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# Searching for FRBs with EPIC

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## Acknowledgements

This research has made use of the CHIME/FRB VOEvent Service.

## Background

De-dispersing some of the EPIC sources triggered from CHIME's VOEvent service and plotting their spectrograms could make FRBs more visible. The data we used had a bandwidth of 3.2 MHz, 4 polarizations, 64 channels, and an integration time of 80 ms. Some interference in the spectrograms has been masked out.

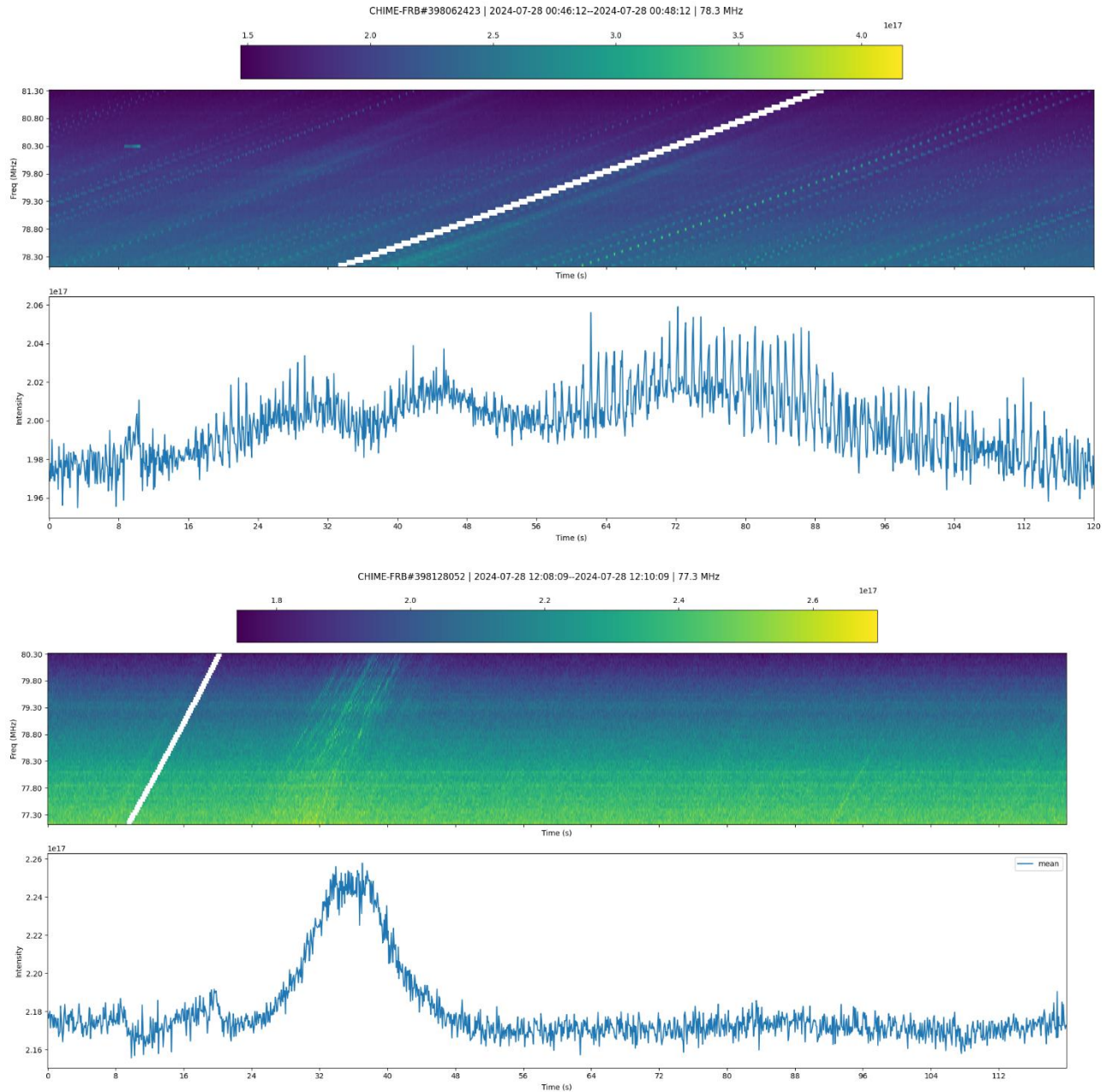
## Arrival Time Calculations

$$t_1 - t_2 = 4.15 \left( \frac{\text{DM}}{\text{cm}^{-3} \text{ pc}} \right) \left[ \left( \frac{\nu_1}{\text{GHz}} \right)^{-2} - \left( \frac{\nu_2}{\text{GHz}} \right)^{-2} \right] \text{ ms}$$

