LWA Update & Plans

Greg Taylor (UNM)
On behalf of the LWA Collaboration

LWA Users Meeting, 7/30/2020

Meeting Logistics

- Speakers keep your chat window open for questions
- I will send a classy beeping noise at T +15 min
- After T+17 min you are into your Q&A time

- LWA Tutorials on Friday afternoon

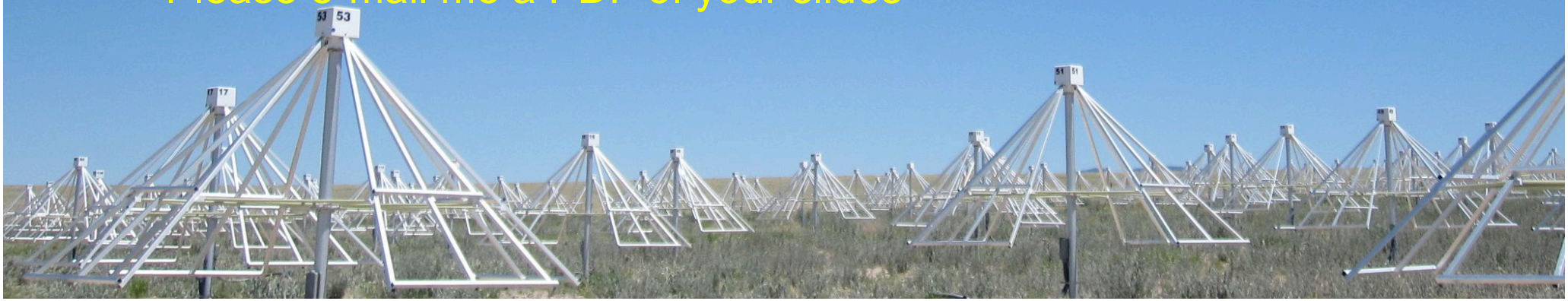
  Office Hours: Jayce Dowell, Greg Taylor, Pratik Kumar

  Will use the same zoom room.

  Friday 2:00 – 4:30 pm

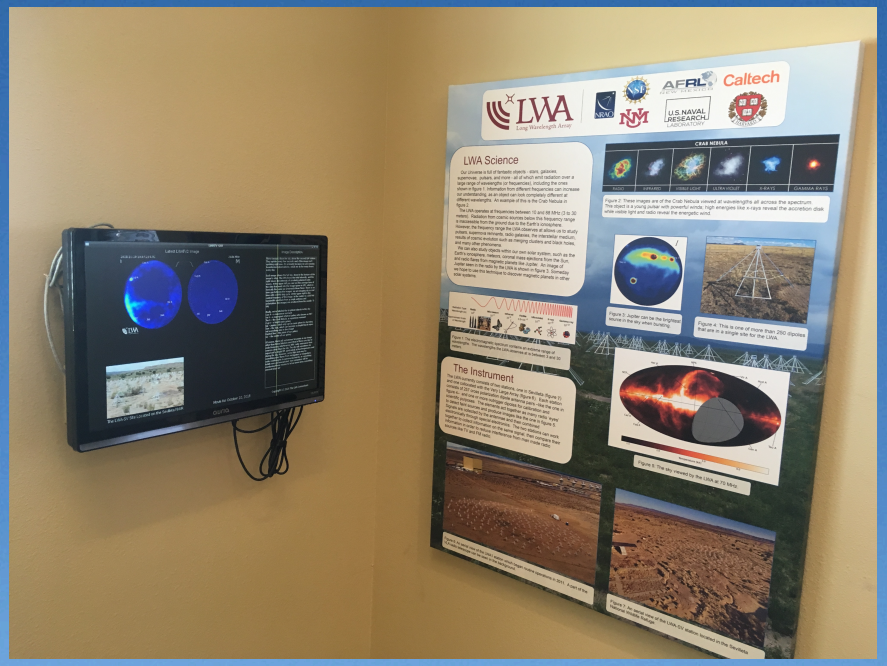
  You should download tutorials + data + docker/xpra and look it over before tomorrow

- Please e-mail me a PDF of your slides



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
  - Single Baseline Interferometer
- Docker containers now available
- LWA interactive sky maps:



http://fornax.phys.unm.edu/low-frequency-sky/index.html
https://fornax.phys.unm.edu/multi-wavelength-sky/index.html

Current Support

- Novel Imaging Correlator (NSF) – ends 9/31/2020
- Meteor Trail Radio Emission (NSF) – ends 8/31/2021
- Spectrum Innovation Initiative: Spectrum-Agile Cognitive Communications for Terrestrial and Space Applications (NSF) – ends 9/1/2021
- Mid-Scale Innovations Program (NSF) – ends 9/30/2021
- Ionosphere and Transients (NRL) - ends 7/31/2024
- Ionospheric Research (AFRL) – ends 7/31/2025
- LWA Center at UNM (unrestricted)

Projects

~60 observing projects ongoing
Cumulative: 100+ users from 40 institutions and 4 countries

CFP9 deadline November 2020
CFP9 observing begins January 1, 2021

CFP8

CFP: 8

Code	Allocated	Observed	Percent Completed
LB007	100.000	4.000	4.00
LD011	500.000	298.333	59.67
LD012	500.000	328.600	65.72
LD013	400.000	185.936	46.48
LD014	42.000	30.000	71.43
LD015	96.000	0.000	0.00
LH017	39.000	8.000	20.51
LH018	140.000	0.000	0.00
LI002	320.000	111.417	34.82
LK008	48.000	0.000	0.00
LK009	2000.000	547.000	27.35
LS017	72.000	85.583	118.87
LS018	72.000	0.000	0.00
LT005	60.000	0.000	0.00
LT006	535.000	185.000	34.58
LF003	240.000	0.000	0.00
LW010	240.000	42.000	17.50
DD002	7000.000	1114.750	15.92
Summary:	12404.000	2940.619	23.71

Only 24% complete!

LWA Publications

LWA refereed publications

74. **Obenberger, K.S., Dowell, J., Fallen, C.T., Holmes, J.M., Taylor, & G.B., Varghese, S.S.**
2020, Radio Science, submitted
Using Broadband Radio Noise from Power-Lines to Map and Track Dense Es Structures

73. **Dike, V., Taylor, G.B., Dowell, J., & Stovall, K.**
2020, MNRAS, in press
Detecting Pulsar Polarization below 100 MHz with the Long Wavelength Array

72. **Gerekos, C., Bruzzone, L., & Imai, M.**
2020, IEEE Trans. Geosci. Remmote Sens, vol 58, No. 4, p. 2250
A Coherent Method for Simulating Active and Passive Radar Sounding of the Jovian Icy Moons

71. **Obenberger, K.S., Holmes, J.M., Ard, S.G., Dowell, J., Shuman, N.S., Taylor, G.B., Varghese, S.S., & Viggiano, A.A.**
2020, JGR, submitted
Association between Meteor Radio Afterglows and Optical Persistent Trains

70. **DiLullo, C., Taylor, G.B., & Dowell, J.**
2020, JAI, in press
Using the Long Wavelength Array to Search for Cosmic Dawn

69. **Davis, I., Taylor, G.B., & Dowell, J.**
2020, MNRAS, in press
Observing Flare Stars Below 100 MHz with the LWA

68. **Ruan, D., Taylor, G.B., Dowell, J., Stovall, K., Schinzel, F.K., & Demorest, P.B.**
2020, MNRAS, in press
Discovery of a Pulsar Wind Nebula around B0950+08 with the ELWA

67. **Anderson, M., Hallinan, G., Eastwood, M., Monroe, R.M., Callister, T.A., Dowell, J., Hicks, B., Huang, Y., Kassim, N.E., Kocz, J., Lazio, T.J.W., Price, D.C., Schinzel, F., Taylor, G.B,**
2019, ApJ, 886, 123
New Limits on the Low-frequency Radio Transient Sky Using 31 hr of All-sky Data with the OVRO—LWA

66. **Kent, J., Beardsley, A.P., Landman, B., Gull, S.F., Nikolic, B., Dowell, J., Thyagarajan, N., Taylor, G.B., & Bowman, J.**
2019, MNRAS, submitted
Direct Wide-Field Radio Imaging in Real-Time at High Time Resolution using Antenna Electric Fields

