The ARTEMIS FRB Survey

Early Results

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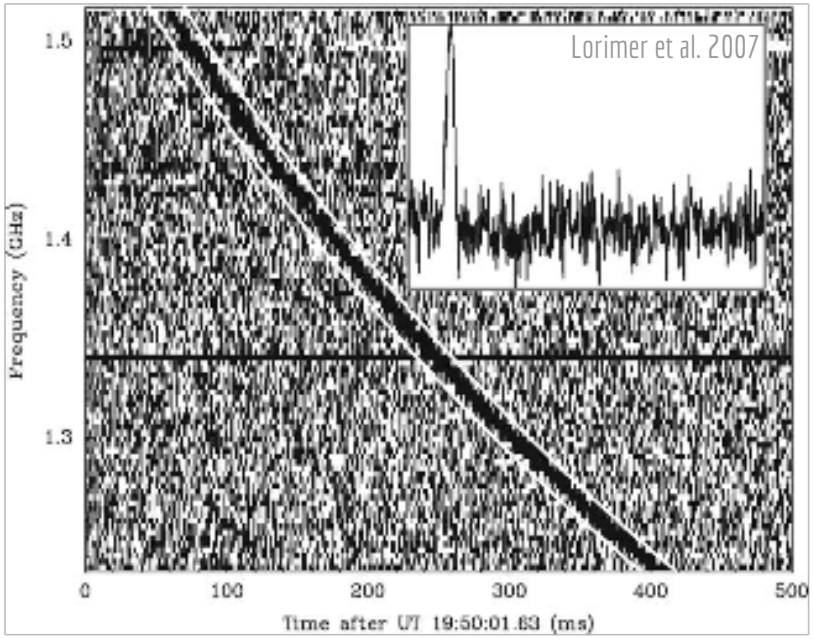
Motivation

- ➔ Fast Radio Bursts
  - Broad-band
  - Pulse widths: ~ms
  - Dispersed: ~f^{-2}
  - Scattered
  - DM > $DM_{Galactic}$



Motivation

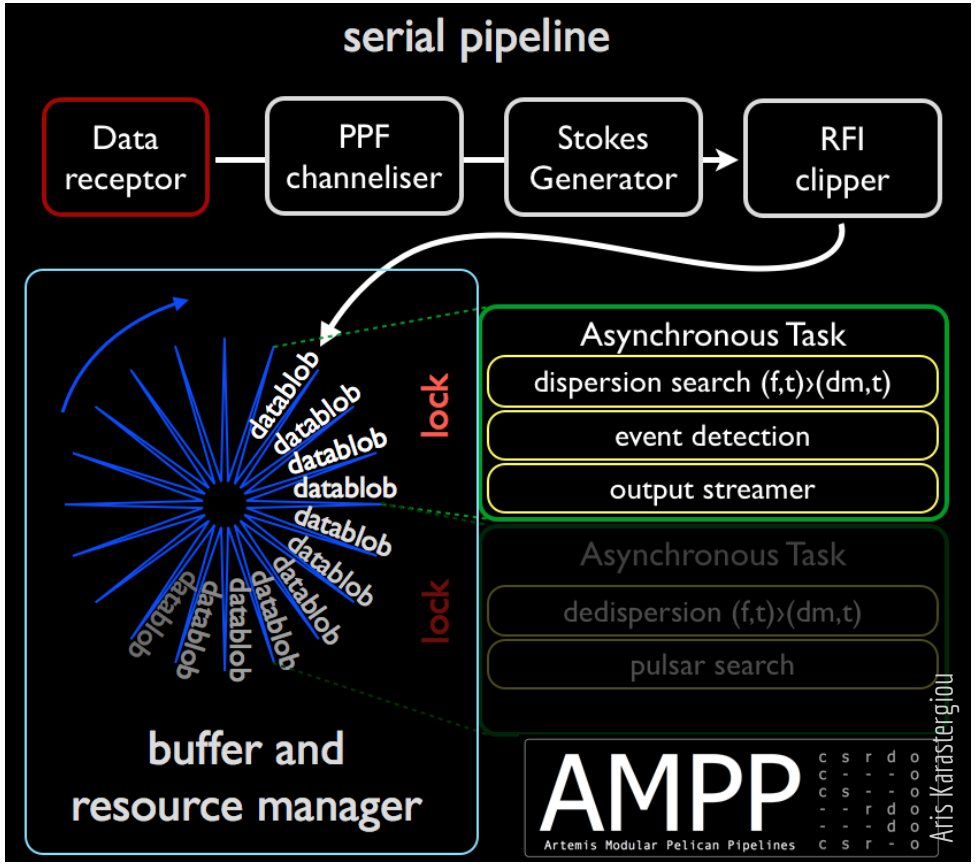
- ➔ > 8 known FRBs (> 7 at Parkes, 1 at Arecibo)
- ➔ Origin:
  - ◆ Extragalactic:
    - Flaring magnetars?
    - Binary neutron star mergers?
    - Gravitational collapse of neutron stars to black holes?
    - Pulsar companions? (Next talk)
    - ...
  - ◆ Galactic (non-local):
    - Nearby flare stars?
    - ...
  - ◆ Local:
    - Atmospheric effects?
    - ...