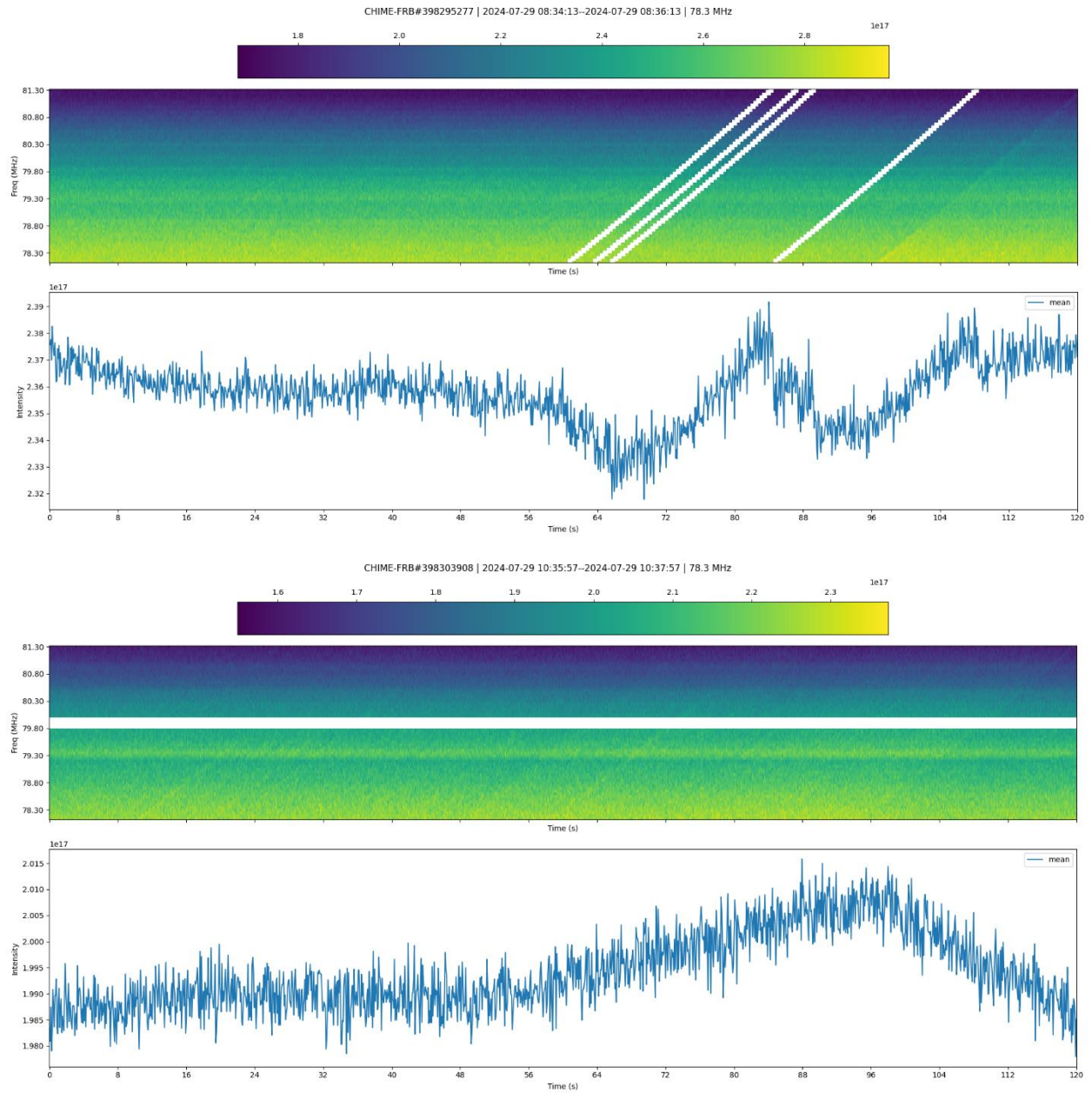
Name	Arrival Time at 400 MHz (utc)	Dispersion Measure (pc/cm <sup>3</sup> )	Our Frequency (MHz)	Delay time (s)	Arrival time (utc)
CHIME-FRB#398062423	2024-07-28 00:35:38.382	1065.93	78.3	693.8805548	2024-07-28 00:47:12.263
CHIME-FRB#398128052	2024-07-28 12:06:59.233	200.165	77.3	133.8282093	2024-07-28 12:09:13.061
CHIME-FRB#398295277	2024-07-29 08:30:16.413	456.538	78.3	297.1891595	2024-07-29 08:35:13.602
CHIME-FRB#398303908	2024-07-29 10:31:41.337	485.653	78.3	316.1419353	2024-07-29 10:36:57.479
CHIME-FRB#398310337	2024-07-29 11:12:47.532	350.996	78.3	228.4852657	2024-07-29 11:16:36.017
CHIME-FRB#398410825	2024-07-29 23:11:17.588	829.371	78.3	539.8894952	2024-07-29 23:20:17.477
CHIME-FRB#398418127	2024-07-30 00:12:22.000	792.169	78.3	515.6723849	2024-07-30 00:20:57.672
CHIME-FRB#398544311	2024-07-30 09:01:32.807	644.976	78.3	419.8552482	2024-07-30 09:08:32.662
CHIME-FRB#400023617	2024-08-02 07:32:20.930	491.314	78.3	319.8270345	2024-08-02 07:37:40.757
CHIME-FRB#400037241	2024-08-02 09:07:40.728	939.361	78.3	611.4888706	2024-08-02 09:17:52.217
CHIME-FRB#400078859	2024-08-02 15:17:22.656	533.369	78.3	347.2032663	2024-08-02 15:23:09.859
CHIME-FRB#400289418	2024-08-04 19:17:54.250	380.516	81.3	229.0434469	2024-08-04 19:21:43.293

