A bimodal burst energy distribution of a repeating fast radio burst source

D Li et al. 2021

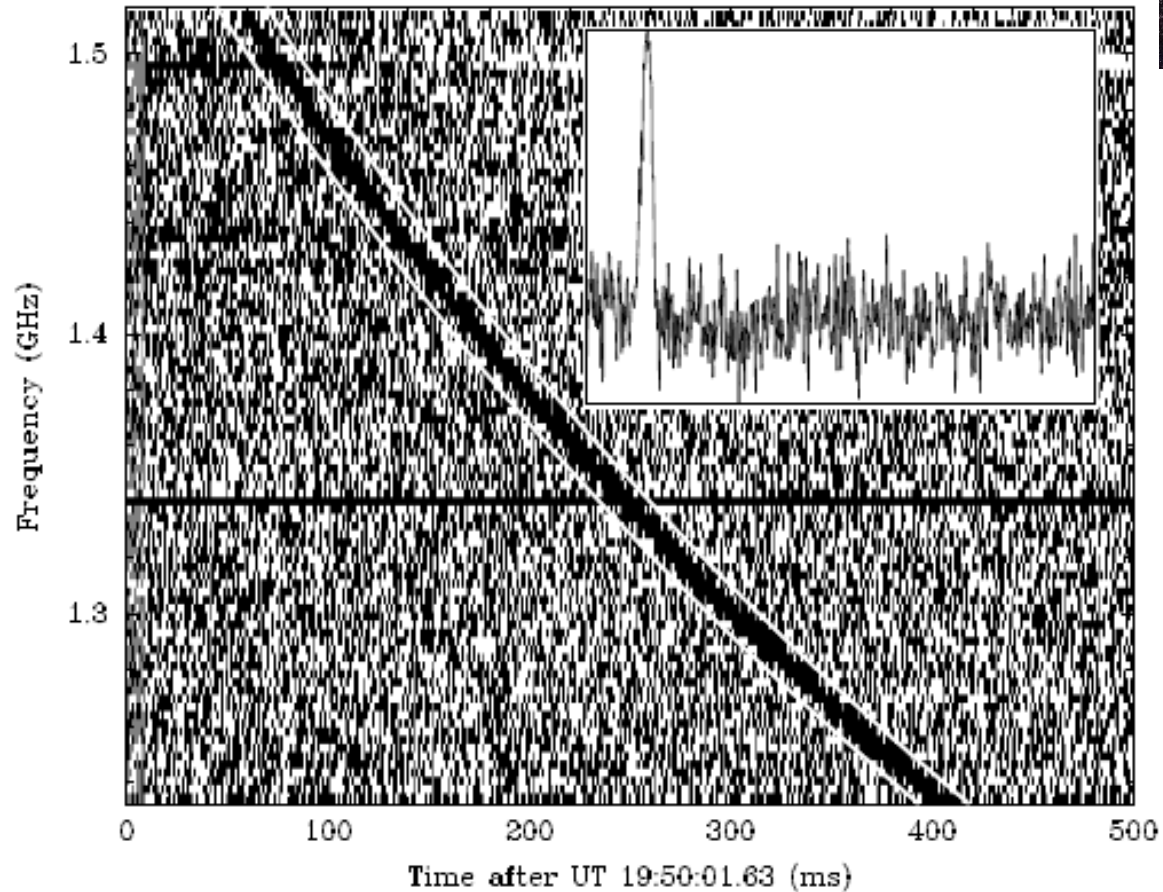Yijia Zhang

2021.10.29

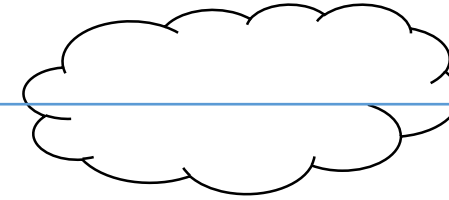# Content

- Background

- Research towards FRB121102

- Discussion

- Questions

Overview towards FRB
