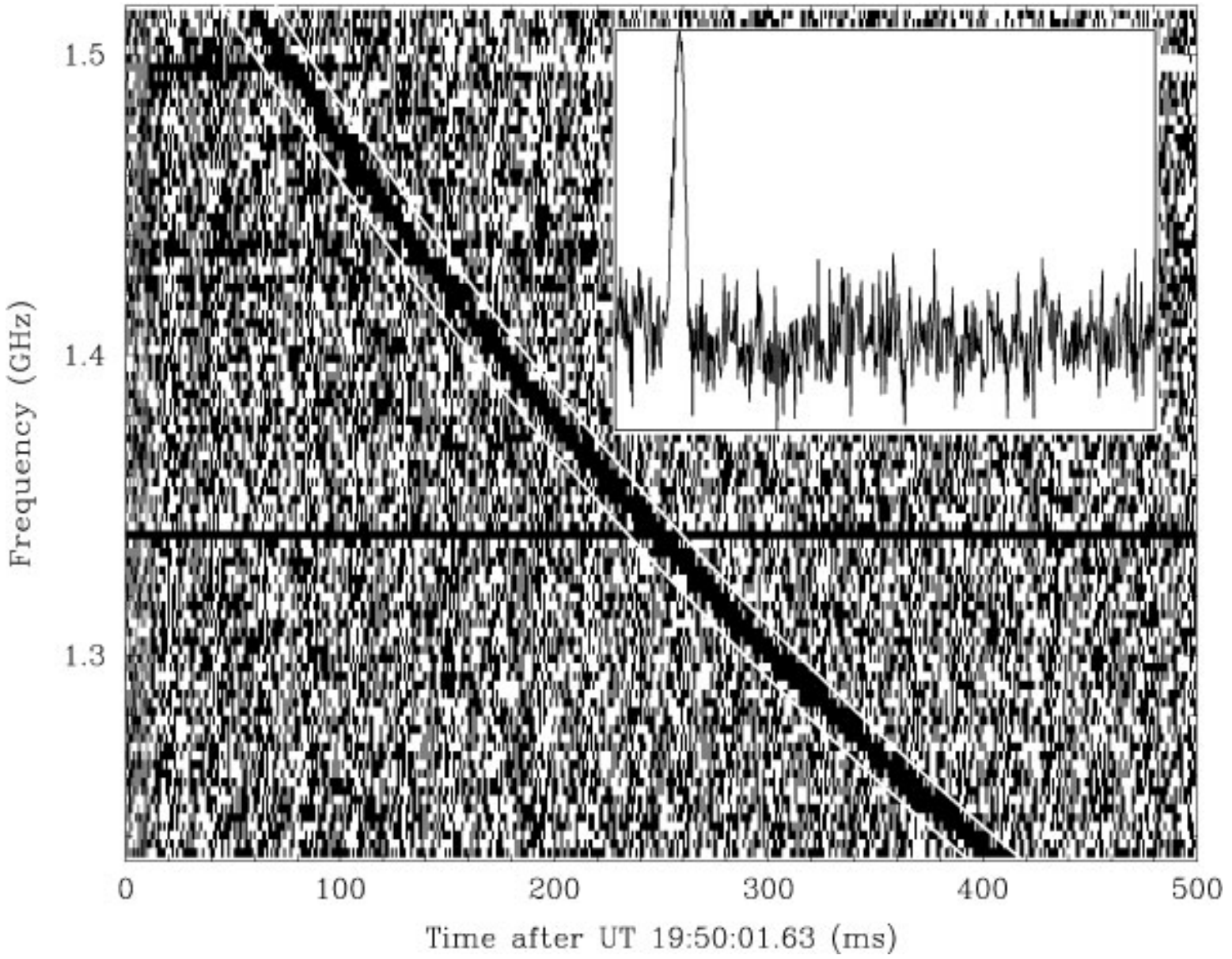




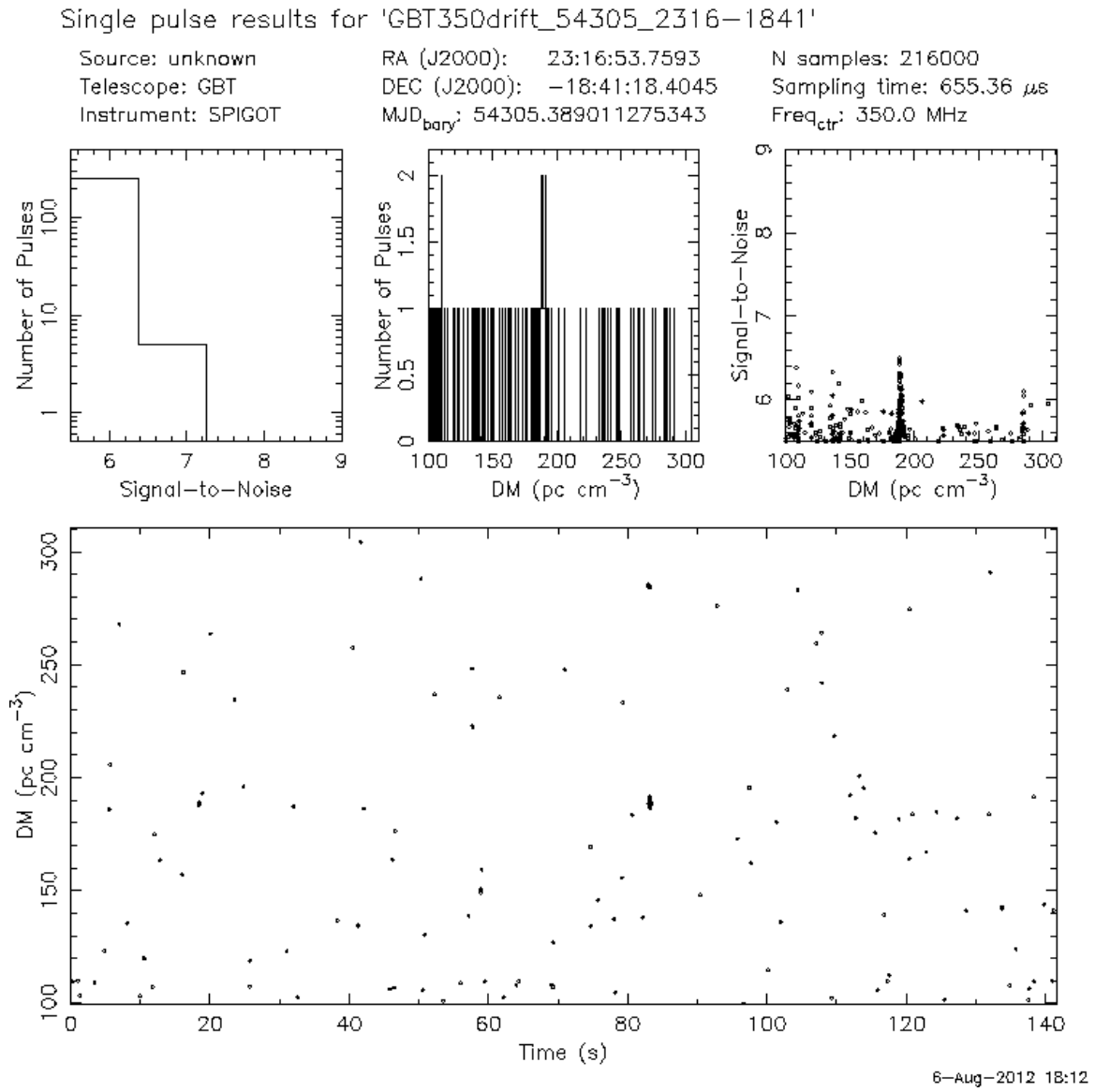
Example search-code output



Bright events are easily visualized

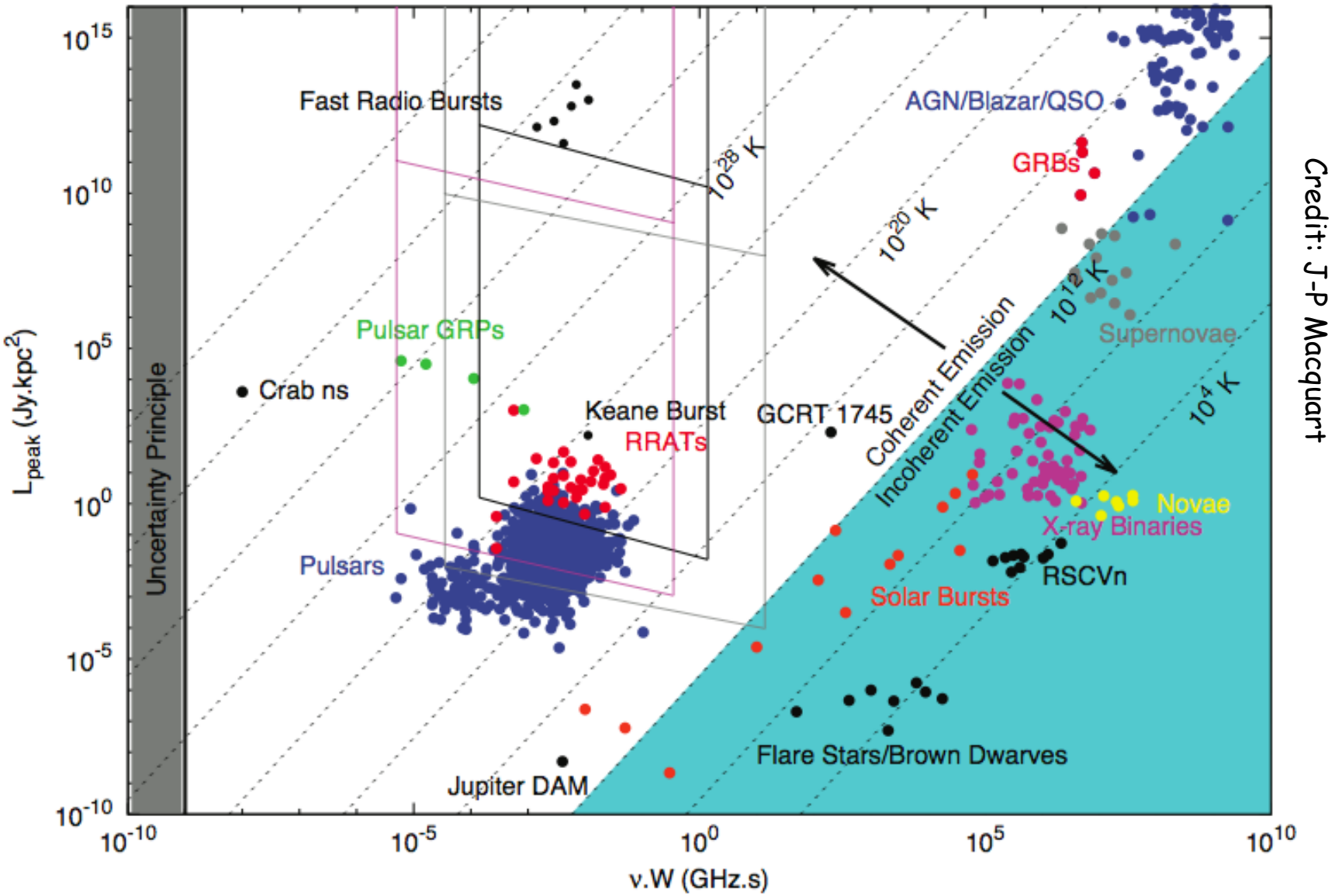


Faint events are harder to see



Credit: Scott Ransom

What could they be?



Credit: J-P Macquart

