LWA Technical Status

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LWA Users Meeting

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Current Status – LWA1

- DP used for the backend
- Three data products:
  - TBW – 12-bit digitizer samples for up to 61 ms from all dipoles
  - TBN – 8+8-bit I/Q data from all dipoles, 100 kHz bandwidth, 100% duty cycle
  - DRX – 4+4-bit I/Q data from a beam, two tunings, dual polarization

Current Status – LWA1

- Up to 19.6 MHz bandwidth per DRX tuning
- Lost beam #1, strictly limited now to only three beams
  - Not clear what happened
  - Unlikely to get back to four beams in the near term
- LASI all-sky imager running when beams are not

Current Status – LWA-SV

- ADP used for the backend – hybrid FPGA/GPU architecture
  - FPGAs used for digitization and conversion to the frequency domain
  - GPUs used for all subsequent processing to form data products
  - Developed using Bifrost
- Four data products:
  - TBF – 4+4-bit complex spectra, two tunings, up to a few seconds
  - TBN – same as LWA1
  - DRX – same as LWA1
  - COR – correlator visibility output with full polarization, one tuning

Current Status – LWA-SV

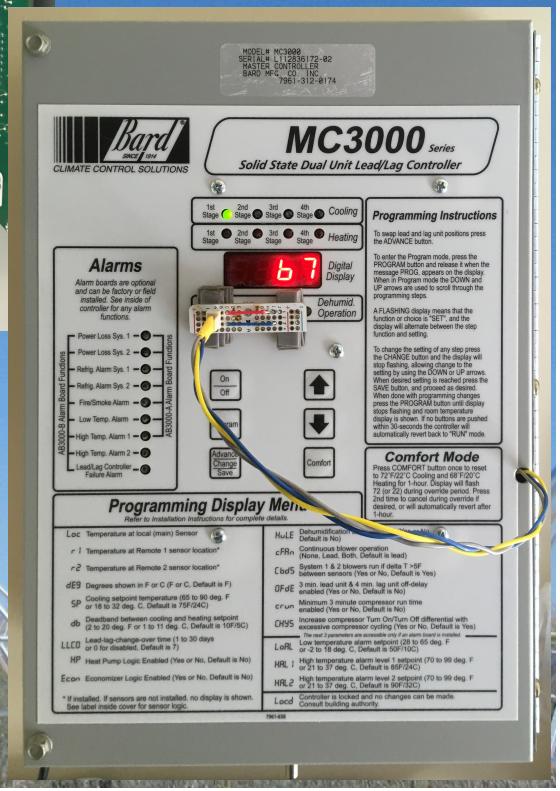
- Up to 9.8 MHz per tuning
  - TBF and wide band correlator running at 10.8 MHz
- Two beams
  - Not fully independent; tunings are tied together
- LASI-SV running even when beams are running

Recent Changes at the Stations

- Overhaul of data recording out at the sites
  - Replaced all DRSUs with single 12 TB hard drives
  - Replaced 3 of the 5 DRs at LWA1 with 1U servers similar to what is installed at LWA-SV
    - Take up less space and use less power, reduces cable clutter
    - "DRSU" drives are now internal via hot-swappable slots
- Active power monitoring at both sites
  - Used to identify brownouts, outages, and other power problems
    - Currently done with cheap DMMs, replacing with dedicated monitors soon

Recent Changes at the Stations (cont'd)

- Designed and built HVAC interface boards for both stations
  - Allow for remote reset of the controller and for disabling the compressors
  - Helps deal with icing at both stations and "run away overheating" at LWA-SV



Recent Changes at the Stations (cont'd)

- Various changes to the HAL systems to improve ease of operation
  - Automated control of the station and observations
  - Power monitoring and automatic recovery from power problems
  - Improvements to triggering, including new modes for solar observations and targets of opportunity
  - Automatic pulsar observations for the pulsar archive
- Continued battles against RFI
  - Not really a change, more like the status quo
  - Powerlines, self-generated RFI, lights, etc.