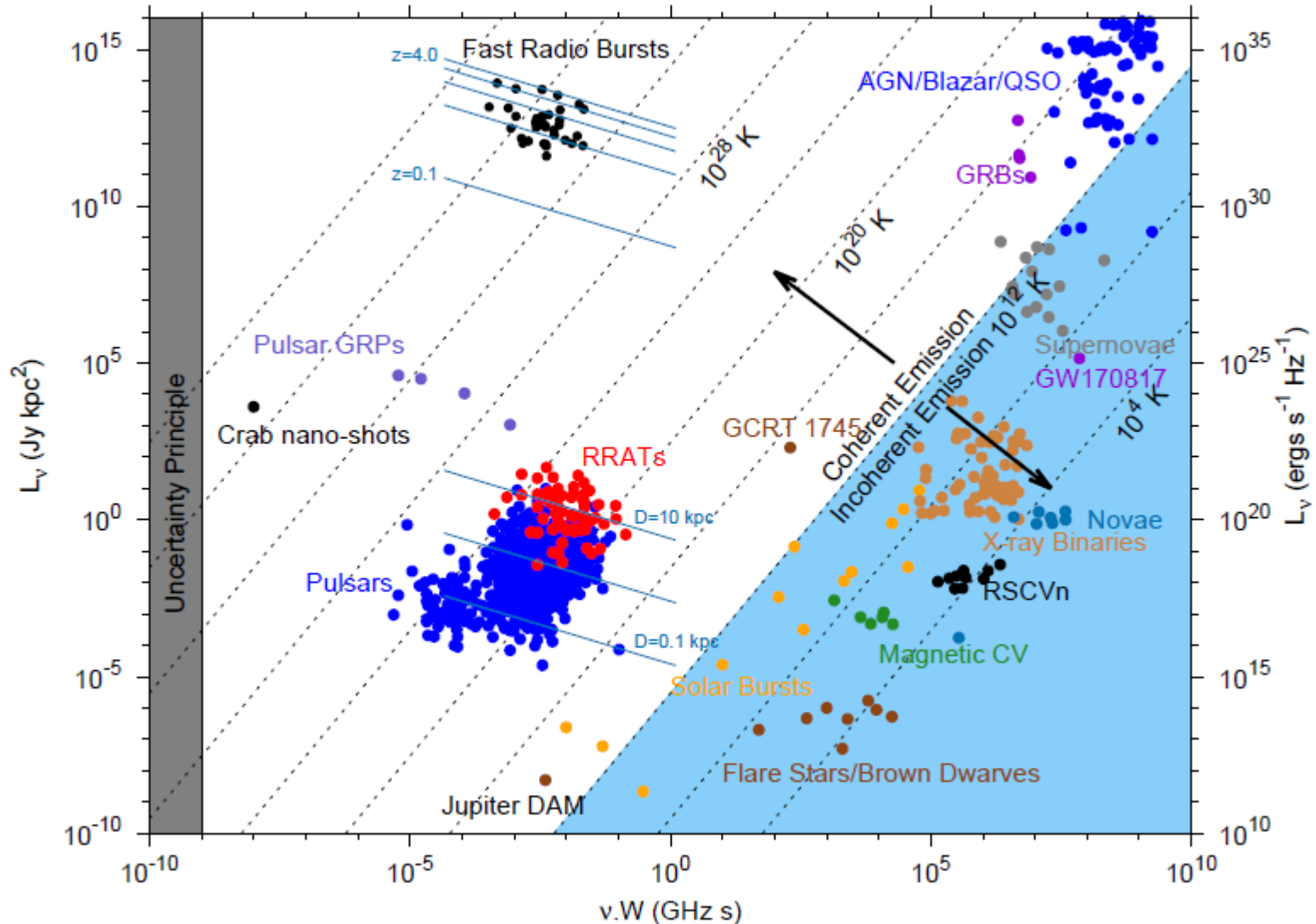
Source

Signal

Milky Way

Host Galaxy

IGM

$$DM = \int n_e dl$$

$$t_2 - t_1 = DM \frac{2\pi^2 e^2 c}{m_e}(v_1^{-2} - v_2^{-2})$$
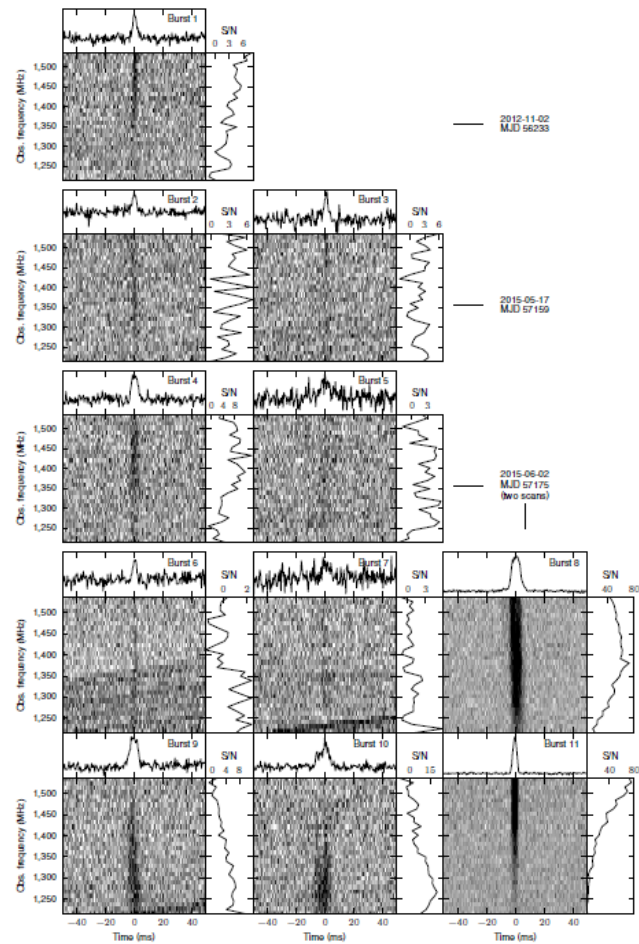
$$DM = DM_{MW} + DM_{IGM} + DM_{host}$$

DM_{host} is unknown, so it's quite hard to measure how far the source is.