Black: Parkes; Pink: SKA1-lo; Grey: SKA1-mid

What could they be?

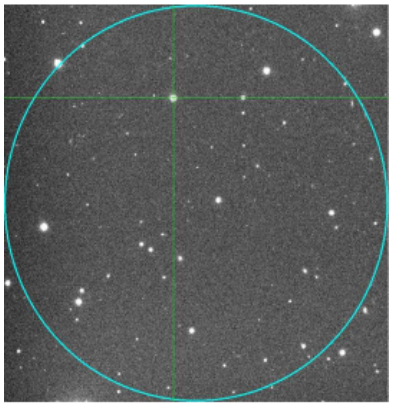
- Local
  - Atmospheric Peryton idea

    (Kulkarni et al. 2014)

- Extra-terrestrial
  - Alien signals

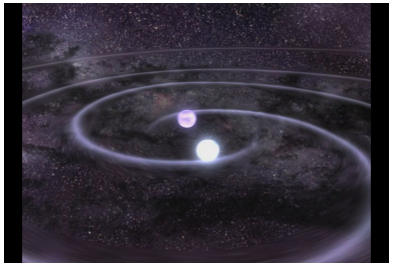
    (Luan & Goldreich 2014)
- Galactic
  - Flare stars

    (Loeb et al. 2014)



- Extragalactic
  - Favored cosmic catastrophe

    (Cobbly et al. 2014)



Extragalactic source possibilities

- Collapsing neutron stars
- Evaporating black holes
- Coalescing neutron stars
- Coalescing white dwarfs
- Magnetar flares
- Supernovae
- Giant pulses
- Cosmic strings...

