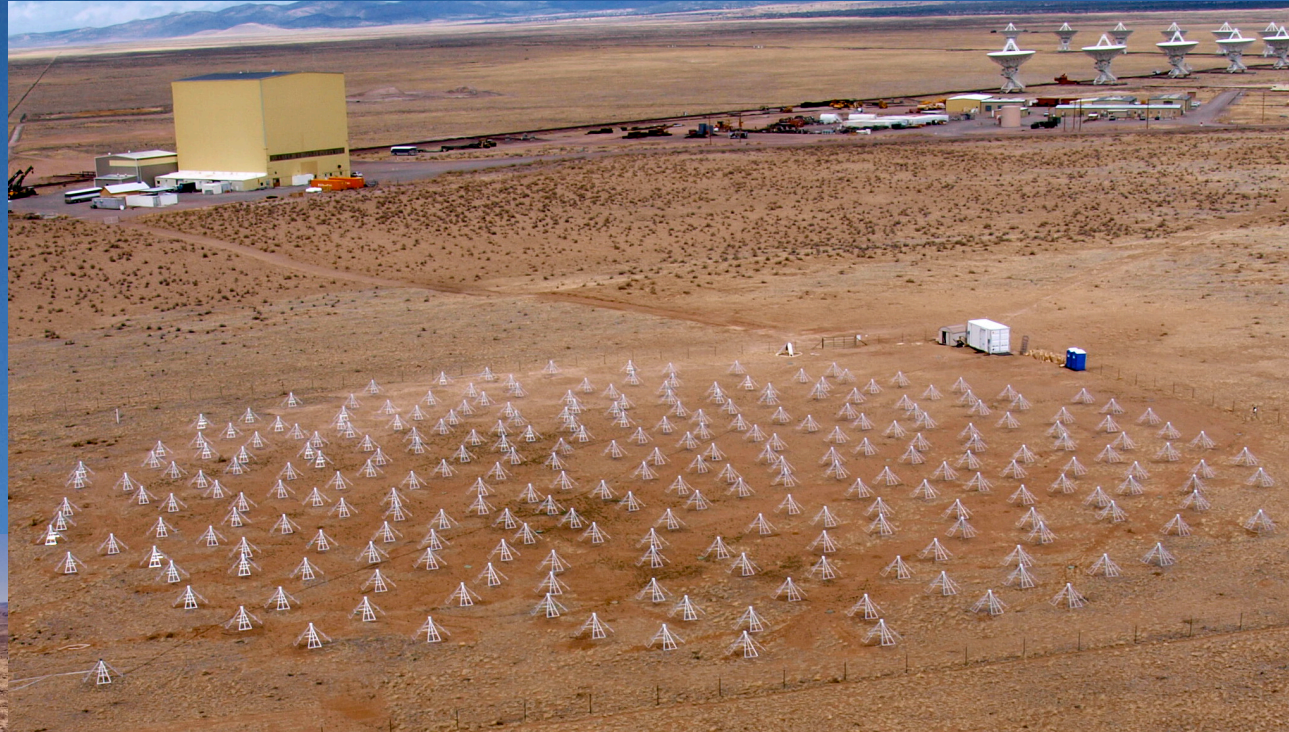




Observatory Update

Greg Taylor (UNM)

LWA Users Meeting
8/1/2019



Meeting Logistics

- Internet access: see instructions on board
- Bathrooms to the right, end of the hall, this floor
- Lunch – at Student Union Building or on Central. Return by 1:10pm.
- Reception – at PandA on Lomas. 6:00pm



PandA

You are here

SUB

RH118

Meeting Logistics

- **Sign up sheets are posted**
- Sign up before 3:30pm today for LWA Tutorials on Friday afternoon
Meet at Regener Hall room 118 at 2pm
- Sign up before 3:30pm today for tour of LWA-SV on Saturday morning
Meet in PandA parking lot at 8:00am
Bring sturdy shoes, hat, water, sunglasses



LWA Brief History

- LWA project began with ONR support in 2006
- LWA1 funded as a University Radio Observatory (from 3/1/12)
- LWA1 Operational April 2012
- LWA-SV Operational March 2017
- LWA1 has 3 beams, 2 x 20 MHz + TBN (all-sky 0.1 MHz bandwidth)
- LWA-SV has 2 beams, 2 x 10 MHz (2 x 20 MHz demonstrated)
 - + TBN (all-sky 0.1 MHz) + correlator (all-sky 10 MHz, 10 sec integ)
- LWA Swarm (2 stations) starting in 2018 (2 x 10 MHz beams)
- ELWA (27 VLA + 2 LWA) starting in 2018 (1 x 10 MHz beam)