Lorimer et al. 2007

Observational profiles

Timescale ~ ms

Lengthscale ~ Compact star

Characteristic Energy: 10^{38} erg

Redshift: 0.1~2

Luminosity ~ 10^{41} erg/s

Brightness Temperature > 10^{37} K

Physical Origin: Not quite clear

Keane et al. 2018
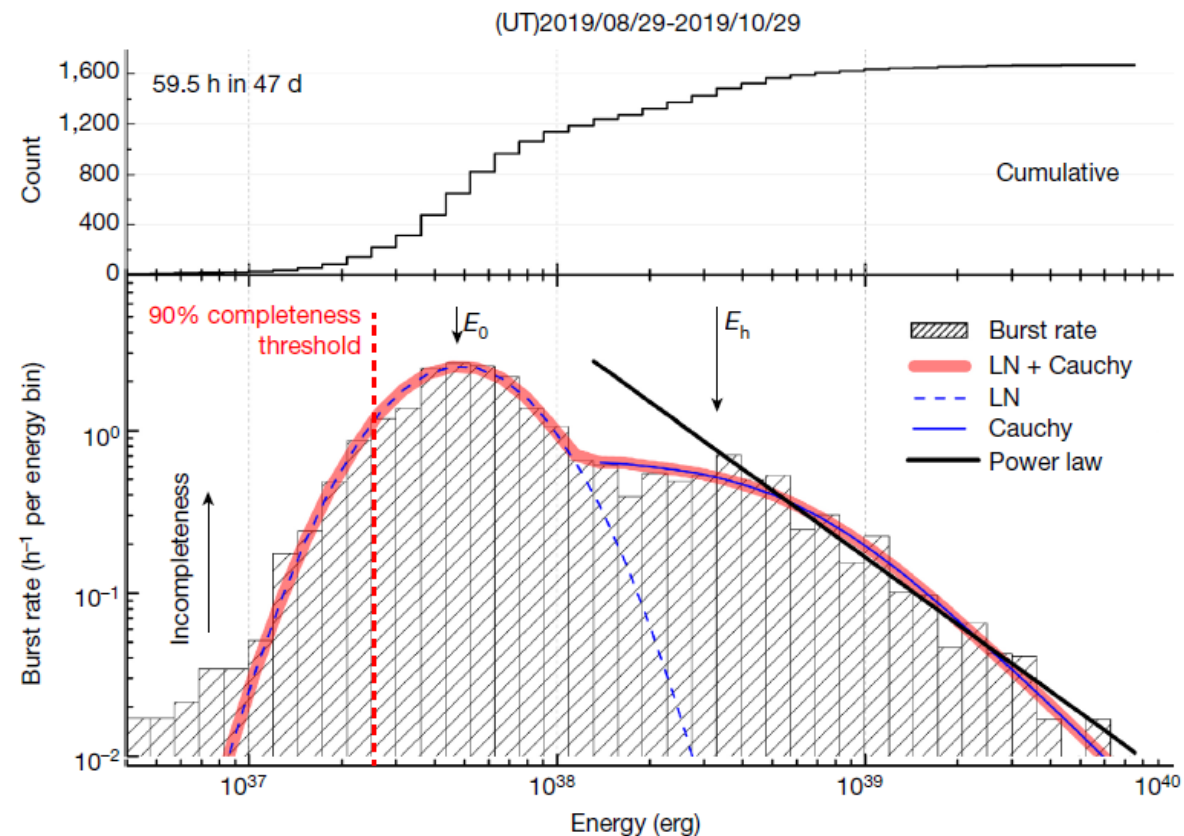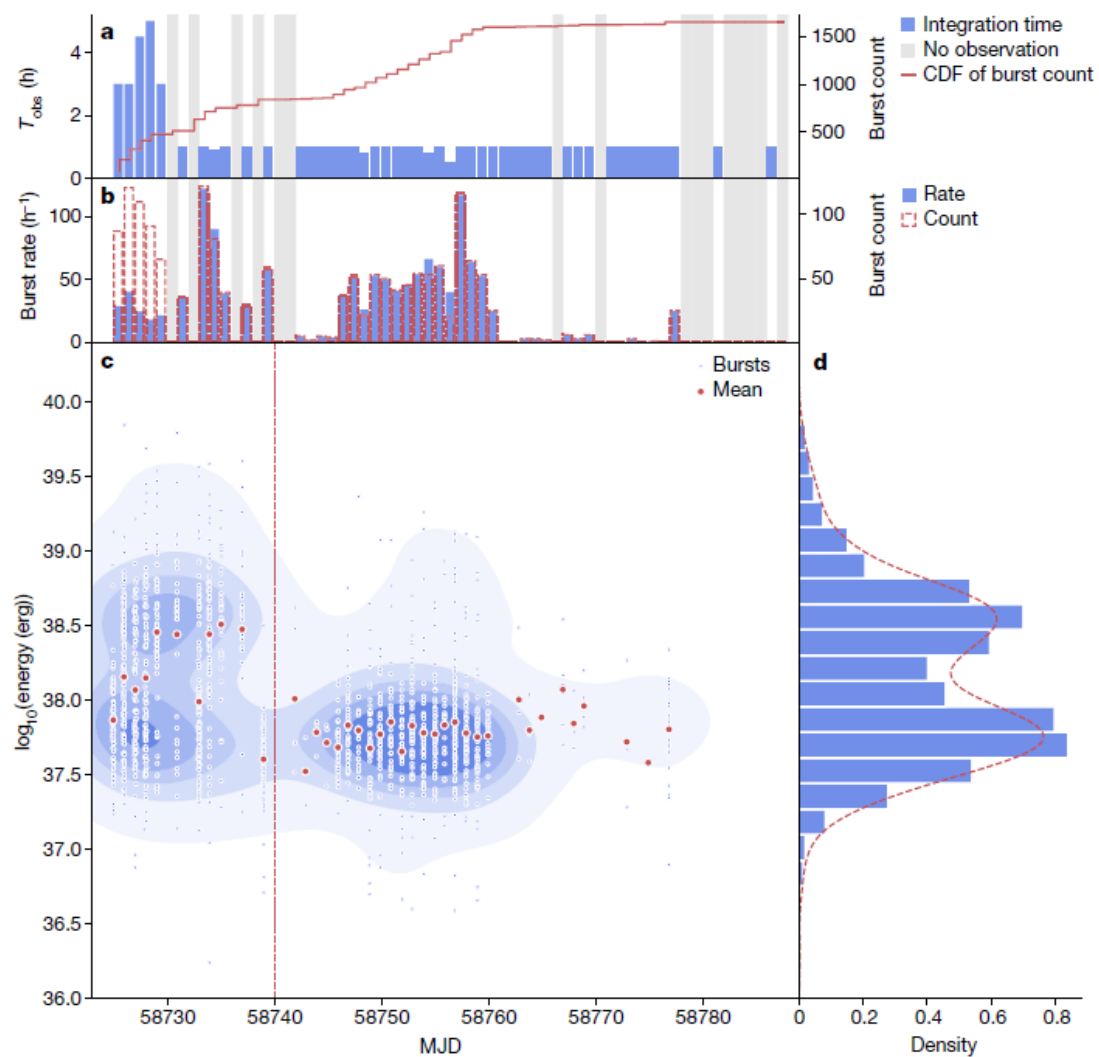
FRB121102

