Hundreds of Bursts from FRB121102

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Fast Radio Bursts

Fast radio bursts (**FRBs**) are milli-second duration, extremely bright flashes of radio emission associated with extragalactic distances. The majority of FRBs are observed as **one-off** events, but a few have exhibited **repeating** bursts. So far hundreds of FRBs have been detected and over a dozen have been localized to host galaxies and yet, despite numerous models (typically invoking highly magnetized neutron stars), the FRB emission mechanism(s) and their progenitors remain unknown.

Importantly, the nature of the apparent source dichotomy is also unanswered: are repeating and one-off FRBs **distinct** populations, or in fact **one** population (with a non-trivial energy distribution) that is splintered by observational biases?

In this poster we attempt to address this question using Arecibo observations in which we detected **hundreds** of bursts from the repeating FRB, FRB121102.

The Differences between One-off and Repeating FRBs

There is growing evidence in the literature that the properties of bursts observed from repeating and one-off FRBs are, on average, **different**.

Repeating FRB bursts	One-off FRB bursts
Often multiple sub-bursts + sad trombone effect	Often a single component burst
100% linearly polarised + flat polarisation position angle	Variety of polarimetric properties + swinging polarisation position angles
Longer durations + narrower bandwidths	Shorter durations + wider bandwidths

Notably, population synthesis studies have shown that the FRB sky can be described by **a single population** (Gardenier et al. 2021). By plotting the width of our sample of bursts from FRB121102 against their fluence/energy (see Figure 1), we see **two potential groups of repeating bursts**. This distinction becomes more prominent when also considering the **bandwidth** of the bursts. In Figure 2 we compare our bursts to other bursts from FRB121102 in the literature.

FRB121102: The First Discovered Repeating FRB

FRB121102 was the first repeating FRB detected (Spitler et al. 2016). Since then a multitude of bursts have been detected from it in frequencies ranging from ~ 600 MHz (Josephy et al. 2019) to ~ 8 GHz (Gajjar et al. 2018). FRB121102 has been localised to a star-forming region in dwarf galaxy at z=0.193 (Chatterjee et al. 2017, Tendulkar et al. 2017, Marcote et al. 2017). Additionally, there is also some evidence for a ~160 day periodicity for FRB121102 (Rajwade et al. 2020, Cruces et al. 2021).

The bursts generated by FRB121102 are not identical. Many of these bursts consist of multiple components that drift down in frequency (the "sad trombone" effect) and exhibit complex spectrotemporal features (Hessels et al. 2019). Gourdji et al. (2019) also demonstrated that the bursts from FRB121102 can be surprisingly narrowbanded and "smudgy". We, too, detect bursts displaying a wide range of morphologies.

