Fast Radio Bursts and the Physics of Their Emission Mechanism

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Program: Spontaneous R&TD

PROJECT OBJECTIVE

- Initiate a pilot project at the DSN to observe a sample of repeating FRBs
- Make use of excellent sensitivity, unique frequency coverage, and existing pulsar instrumentation at DSS-43 in Canberra
- Characterize the broadband emission of individual bursts
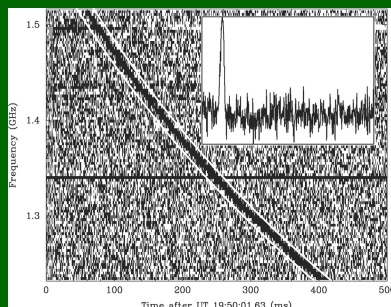
The original FRB: Lorimer+ Science 2008

BACKGROUND

- FRBs are bright , but short duration emission at radio frequencies
  - Typical flux densities range from 50 mJy – 100 Jy
  - Bursts have been detected with durations of ~1 millisecond
- The origin of these bursts remains an outstanding mystery
- First FRB was discovered in 2008
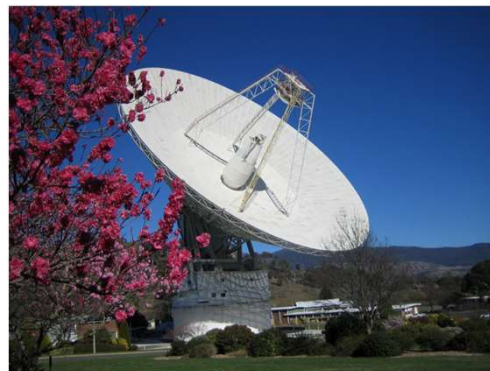- Current census includes ~100 FRBs, including 11 repeaters

BENEFITS TO NASA & JPL

- Developed a robust detection pipeline for identifying FRB candidates
- Broadband characterization of individual bursts with implications for the nature of the emission process
- Make use of DSN capabilities to carry out research in an exciting and developing frontier in time domain astronomy
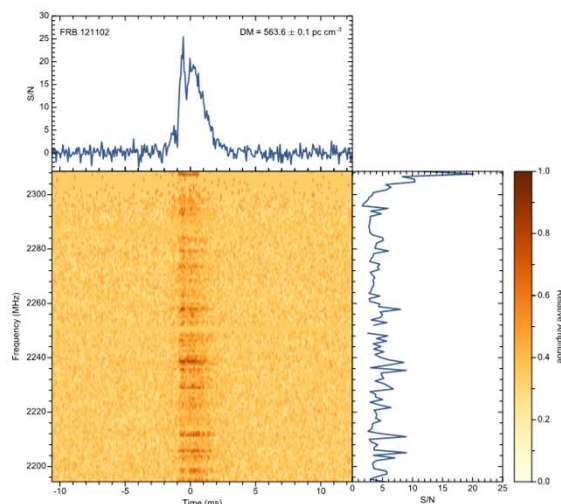- Positions Caltech and JPL scientists to make unique contributions in this emerging field

PUBLICATIONS

- *Pearlman, A., Majid, W., Prince, T. et al., "Detection of Multiple Radio Bursts from FRB 121102 using the Deep Space Network", The Astronomer's Telegram, To be submitted soon.*
- *Majid, W., Pearlman, A., Prince, T., et al., "Detection of Multiple Radio Bursts with Spectral-Temporal Features from FRB 121102 using the Deep Space Network", To be submitted to ApJL.*
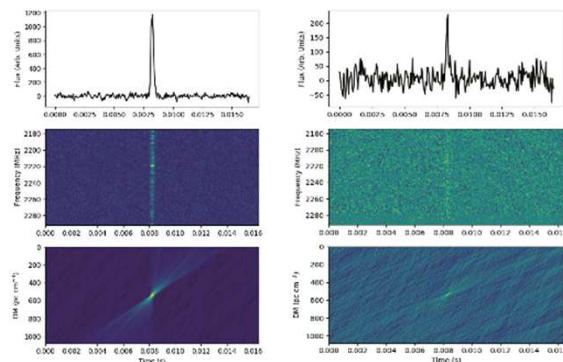
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The 70-m DSN Dish in Canberra

First Detection of a FRB with a DSN Dish

Dynamic spectrum of a burst from FRB121102 showing the time frequency structure of the candidate event captured with DSS-43 at S-band.

FRB candidates with detection SNR > 6 were saved and classified using a machine learning pipeline based on the FETCH package. The figure above shows two such identified candidates with very different SNRs