Repeated Bursts
Arecibo Detection

Spitler et al. 2016
Chatterjee 2017
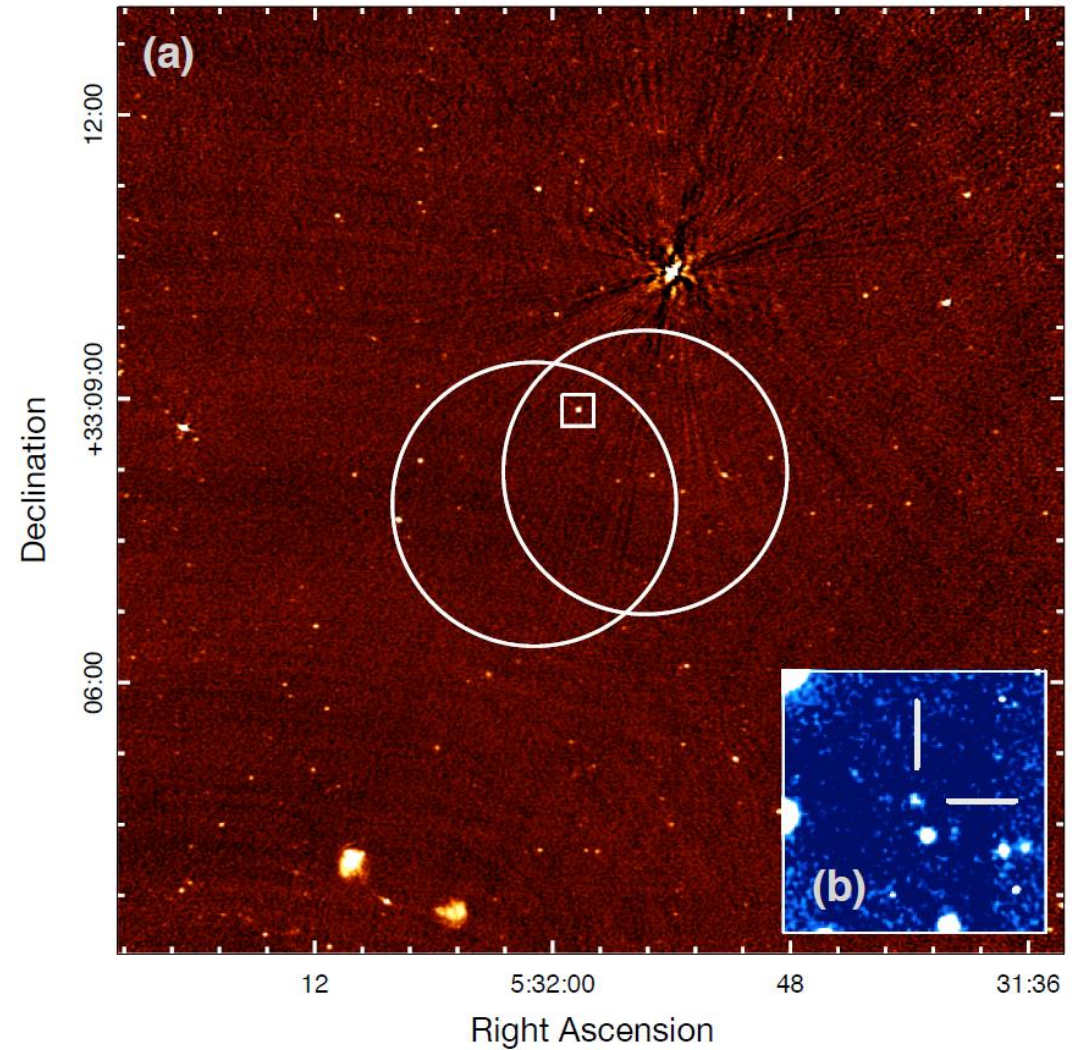
$z = 0.193$