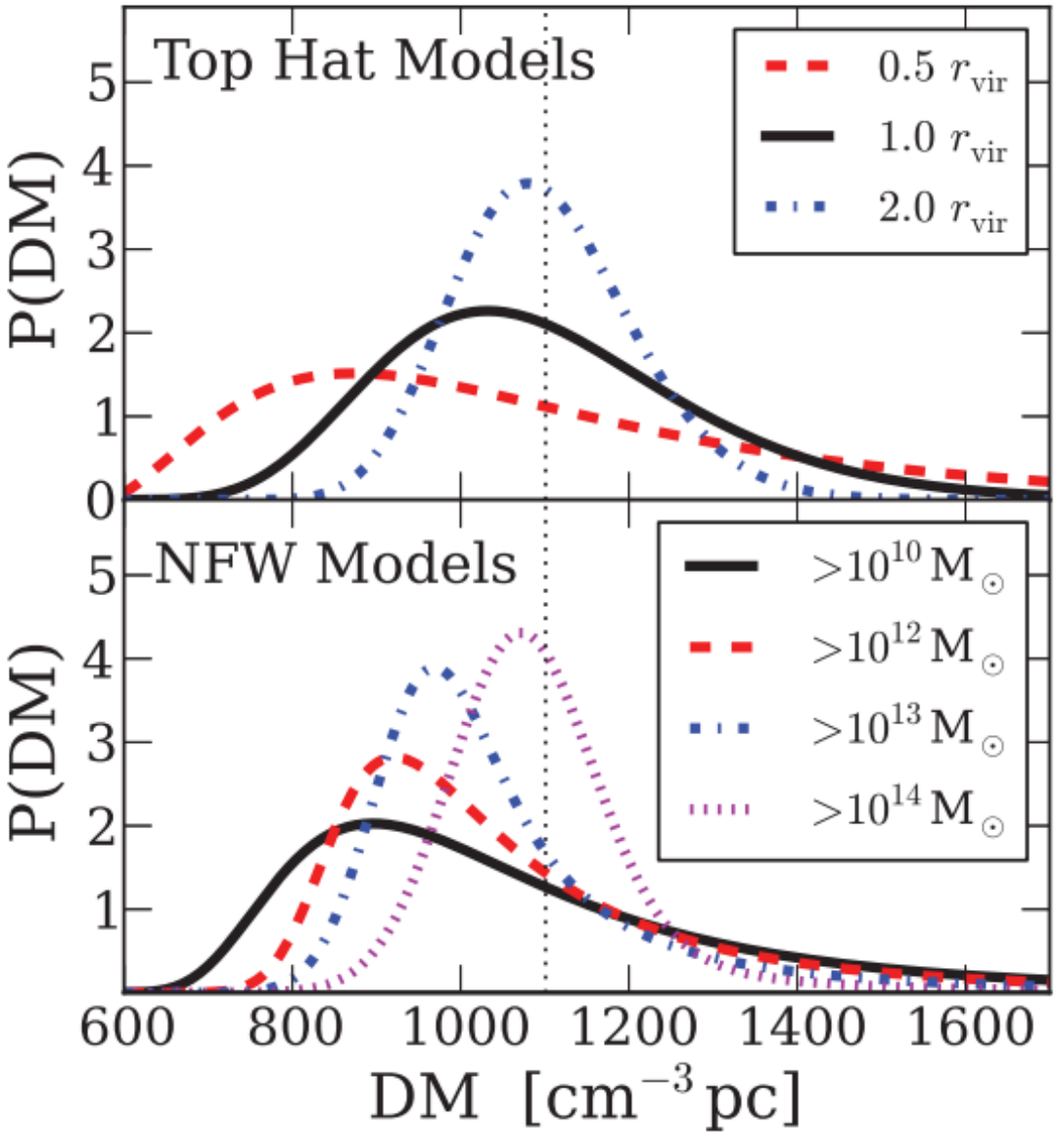
Desperately need counterparts

What can we do with 'em?

(assuming that they are extragalactic)

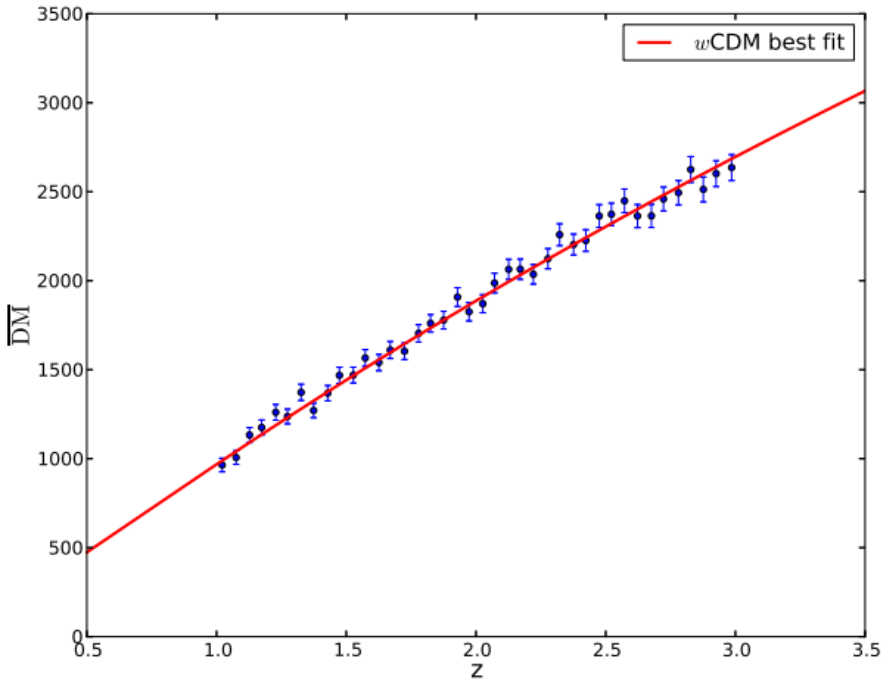
- Measure the distance → origins
- Measure the intergalactic DM
- Measure turbulence in IGM
- Probe missing baryons and DE
- Measure the intergalactic B-field
- Probe population at different redshifts

