Pulsar Scintillometry

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Overview

- History
- Pulsars
- Scintillometry
- data
- next steps
April 17, 1967. First VLBI ARO-DRAO, Galt, Yen et al.

IEEE Milestone: **VLBI combines the signals of widely separated telescopes in order to form a single observation range.** In the experiment that was recognized as an IEEE Milestone, the range achieved between a first telescope at the DRAO facility in Penticton, British Columbia and a second one in Algonquin Park, Ontario was 3,074 kilometers

the next IEEE milestones: invention of LCD’s, CERN, internet.

Achieved with CBC video tape recorders, 5 MHz bandwidth

Modern processing: 400 MHz bandwidth, digital signal processing

Galt and Lyne 1972: DRAO-JB pulsar observations
Pulsar VLBI

- coherent, unresolved point sources
- radar/holography imaging through ISM
- excellent polarization calibrators (CHIME)
- potential for imaging pulsar magnetosphere, ISM.
New Pulsar Science

- use interstellar plasma as telescope
- unprecedented angular precision: 50 picoarcseconds
News

- preliminary pulsar study press release showing 50 pico arcsecond astrometry, million times better than before (pre-ARO data).
- picked up by 19 news outlets in 5 countries, over 26k youtube hits for Swinburne animation.

Scintellometry

- Brisken et al 2010, ULP+2014 (** xv files **)
Applications

- so far, two pulsar Nobel prizes (on par with CMB)
- potential detection of gravitational waves
- precision tests of GR
- matter at extreme conditions
- probes of the ISM
Current Status

- Successful VLBI run in 2014.
- Simultaneous ARO-DRAO observations, like 1967, two orders of magnitude more bandwidth (400-800 MHz), widest low frequency VLBI.
- Goal to redevelop Canadian VLBI network, pending CFI proposal.
- 200+TB of data converging on Toronto BGQ.
Looking forward

- regular DRAO-ARO broadband pulsar VLBI + other networks
- emission structure of pulsars
- binary orbit parameters: potentially most massive neutron star 1957+20
- ISM lensing: precise distances?
- ISM structure: superconducting cosmic strings? strange quark nuggets? Evaporating dark matter? Reconnection sheets?
Speculation

- grazing incidence reconnection sheets
- ULP + Levin 2014
- ULP + King 2012
- 1-D structure
- localized scattering