$D_L = 949 \text{ kpc}$
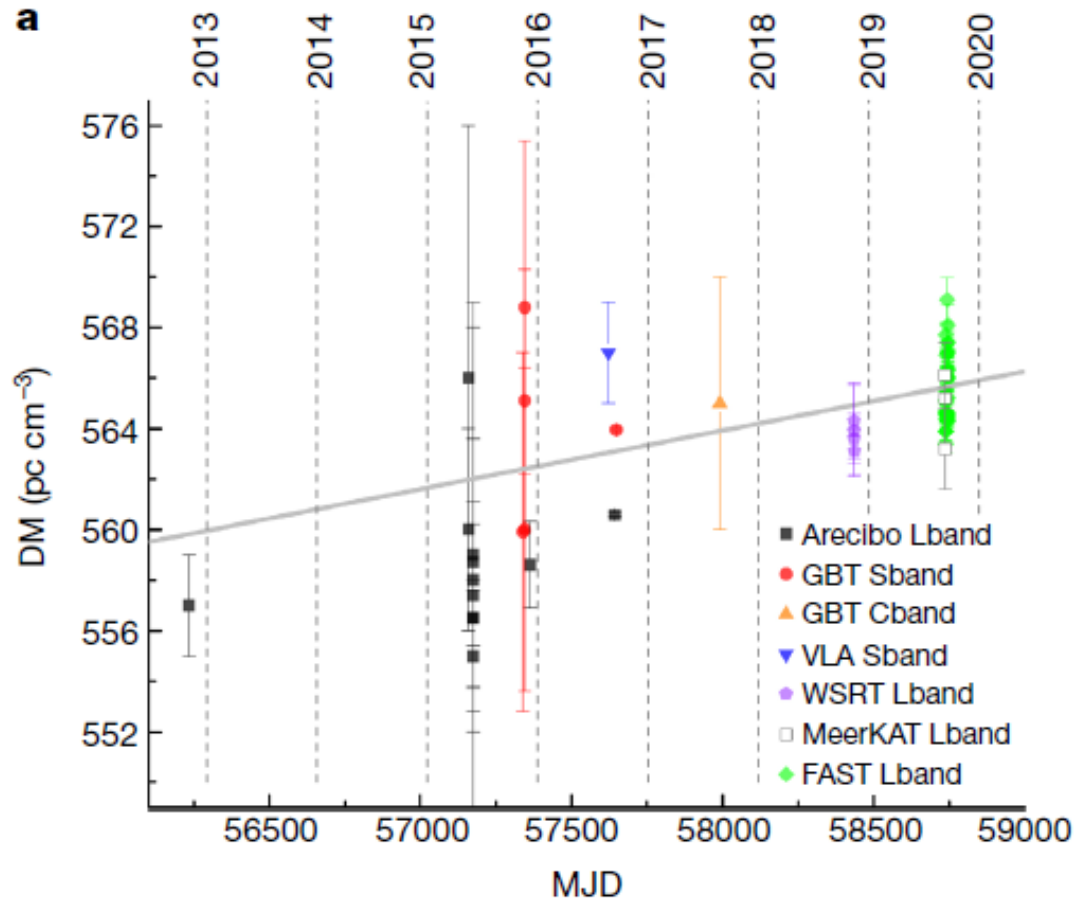
FAST Observation

- 59.5 hours observation towards FRB121102 in two months.
- Two peaks in energy distribution
- LogNormal and Cauchy model to fit burst rate curve