Phased Development of LWA

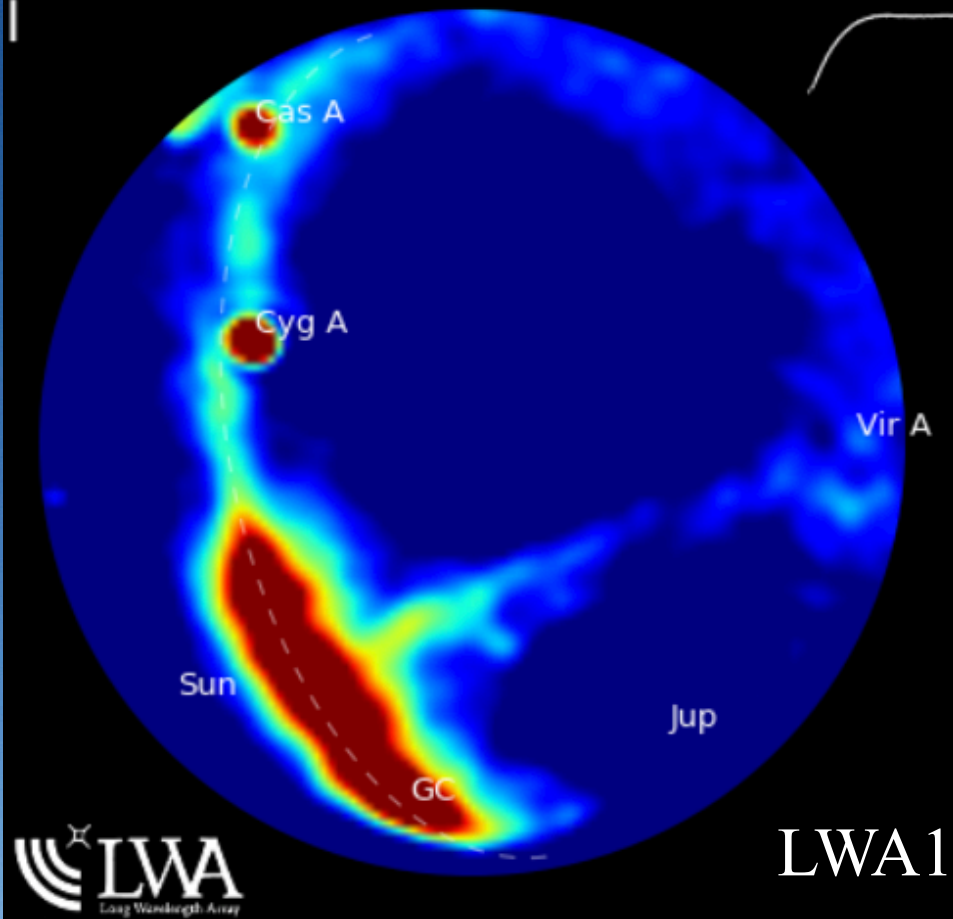
From a talk in 2006

Time	Phase	Description	Acronym
2004	0	Existing 74 MHz VLA	VLA74
2006-2008	I Funded!	Long Wavelength Development Array +Long Wavelength Array Station #1	LWDA LWA1
2008-2010	II	9 station Long Wavelength Intermediate Array	LWIA
2010-2012	III	LWA Core + Outliers	LWAC
2012-2014	IV	High Resolution LWA	LWA
2009-	V	LW Operations and Science Center	LWOSC