Calculations for the arrival time were done for the lowest channel in the highest frequency band. Spectrograms of 2 minutes were then retrieved from the database centered around the expected arrival time of the FRB. Only the central pixel of the kernel was used to create the spectrograms.

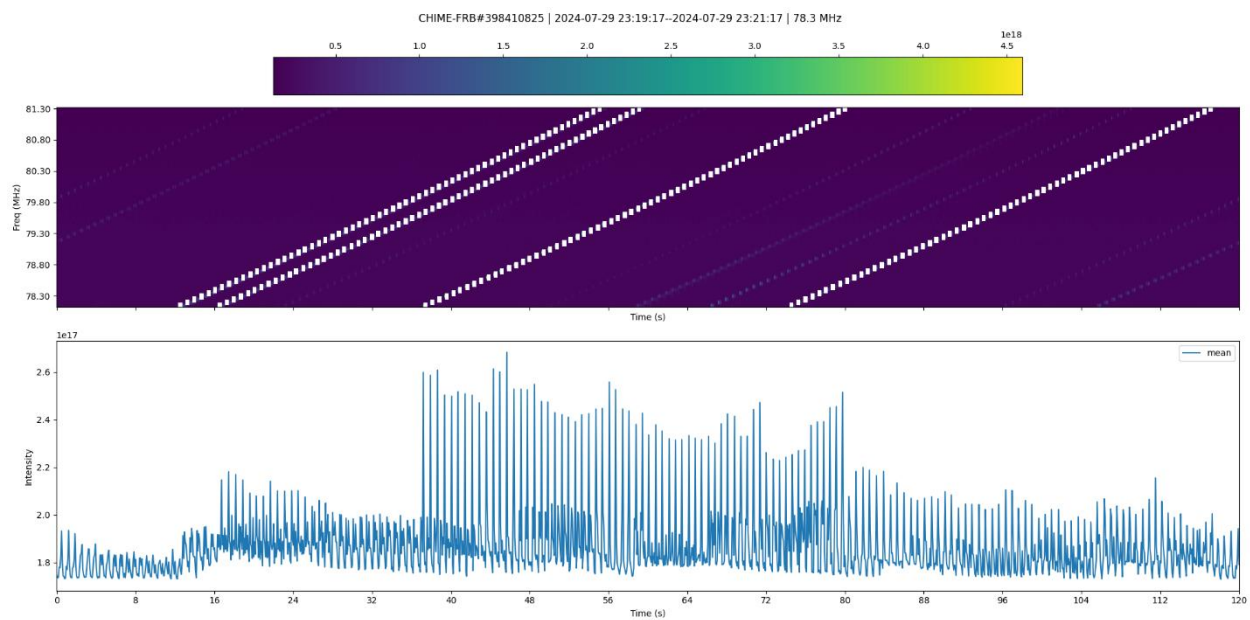
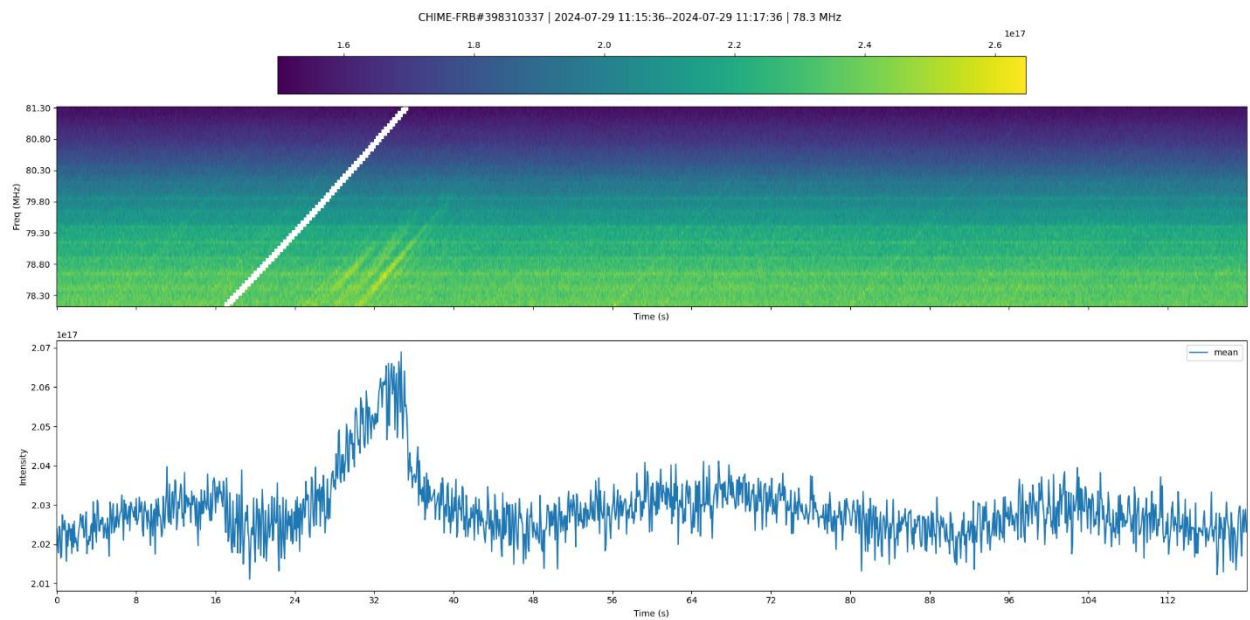
# Plots

