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

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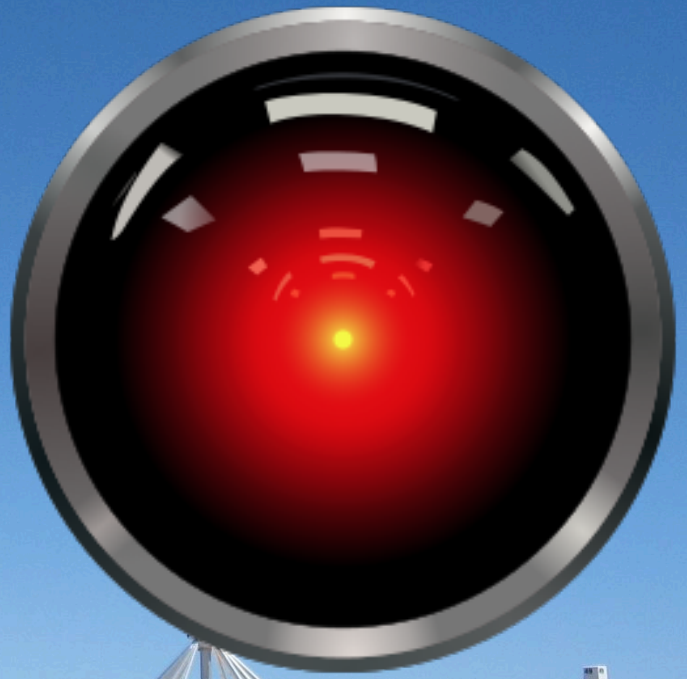

Postdocs and Students

Karishma Bansal

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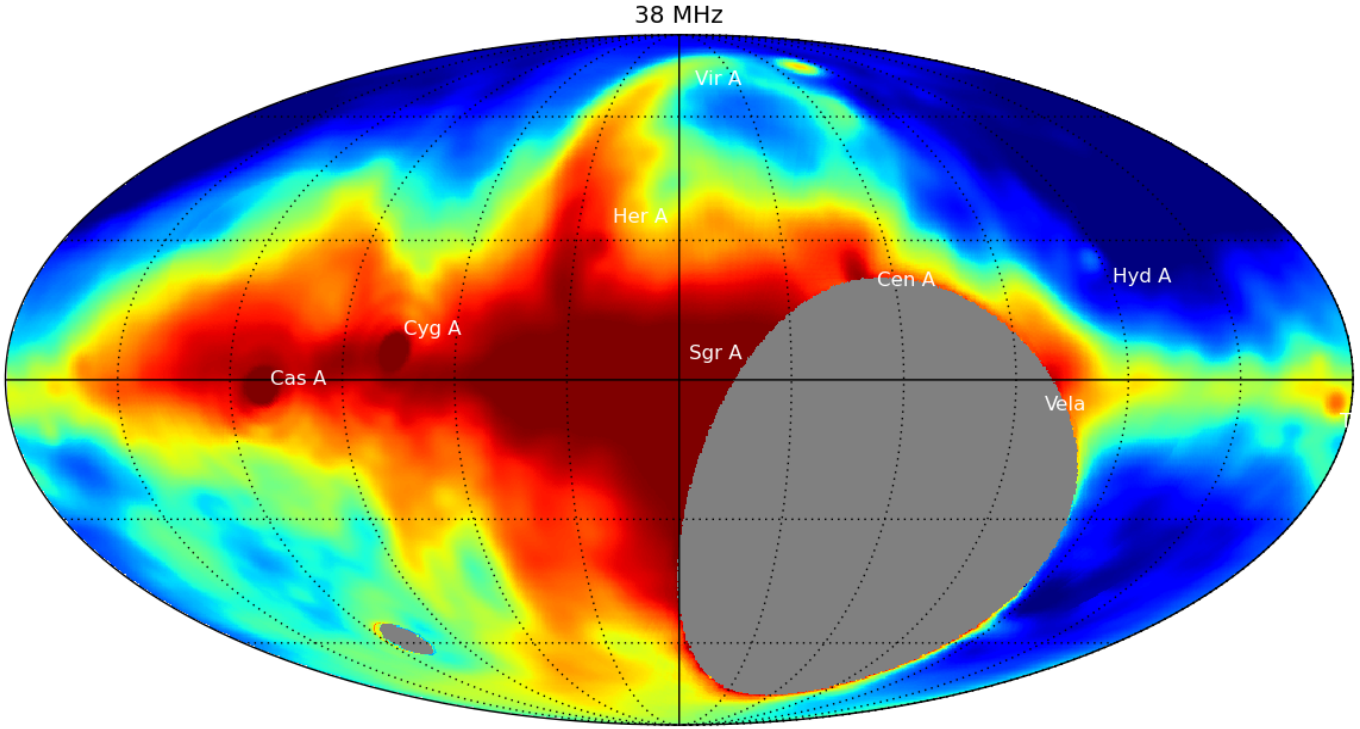


10-88 MHz usable Galactic noise-dominated (>4:1) 24-87 MHz

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

SEFD ~ 6 kJy (zenith) S_{min} ~ 10 Jy (5σ, 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