Computing – Status and Changes

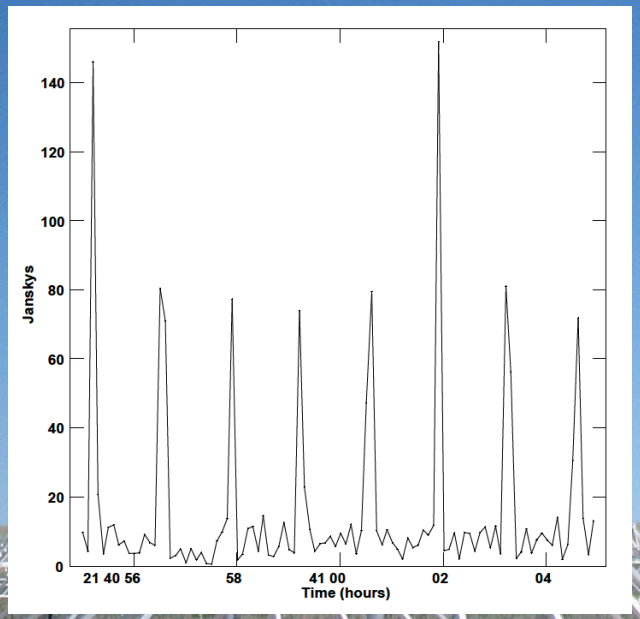
- LWA Users Computing Facility
  - Six nodes with hexacore processors and Ubuntu 14.04
    - 32 to 64 GB of memory
    - 4 to 6 TB of scratch storage
    - Recently upgraded to have at least one Nvidia GTX 980 GPU per node
  - Pooled storage of 138 TB for raw data
  - Also serves as a software correlator

Computing – Status and Changes

- LWA Data Archive
  - Stores various data products:
    - Spectrometer data
    - Interferometer data
    - LASI and LASI-SV images
    - LWA Pulsar Archive
  - Recently upgraded to a 270 TB ZFS system
    - Expandable up to 750 TB with current chassis

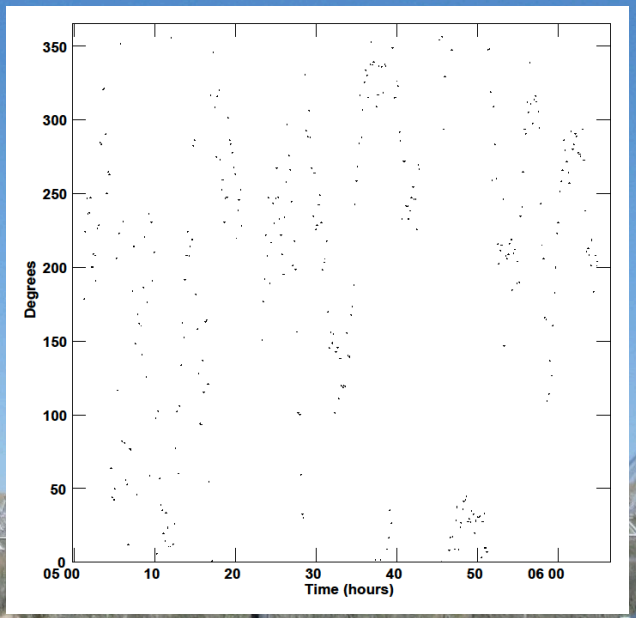
The LWA Single-Baseline Interferometer

- New interferometry mode first available in CFP7
- Single baseline of ~70 km with up to ~20 MHz of bandwidth
- Observing strategy uses two beams
  - one on source and another on a nearby (<5°) phase calibrator
  - ~100 s coherence time



Pulses from B1919+21

Davis et al., in prep.