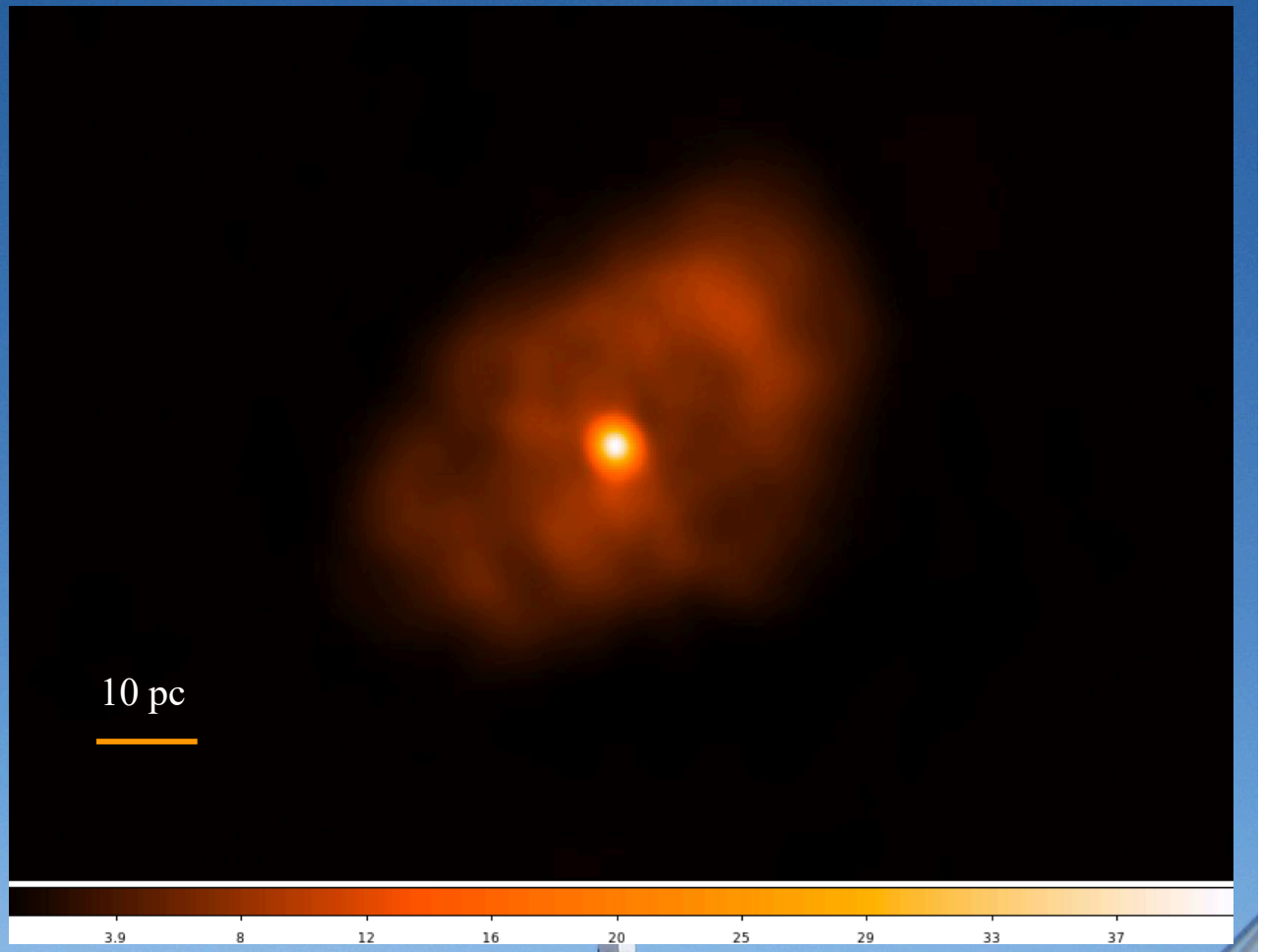
65. **Monroe, R., Hallinan, G., Neiles, A., Eastwood, M., Anderson, M., D'Addario, L., Kocz, J., Cody, D., Woody, D., Schinzel, F., Taylor, G., Greenhill, L., & Price, D.**

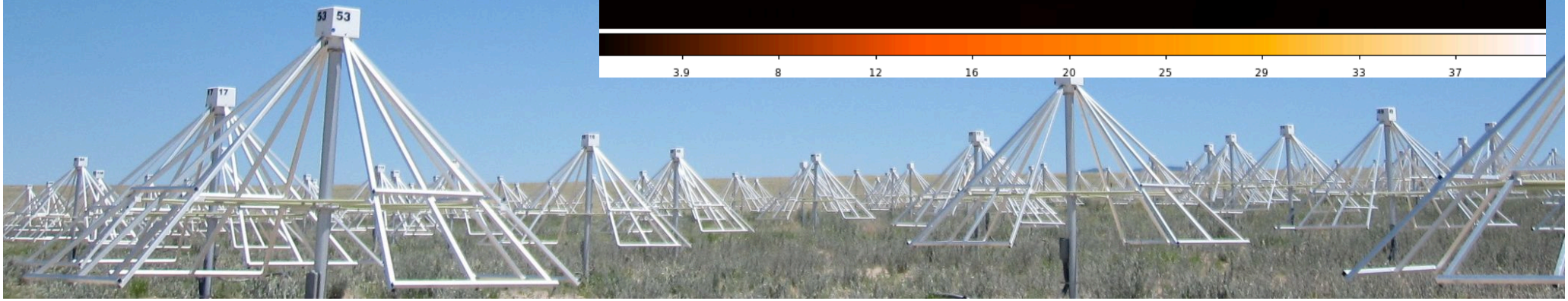
VLA 50-86 MHz

New 4 band feeds (MJP)
4 meter band: 50-86 MHz
All 28 installed

ELWA - Demonstration

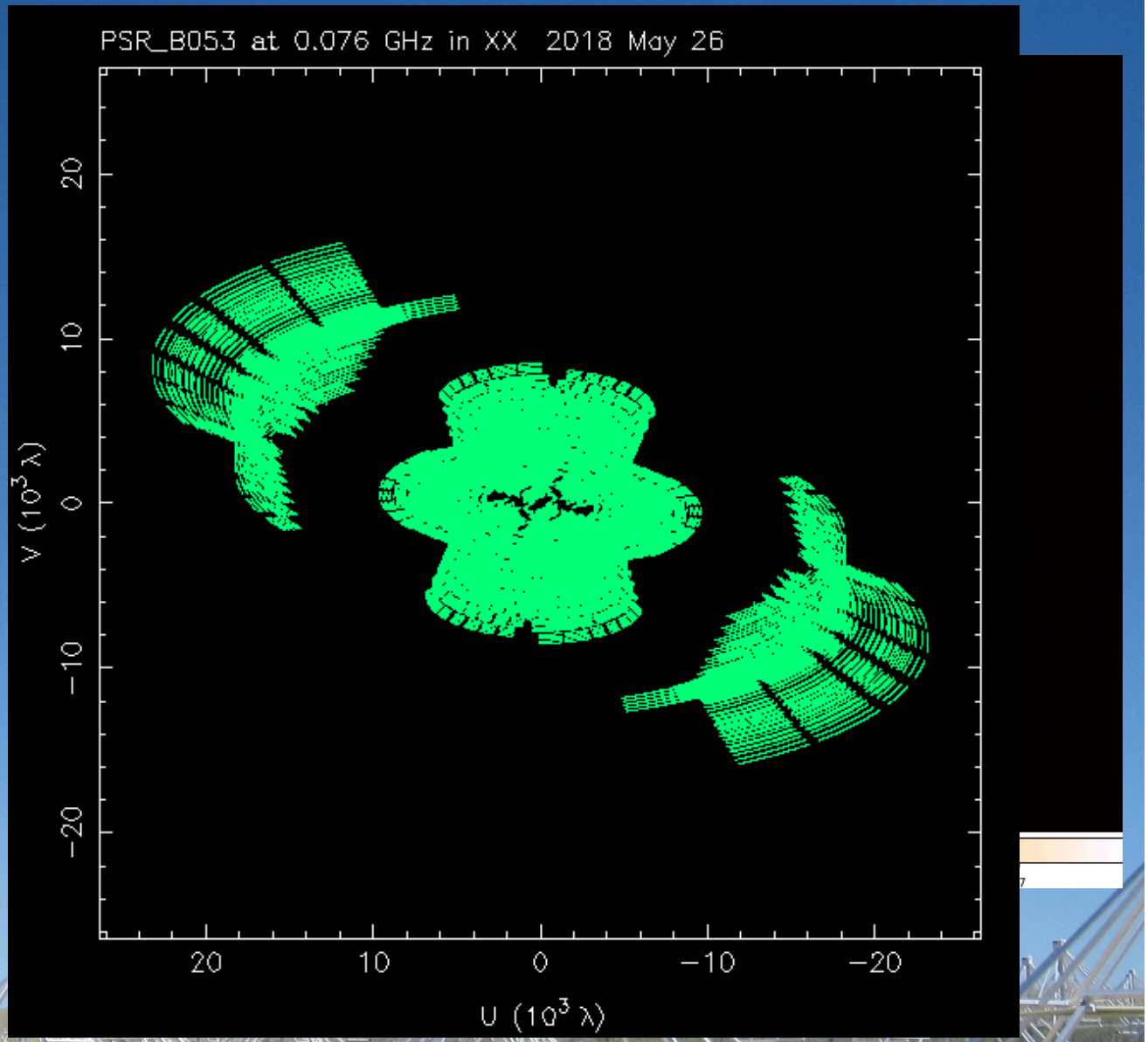
TauA (crab) at 72 MHz
May 26, 2018
2 LWA + 23 VLA
4 hours on source
38 Jy peak
RMS ~ 40 mJy/beam