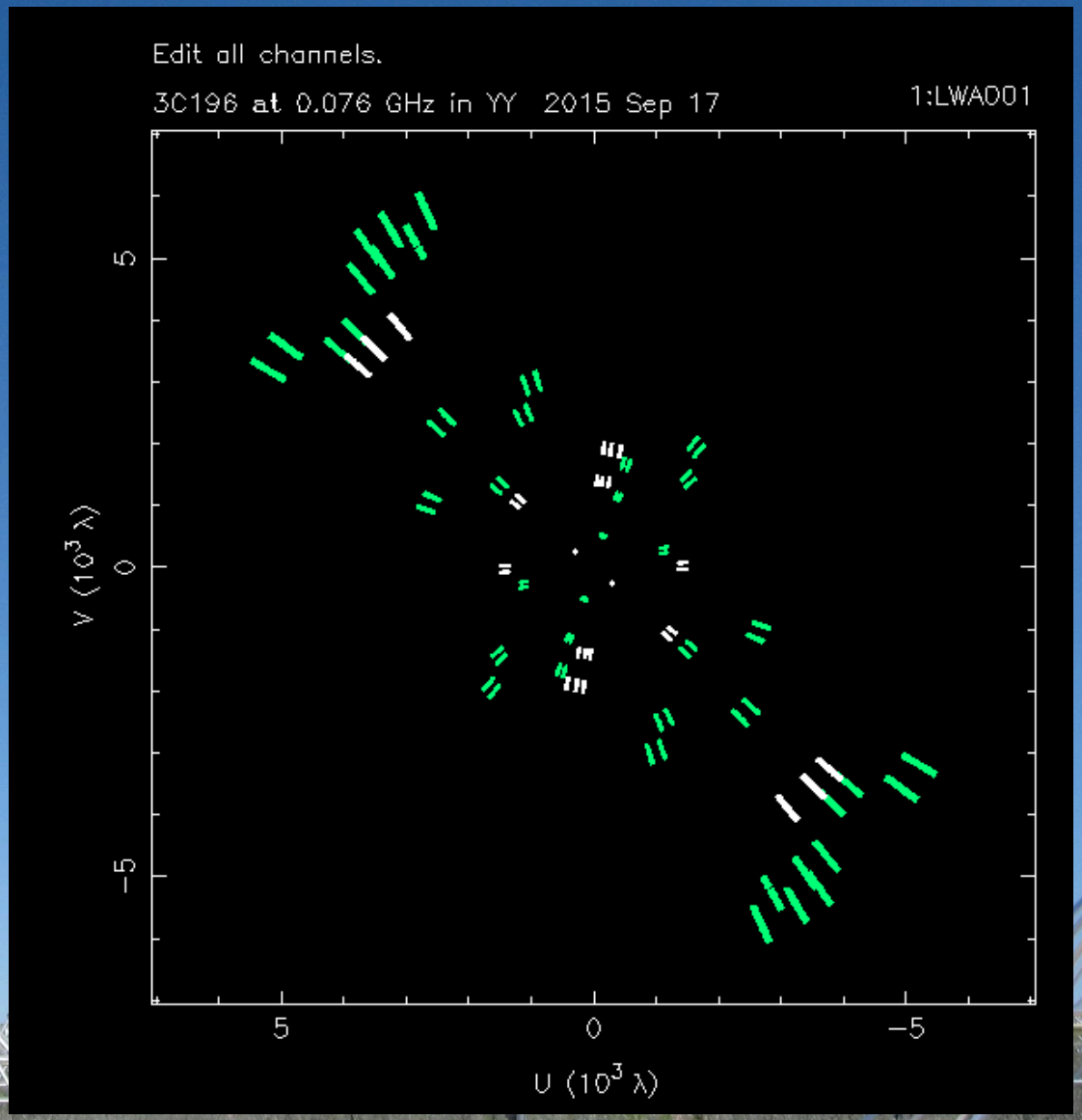
ea06
ea09*
ea10
ea12
ea14
ea18
ea19
ea23*
ea27*