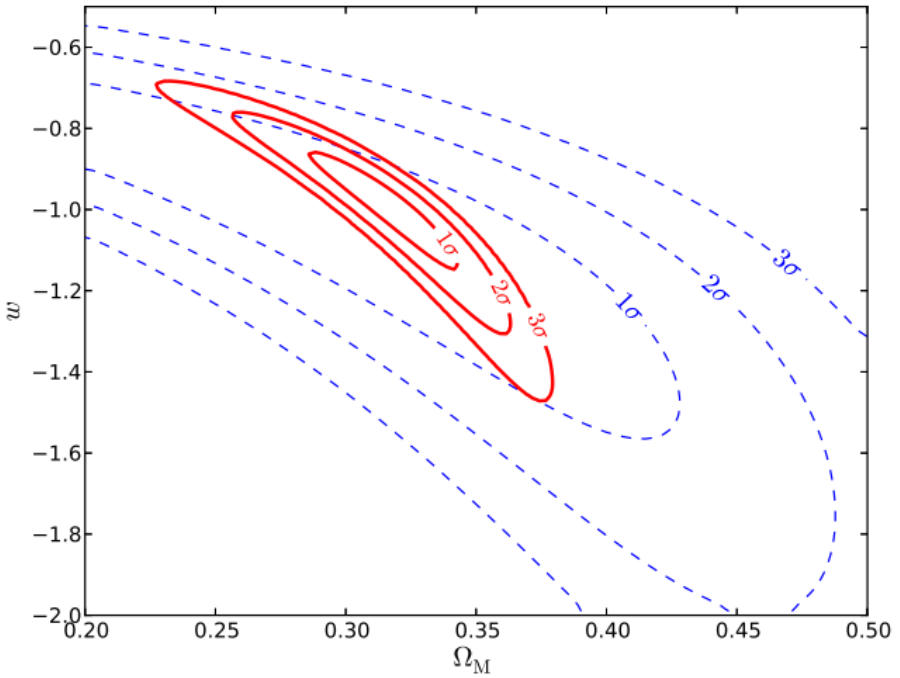
Probing the missing baryons



Credit: McQuinn (2014)