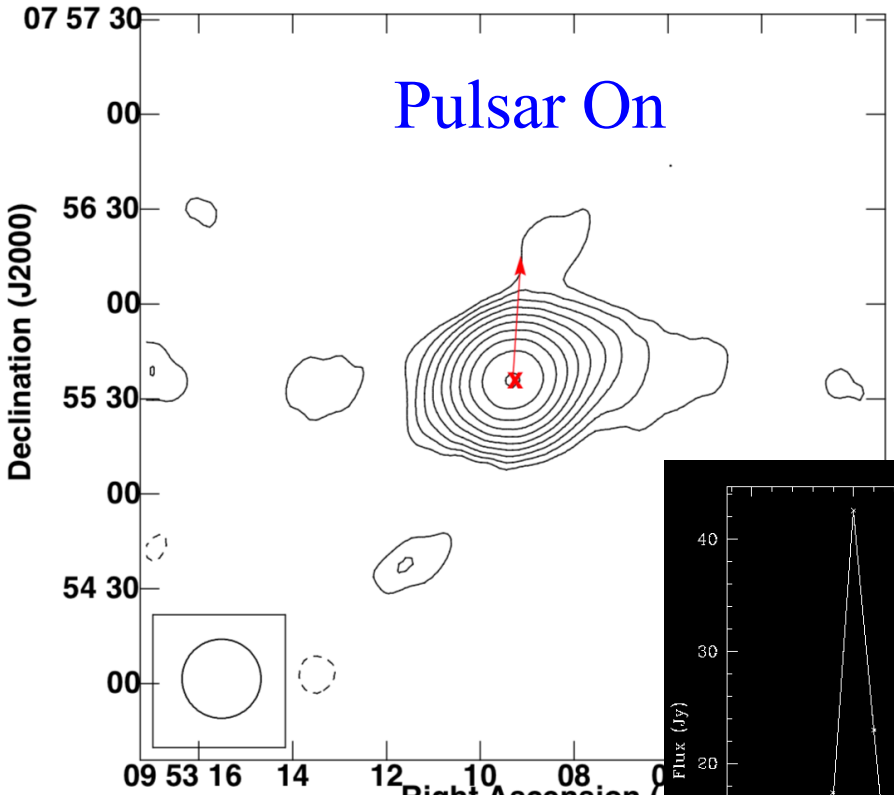
ELWA - Demonstration

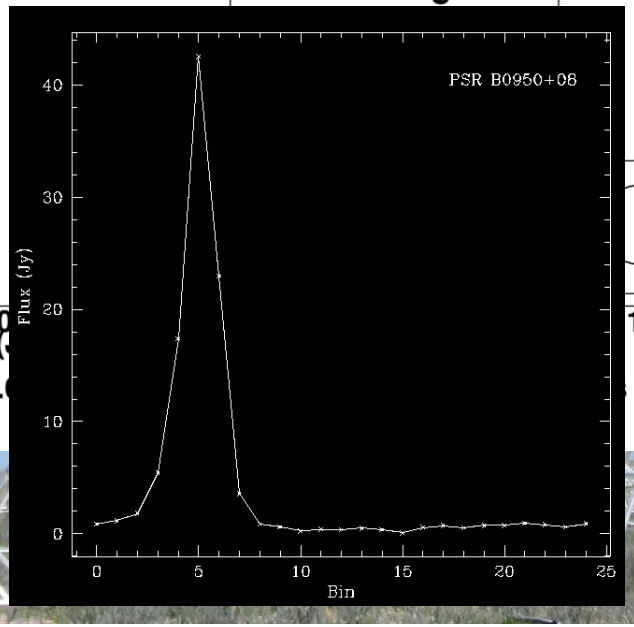
TauA (crab) at 72 MHz
May 26, 2018
2 LWA + 23 VLA
4 hours on source
38 Jy peak
RMS ~ 40 mJy/beam
Resolution ~ 15”

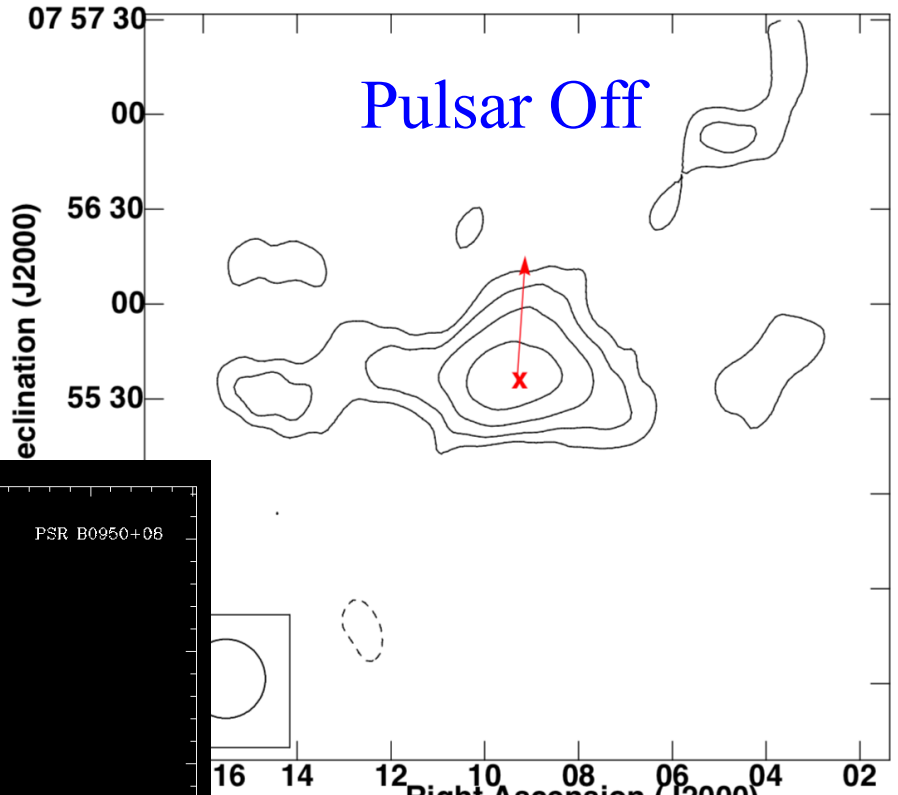


ELWA – Discovery of a Pulsar Wind Nebula around B0950+08

Ruan et al. 2020

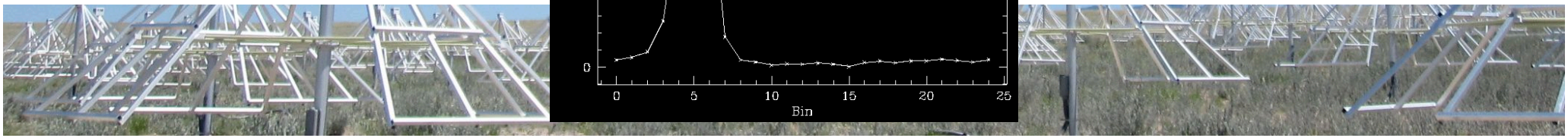






Levs = 1.700E-01 * (-1, 1, 1.414, 2, 2.828, 4, 5.
22.63, 32)

= 1.700E-01 * (-1, 1, 1.414, 2, 2.828)