The ARTEMIS Survey

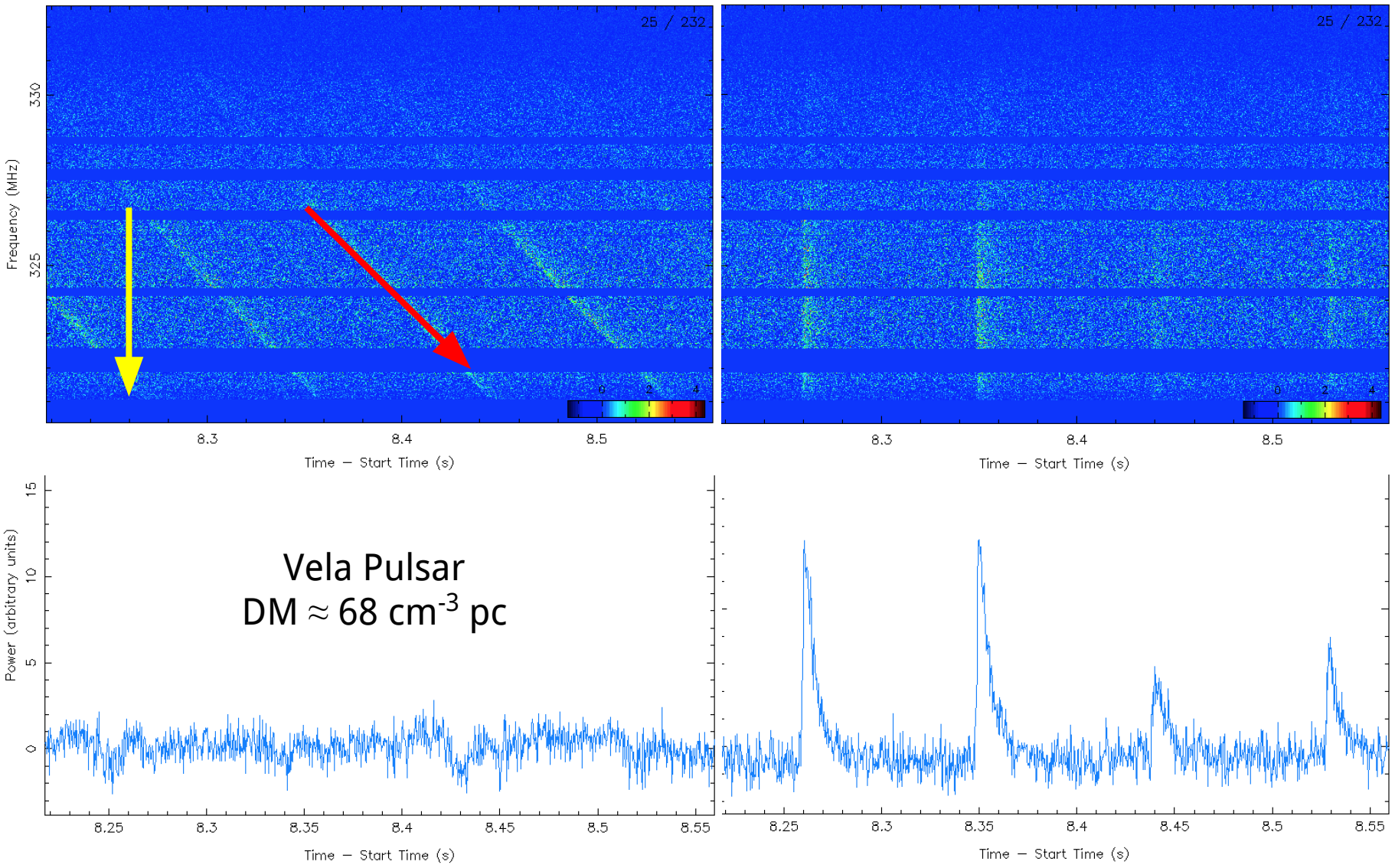
- ARTEMIS: Advanced Radio Transient Event Monitor and Identification System
  - Real-time incoherent dedispersion search
  - Use individual LOFAR stations to search for FRBs
    - Chilbolton, UK
  - HBA (120 - 240 MHz)
  - $f_c \approx 146$ MHz; BW ≈ 6 MHz
  - Drift scan; Beams = 8; Beamwidth $\approx 2^o \Rightarrow 30$ sq. deg.
  - Sensitivity ≈ 35 Jy
  - GPU-powered HPC
    - Four 12-core servers, with NVIDIA Fermi-architecture GPU cards

