The expanded Long Wavelength Array

Greg Taylor (UNM)

New Mexico Symposium
November 6, 2015

http://lwa.unm.edu
The LWA Radio Observatory Staff (at UNM)

Faculty and Staff
Trish Henning
Greg Taylor       Jayce Dowell
John Dickel       Lanie Dickel
HAL

Postdocs and Students
Karishma Bansal   Veronica Dike
Joe Malins        Jessica Lopez
Frank Schinzel    Kevin Stovall
10-88 MHz usable Galactic noise-dominated (>4:1) 24-87 MHz

4 independent beams x 2 pol. x 2 tunings each, 2 degrees wide at 80 MHz

SEFD ~ 6 kJy (zenith)  \( S_{\text{min}} \sim 10 \text{ Jy} \) (5\( \sigma \), 1 s, 16 MHz, zenith)

All sky (all dipoles) modes: TBN (70 kHz-bandwidth; continuous)

TBW (78 MHz-bandwidth, 61 ms burst)

LWA1 science emphasis: transients, pulsars, Sun, Jupiter & Ionosphere

Open skies – LWA1 is funded by NSF as a University Radio Observatory
VLA 4-band Modified J-Poles (MJP)s

- Adds 50-80 MHz capability to the VLA
- More sensitive (wider band) than old 4-band system
- Resolution ~ 20” in A config

As of 10/30 from Dan Mertely

ea06
ea09*
ea10
ea12
ea14
ea18
ea19
ea23*
ea27*

* = Recent install
+ 5 more soon
eLWA - Demonstration

9/17/2015: 3C196
6 VLA + LWA1
Raw VDIF format
35 minutes
A config
72 – 80 MHz
Correlated using the LWA Software Library

31 microsec offset for LWA1
eLWA - Bandpass
eLWA – Amplitude vs (u,v) distance
eLWA - Demonstration

3C196
Peak ~ 100 Jy
Noise ~ 200 mJy
SEFD ~ 8000 Jy LWA1
SEFD ~ 20 – 40 kJy
Problems:

Delays sometimes jump
eLWA - Demonstration

Problems:

Delays sometimes jump
Or drift
Problems:

Delays sometimes jump
Or drift
And this can be between VLA antennas
LWA-SV

- Power and Fiber installed
- 4-88 MHz frequency range
- Racks in place
- Cabling in place
- All 256 antennas deployed
- Advanced Digital Processor under development
10 VLITE + LWA1 + SV

~10 arcsec resolution at 74 MHz
~20 mJy sensitivity
The Long Wavelength Array

LWA-1

- Frequency Range: 10-88 MHz
- 4 beams x 2 pol. x 2 tunings x 16 MHz
- 2 all-sky transient obs. modes

New Mexico
Summary

- LWA1 has demonstrated technical feasibility and scientific results.
- Lots of exciting science at low frequencies. Progress requires:
  - High temporal, spectral, and spatial resolution
  - Sensitivity
  - Software development
- Current experiments are providing new hardware and software, and a better understanding of the sky at long wavelengths.
- We have begun the next phase – interferometry with LWA and VLA stations.
- Science at Low Frequencies meeting in Albuquerque Dec 2-5, 2015.
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<tr>
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<th>Responsible</th>
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<td>NRAO</td>
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**Decision Tree: 2015-2018 LOBO – LWA ROADMAP**

**High Level Schedule and Decision Tree**

**Version A: Winter 2015**

- If VLA 4-band complete: Upgrade to LOBO correlator
- Upgrade VLITE Correlator to dual 74/330 MHz
- Do nothing and re-visit in next FY budget
- Stop

**Tasks:**

- **a**: Do nothing and re-visit in next FY budget
- **b**: Stop
- **c**: Do nothing and re-visit in next FY budget
- **d**: Upgrade VLITE Correlator to dual 74/330 MHz
- **e**: Input for h
- **f**: Upgrade VLITE Correlator to process dual 74MHz/330MHz for narrow 4P-band + LWA1, LWA-SV
- **g**: Upgrade VLITE Correlator to process full 4P-band + LWA1, LWA-SV
- **h**: Upgrade VLITE Correlator to process broadband 4P-band
- **i**: Upgrade VLITE Correlator to process dual 74/330 MHz for narrow 4P-band + LWA1, LWA-SV

**Responsible Parties:**

- NRAO
- UNM
- NRL
- Frazer Owen
- Dale Frail
- Greg Taylor
- Namir Kassim

**Timeline:**

- 2015-2018
- Winter 2015

**Notes:**

- Change 4-band design and build again
- Lo bo Correlator able to process dual 74MHz/330MHz
- Upgrade all 28 VLA antennas at 4-band
- LWA1 + VLA 4-band does not perform as required
- LWA1 + LWA-SV + VLA 4-band does not perform as required
- VLA 4-band does not perform as required
- VLA 4-band Complete
- Proposal to expand 4-band
- Upgrade VLITE Correlator to process full 4P-band + LWA1, LWA-SV
- Upgrade all 28 VLA antennas at 4-band
- Upgrade VLITE Correlator to process broadband 4P-band
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LWA-SV

Construction

Advanced Digital Processor
LWA-SV commissioning
eLWA - Demonstration

3C196
Peak ~ 100 Jy
Noise ~ 400 mJy
SEFD ~ 8000 Jy LWA1
SEFD ~ 40 – 80 kJy

Clean XX map. Array: LWA1
3C196 at 0.076 GHz 2015 Sep 17