Following CHIME Fast Radio Bursts with VERITAS

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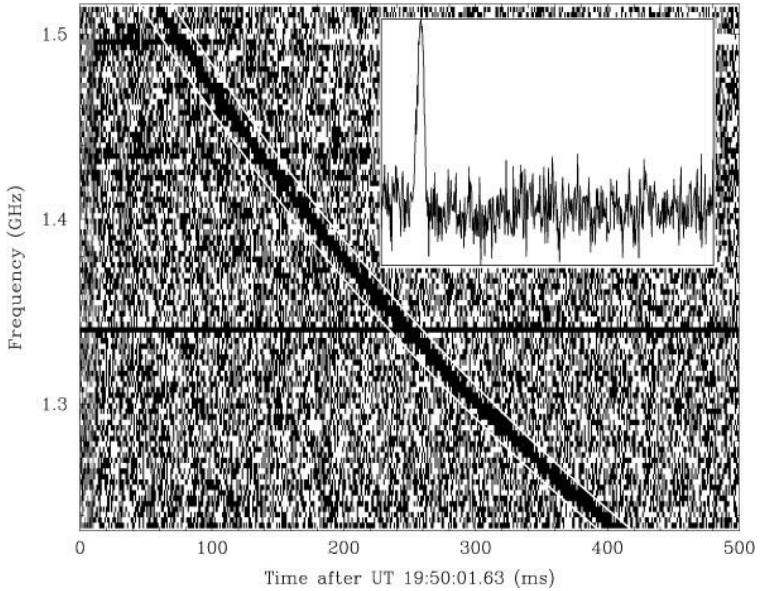
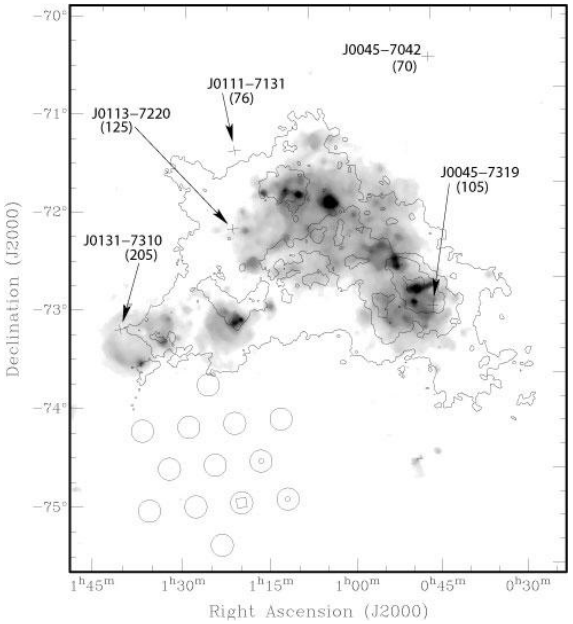
FERMI Summer School 2019

Initial Discovery

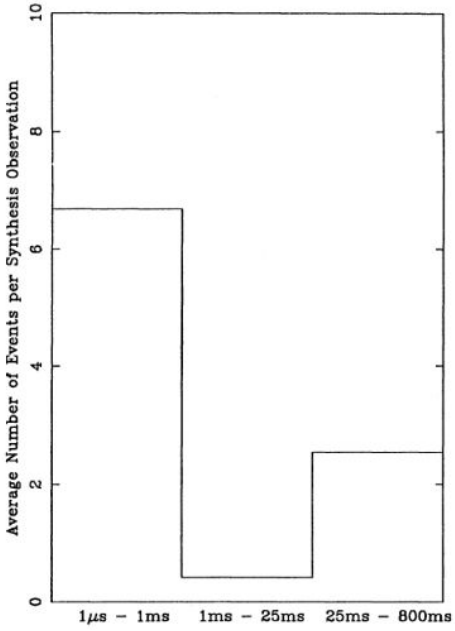


The first detected FRB, “waterfall plot” of intensity as a function of radio frequency versus time