Phase for 4C 55.28 (4.5 Jy)

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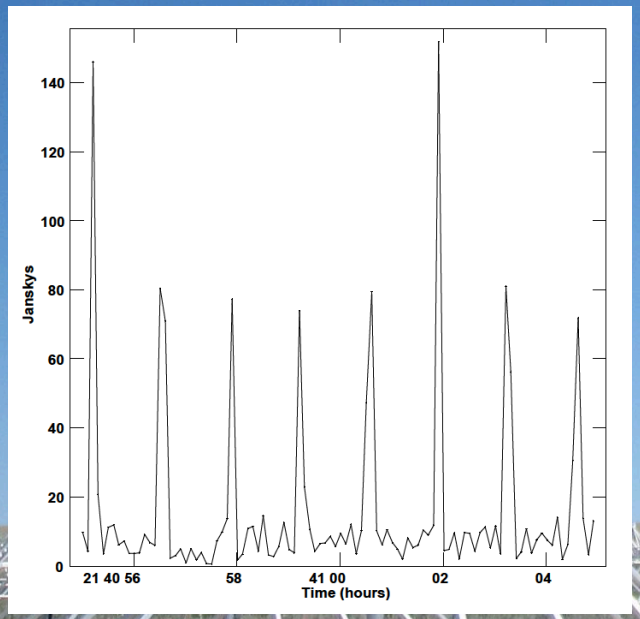

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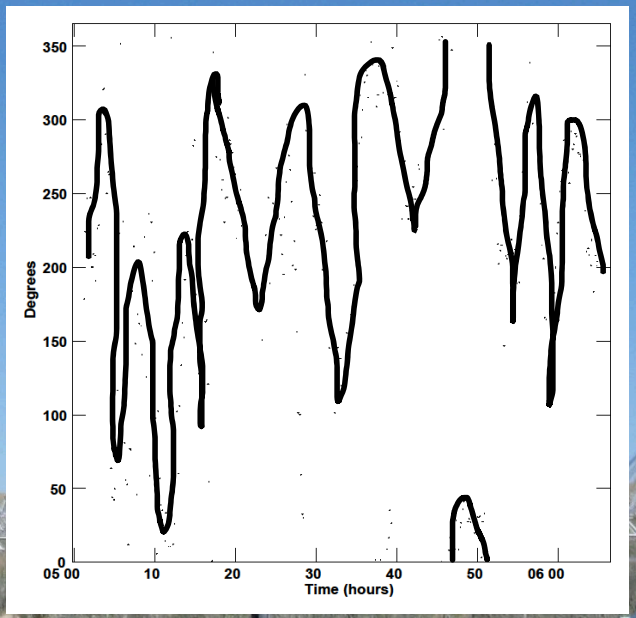
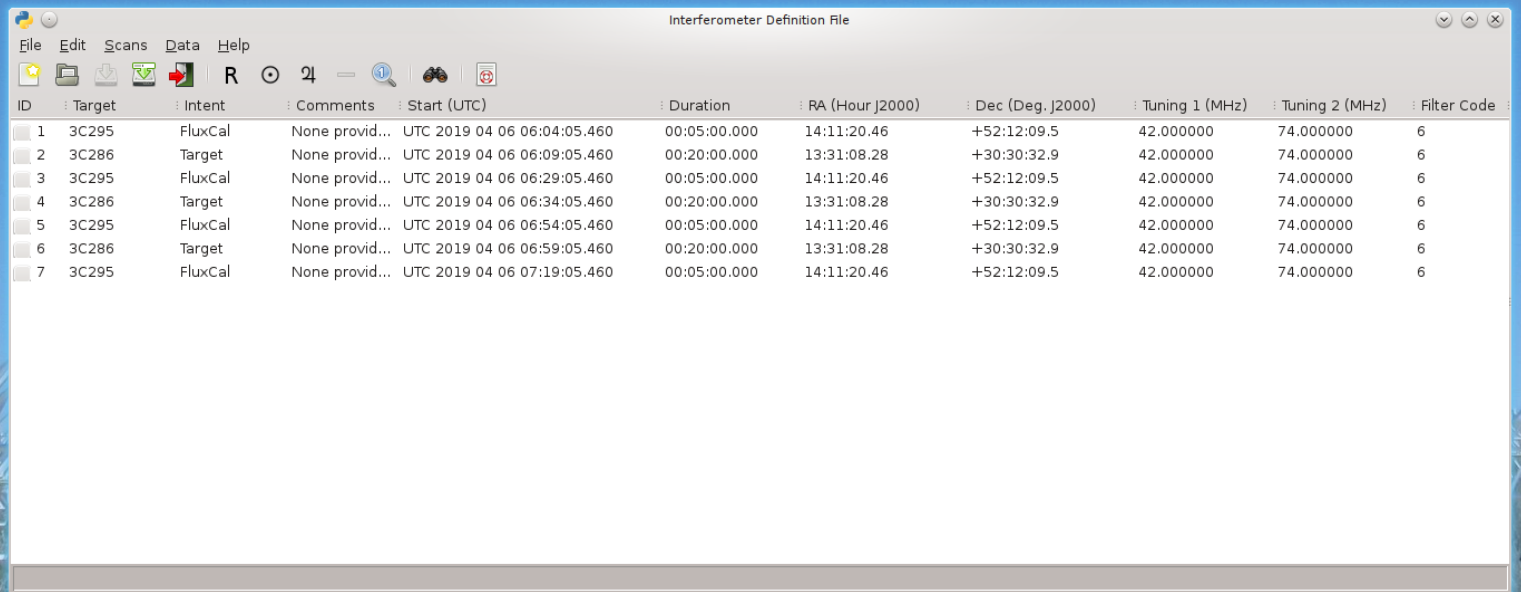