* = Recent install
+ 5 more soon

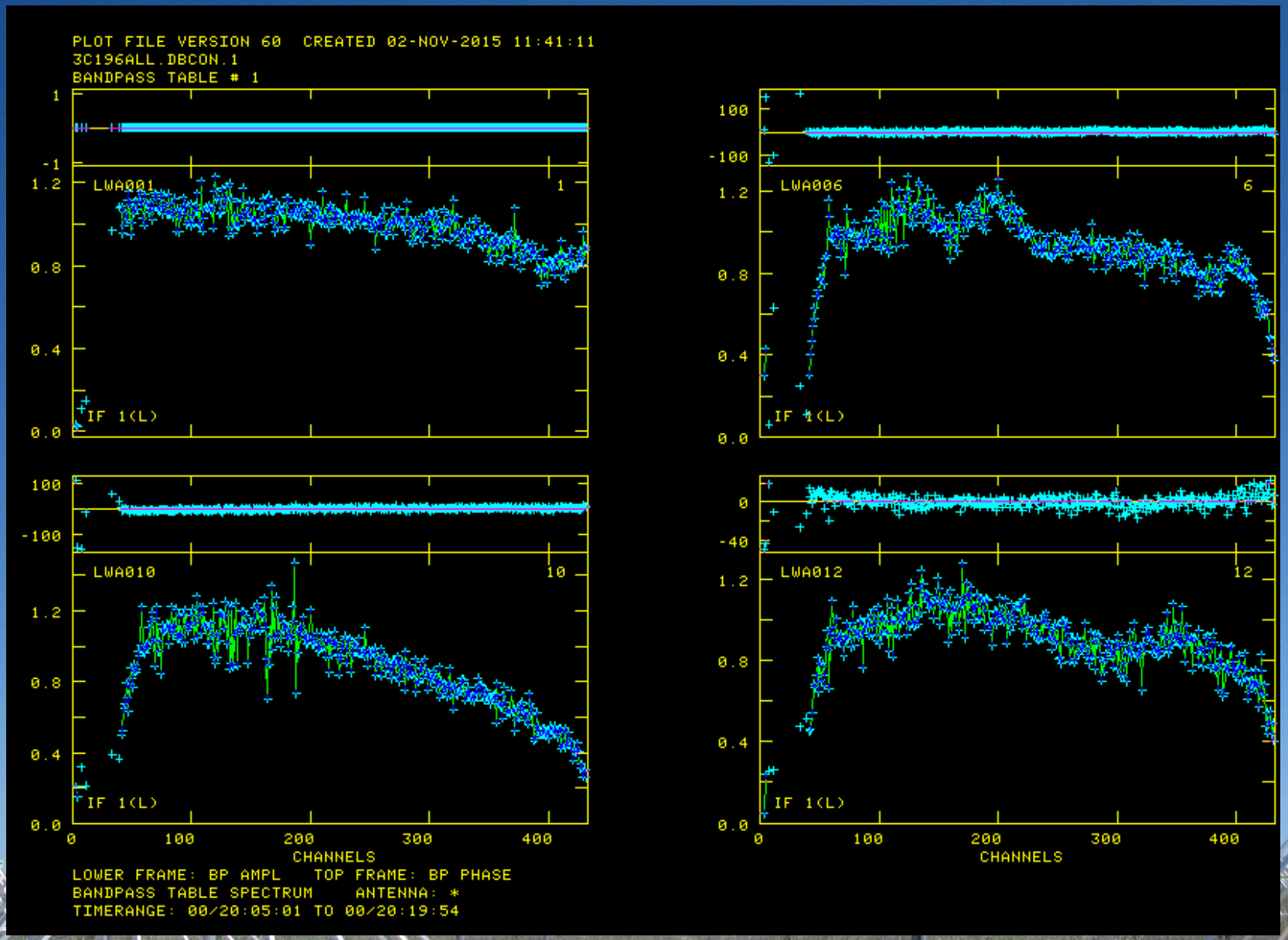
eLWA - Demonstration

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

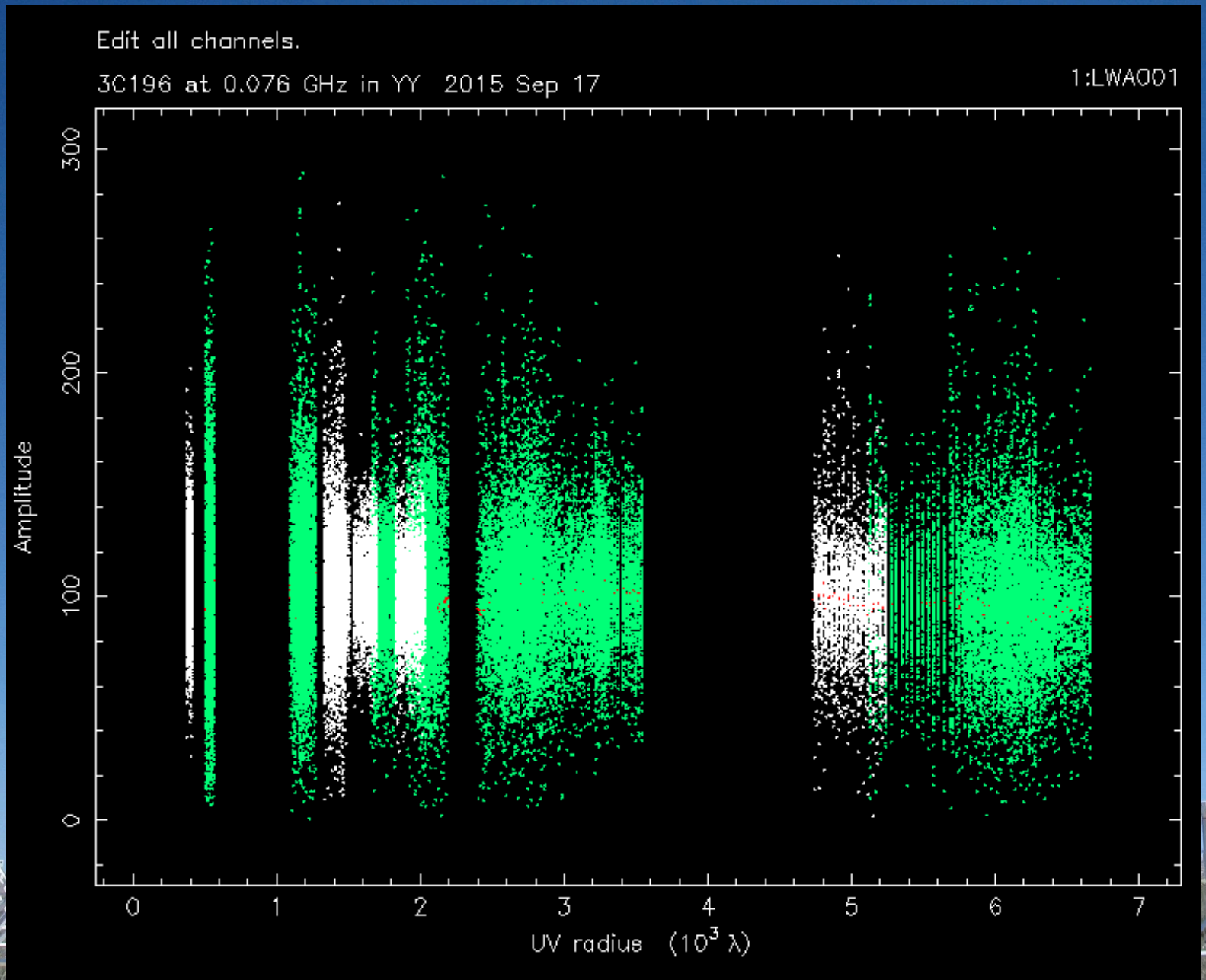
31 microsec offset for LWA1



eLWA - Bandpass