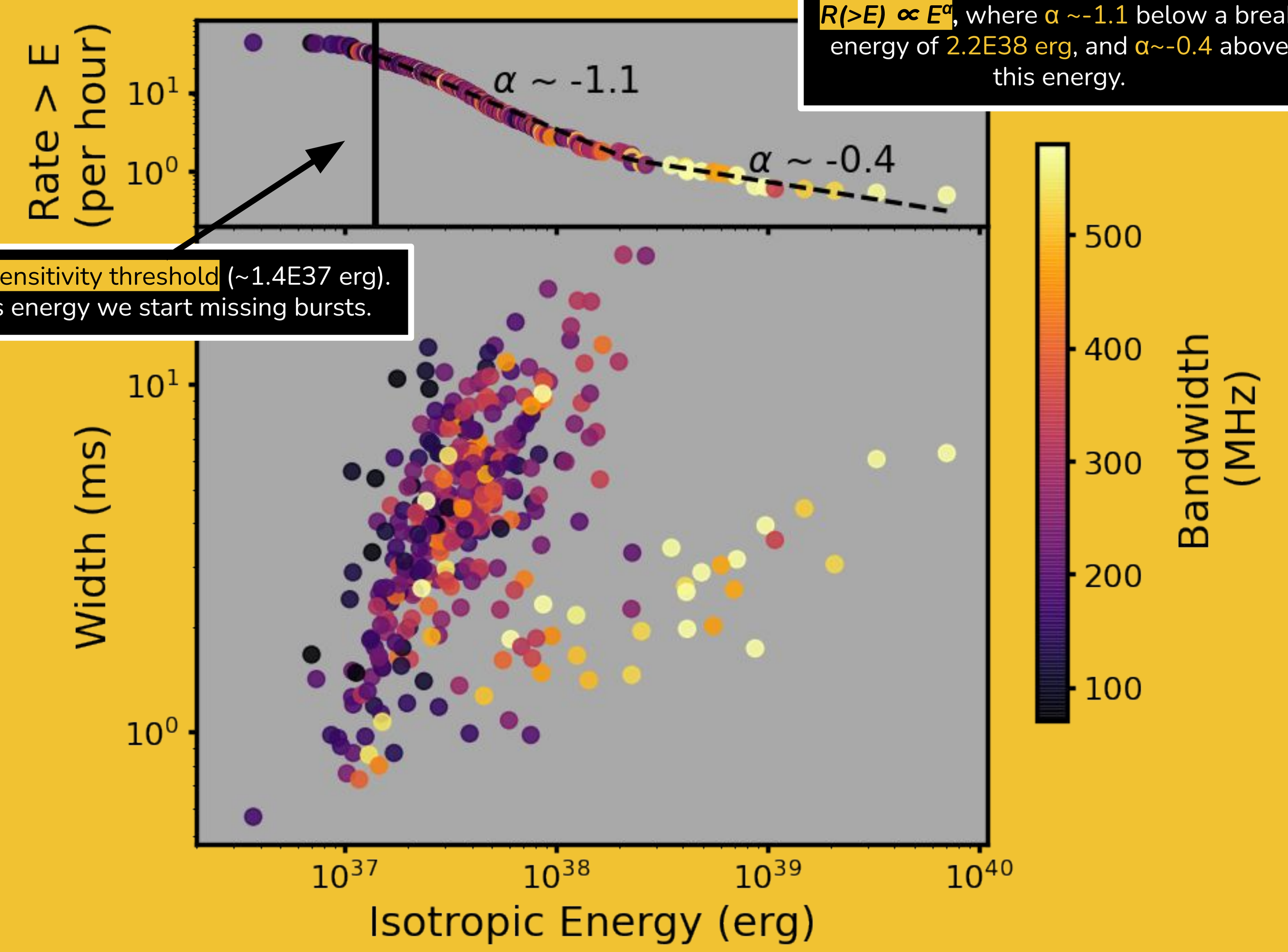


Figure 1 *Top panel* The isotropic burst energy cumulative distribution for our detected bursts. *Bottom panel* Burst width plotted as a function of isotropic burst energy for our 360 detected bursts from FRB1211202. The datapoints are coloured according to the bandwidth of the burst, and correspond to the points in the top panel. This plot hints towards **two possible populations of repeating bursts**, with the most energetic bursts typically having the largest bandwidths and being shorter duration than expected from their lower energy siblings - *much like one-off FRBs*.

Burst Detection: The Power of Arecibo + FETCH

FRB121102 was monitored for ~20 hours using the Arecibo Observatory between August and October 2016 (PI: Laura Spitler, P3054). These data were searched using standard procedures with PRESTO for bursts with a S/N > 6 after which burst candidates were assigned a probability of being astrophysical using the machine learning algorithm **FETCH** (Agarwal et al. 2020). Additionally, these astrophysical candidates were then subjected to two independent manually inspections to confirm their status. This resulted in (at least) **360 bursts** being detected from FRB121102 over the course of our observations.