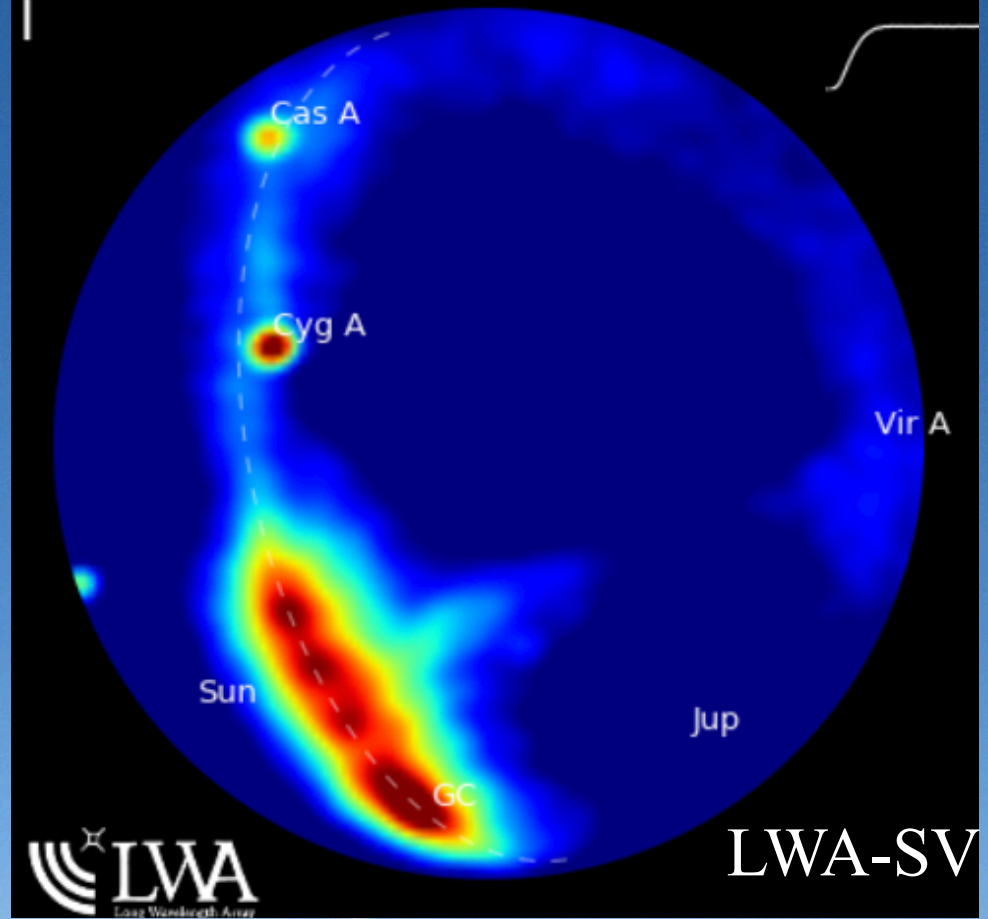
FY06+FY07 funds (\$5M): LWA1 + partial
build of LWA2 and LWA3

Two views of the sky

2018-01-22 16:11:52 UTC



2018-01-22 16:12:08 UTC



LWA Outreach

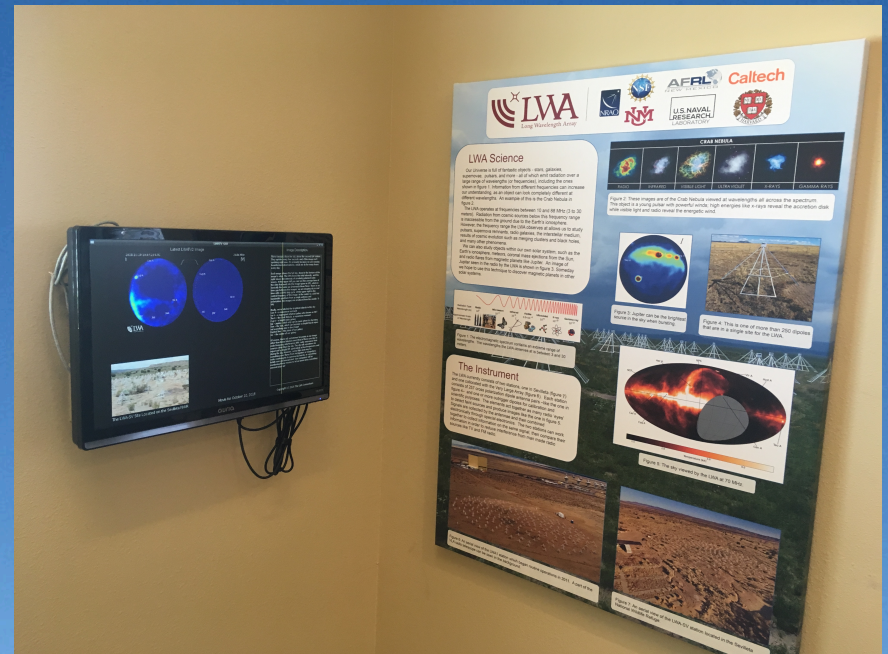
- LWA-TV and LWA-TV channel 2 (GUI available in LSL)
- LWA-TV running at Sevilleta, PandA, VLA Visitor Center, NRL, ERAU, others?
- LWA demos/tutorials