ELWA – Discovery of a Pulsar Wind Nebula around B0950+08

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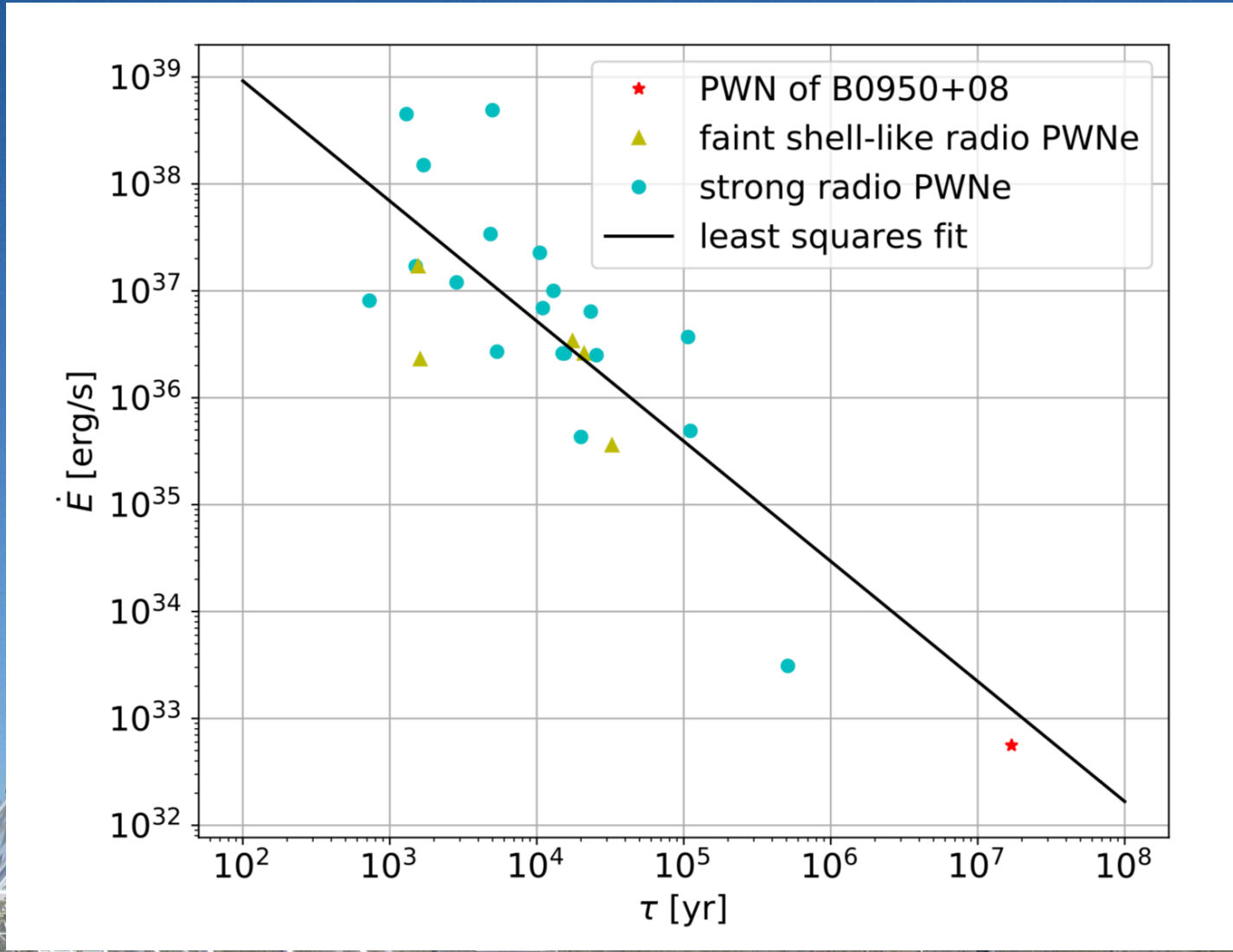
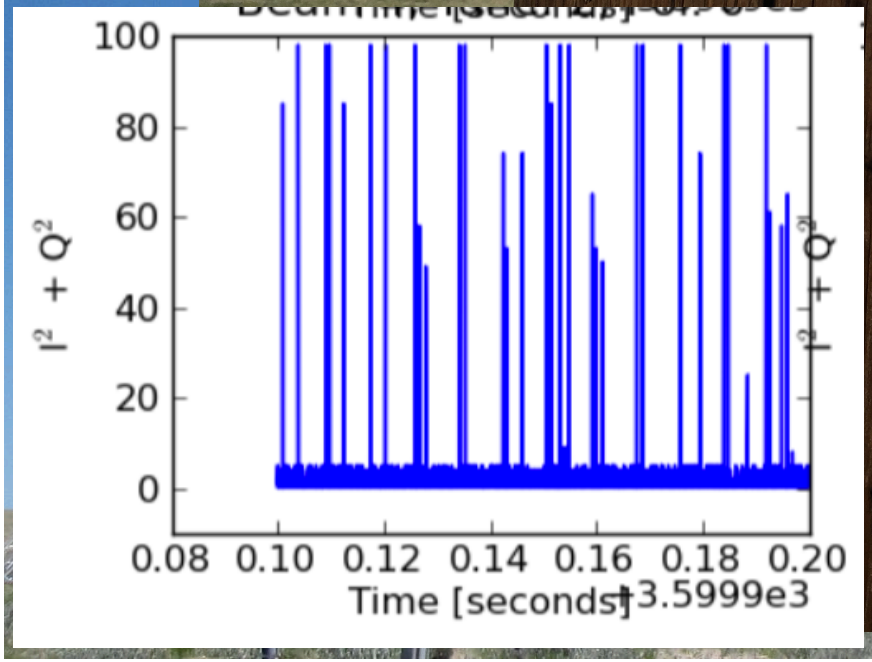
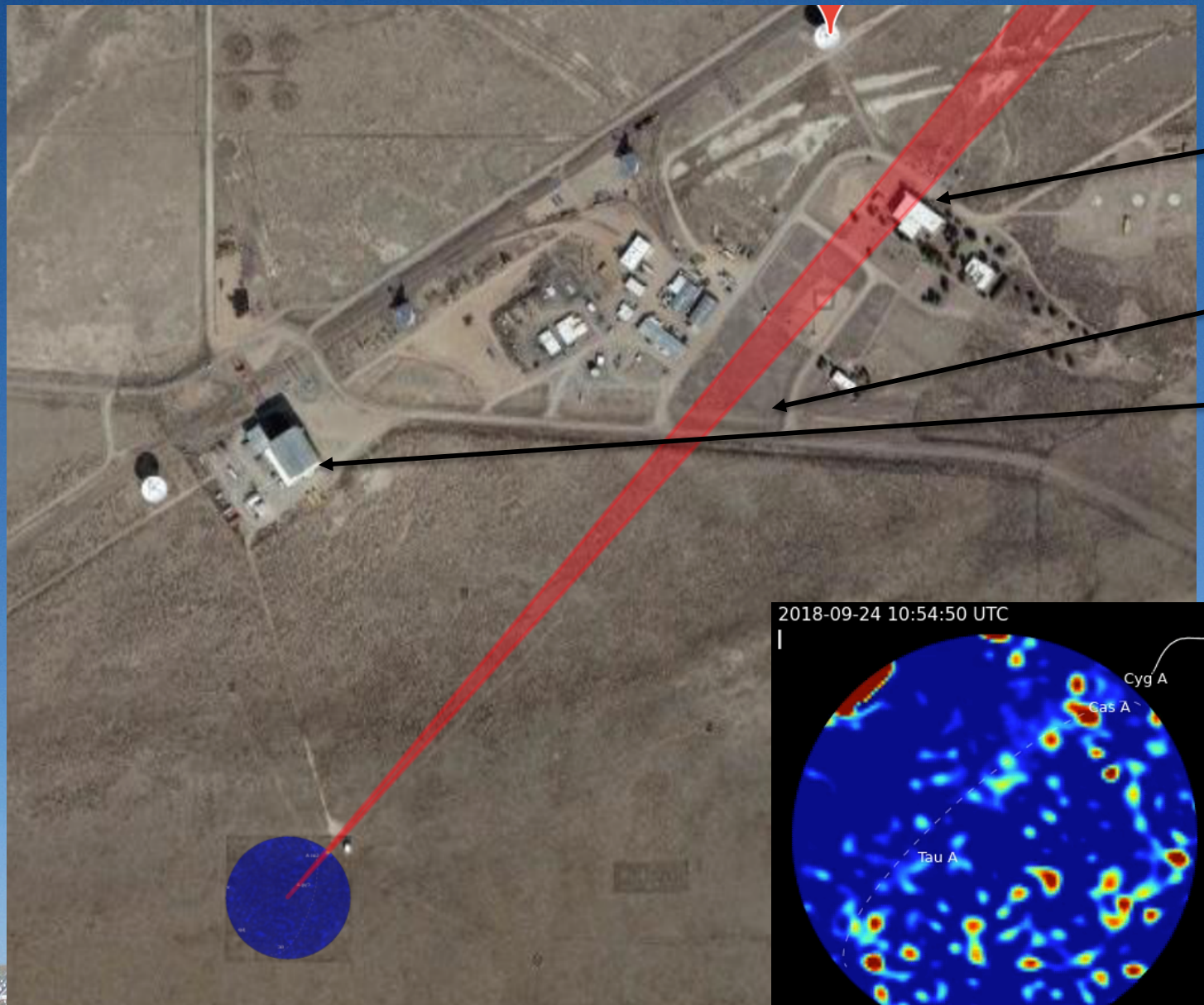