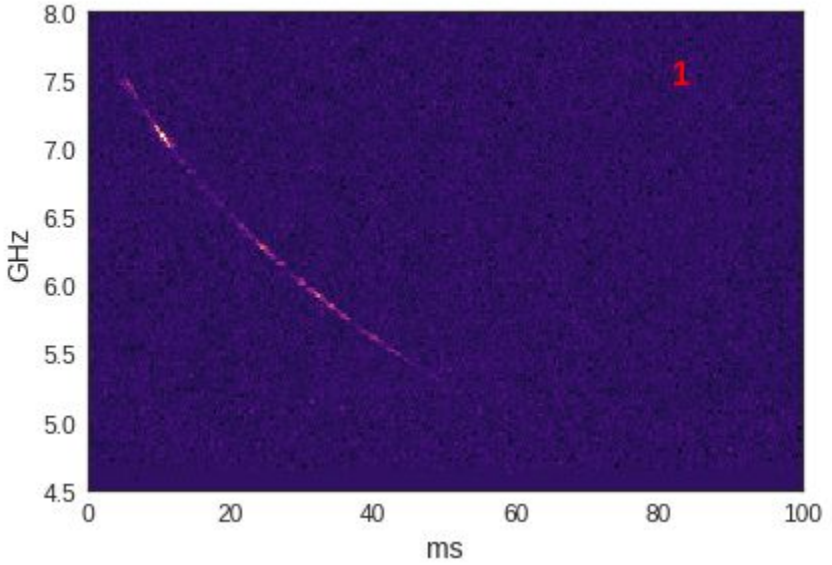


Location of first burst as indicated by the square, open circles show the positions of the 13 beams in the original survey pointing

Discoveries since Confirmation



Excess of unexplained events in the 1 us - 1 ms range during a 1989 survey done by Molonglo Observatory Synthesis Telescope



An animation of the series of detections of FRB 121102, the first found FRB repeater; numbers in red represent data from the first detection; the rest was found in archival data by an AI at the Green Bank Telescope

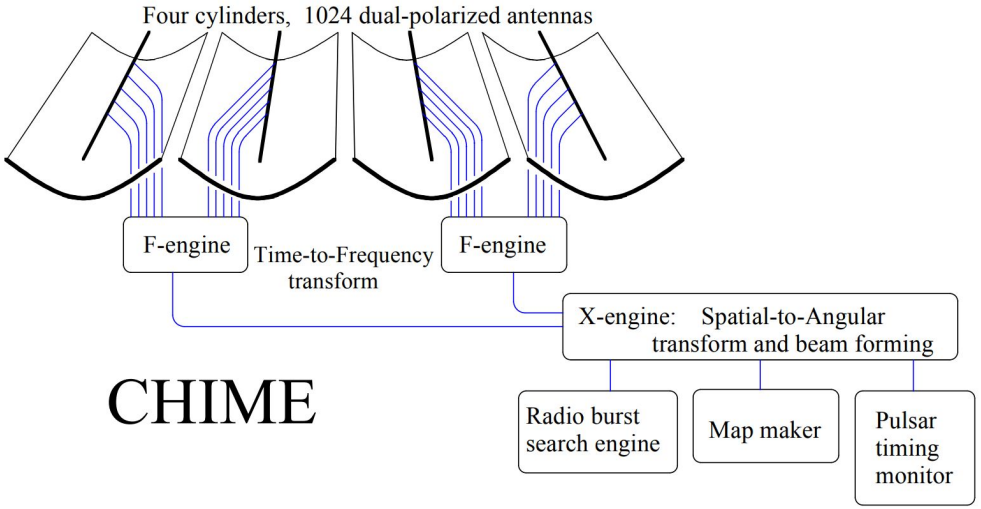
Progenitor Theories

“Until recently, there were more theories [about FRBs] than actual radio bursts” - West Virginia University astrophysicist Sarah Burke-Spolaor comment to Snopes

- Roughly 55 Theories which cover:
  - Neutron Stars
  - Black Holes
  - Cosmic Strings
  - Strange Stars
  - Aliens?