$$N(E) = \frac{N_0}{\sqrt{2\pi}\,\sigma_E E} \exp\left[\frac{-(\log E - \log E_0)^2}{2\sigma_E^2}\right] + \frac{\epsilon_E}{1 + (E/E_0)^{\alpha_E}},$$
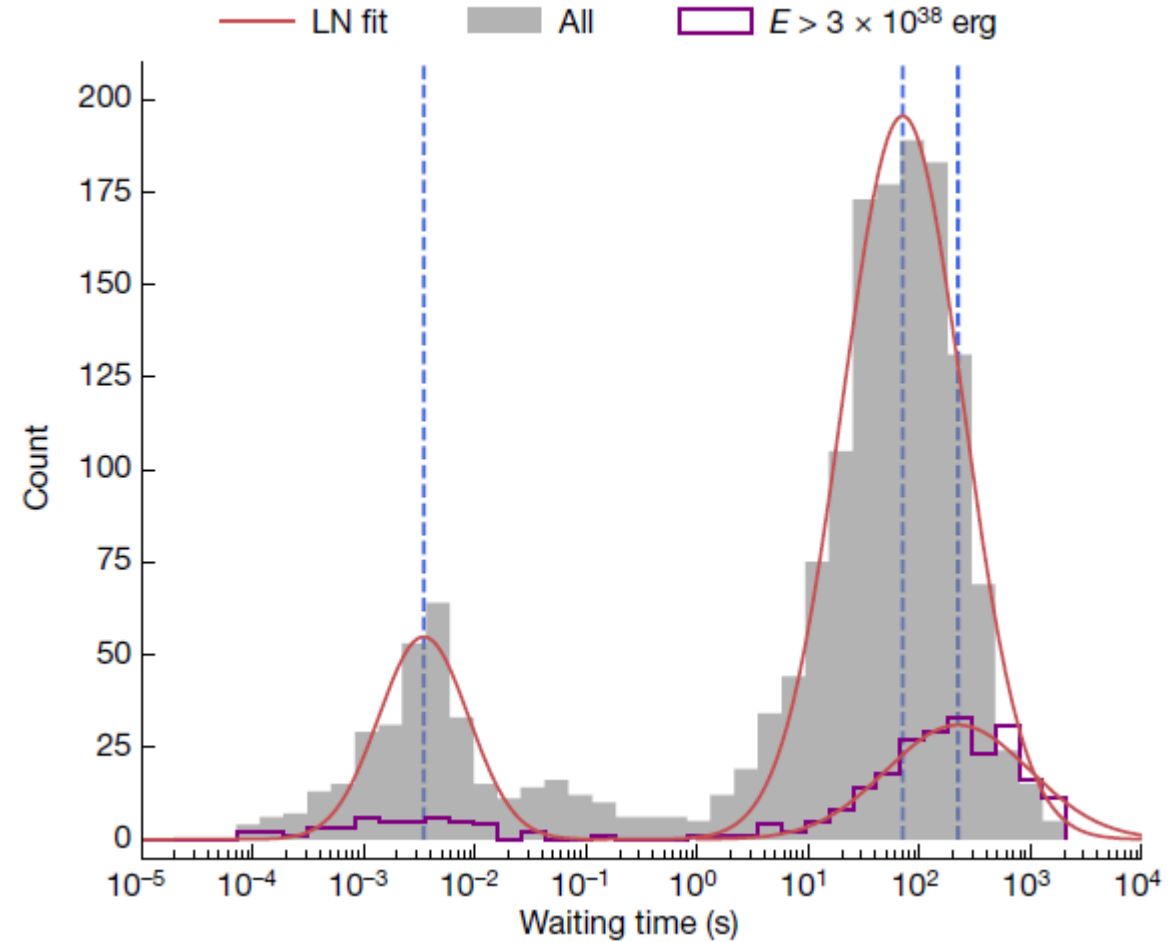
$E_0 = 7.2 \times 10^{37}$ erg $\alpha_E = 1.85$