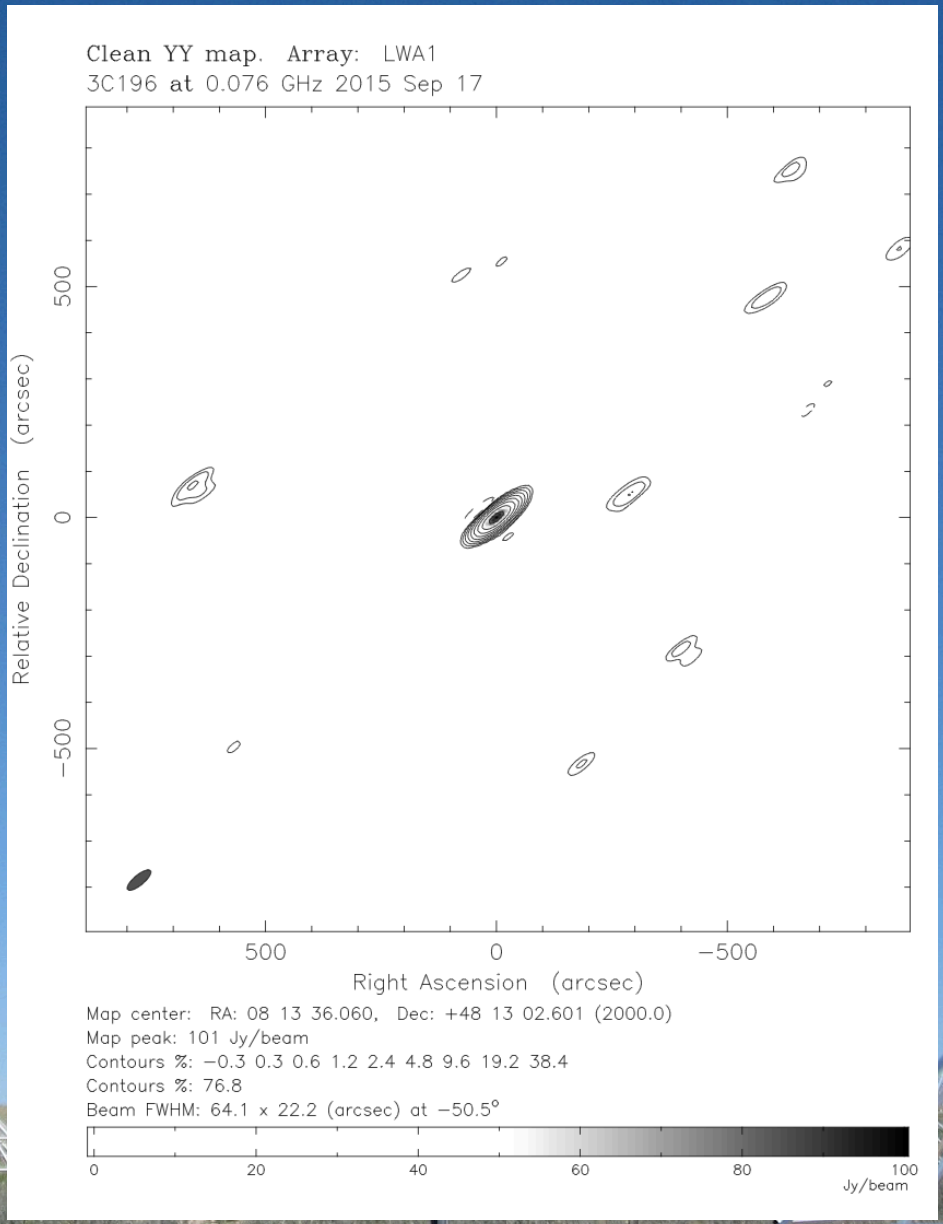


eLWA – Amplitude vs (u,v) distance



eLWA - Demonstration

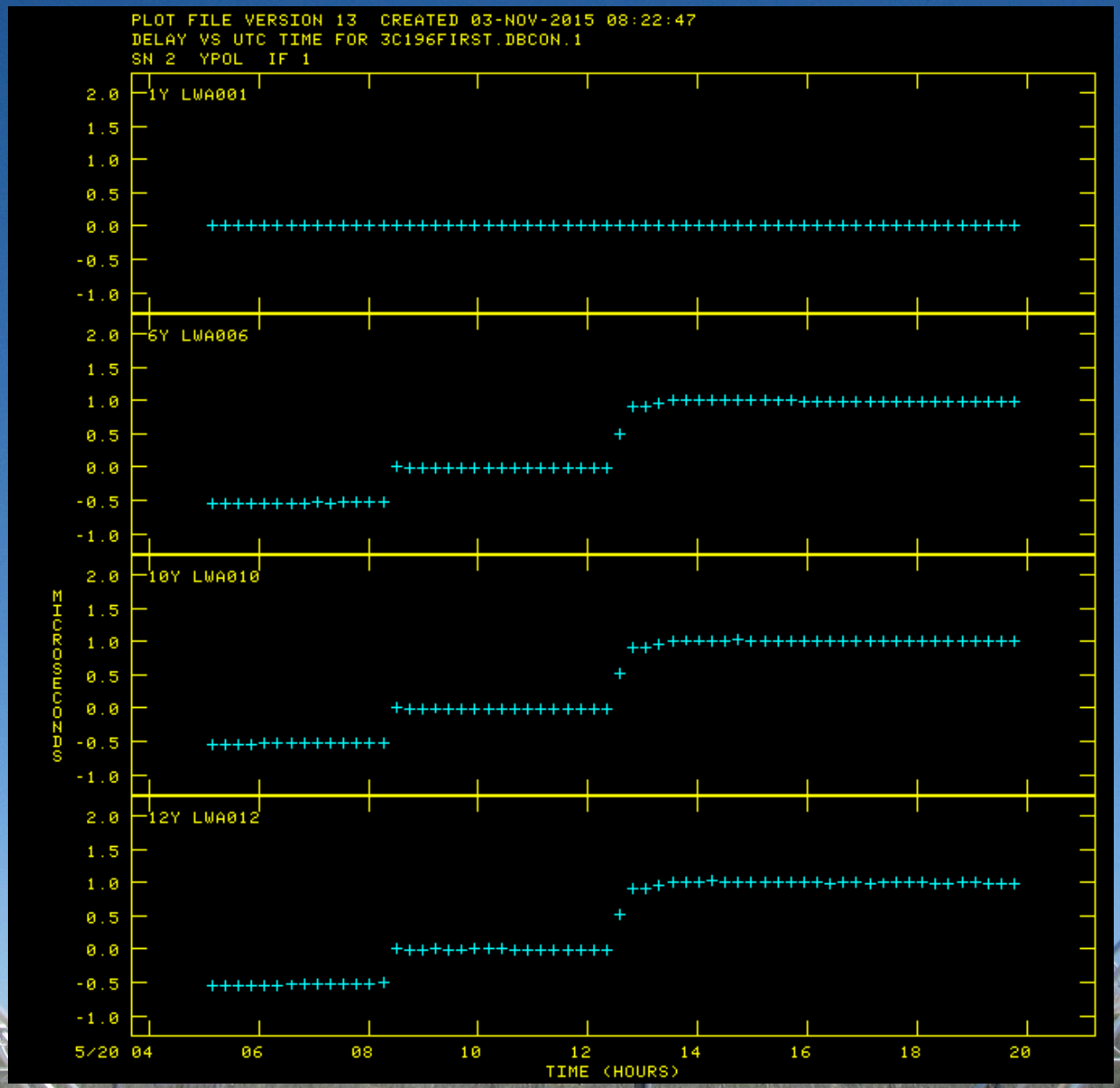
3C196
Peak ~ 100 Jy
Noise ~ 200 mJy
SEFD ~ 8000 Jy LWA1
SEFD ~ 20 – 40 kJy



eLWA - Demonstration

Problems:

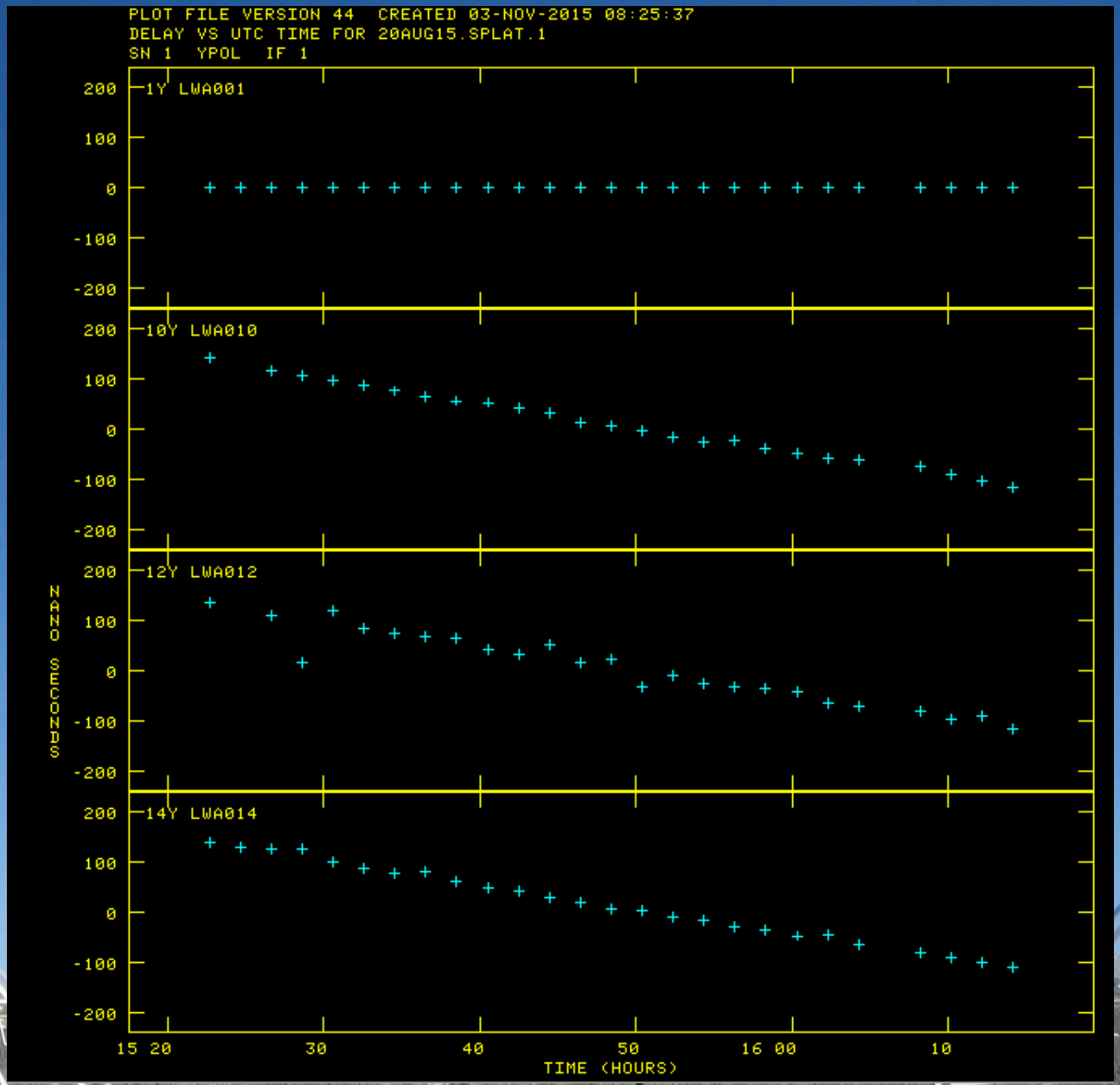
Delays sometimes jump



eLWA - Demonstration

Problems:

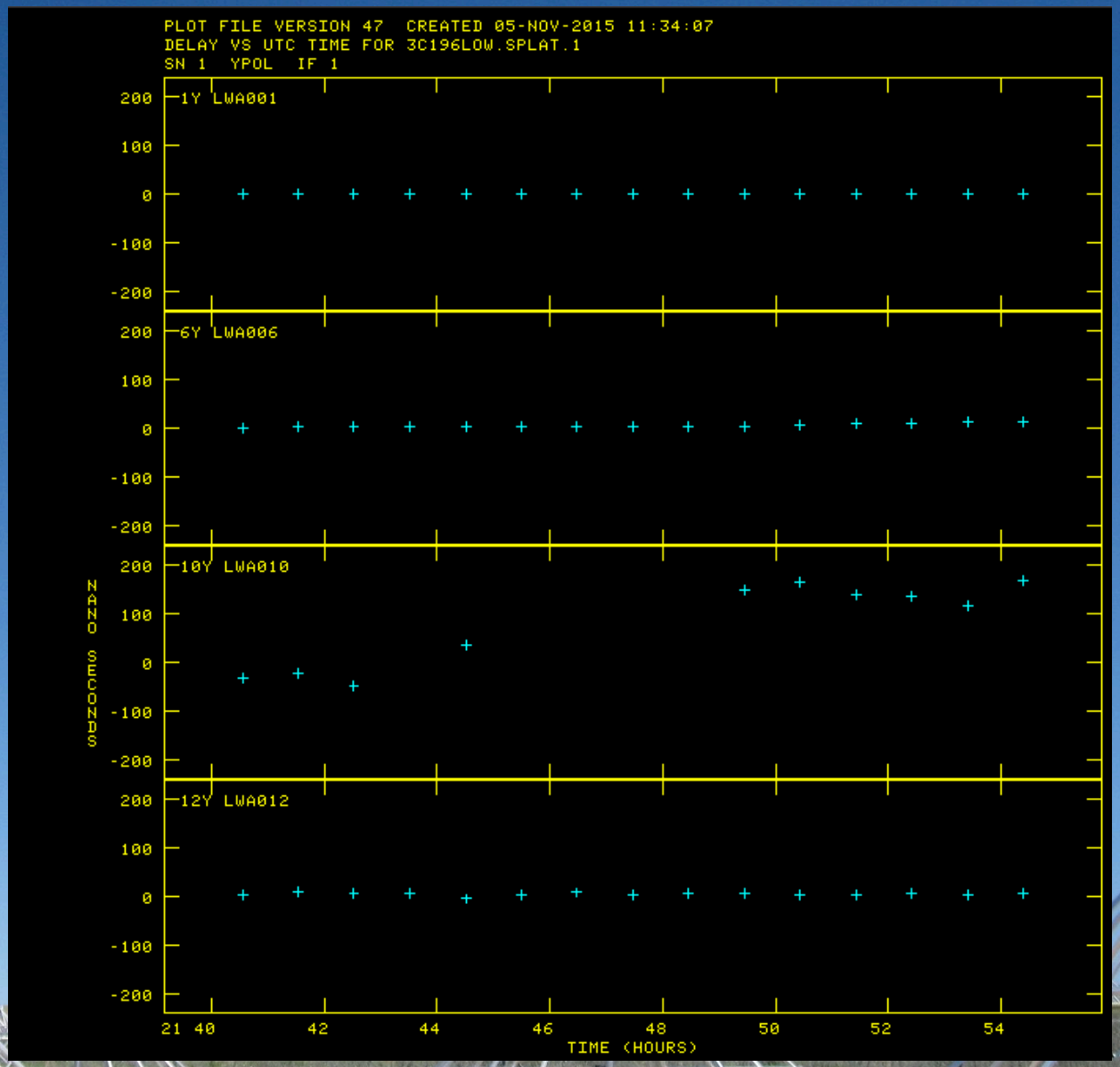
Delays sometimes jump
Or drift



eLWA - Demonstration

Problems:

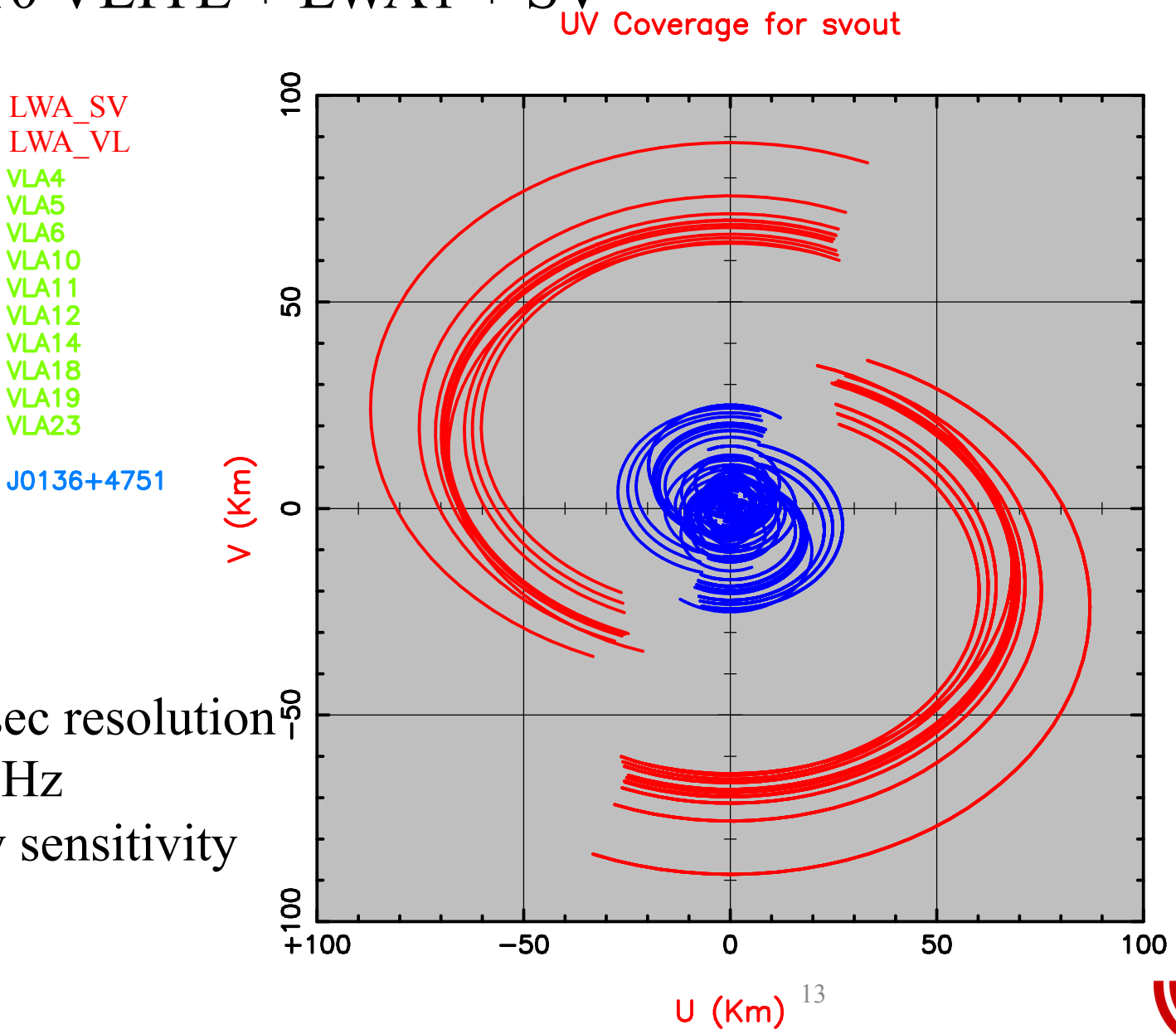
Delays sometimes jump
Or drift
And this can be between VLA antennas