Detection and Mitigation of RFI Spring 2020



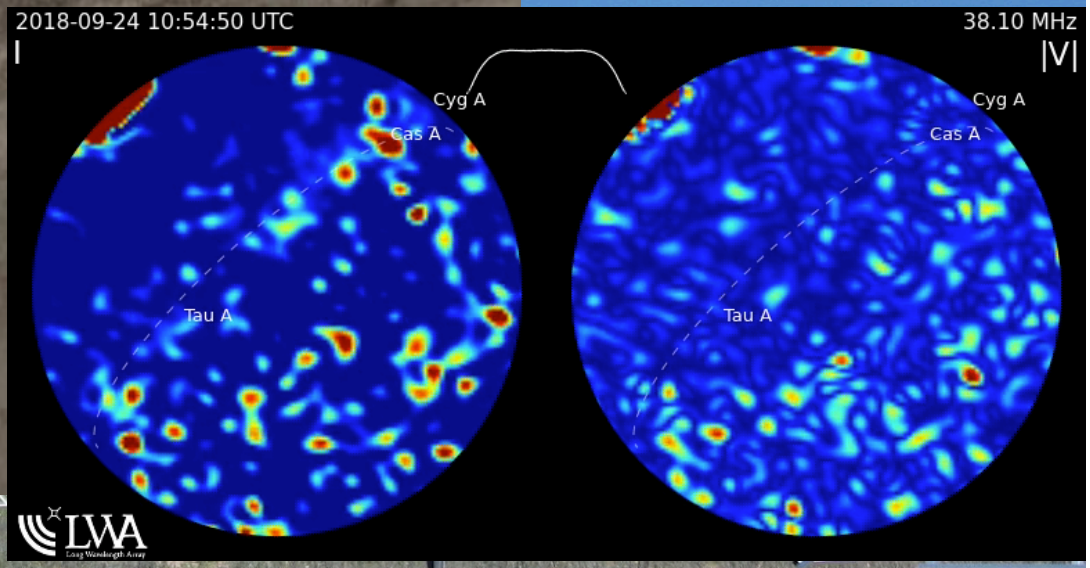
RFI – Powerlines Movie



Control Bldg

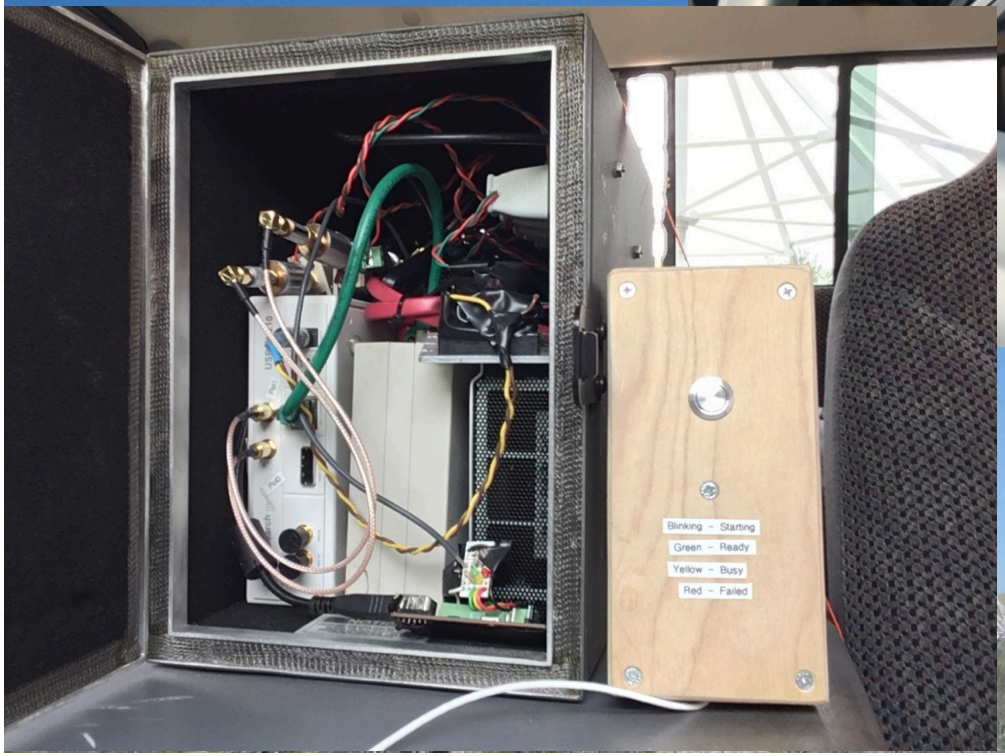
Powerlines

Antenna Assembly Building

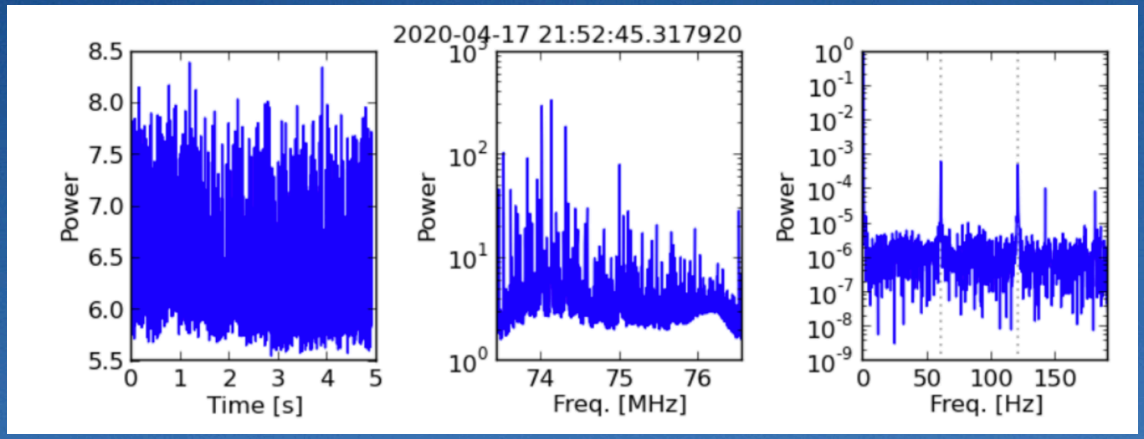


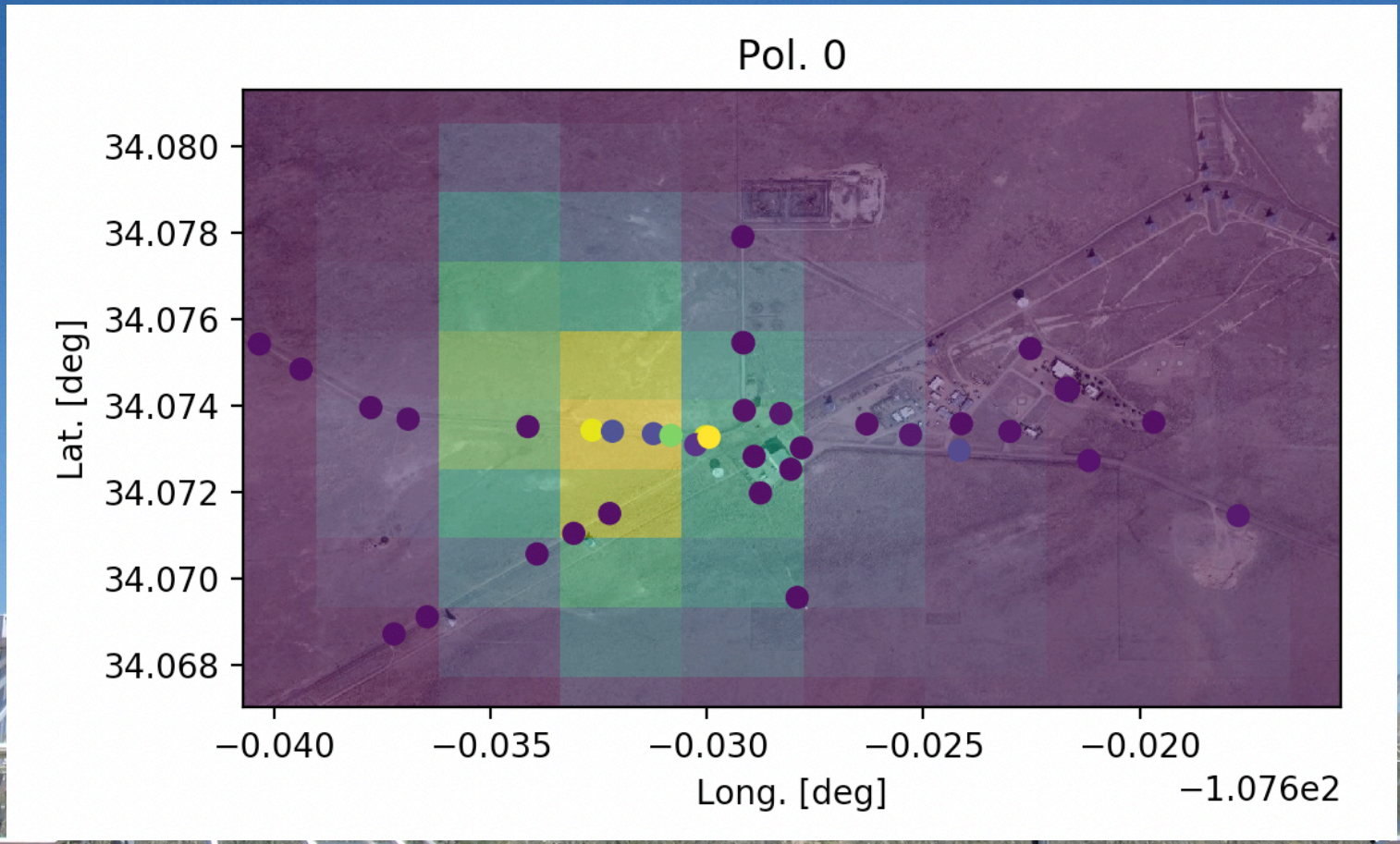
Detection and Mitigation of RFI Spring 2020

Mobile Antenna for RFI Characterization (MARC)
+
Mobile RFI Identification System (MoRIS)
=
MARC MoRIS
Dowell, Taylor & DiLullo
2020, LWA Memo 212



Detection and Mitigation of RFI Spring 2020





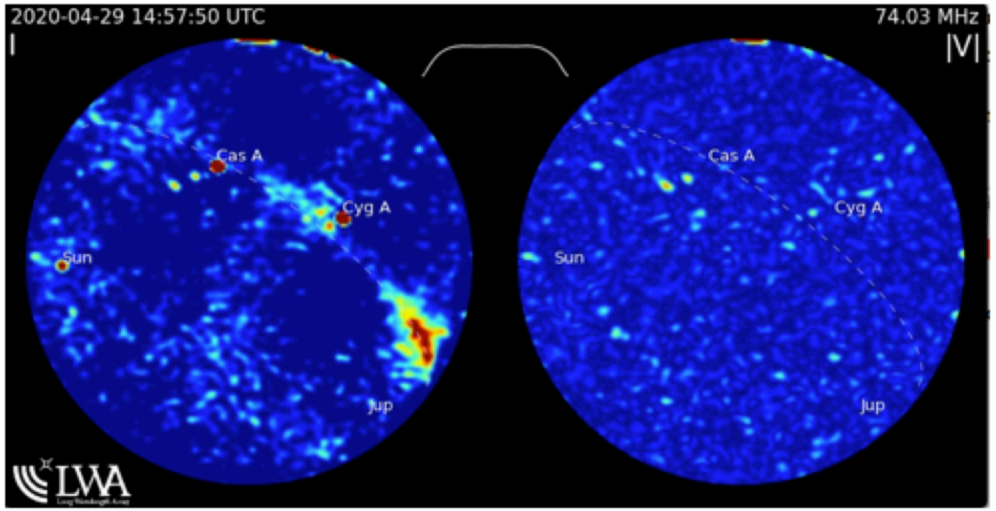
Detection and Mitigation of RFI Spring 2020

Figure 6. View of the suspected noisy pole with MARC in the foreground.

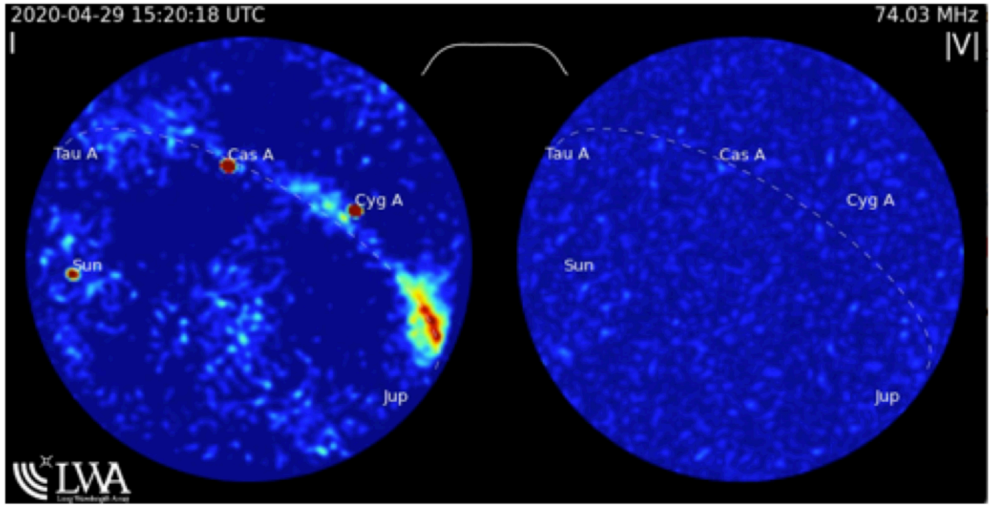

TERE

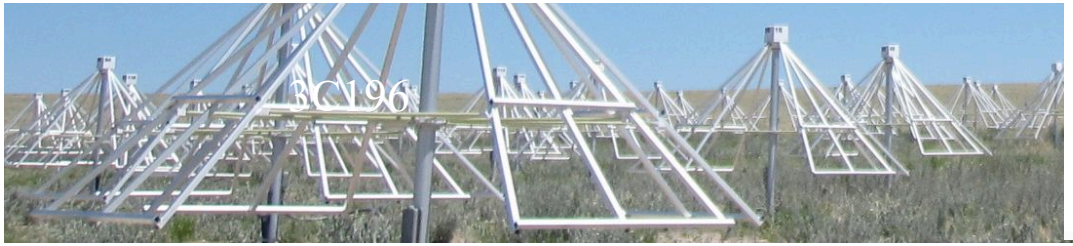
Detection and Mitigation of RFI Spring 2020