- Pulsar B0329+54
- Unknown Pulsar
- Pulsar Rotation Measure
- Jovian Burst
- Solar Burst
- Crab Pulsar Giant Pulses
- All-Sky Meteor Echoes

- Numerous tours and class trips
- LWA interactive sky maps:

<http://fornax.phys.unm.edu/low-frequency-sky/index.html>

<https://fornax.phys.unm.edu/multi-wavelength-sky/index.html>



UNM Computing Capabilities

- Hercules – dual hexacore Mac Pro
- Virgo – dual quad core with 128 GB RAM
- Leo – quad core with 55 TB storage
- LDA – quad core with 270 TB storage at CARC
- LDA backup – quad core 200 TB

Leo + LDA backup

LDA



LWA Archive

- Metadata
- All spectrometer mode observations
- Calibration data
- Pulsar archive
- All sky images both NM stations



Welcome to the LWA Data Archive

LWA Database

LWAdb Utility

LWAdb Sessions Observations Projects Reports LWAdb Administration gtaylor

Sessions Management

[Create New Session](#)

Show

10

entries

Search:

Showing 1 to 10 of 28,782 entries

Session ID	Sub ID	Project	UTC Date	Operator	Observations	DRSU Tag	Actions
1966	0	LS016	19-07-17 17:13 UTC	HAL	1	058681_000255984	view or edit
1967	0	LS016	19-07-17 17:13 UTC	HAL	1	058681_000255985	view or edit
97	0	LH015	19-07-17 08:13 UTC	HAL	1	058681_000251844	view or edit
98	0	LH015	19-07-17 08:13 UTC	HAL	1	058681_000251845	view or edit
99	0	LH015	19-07-17 08:13 UTC	SAL	1	058681_000188965	view or edit
100	0	LH015	19-07-17 08:13 UTC	SAL	1	058681_000188964	view or edit
1964	0	LS016	19-07-16 15:59 UTC	HAL	1	058680_000243969	view or edit
1965	0	LS016	19-07-16 15:59 UTC	HAL	1	058680_000243970	view or edit
1962	0	LS016	19-07-16 14:28 UTC	HAL	1	058680_000242482	view or edit
1963	0	LS016	19-07-16 14:28 UTC	HAL	1	058680_000242483	view or edit

Showing 1 to 10 of 28,782 entries

◀ Previous Next ▶



Current Support

- Meteor Trail Radio Emission (NSF) – ends 8/31/2020
- Novel Imaging Correlator (NSF) – ends 7/31/2020
- Mid-Scale Innovations Program (NSF) – ends 9/30/2021
- Ionosphere and Transients (NRL) - ends 7/31/2024
- Ionospheric Research (AFRL) – pending
- LWA Center at UNM (unrestricted)



Projects

~60 observing projects ongoing

Cumulative: 100+ users from 40 institutions and 4 countries

CFP8 deadline November 2019

CFP8 observing begins January 1, 2020



CFP7

CFP: 7

Code Allocated Observed Percent Completed

LB006	48.000	0.000	0.00
LD006	800.000	31.800	3.98
LD007	2000.000	106.000	5.30
LD008	96.000	96.526	100.55
LD009	96.000	1.005	1.05
LF002	120.000	15.500	12.92
LH015	416.000	184.000	44.23
LH016	150.000	0.000	0.00
LL002	20.000	0.000	0.00
LM005	20.000	0.000	0.00
LO004	50.000	0.000	0.00
LD010	20.000	4.000	20.00
LR006	380.000	0.000	0.00
LS013	104.000	44.000	42.31
LV004	210.000	0.000	0.00
LS014	120.000	170.620	142.18
LS015	192.000	0.000	0.00
LS016	1600.000	1072.000	67.00
LW009	200.000	143.333	71.67
DA002	12.000	12.000	100.00

Only 28% complete!