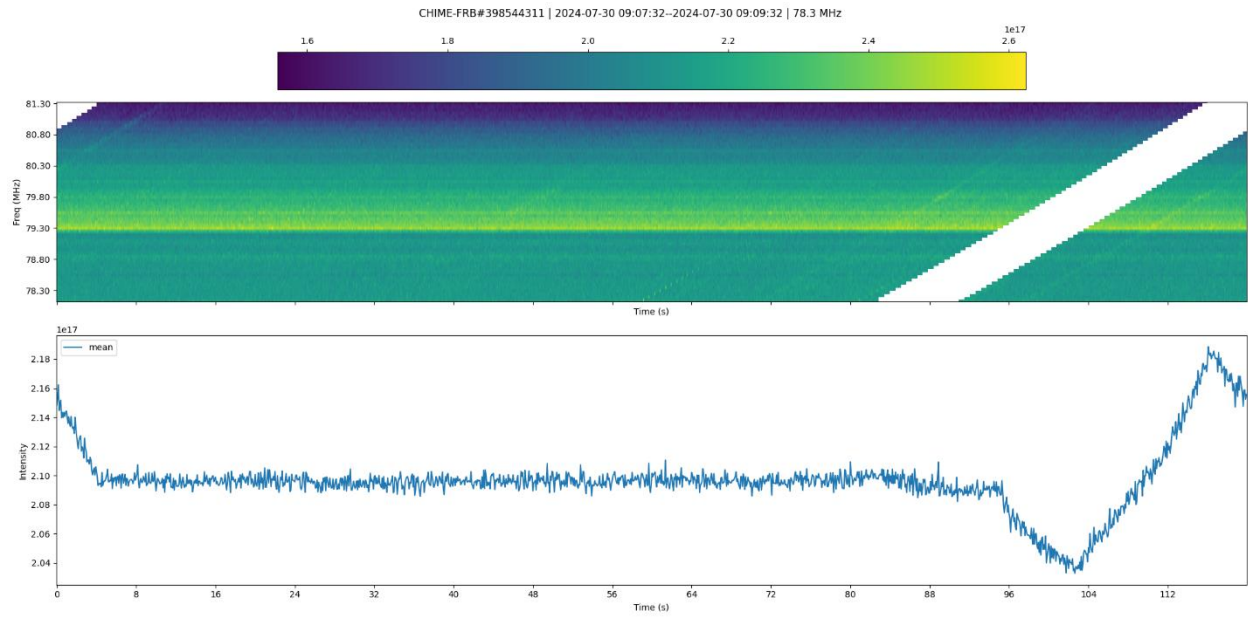


The first spike in the bottom plot is caused by the interference masking replacing values that decrease in intensity over time. The second spike is probably interference from another source since it had a very low dispersion measure compared to what CHIME measured for the FRB. The following plots with interference masking or similar interference show the same artificial spikes.



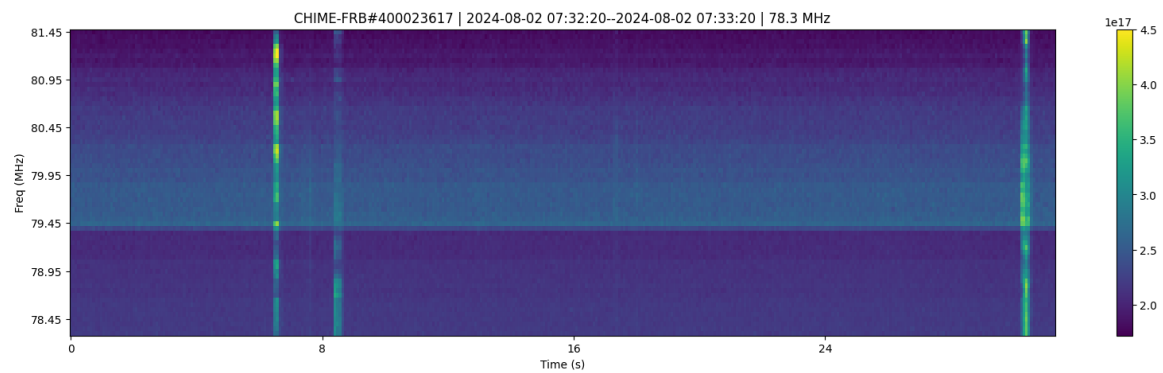
A gradual gain over time can be seen in the above plot. This could be a product of the epic algorithm or some interference from the sky.