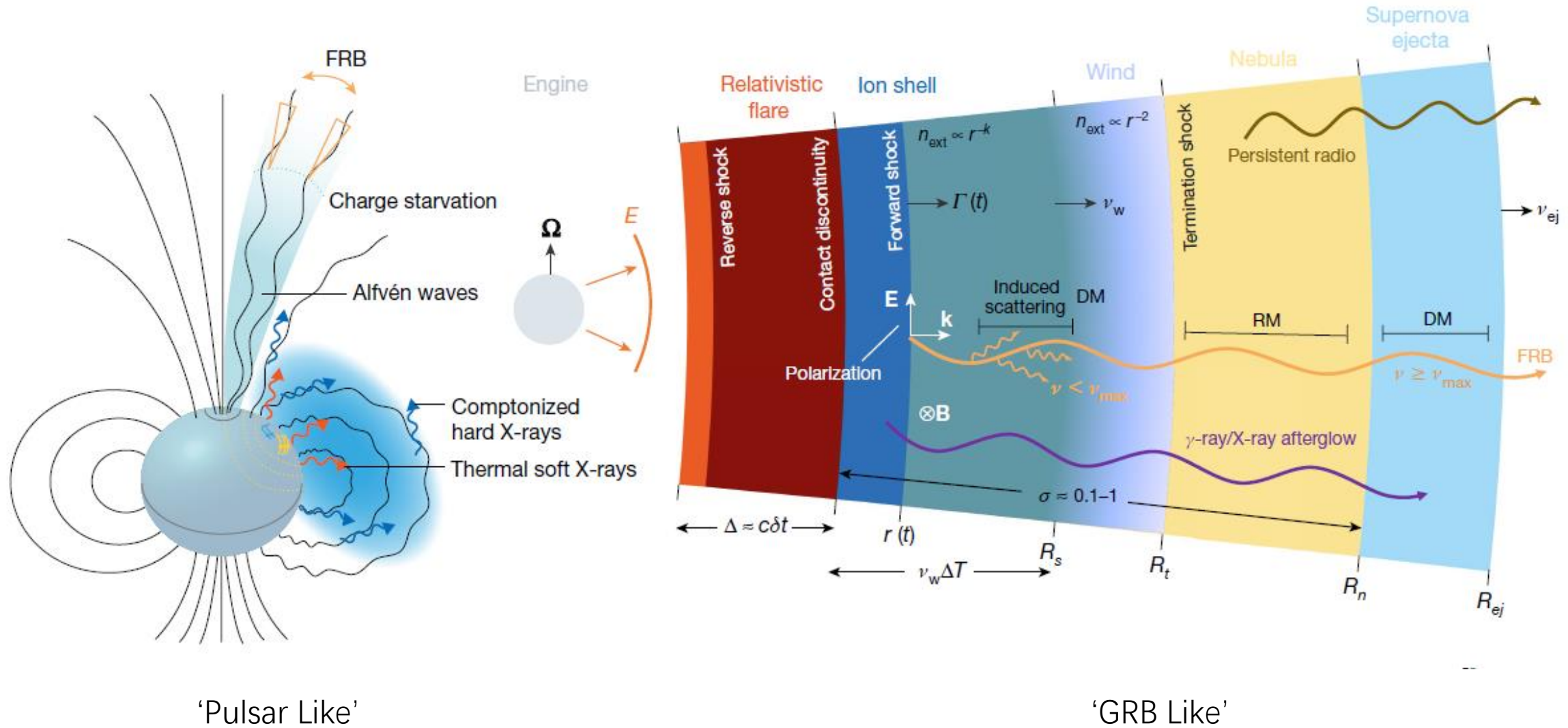$E_h = 3 \times 10^{38}$ erg

FAST Observation

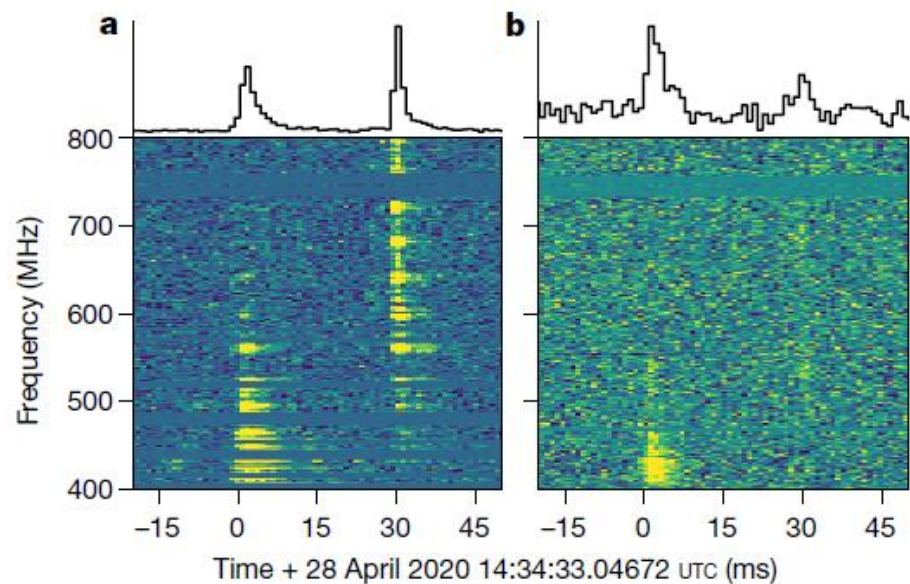$$\frac{d\text{DM}}{dt} = +0.85 \pm 0.10 \text{ pc cm}^{-3} \text{ yr}^{-1}$$