Summary: 6654.000 1880.785 28.27



LWA Publications

LWA refereed publications

64. Varghese, S.S., Obenberger, K.S., Taylor, G.B., & Dowell, J.
2019, JGR Space Physics, submitted
[Testing the Radiation Pattern of Meteor Radio Afterglow](#)
63. Malins, J., Obenberger, K.S., Taylor, G.B., & Dowell, J.
2019, Radio Science, submitted
[Three Dimensional Mapping of Lightning Produced Ionospheric Reflections](#)
62. Callister, T.A., Anderson, M.M., Hallinan, G., D'addario, L.R., Dowell, J., Kassim, N.E., Lazio, J.W., Price, D.C., & Schinzel, F.K.
2019, ApJ, submitted
[A First Search for Prompt Radio Emission from a Gravitational-Wave Event](#)
61. Bansal, K., Taylor, G.B., Stovall, K., & Dowell, J.
2019, ApJ, submitted
[Echoes in PSR B1508+55 using the LWA1](#)
60. Anderson, M.M., Hallinan, G.H. Eastwood, M.W., et al.
2019, ApJ, submitted
[New limits on the low frequency radio transient sky using 31 hours of all-sky data with the OVRO-LWA](#)
59. Kent, J., Dowell, J., Beardsley, A., Thyagarajan, N., Taylor, G.B., & Bowman, J.
2019, MNRAS, 486, 5052
[A Real-Time, All-Sky, High Time Resolution, Direct Imager for the Long Wavelength Array](#)
58. Imai, M., A. Lecacheux, T. E. Clarke, C. A. Higgins, M. Panchenko, V. V. Zakharenko, A. I. Brazhenko, A. V. Frantsuzenko, O. N. Ivantyshin, A. A. Konovalenko, and V. V. Koshovyy,
, Space Physics on December 24, 2018.
2019, submitted to J. Geophys. Res.
[Concurrent Jovian S-burst beaming as observed from LWA1, NDA, and Ukrainian radio telescopes](#)
57. Obenberger, K.S., Dao, E., & Dowell, J.
2018, Radio Science, submitted
[Experimenting with frequency and angular sounding to characterize traveling ionospheric disturbances using the LWA-SV Radio Telescope and DPS4D](#)
56. Varghese, S.S., Obenberger, K.S., Dowell, J., & Taylor, G.B.
2018, ApJ, 874, 151
[Detection of a Low Frequency Cosmic Radio Transient Using Two LWA Stations](#)

Meeting Goals

- **Review LWA Hardware and current capabilities**
- **Learn How to Use LWA**
- **Results with LWA**
- **New Instrumentation**
- **Inform you about many related projects & proposals**
- **Exchange ideas**
- **Discuss future capabilities**



Backup Slides



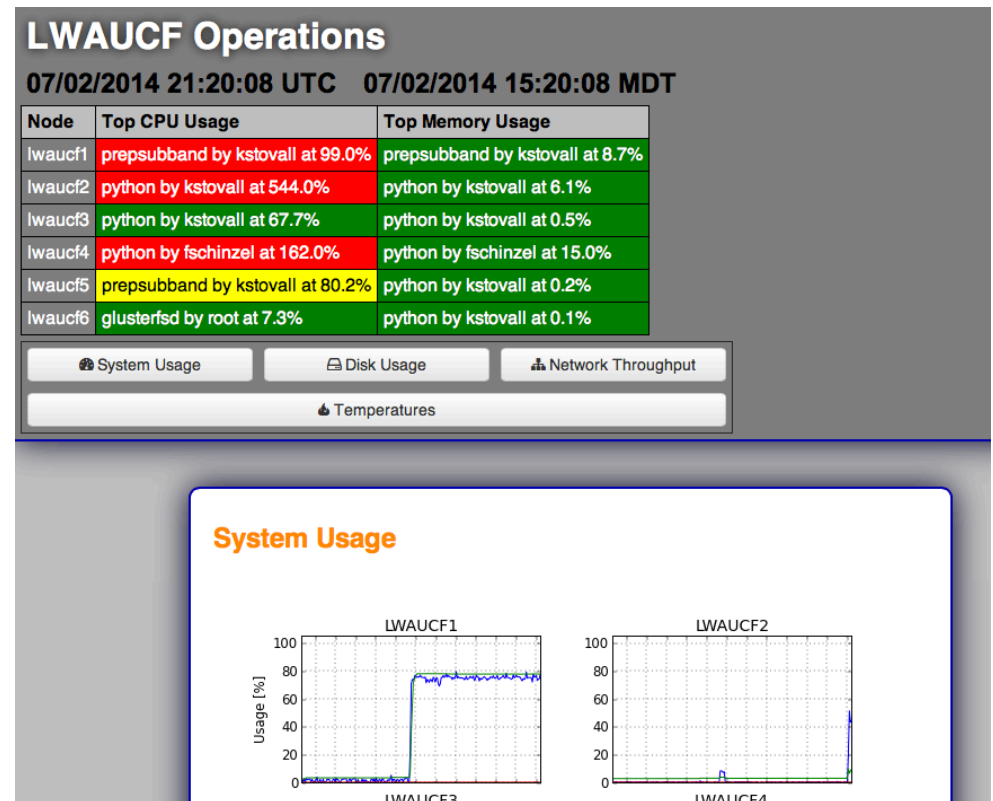


Natural Hazards



The LWA User's Computing Facility

- LWA has large data volumes (up to ~1 TB/hour) and a relatively remote site
 - Quick turn around on data requires computing close to the data
- LWA User's Computing Facility Cluster
 - Six nodes each with 2 GPUs
 - Located in the old correlator room of the VLA control building
 - Connected to the LWA1 site via a 10GbE link
 - 138 TB on /data/network
 - GPUs updated May 2019
 - Also serves as LWA correlator