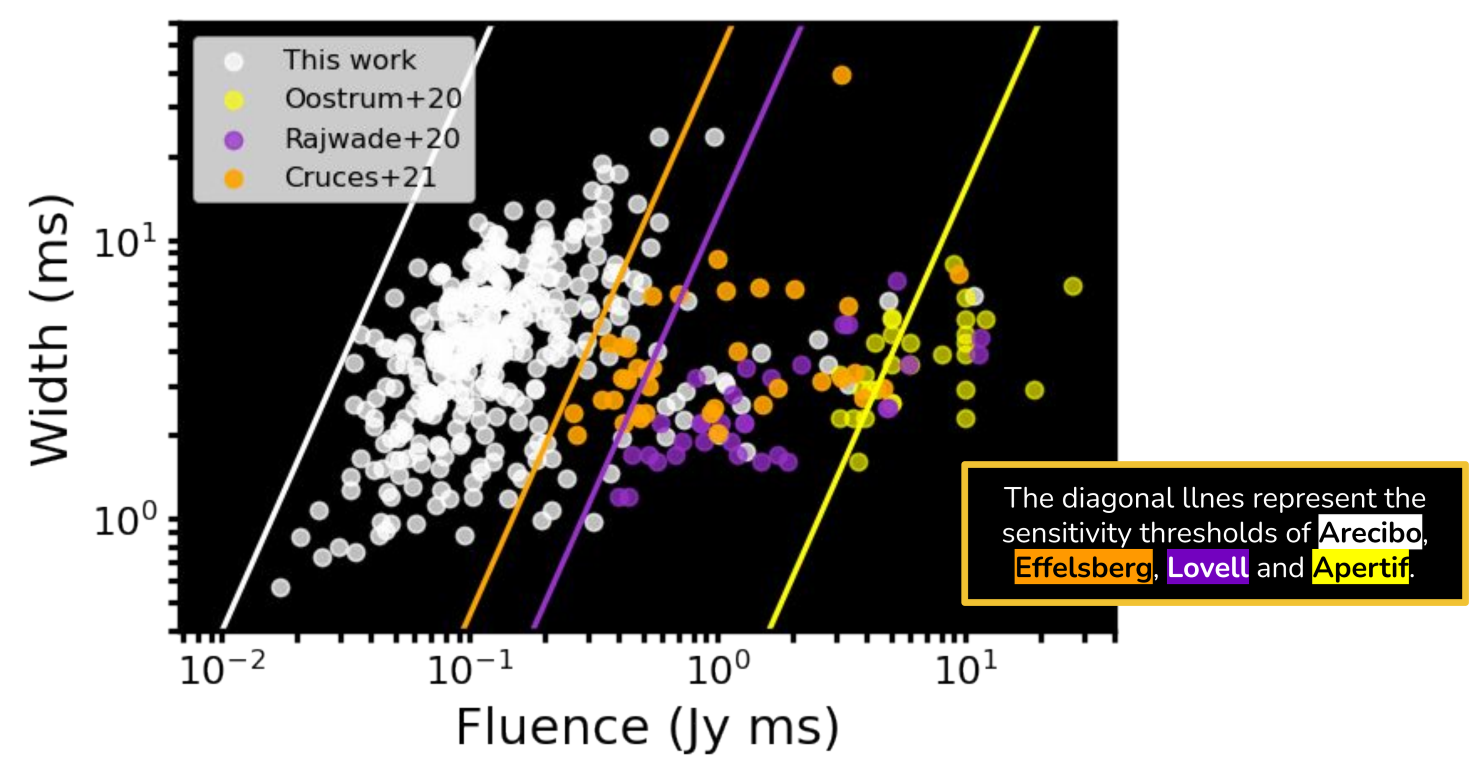
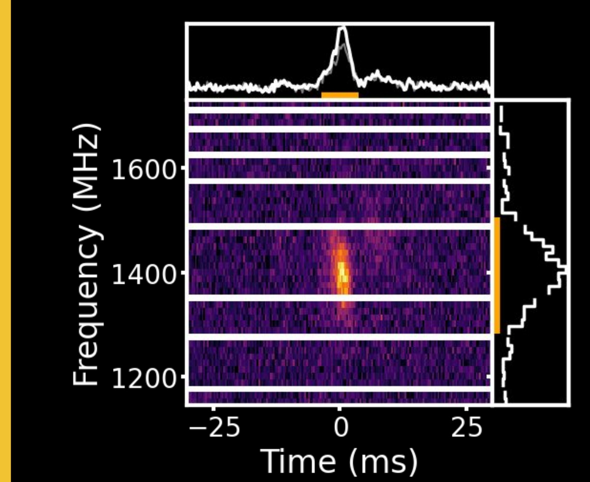
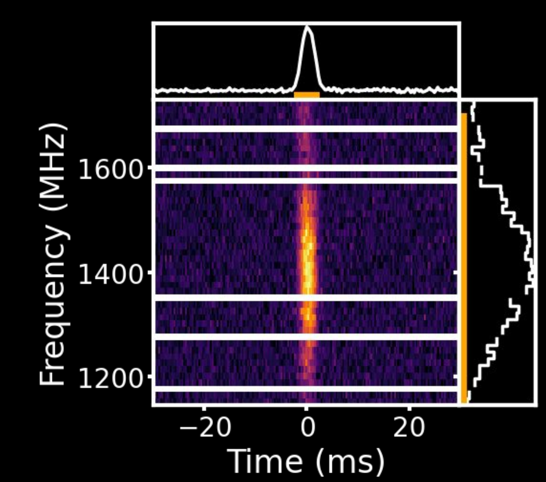


Figure 2 Burst width as a function of burst fluence for our detected bursts **(white)**, as well as numerous other previously reported bursts from FRB121102 at L-band. Oostrum et al. (2021) made use of Apertif **(yellow)**. Rajwade et al. (2020) made use of the Lovell Telescope **(purple)** and Cruces et al. (2020) used the Effelsberg telescope **(orange)**. The bursts detected by Cruces et al. (~128 hours of observation) inhabit a parameter space unoccupied by our observations (~20 hours), potentially representing the most energetic burst from the lower-energy group. On the other hand, bursts from Rajwade et al. (~198 hours) and Oostrum et al. (~130 hours) would form part of the potential higher energy group.



Here we show dynamic spectra (frequency vs time) of 2 bursts that we detected. Above each dynamic spectrum is a frequency-averaged burst profile and to the right is a time-averaged spectrum. Horizontal white bands are channels that have been zapped. The bursts on the left- and right-hand sides are from the potential lower- and higher-energy groups of FRB121102 bursts, respectively (as inferred by Figure 1).



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