Extremely high rate disfavors the models which need expensive trigger to each burst.
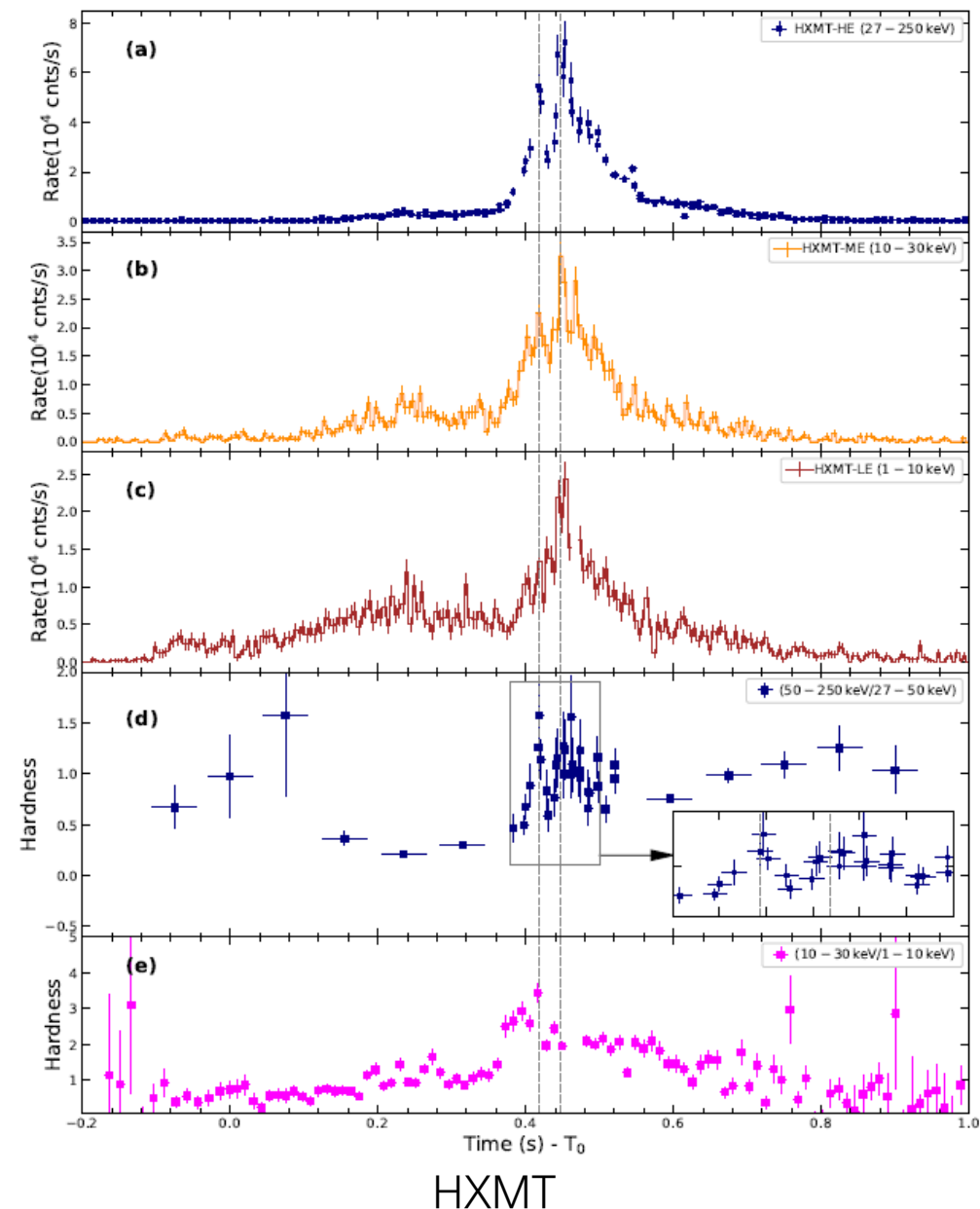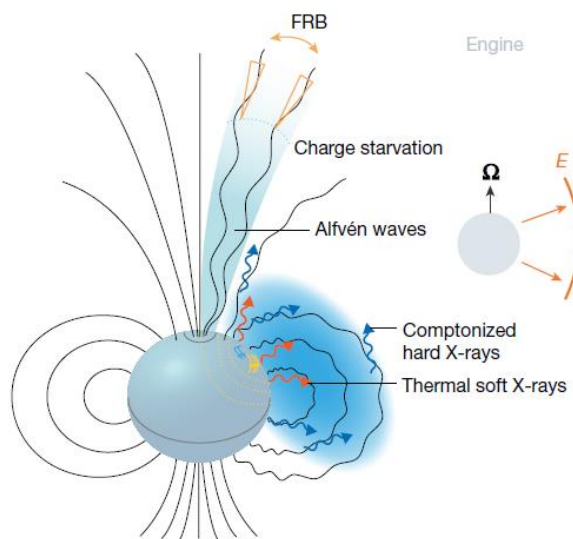
Mechanism

'Pulsar Like'   'GRB Like'

Lu et al.2020
Metzger et al. 2019

FRB from Magnetar

CHIME/FRB

SGR J1935+2154

$D \sim 9.5 \; kpc$ (Not quite sure)

$P \sim 3.24 \; s$

$\dot{P} \sim 10^{-11} s \; s^{-1}$

$B \sim 10^{14} G$ ('Magnetar')

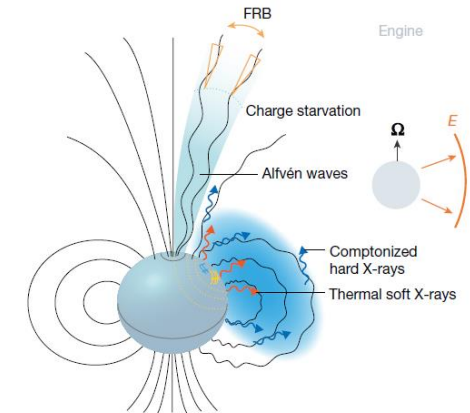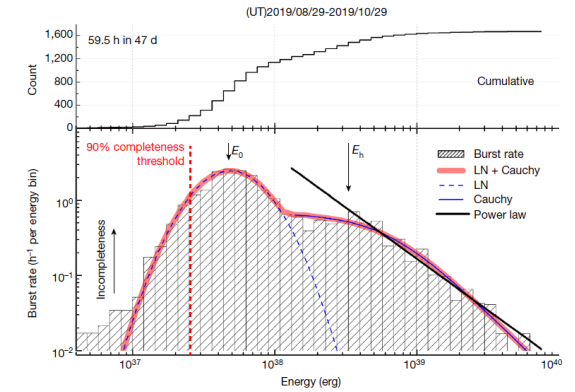CHIME/FRB 2020
HXMT 2020
Lu et al.2020

HXMT

Take Home Message

1) FAST detected FRB121102 for 59.5 hours and 1652 events were derived.

2) Energy distribution can be fitted by Lognormal and Cauchy model, which implies complicated mechanism.

3) Periodic search got no result.

4) Coherent emission model of neutron star is preferred.

Open Questions

1) Are all FRBs repeaters? If not, what're their mechanism?

2) Are there engines other than magnetars that can power FRBs? If so, what are they?

3) How is FRB generated from magnetar? Magnetosphere or relativistic shock?