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

LWA Long Wavelength Array

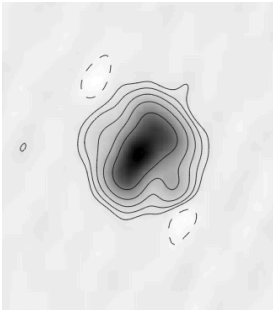
The Long Wavelength Array

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

LWA
Long Wavelength Array

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

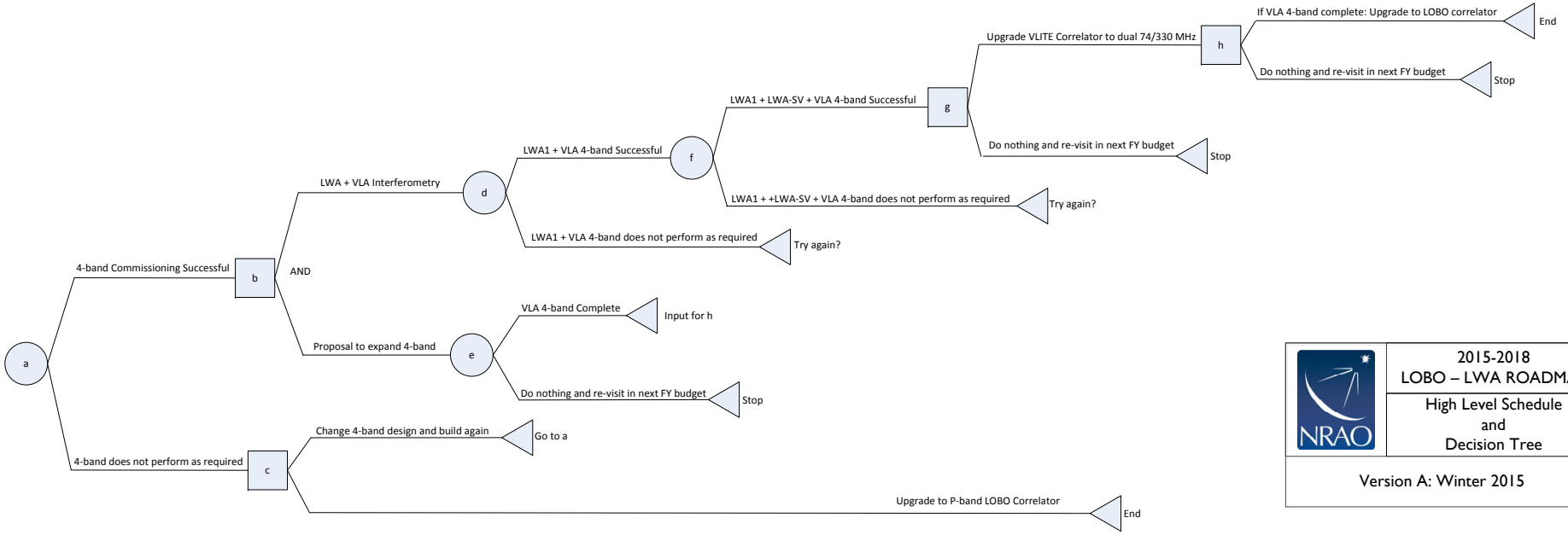


Tau A

3C196

LWA Long Wavelength Array

ID	Task Name	Responsible	Start	Finish
1	**VLA 4-band**	**NRAO**	**6/22/2015**	**12/22/2017**
2	Validate 6 antennas VLA 4-band (Commissioning)	Frazer Owen	6/22/2015	9/21/2015
3	VLA 4-band validated (node b in decision tree)		9/22/2015	9/22/2015
4	Upgrade all 28 VLA antennas at 4-band	Dale Frail	9/21/2017	12/21/2017
5	VLA 4-band complete		12/22/2017	12/22/2017
6	**Interferometry with LWA1 and VLA 4-band**	**UNM**	**9/22/2015**	**12/22/2015**
7	Fringes between VLA 4-band and LWA1 using VLITE Correlator	Greg Taylor	9/22/2015	11/2/2015
8	Validate LW1 – VLA 4-band Interferometry (Commissioning w/o disrupting VLITE OPS)	Greg Taylor + Dale Frail	11/9/2015	12/21/2015
9	LWA1 + VLA 4-band interferometer Validated (node f in decision tree)		12/22/2015	12/22/2015
10	**Interferometry with LWA1, LWA-SV and VLA 4-Band**	**UNM**	**12/22/2015**	**9/22/2016**
11	Fringes between LWA1 & LWA-SV (UNM)	Greg Taylor	12/22/2015	3/22/2016
12	Temporarily add LWA-SV with LWA1 + VLA 4-band using VLITE Correlator	Greg Taylor + Dale Frail	3/23/2016	6/22/2016
13	Validate System in non-confusion dominated regime (Commissioning w/o disrupting VLITE OPS)	Greg Taylor + Dale Frail	6/22/2016	9/21/2016
14	LWA1, LWA-SV and VLA 4-band Interferometer Validated (node g in decision tree)		9/22/2016	9/22/2016
15	**LOBO (VLITE Expansion)**	**NRL**	**3/21/2017**	**12/24/2018**
16	Upgrade VLITE Correlator to process dual 74MHz/330MHz for narrow 4P-band + LWA1, LWA-SV	Namir Kassim	3/21/2017	6/21/2017
17	VLITE Correlator able to dual process 74/330 MHz		6/22/2017	6/22/2017
18	Upgrade VLITE Correlator to process full 4P-band + LWA1, LWA-SV	Namir Kassim	12/22/2017	12/21/2018
19	LOBO CORRELATOR (able to process broadband 4P-band)		12/24/2018	12/24/2018



2015-2018
LOBO – LWA ROADMAP

High Level Schedule
and
Decision Tree

Version A: Winter 2015

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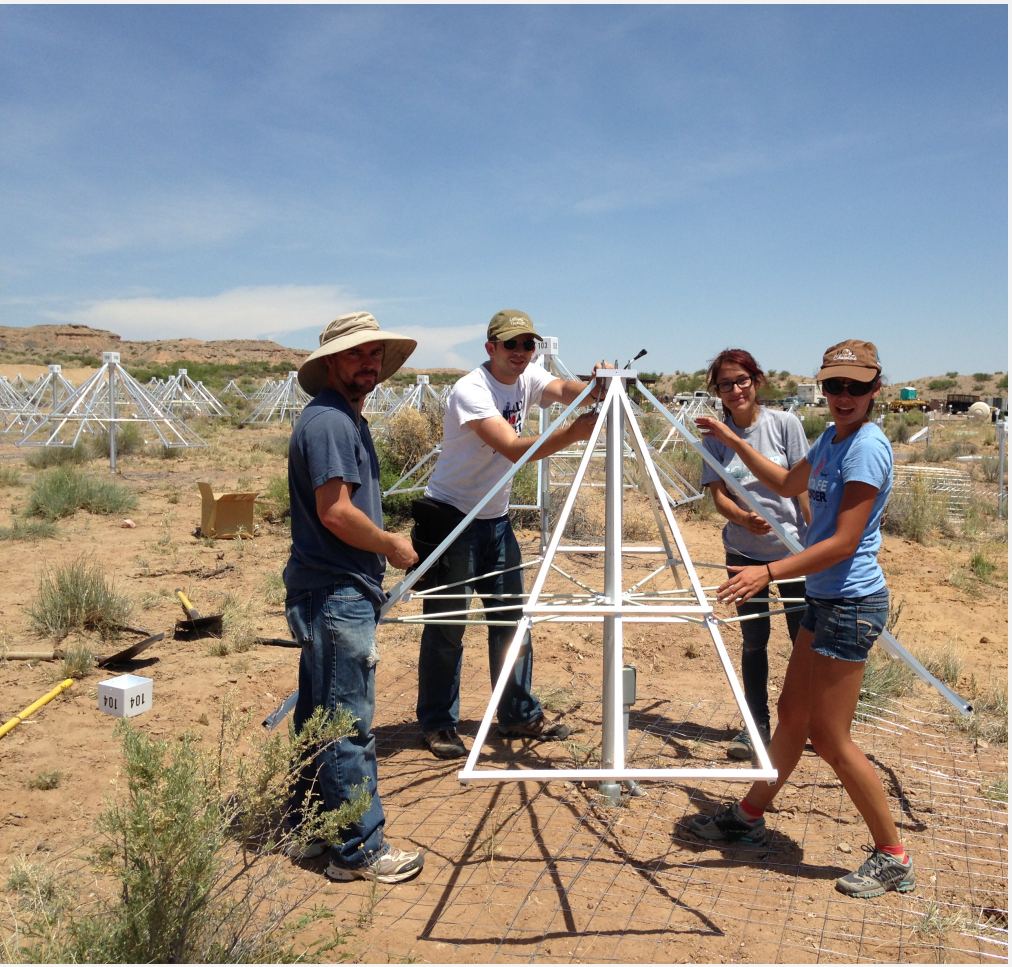
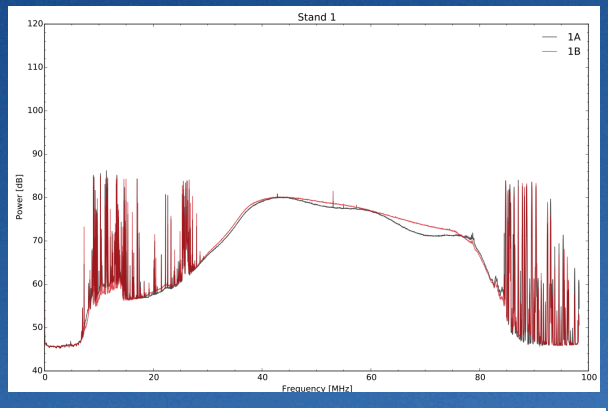
LWA-SV