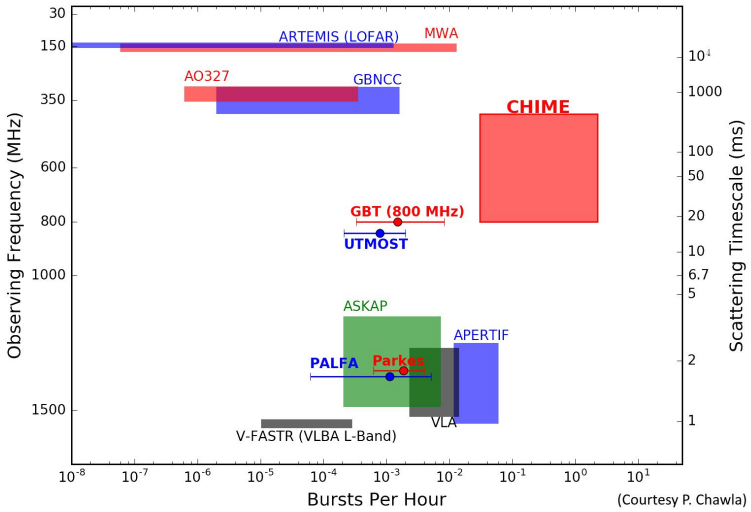
CHIME Summary

View of the CHIME telescope

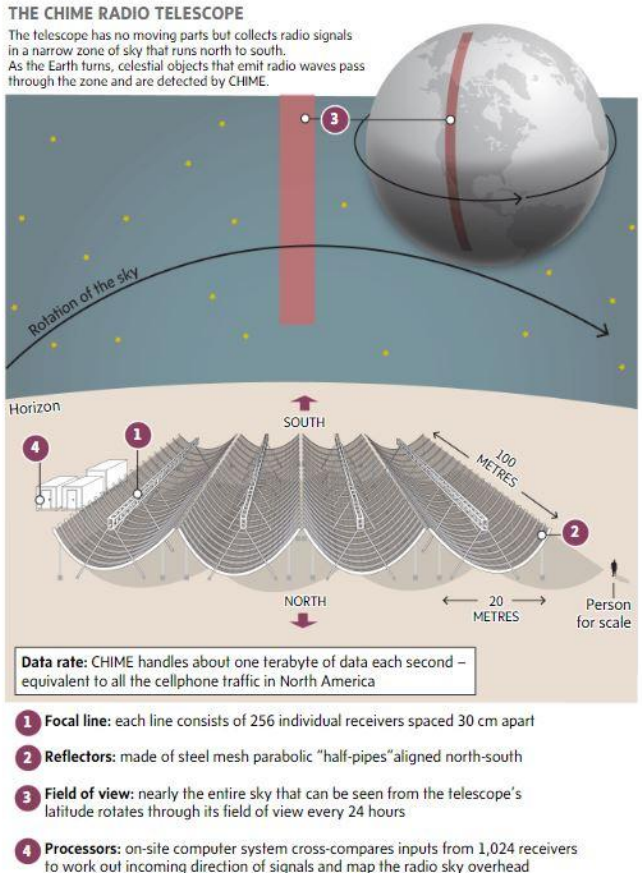


CHIME Schematic, the various components of its data pipeline

CHIME FRB Goals



Observing domain of CHIME for FRBs and how it compares to other telescopes



Why VERITAS

- VERITAS has a large collecting area
- Through the use of PMTs, is able to reach the time scales of FRBs
- In a convenient location for coincident observations with a canadian telescope

Issues with coincident observing with CHIME

- Cannot interfere with normal operation
- Overlap Field Of View
- Long enough to collect data
- Luck

Coincident Observing with CHIME

- Use targets which were already being observed
- Figure out when the FoV is overlapping
- Allow observer to make a determination of the timing
- High expected rate implies eventual guarantee

Future Work

- Current data analysis, already results from CHIME
- Archival analysis

Questions?

Backups

Neutron Star Theories

- Regular emission from young neutron stars
- Wandering beams
- Magnetic reconnection from violent collision
- Magnetar hyperflare
- Young magnetar MASER
- Birth of Neutron Star
- Death of Neutron Star
- Quark Nova

Black Hole Theories

- Jet interacting with the surrounding medium
- Binary black hole jet interaction
- Magnetic reconnection with primordial black holes
- Neutron Star - Black Hole merger

Other Theories

- Black Hole going to White Hole
- Strange Star interacting with turbulent wind
- Strange Star Collapse
- Superconducting cosmic strings
- Decay of Cosmic String Cusps
- Superconducting Dipoles orbiting Supermassive Black Holes
- Axion Miniclusters
- Cavitons
- Dicke superradiance
- Alien Light Sails