Phase for 4C 55.28 (4.5 Jy)

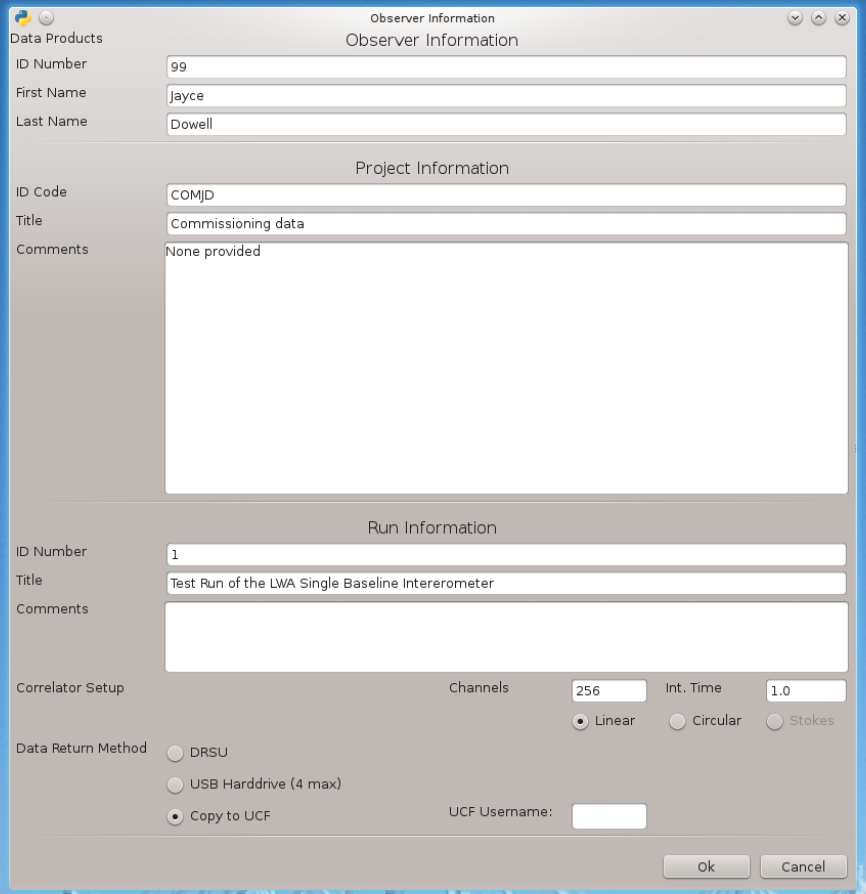
The LWA Single-Baseline Interferometer

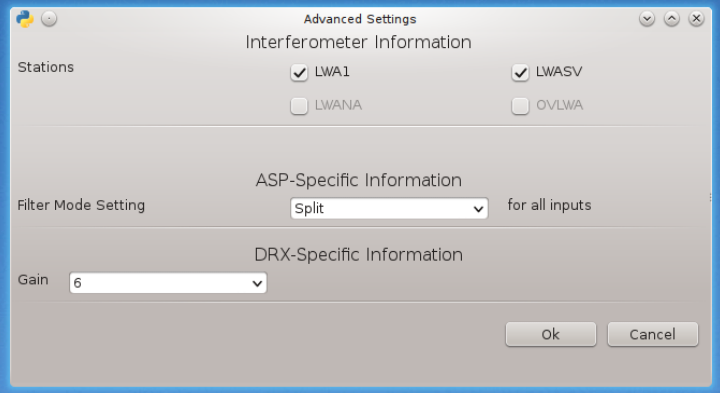
- Observations defined with Interferometer Definition Files (IDFs)
  - Submitted through the validator, similar to SDFs
  - Supported in LSL starting with version 1.2.4
- Suite of tools to help setup observations
  - swarmGUI.py – IDF builder
  - calibratorSearch.py – Phase calibrator search tool

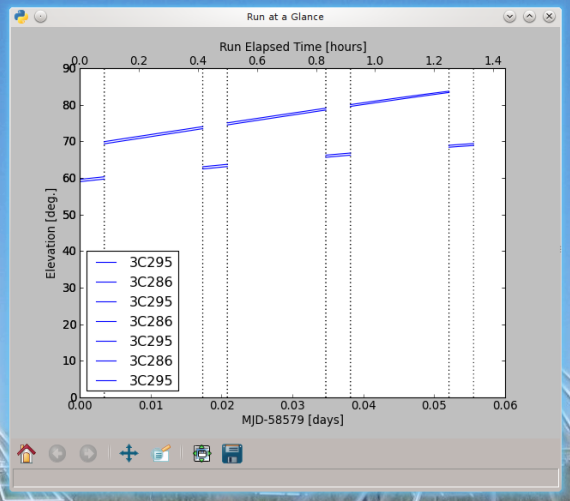


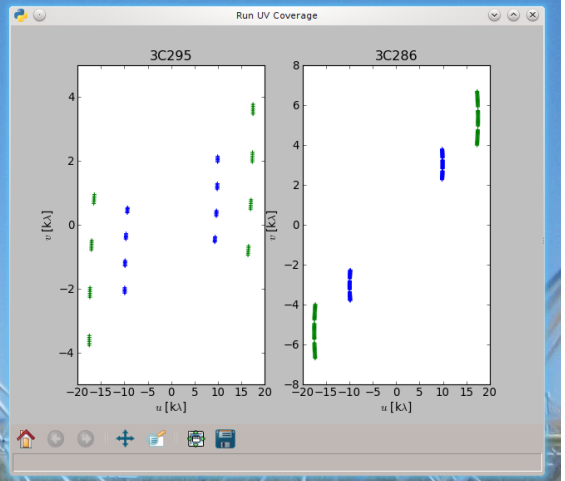
ID	Target	Intent	Comments	Start (UTC)	Duration	RA (Hour J2000)	Dec (Deg. J2000)	Tuning 1 (MHz)	Tuning 2 (MHz)	Filter Code
1	3C295	FluxCal	None provid...	UTC 2019 04 06 06:04:05.460	00:05:00.000	14:11:20.46	+52:12:09.5	42.000000	74.000000	6
2	3C286	Target	None provid...	UTC 2019 04 06 06:09:05.460	00:20:00.000	13:31:08.28	+30:30:32.9	42.000000	74.000000	6
3	3C295	FluxCal	None provid...	UTC 2019 04 06 06:29:05.460	00:05:00.000	14:11:20.46	+52:12:09.5	42.000000	74.000000	6
4	3C286	Target	None provid...	UTC 2019 04 06 06:34:05.460	00:20:00.000	13:31:08.28	+30:30:32.9	42.000000	74.000000	6
5	3C295	FluxCal	None provid...	UTC 2019 04 06 06:54:05.460	00:05:00.000	14:11:20.46	+52:12:09.5	42.000000	74.000000	6
6	3C286	Target	None provid...	UTC 2019 04 06 06:59:05.460	00:20:00.000	13:31:08.28	+30:30:32.9	42.000000	74.000000	6
7	3C295	FluxCal	None provid...	UTC 2019 04 06 07:19:05.460	00:05:00.000	14:11:20.46	+52:12:09.5	42.000000	74.000000	6