FRBs as cosmic rulers



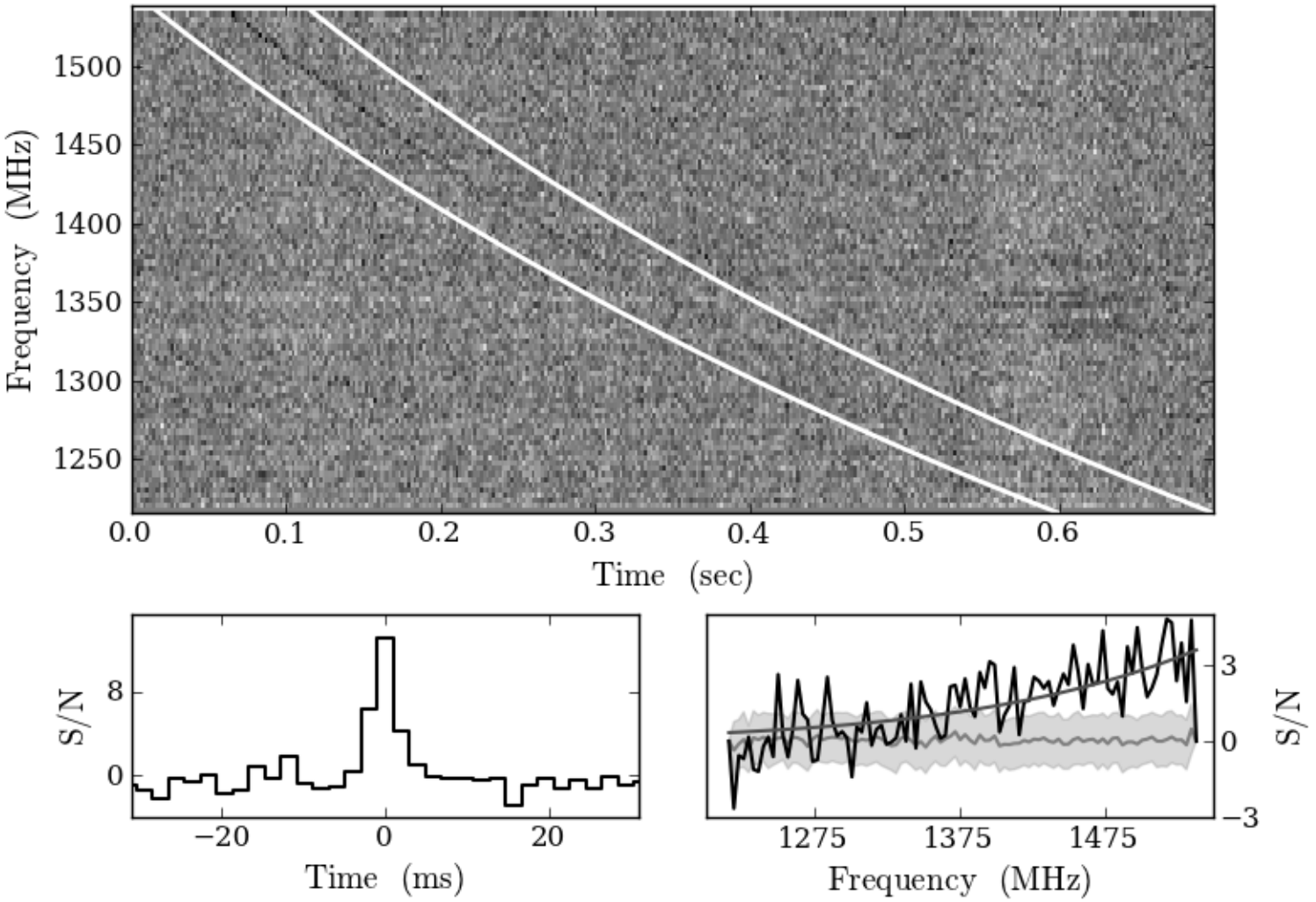


Credit: Zhou et al (2014)

$$\langle \mathrm{DM_{IGM}} \rangle(z) = \Omega_{\mathrm{b}} \frac{3H_0 c}{8\pi G m_{\mathrm{p}}} \int_0^z \frac{(1+z') f_{\mathrm{IGM}} (\frac{3}{4} X_{\mathrm{e,H}}(z') + \frac{1}{8} X_{\mathrm{e,He}}(z'))}{\{\Omega_{\mathrm{M}}(1+z')^3 + \Omega_{\mathrm{DE}}(1+z')^{3[1+w(z')]}\}^{1/2}} dz'$$

What next?