ARTEMIS

- AMPP: Artemis Modular PELICAN Pipelines
  - PELICAN: C++ framework with configurable client-server architecture
  - Distributes incoming data across processing nodes

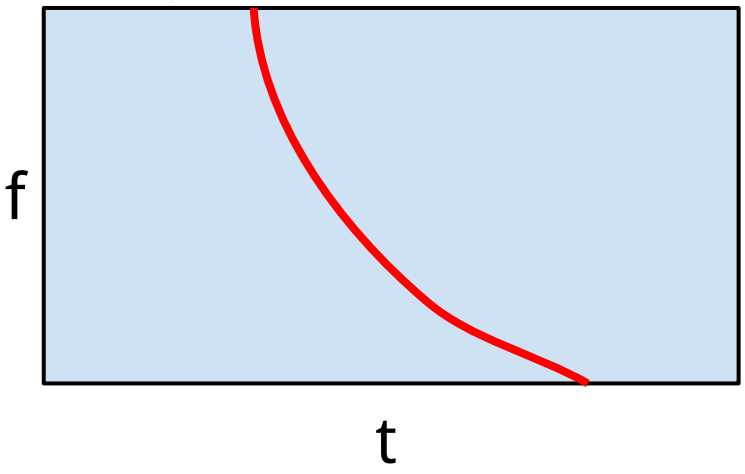


Data Processing

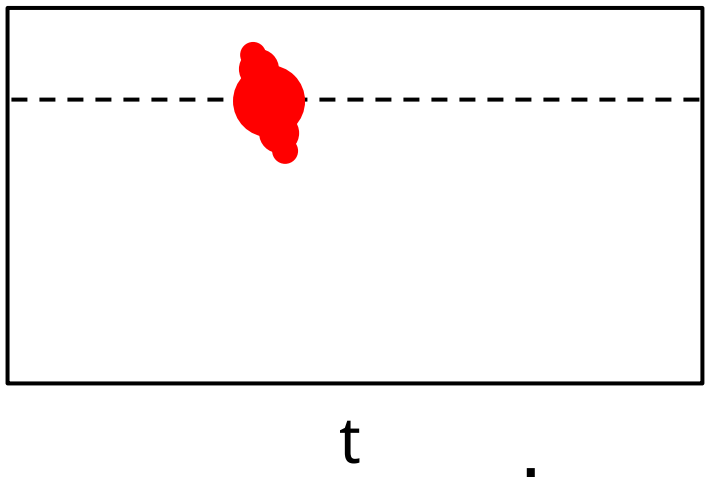


Data Processing

Polyphase channelization
Stokes generation
RFI clipping



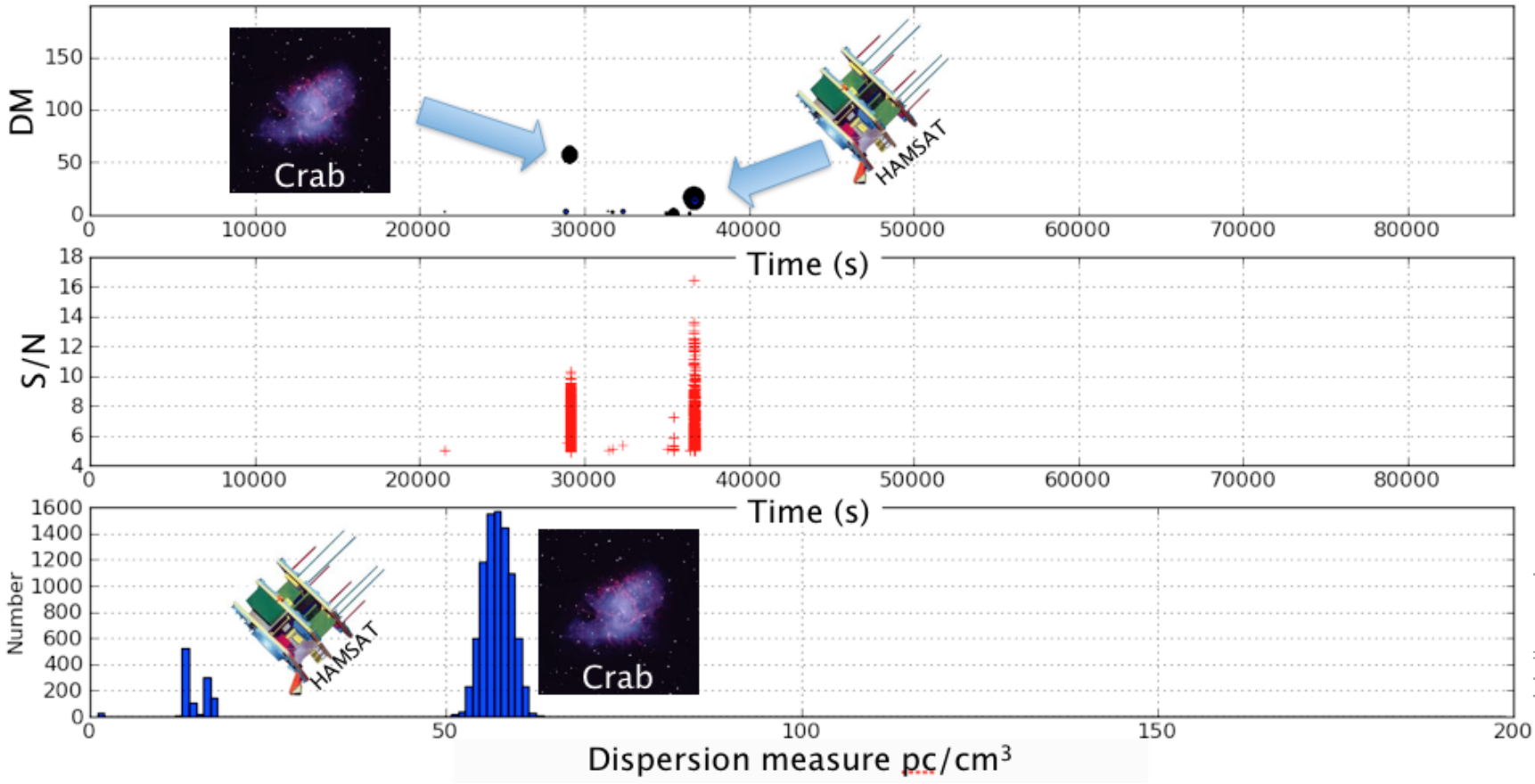