The LWA Single-Baseline Interferometer









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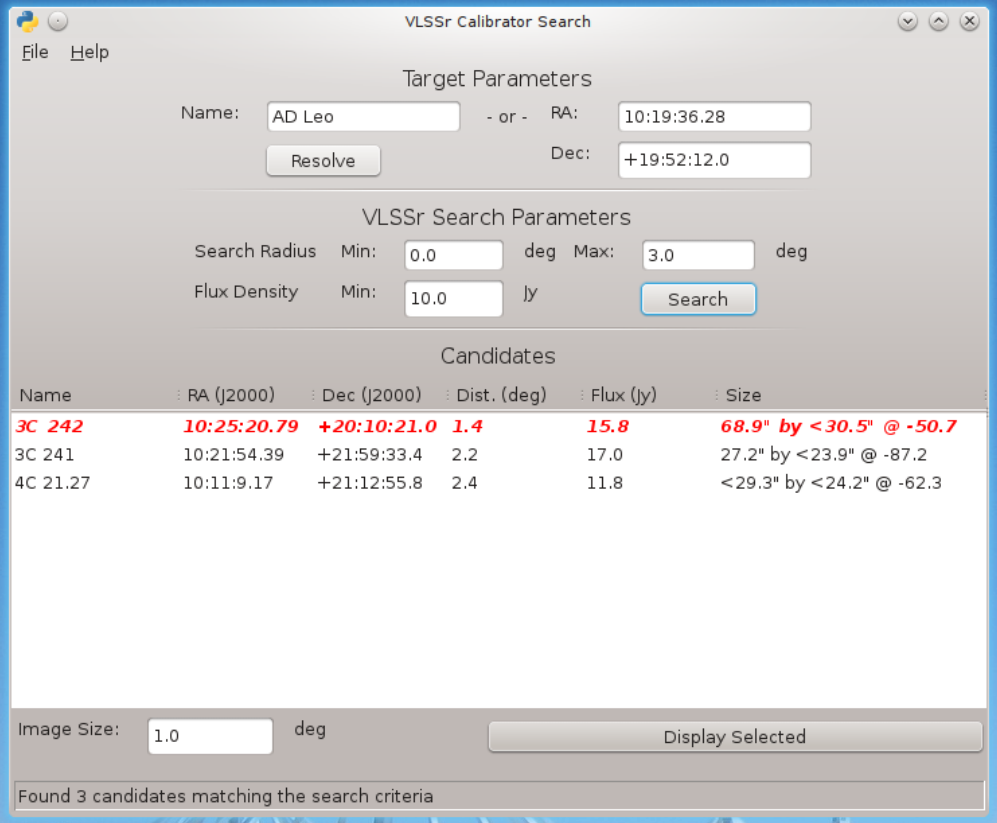