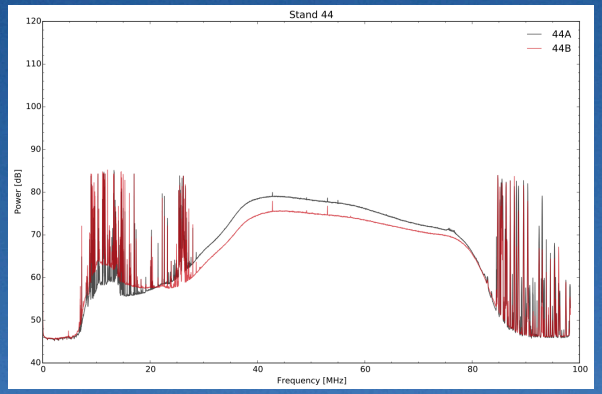
Construction

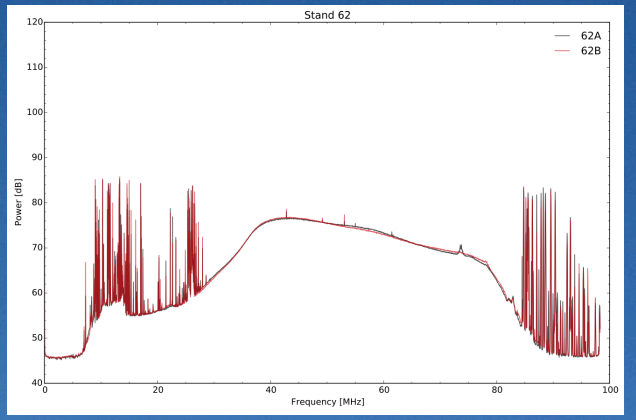


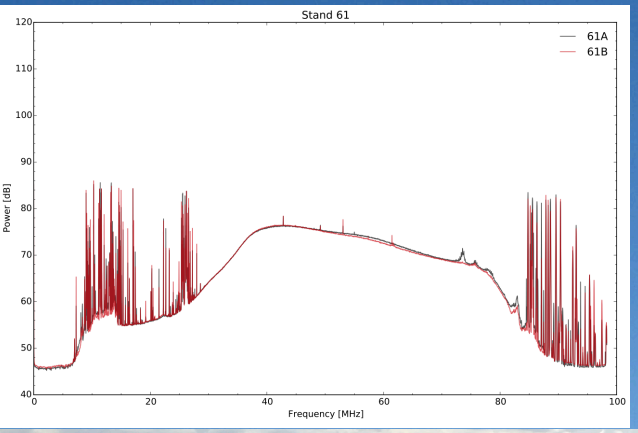
Advanced Digital Processor

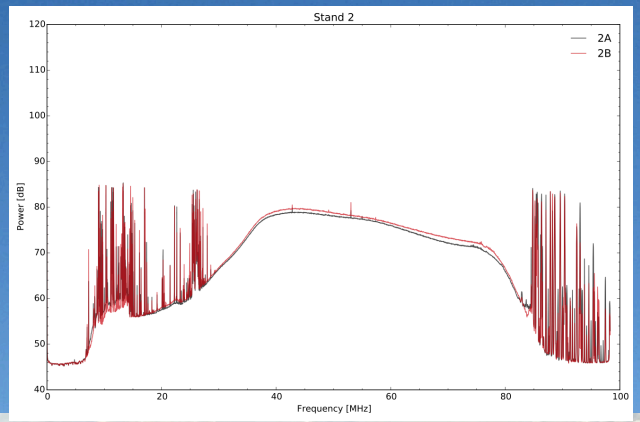
LWA-SV commissioning

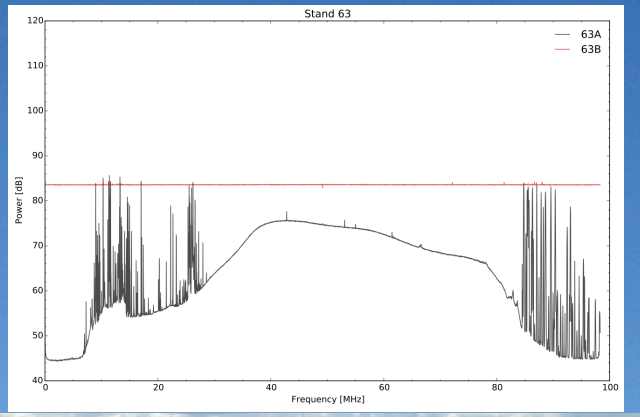












Natural Hazards

eLWA - Demonstration

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