DM_{max} = 150 cm^{-3} pc



Dedispersion transform:
(f, t) → (dm, t)
Smoothing, thresholding

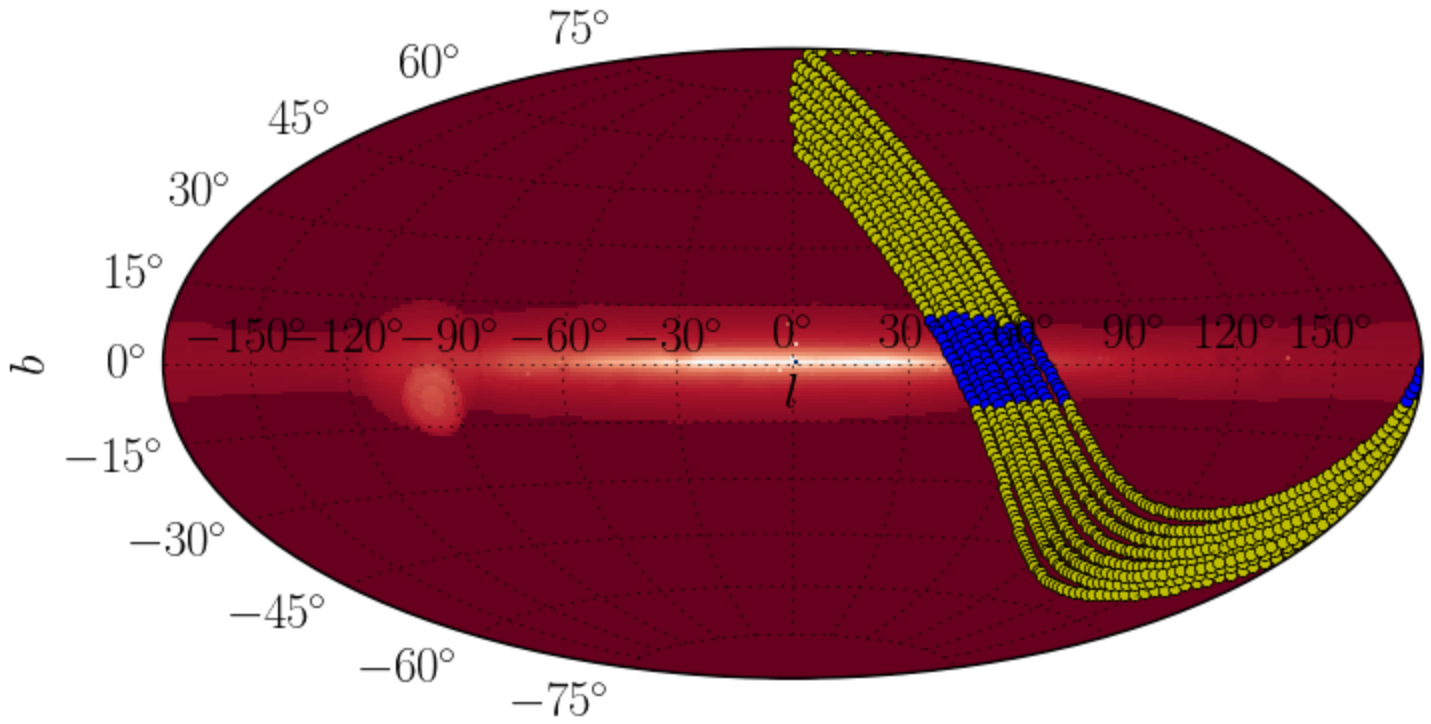
Manual examination of plots

Early Results



Aris Karastergiou

Early Results



DM_{max} = 150 cm^{-3} pc ⇒ Volume ≈ 2.12 x 10^7 Mpc^3
(z_{max} ≈ 0.1)

n = 10^{-3} Mpc^{-3} ⇒ 10^4 galaxies ⇒ 10 FRBs per year
(using Thornton et al. 2013 rate)

Early Results

- ➔ Total time surveyed ~ 1000 hours
- ➔ Expected number of events (using Thornton et al. 2013 rate) ~ 3
- ➔ Detected number of events = 0 $\Rightarrow$ Rate < 33 sky^{-1} day^{-1} above 35 Jy

Future Work

- ➔ LOFAR: DM_{max} = 320 cm^{-3} pc
  (10s of FRBs in 1000 hours)
- ➔ Arecibo: ALFABURST
  (a few FRBs per month)

Credits

FRB figure	Lorimer et al. 2007
AMPP figure	Aris Karastergiou
LOFAR drift scan figure	Aris Karastergiou