<http://lwalab.phys.unm.edu/CompScreen/cs.php>

Technical Specifications:

	<u>Required</u>	<u>Achieved</u>
• Frequency Range:	20 MHz to 80 MHz	10 MHz to 88 MHz
• Angular resolution:	$\theta \leq [8,2]''$	$\theta \leq [7,1.4]''$
• LAS at [20,80] MHz	$\geq [8,2]^\circ$	$\geq [16,4]^\circ$
• Baseline range:	100 m to 400 km	50 m to 600 km
• Sensitivity [20,80 MHz]:	$\sigma \leq [1.0,0.5]$	$\sigma \leq [0.5,0.1]$
• Collecting Area (m ²)	$A_e = 1 \times 10^6$	$A_e = 4 \times 10^6$
• Dynamic range:	$DR \geq [1 \times 10^3, 2 \times 10^3]$	$DR \geq [2 \times 10^3, 8 \times 10^3]$
• Δv_{\max} (per beam)	$\Delta v \geq 4$ MHz	$\Delta v = 20$ MHz
• Δv_{\min}	$\Delta v \leq 100$ Hz	$\Delta v \leq 10$ Hz
• Temporal Res	$\Delta \tau = 10$ msec	$\Delta \tau \leq 0.1$ msec
• Polarization:	1 circular	Full
• Sky Coverage:	$z \geq 40^\circ$	$z \geq 15^\circ$
• FoV [20,80] MHz	$[8,2]^\circ$	$\leq [16,4]^\circ$
• # of beams:	4 single pol.	4 single pol.
• Configuration:	2D array, N = 53 stations	2D array, N \geq 53



continued

- Detection and Flux Density Measurements of the Millisecond Pulsar J2145-0750 below 100 MHz, Dowell et al. 2013, ApJL submitted
- All-sky Imaging of Meteor Trails at 55.25 MHz with the first station of the LWA, Helmboldt et al. 2013, Radio Science, submitted
- Observations of Crab Giant Pulses in 20-84 MHz using the LWA1, Ellingson et al. 2013, ApJ, in press
- Passive over-the horizon radar with WWV and the first station of the Long Wavelength Array, Helmboldt, J.F. et al. 2013, Radio Science, submitted



LWA Proceedings in 2012-2013

- 1 [2013AAS...22134518D](#) 1.000 01/2013 [A](#) [U](#)
Dartez, Louis P.; Jenet, F.; Cohen, S.; A ROACH Based Data Acquisition System for the Low Frequency All Sky Monitor (LoFASM)
Creighton, T. D.; Ford, A.; Garcia, A.;
Hicks, B.; Hinojosa, J.; Kassim, N. E.;
Longoria, C.; **and 10 coauthors**

- 2 [2013AAS...22134517F](#) 1.000 01/2013 [A](#) [U](#)
Ford, Anthony; Jenet, F.; Craig, J.; Progress on the Low Frequency All Sky Monitor
Creighton, T. D.; Dartez, L. P.;
Hicks, B.; Hinojosa, J.; Jaramillo, R.;
Kassim, N. E.; Lunsford, G.; **and 5**
coauthors

- 3 [2013AAS...22134110M](#) 1.000 01/2013 [A](#) [U](#)
Monkiewicz, Jacqueline A.; Observing Cosmic Dawn with the Long Wavelength Array: Custom Beamforming Techniques
Bowman, J. D.; Hartman, J.;
Taylor, G. B.; Monkiewicz, J. A.

Total of 16 published abstracts



Projects as of Aug. 9, 2013

Science Area	Projects	Hours
Hot Jupiters:	2	1372
Transients	6	1096
Pulsars:	7	569
Solar and Space Weather	3	505
Ionosphere/Atmos	10	332
Planets	4	248
Cosmology	2	16
Others	8	282
Commissioning	-	2038

Total

42

6459