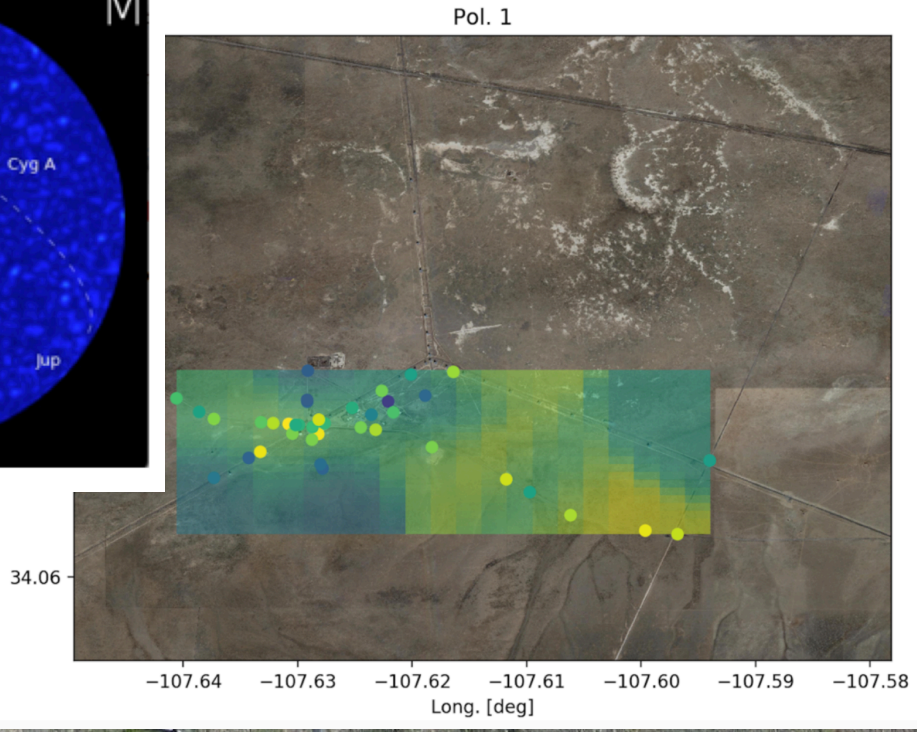
Before



After

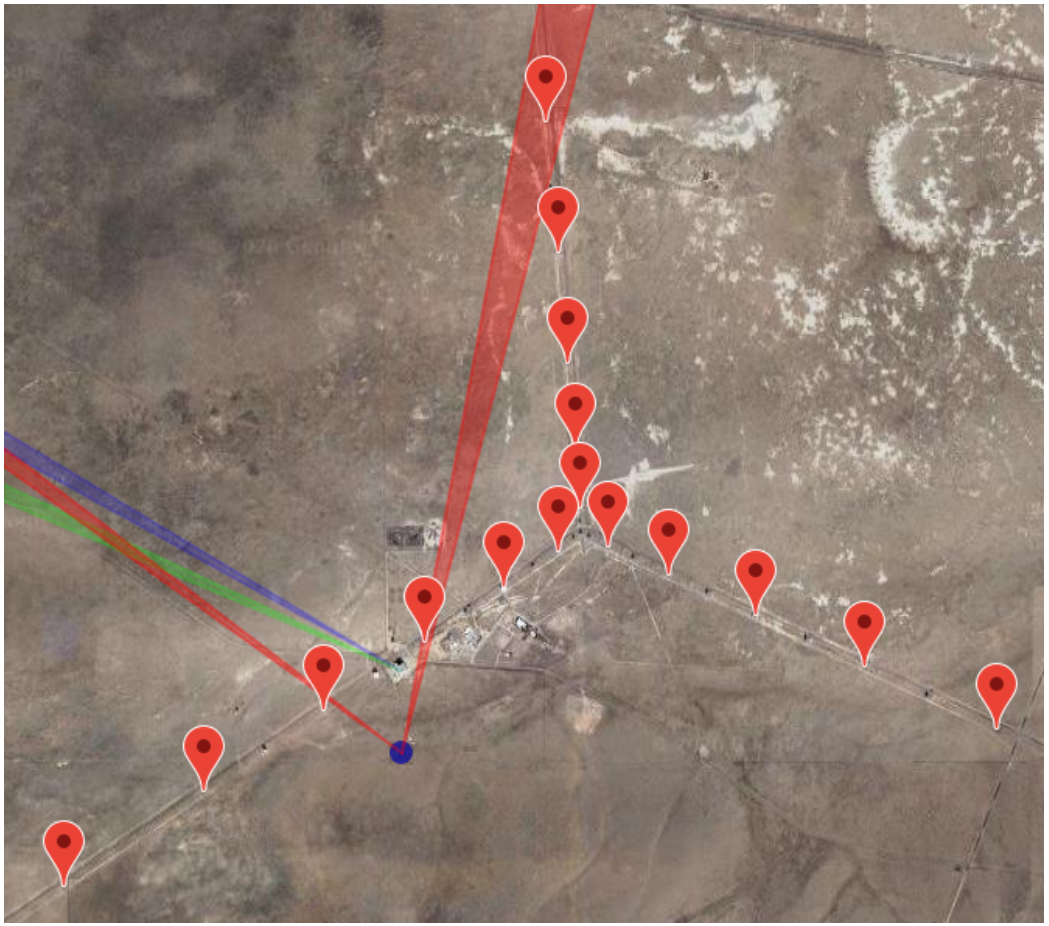






63 MHz RFI!

- Strong interference seen on June 29st at 62.925 MHz
- Intermittent, wipes out LWA1 TV



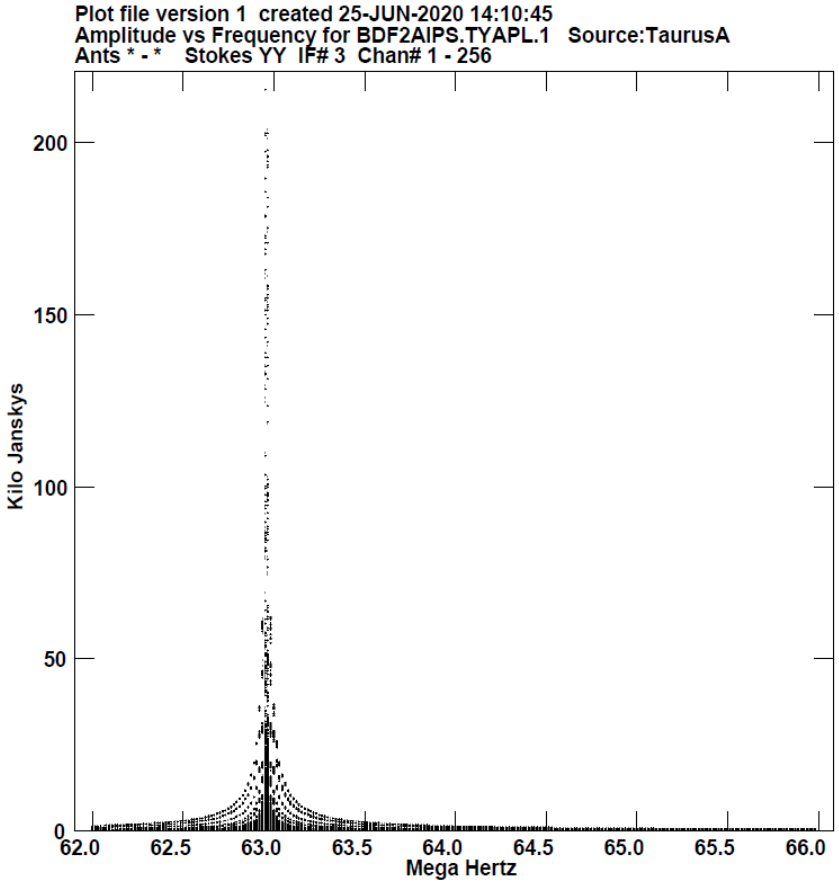
LWA1 TV triangulates to:

