Presenting work with Don Backer, Joeri van Leeuwen, Dan Werthimer, The Fly’s Eye Team and the CASPER Group.
Overview

- Pulsar Instrumentation
- ATA Fly’s Eye
- The Parkes Spectrometer: *Parspec*
- Berkeley ATA Pulsar Processor (BAPP)
- Channelizers for Coherent Dedispersion (Nancay)
Pulsar Instrumentation (1)

- Spectrometer for Incoherent Dedispersion Applications:
Pulsar Instrumentation (2)

- Spectrometer for Coherent Dedispersion Applications:
The Fly’s Eye Search for Highly Energetic Radio Pulses from Extragalactic Sources
Background

Lorimer et. al. Pulse Details

- 30Jy pulse (saturated digitizer on one of 13 receivers; appeared in two others)
- DM = 375 pc/cm^3
  - Implies distance of up to 1 Gpc
- Located away from other known sources
- Found during search of 2001 archival data; no other pulses seen during 40 hour follow-up
- We need more data to constrain the rate and to help determine what the source is.
The Fly’s Eye: A search for HERPES

- Highly Energetic Radio Pulses from Extragalactic Sources
- Fly’s Eye Team: Geoff Bower, Jim Cordes, Griffin Foster, Peter McMahon, Andrew Siemion, Joeri van Leeuwen, Mark Wagner, Dan Werthimer (with help from RAL/CASPER)
- Objective: Build a set of independent spectrometers for the ATA and use them to search for HERPES.
The Allen Telescope Array

- 42x 6m dishes; 0.5–11GHz
- 4 independent IFs
- First light in October 2007 (Galaxy M31 image)
- Original target was 350 antennas; currently seeking grants for expansion
- First solicitation of proposals in January 2008; before ~June 2008, engineering testing during the day and science at night.
The ATA’s Advantage

- #1: Lots of time available.
- #2: Small antennas, which have poor individual sensitivity, but wide beams.

- We were awarded >400 hours on weekends.
- Using all 42 antennas, we could cover a significant portion of the sky in 24 hours.
The Fly’s Eye

ATA Fly’s Eye Experiment

42 antennas; 197.6 square degrees at half power

24 Hours of Fly’s Eye Coverage
The Fly’s Eye Instrument

- 44 independent spectrometers implemented in 11 IBOBs
- 209MHz bandwidth (sky frequency centred at 1430MHz)
- 128 channels each
- 1600Hz spectral dump rate
- 8 bits (with 64-bit debugging mode)
An IBOB, with iADCs
Fly’s Eye Control and Monitoring

- Scripts on Fly’s Eye control machine set up IBOBs and control data recording.
- Observations were done in 1-hour sets – after each hour, a 1-minute diagnostic run was done.
- Packet loss statistics and spectra from diagnostic runs were uploaded to a web server.
Advanced XAUI cable stability-control technology.
ATA — PSR B0329+54
Two pulses of best profile
Test Results (2)
Test Results (3)

Crab Pulsar: Giant Pulse Detection (sigma = 15.75)

fitted $dm = 56.78$
Pathological RFI Example
Parkes Spectrometer (1)

- Parkes multibeam pulsar survey

400MHz 10GbE readout spectrometer
5.12us to 655us integration time
**Parspec Results**

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**B1937+21**
Glen Langston

**J1028-5820**
Willem van Straten
More Parspec Results

2 Pulses of Best Profile

![Graph showing 2 pulses of best profile over time and phase.](image)
Berkeley ATA Pulsar Processor
BAPP (3)
BAPP (5)

Image courtesy Joeri van Leeuwen.
CoDeDi Channelizer (3)
Berkeley–Orleans–Nancay (BON) system handles 128MHz bandwidth for pulsar timing using pre–CASPER hardware.

Intended upgrade to 400MHz.

FPGA performs coarse channelization, then CPU/GPU cluster performs coherent dedispersion and folding.
Nancay CoDeDi System (2)

Reached conclusion that likely each computer will only be able to process a 100MHz bandwidth.

Hence final system will probably be ROACH-based (IBOB has 2x 10GbE; ROACH has 4x).
Nancay CoDeDi System (4)
Nancay IBOB Test Results (1)

Figure courtesy Gregory Desvignes and Ismael Cognard.
Nancay IBOB Test Results (2)

Figure courtesy Gregory Desvignes and Ismael Cognard.
Links

- http://casper.berkeley.edu/wiki/Pulsar_Machine_Development_At_Berkeley
- http://casper.berkeley.edu/wiki/Parspec