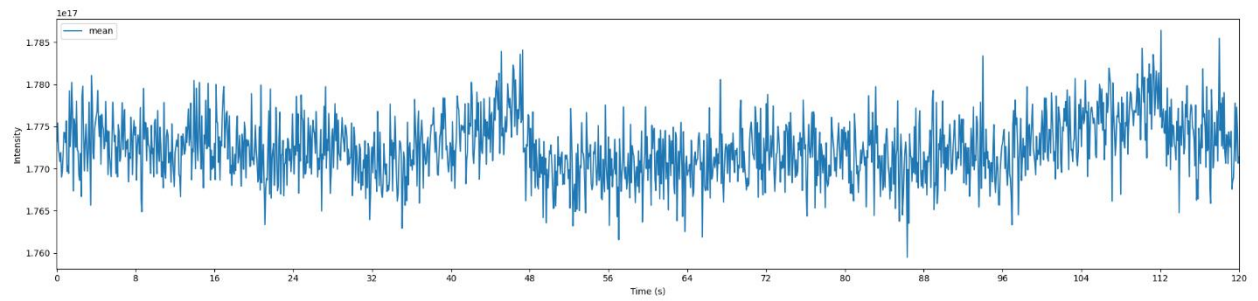
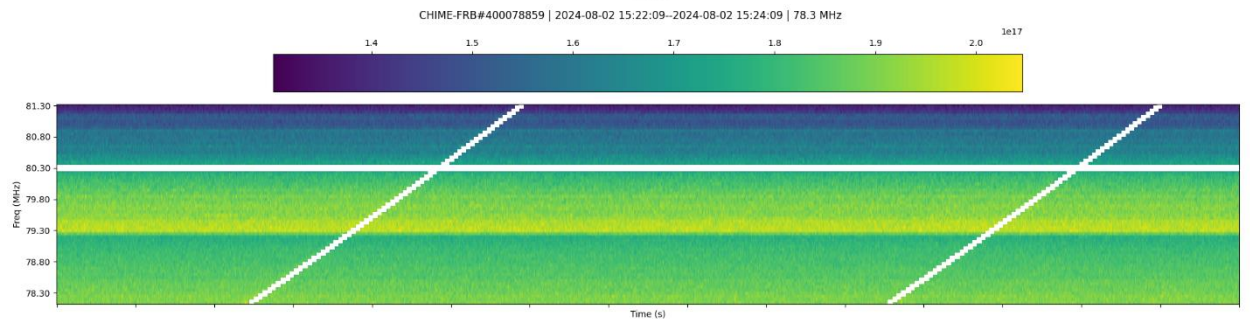
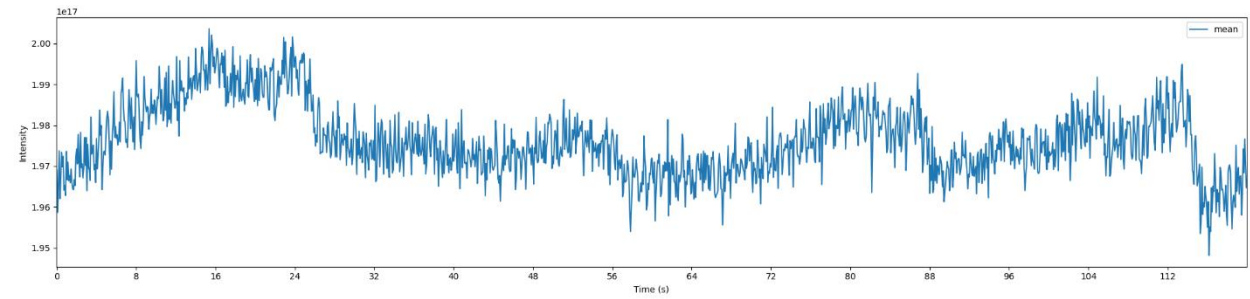
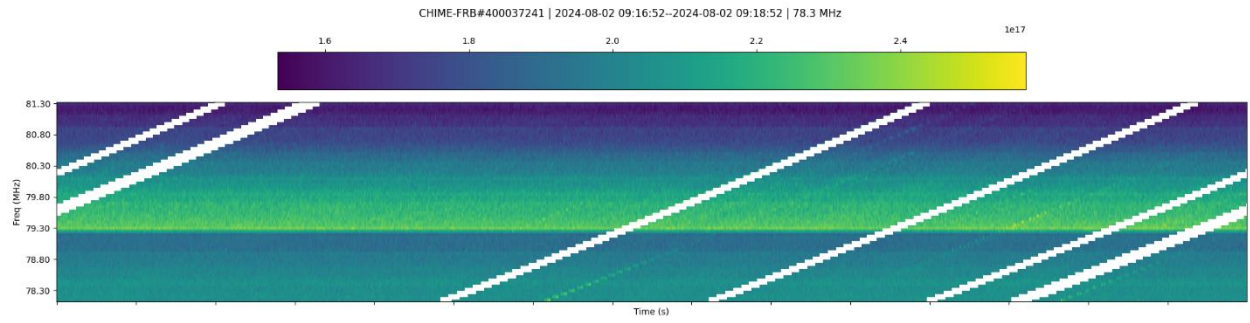


