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}

Lorimer et al. 2007
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 $\approx 6$ MHz
  ◆ Drift scan; Beams = 8; Beamwidth $\approx 2^\circ \Rightarrow 30$ sq. deg.
  ◆ Sensitivity $\approx 35$ Jy
  ◆ GPU-powered HPC
    ● Four 12-core servers, with NVIDIA Fermi-architecture GPU cards
→ AMPP: Artemis Modular PELICAN Pipelines
  ◆ PELICAN: C++ framework with configurable client-server architecture
  ◆ Distributes incoming data across processing nodes
Data Processing

Vela Pulsar
DM $\approx 68 \text{ cm}^{-3} \text{ pc}$
Data Processing

Polyphase channelization
Stokes generation
RFI clipping

Dedispersion transform: \((f, t) \rightarrow (dm, t)\)
Smoothing, thresholding

\(DM_{\text{max}} = 150 \, \text{cm}^{-3} \, \text{pc}\)

Manual examination of plots
Early Results

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Early Results

\[ DM_{\text{max}} = 150 \text{ cm}^{-3} \text{ pc} \Rightarrow \text{Volume} \approx 2.12 \times 10^7 \text{ Mpc}^3 \]
\[ (z_{\text{max}} \approx 0.1) \]

\[ n = 10^{-3} \text{ Mpc}^{-3} \Rightarrow 10^4 \text{ galaxies} \Rightarrow 10 \text{ FRBs per year} \]
(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 \text{Rate} < 33 \text{ sky}^{-1} \text{ day}^{-1} \text{ above 35 Jy}
Future Work

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

FRB figure
AMPP figure
LOFAR drift scan figure

Lorimer et al. 2007
Aris Karastergiou
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