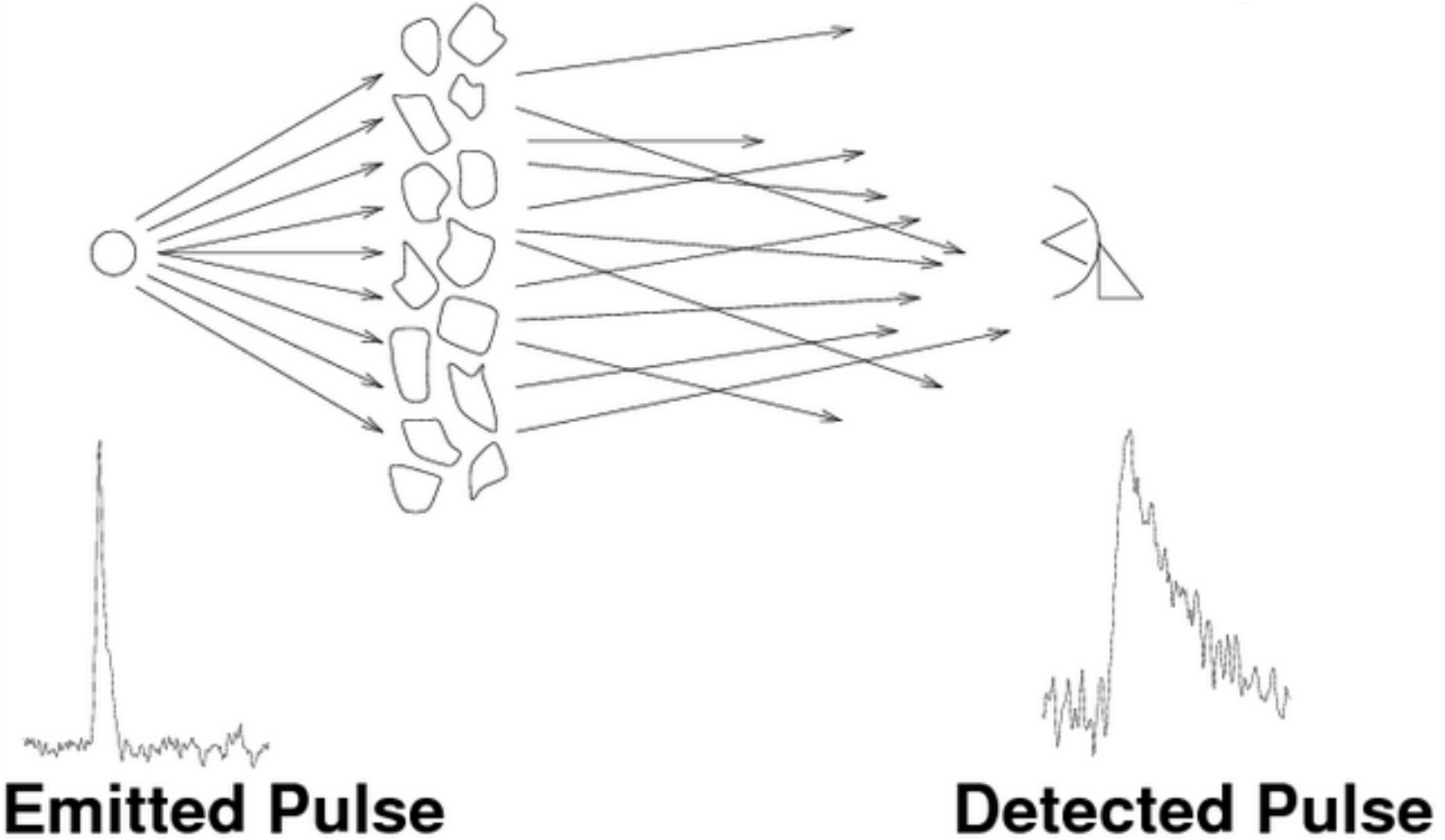
- Find bursts with other telescopes



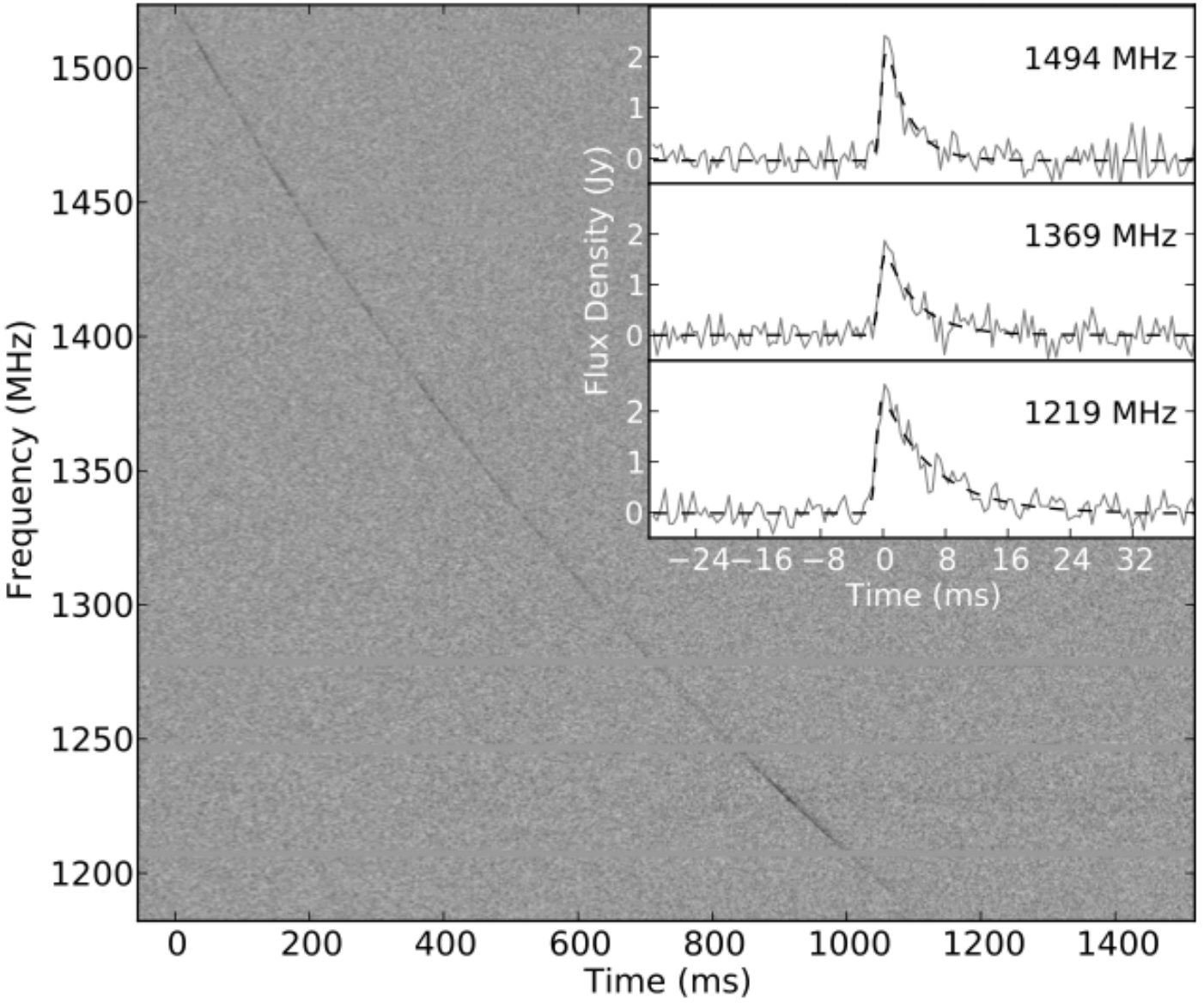
Credit: Spitler et al. (2014, in press)