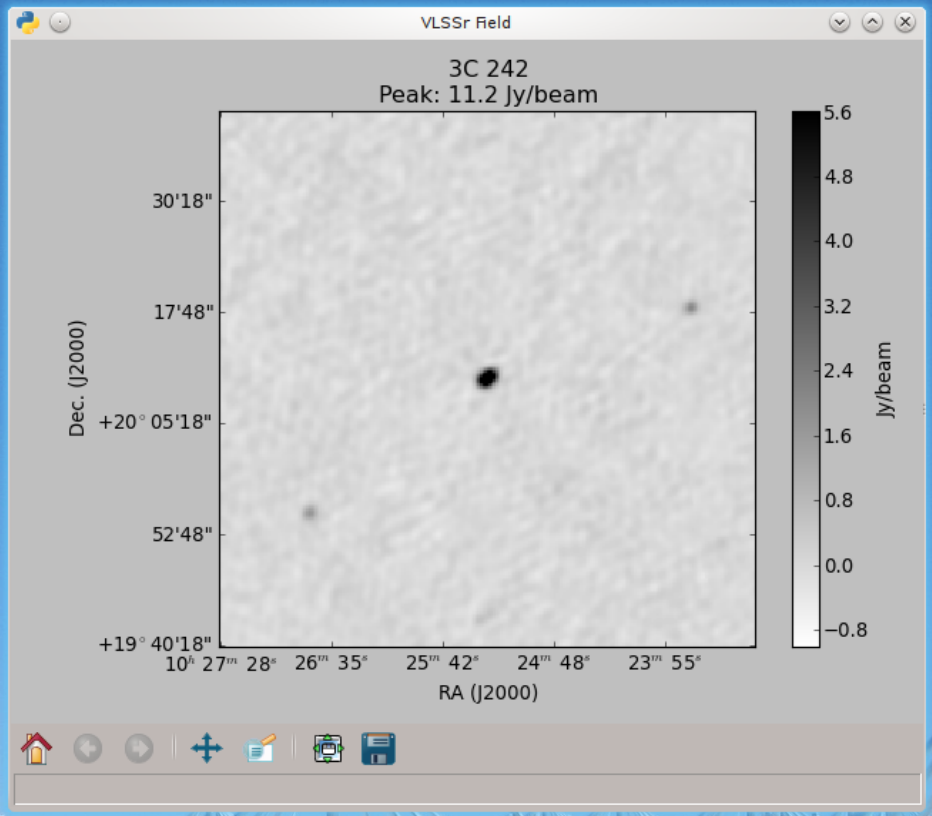

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