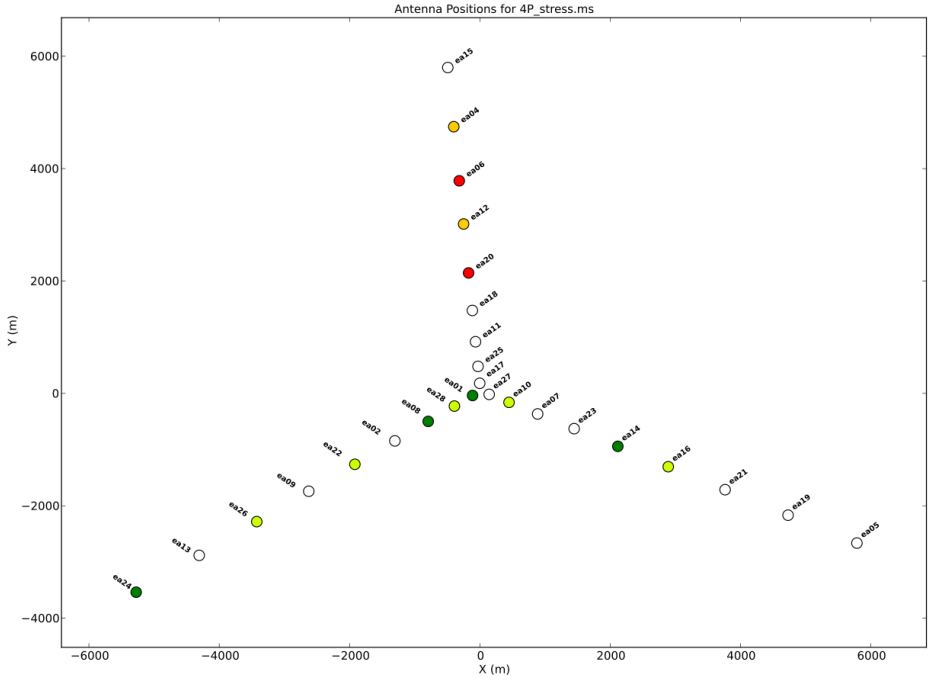
- ea08/W12
- ea29/N20

Courtesy: Frank Schinzel

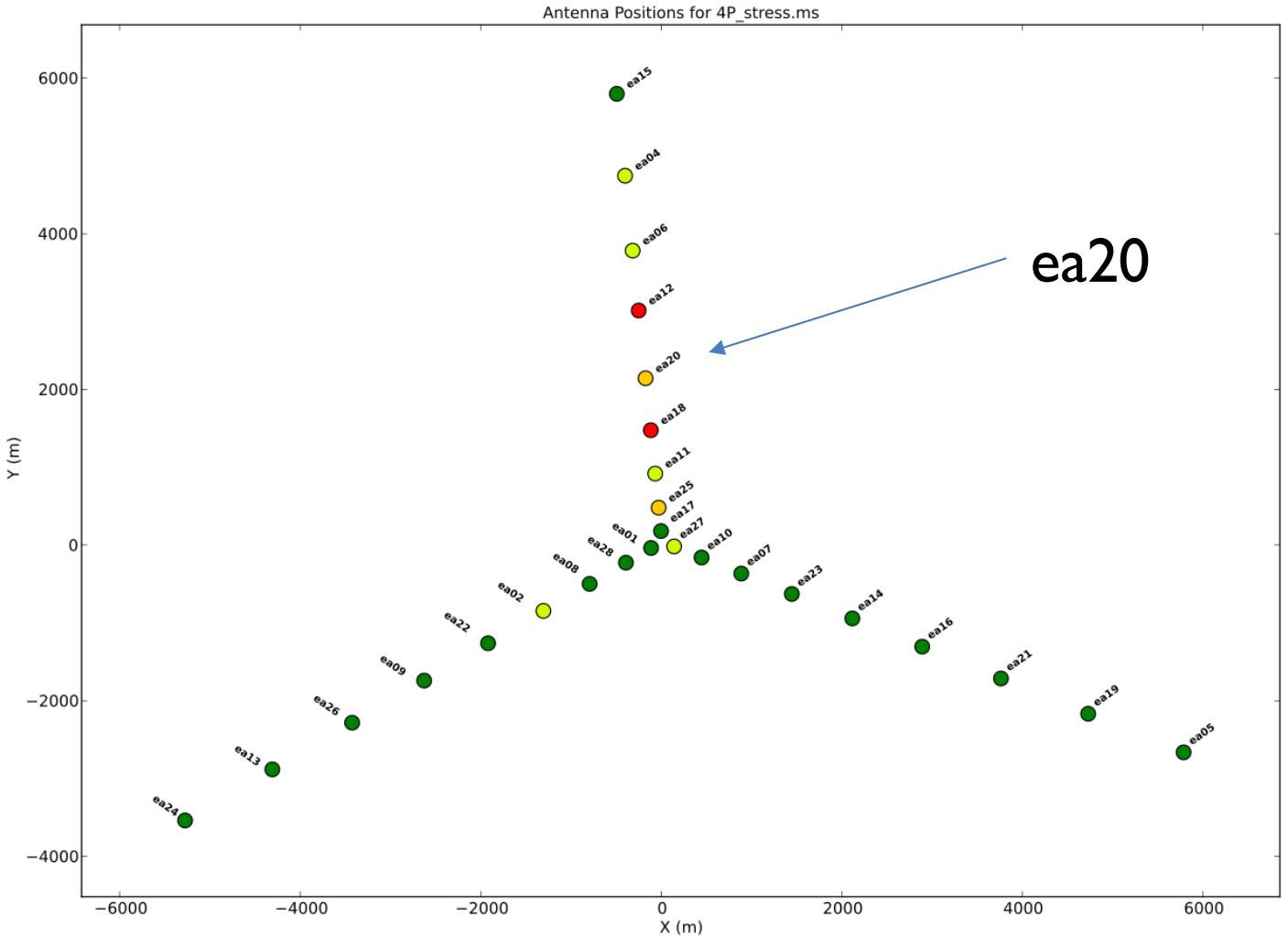
63 MHz RFI!

- Strong interference seen on June 29st at 62.925 MHz (not stable)
- WIDAR also sees it



