Commissioning the First Station of the Long Wavelength Array

Jayce Dowell (UNM)
On behalf of the LWA Collaboration
Goal is to phase or delay the various antenna signals so they add coherently in a particular direction on the sky.

Two basic methods:
1) phase-and-sum
2) delay-and-sum

Good delay calibration is key.
Cygnus A drifts through a beam at 74 MHz

- 12/2/2011
- 19.6 MS/s (~16 MHz usable bandwidth)
- 175 dipoles
- Minimal RFI excision
- No bandpass cal.
Cyg A: 295.0 az., 49.5 el.

Cas A: 0.0 az., 65.2 el.
LWA Software Library

**LSL (LWA Software Library)** defines a collection of Python routines for working with LWA data. It consists of routines that:

- describe the setup (location, stand positions, etc.) of the first LWA station (LWA-1),
- read in the three main data formation described in the OP ICD as well as S60 data,
- other utilities.

- Functions for dealing with raw data, basic data analysis, and exporting to standard formats
- Several example scripts for how to use LSL
- Extensions to accomplish specified task, e.g. scheduling observations, that build off the core routines
2 Pulses of Best Profile

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candidate</td>
<td>PSR_1919+21</td>
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<td>Telescope</td>
<td>VLA</td>
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<td>Data Avg</td>
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<td>Data StdDev</td>
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<td>Profile StdDev</td>
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</tbody>
</table>

Reduced $\chi^2 = 7.922$  $P(\text{Noise}) < 4.19e-69$  ($\approx 17.5\sigma$

Dispersion Measure (DM) = 12.455

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>$P_{\text{topo}}$ (ms)</td>
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<td>$P_{\text{bary}}$ (ms)</td>
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<tr>
<td>$P_{\text{topo}}$ (s/s)</td>
<td>0.0(1.5)x10^{-7}</td>
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<tr>
<td>$P_{\text{bary}}$ (s/s)</td>
<td>0.0(1.5)x10^{-7}</td>
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<tr>
<td>$P_{\text{topo}}$ (s/s$^2$)</td>
<td>0.0(8.9)x10^{-10}</td>
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<td>$P_{\text{bary}}$ (s/s$^2$)</td>
<td>0.0(8.9)x10^{-10}</td>
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<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{\text{orb}}$ (s)</td>
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<td>$a_0\sin(i)/c$ (s)</td>
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<tr>
<td>$e$</td>
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<tr>
<td>$\omega$ (rad)</td>
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</table>

38 MHz
High SNR Pulsars

Observation Parameters
- 20 min, 19.6 MS/s (~16 MHz of usable BW) at each tuning
- Tunings at 38 MHz & 74 MHz
- Folding, de-dispersion, averaging with PRESTO-prepfold
- No RFI excision

Pulsars with LWA-1 courtesy Kevin Stovall (UTB)
Solar Activity in a Beam

- Shown ~13:00 (local) on 12/25/2011
- Temporal Res. ~ 0.5 sec
- Freq. Res. ~ 2.4 kHz
- Beam repointed every 4 min
- No Bandpass Cal. or RFI excision

- 20 Dipoles
- 34 MHz TBN
- Phased beam
Decametric Jovian Emission
Decametric Jovian Emission
For more information:


Project Web Site:
http://lwa.unm.edu

Memo Series:
http://www.phys.unm.edu/~lwa/memos

The LWA is on Facebook
Backup Slides
Beamformer Details

196 MSPS x 12 bits from A/Ds

Stand 1

0-1023 steps of 5.102 ns

0..15 steps of 319 ps

Coarse delay, fine delay, and the 4 polarization coeffs can be user-specified if desired

Course delay, fine delay, and the 4 polarization coeffs can be user-specified if desired

LWA-1 has 4 of these, each independently-pointable

Cable dedispersion

Optimized beamforming

Sector beams, nulls

Polarization adjustment is narrowband. Other uses:

- dipole-to-dipole gain equalization
- “turning off” dipoles
- Trading polarizations for additional beams

To DRXs 196 MSPS x 31 bits

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