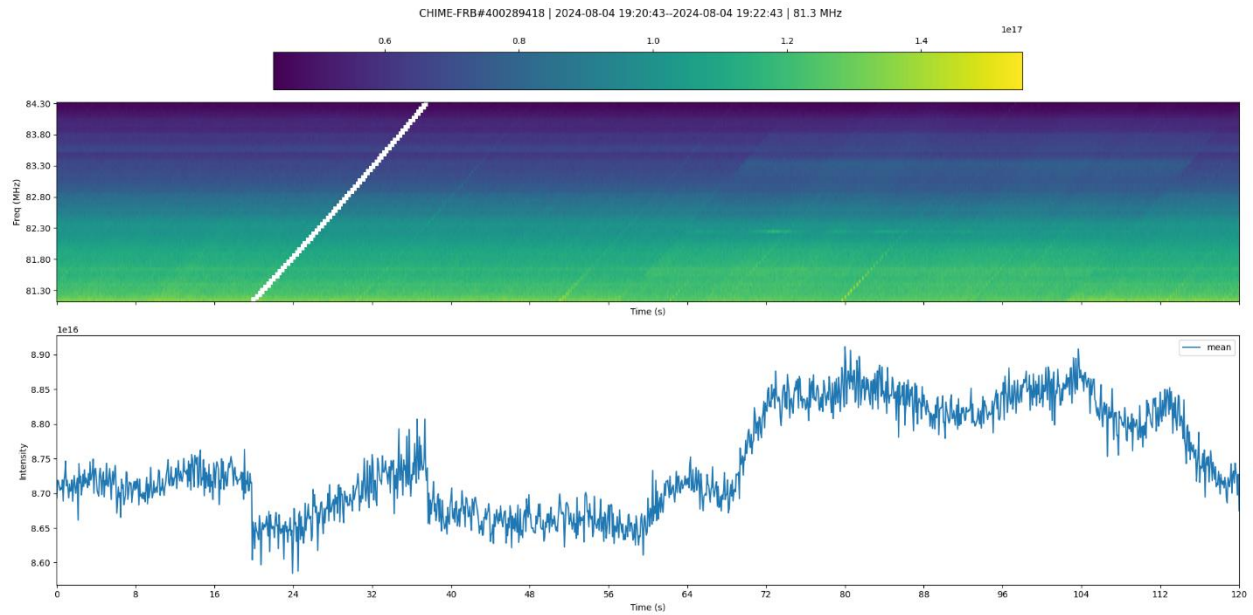
## CHIME-FRB#400023617

We could only query the first 30 seconds of the spectrogram for some reason









## Findings

We could not find any fast radio bursts in the plots. We expect that if they were visible there would be a big spike in the center of the intensity plot.

## Next Steps

To make the search for FRBs better, we could use a more advanced interference masking algorithm, one that uses inpainting instead of replacing interference with nans. Another option that can be explored is automatic creation of these plots and detection of FRBs. Applying a bandpass to cancel out the gradient on the frequency axis could be useful also. One thing that wasn't considered here but should be is the uncertainty in arrival time and dispersion measure.