What next?

- Find bursts with other telescopes
- Find them at different frequencies



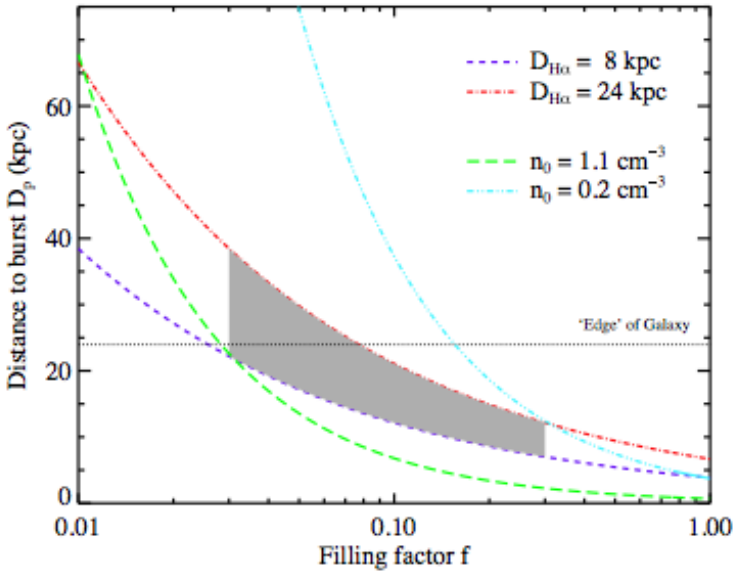
Scattering in FRB 110220

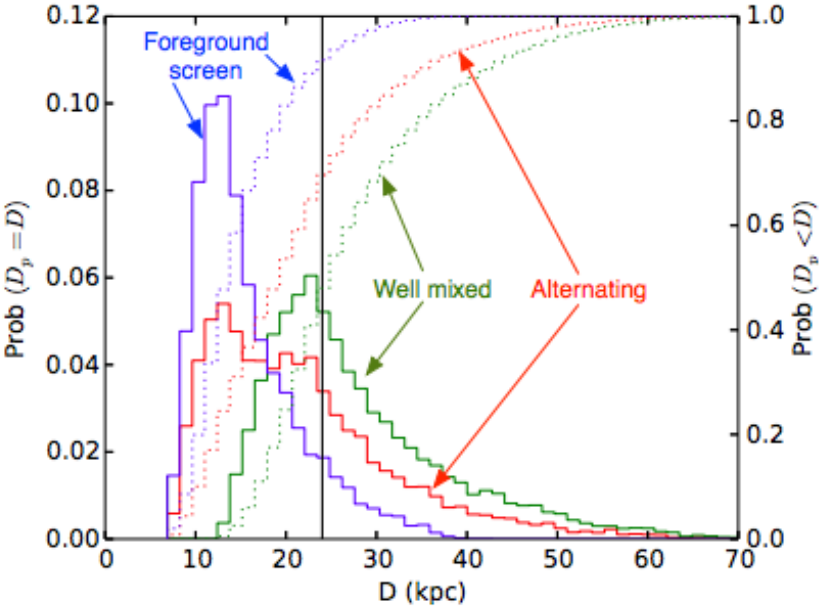


Credit: Thornton et al. 2013

What next?

- Find bursts with other telescopes
- Find them at different frequencies
- Do as much as possible with existing ones





Bannister & Marsden (2014)

What are people doing

- Searching archival data
- Follow-up on existing bursts
- Realtime detectors on large/small dishes
- Staring at the sky with interferometers

Bold predictions

- 2015: counterparts found
- 2020: 100s FRBs found
- 2025: 1000s of FRBs known
- 2030: FRBs essential cosmological tools