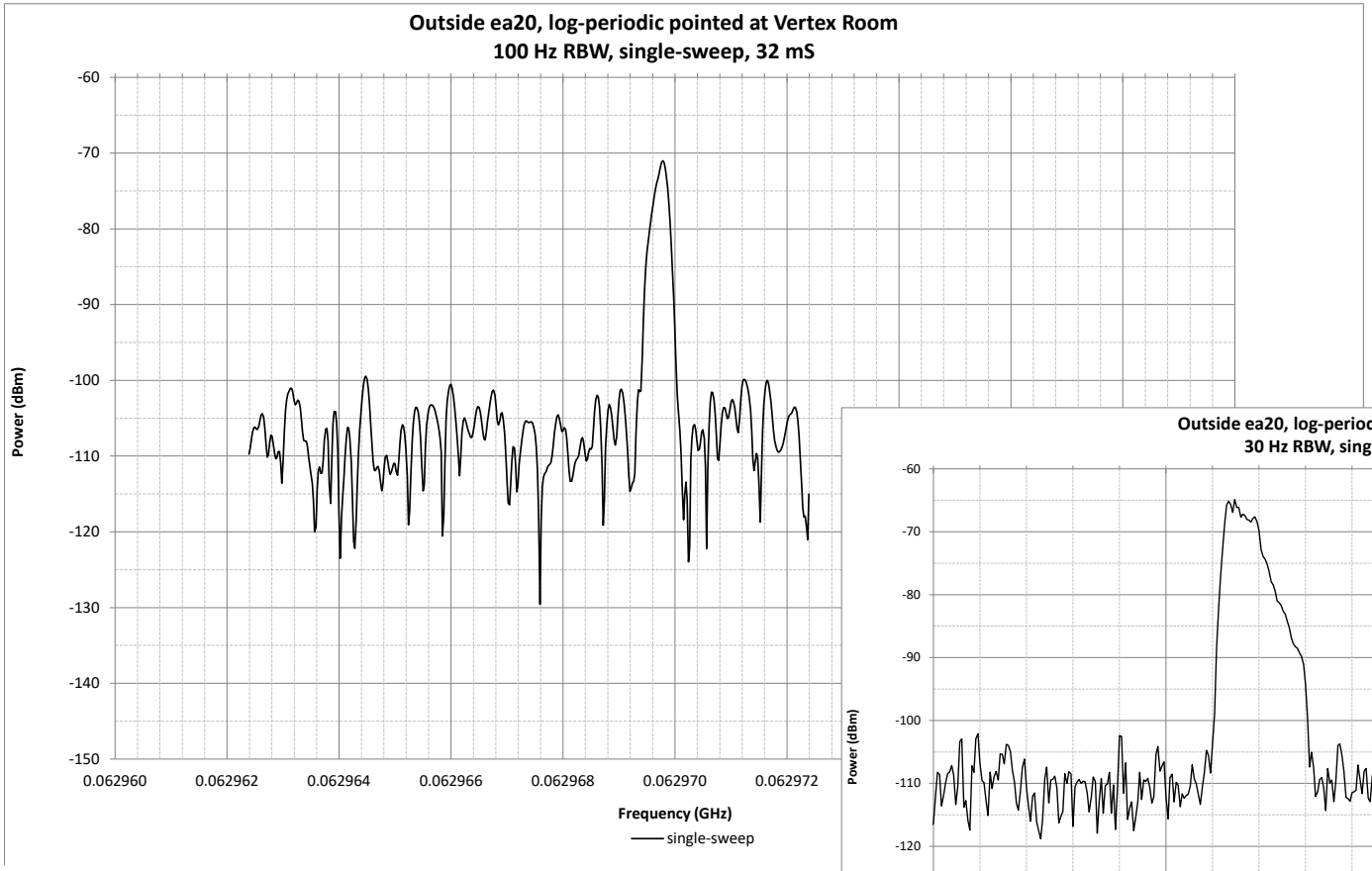


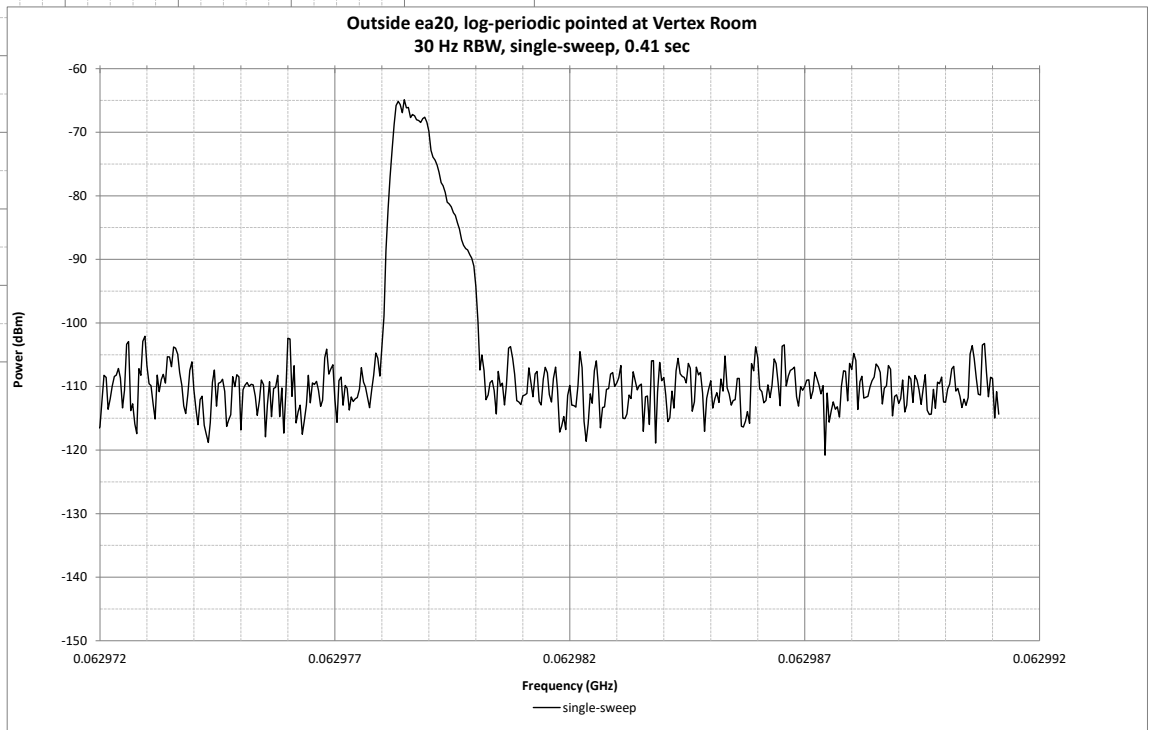
63 MHz RFI!



Most likely source is ea20!

63 MHz RFI!





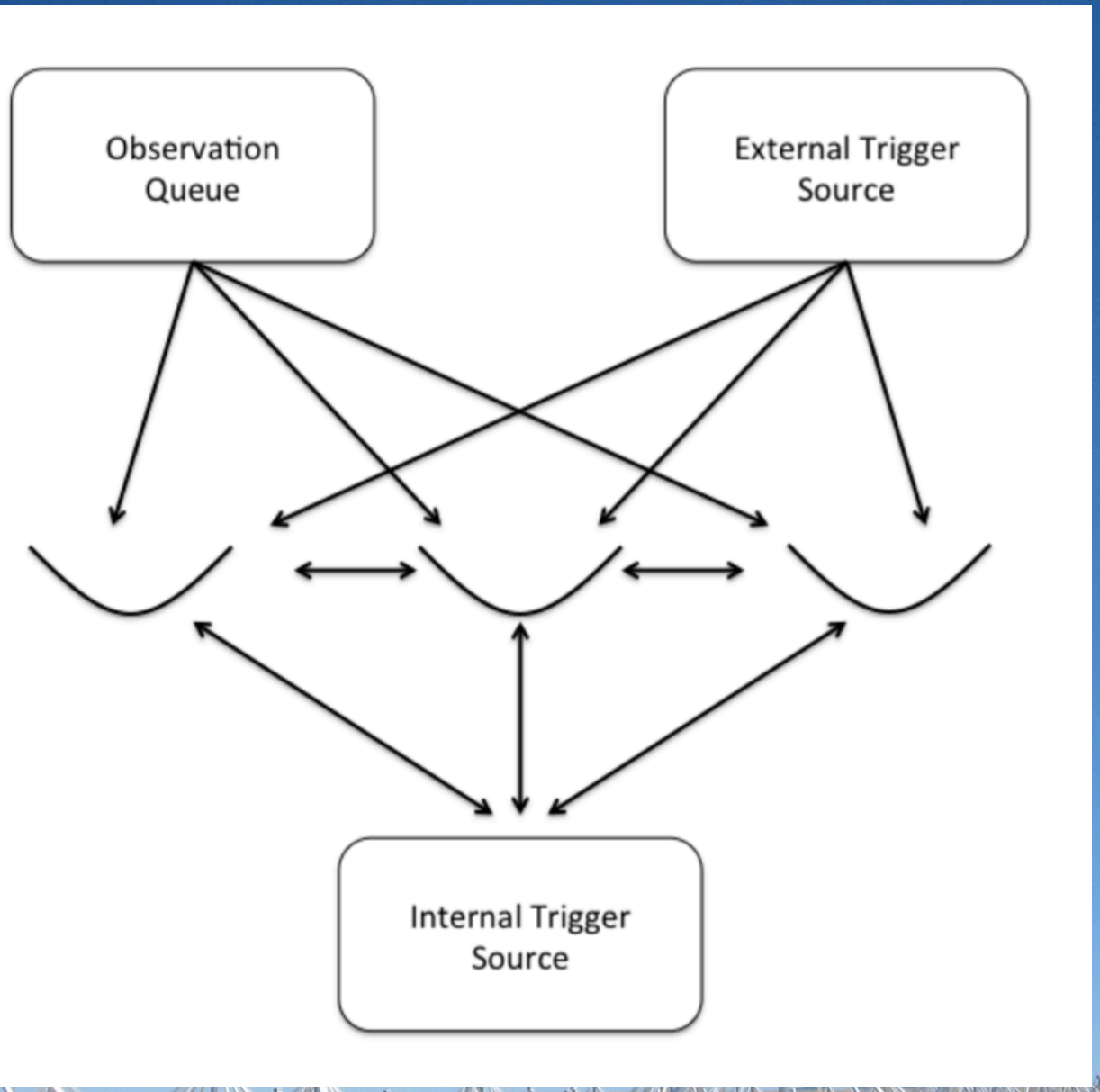
Dan & Joojo exploring around ea20 on Tuesday, June 30

Summary

- LWA has demonstrated technical feasibility and scientific results (>70 refereed publications to date!)
- Lots of exciting science at low frequencies. Progress requires:
  - High temporal, spectral, and spatial resolution
  - Sensitivity

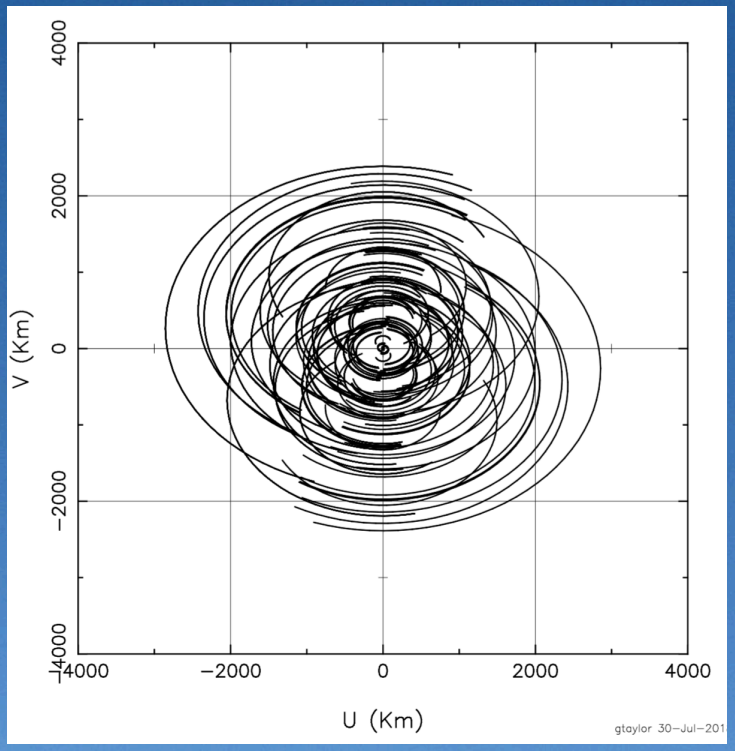
  ➔ LWA Swarm
- Current experiments are providing new hardware and software, and a better understanding of the sky at long wavelengths
- LWA capability continues to increase
- NRAO moving towards shared risk ELWA proposals

LWA Swarm Concept



Dowell & Taylor 2018 JAI

LWA Swarm Concept



- Goal of 3 existing full stations (●) plus ~10 LWA mini stations (●), baselines up to 2500 km for resolution 0.5” at 80 MHz with 5 mJy sensitivity
- Cost is ~$5M including 1 year of operations

LWA Swarm Concept

- Develop new scientific capability in the US
- Provide educational opportunities in STEM (including 3 MSI Universities)
- Build on success of LWA with low risk investment
- White paper submitted to 2020 Decadal Survey

The Swarm Development Concept for the LWA

Greg B. Taylor,[1] Jayce Dowell,[1] Ylva Pihlström,[1] Frank Schinzel,[2] Namir Kassim,[3] Gregg Hallinan,[4] Ian M. Hoffman,[5] Dave Besson,[6] Steven Prohira,[6] Andri M. Gretarsson,[7] Ramon D. Fobes,[7] Thomas J. Maccarone,[8] Timothy Dolch,[9] Judd D. Bowman,[10] Daniel C. Jacobs,[10] Fredrick E. Jenet,[11] Stan Kurtz,[12] and Others[13]