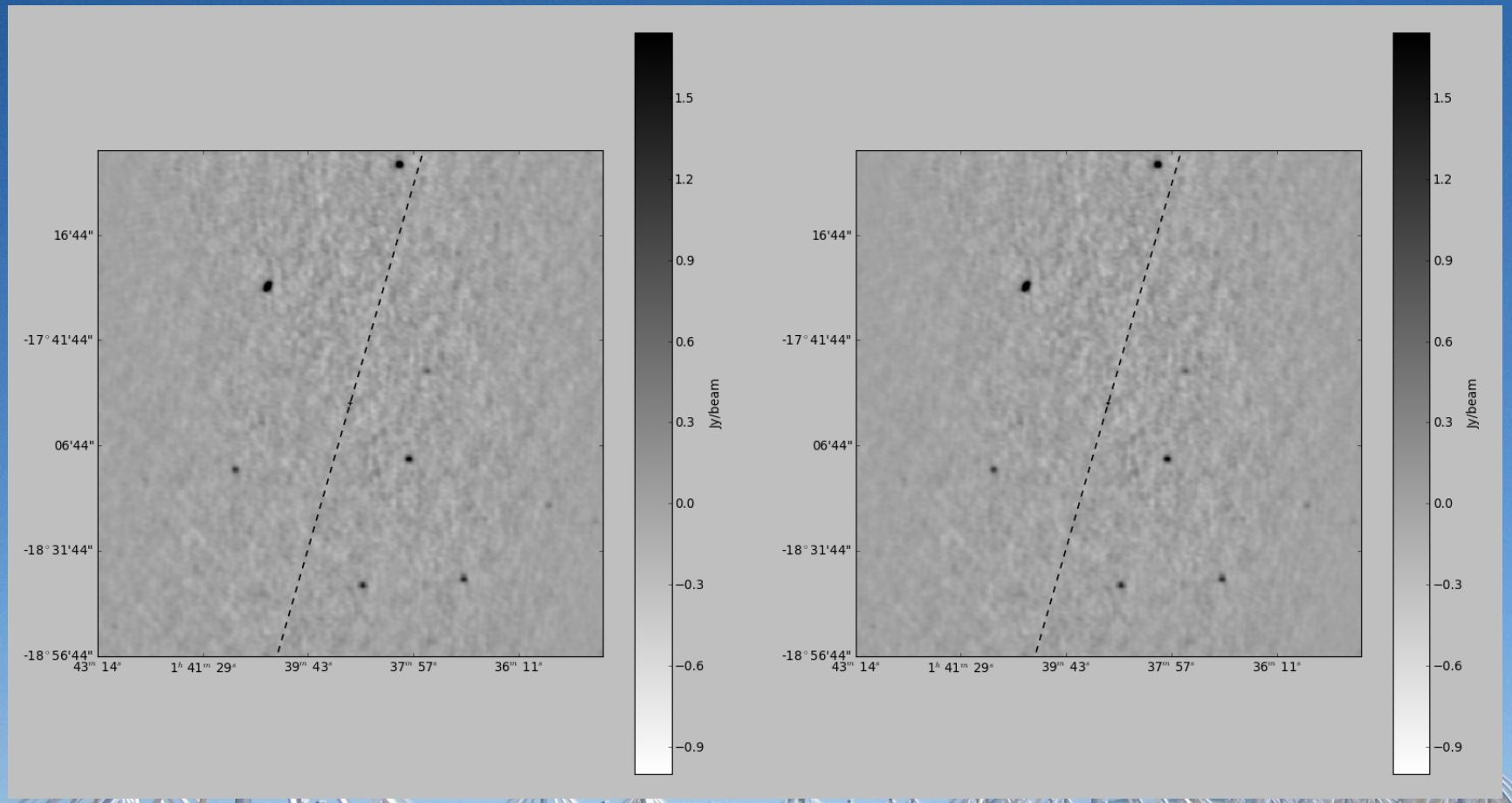
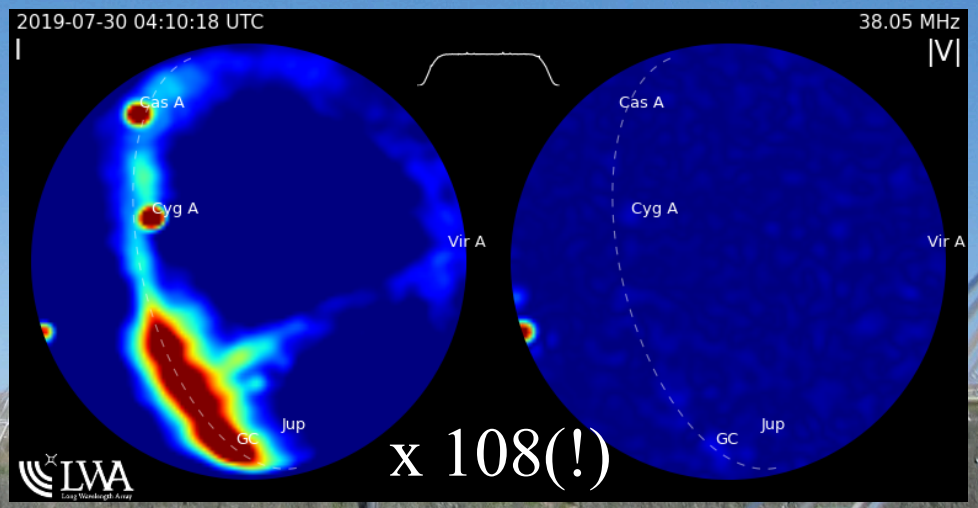


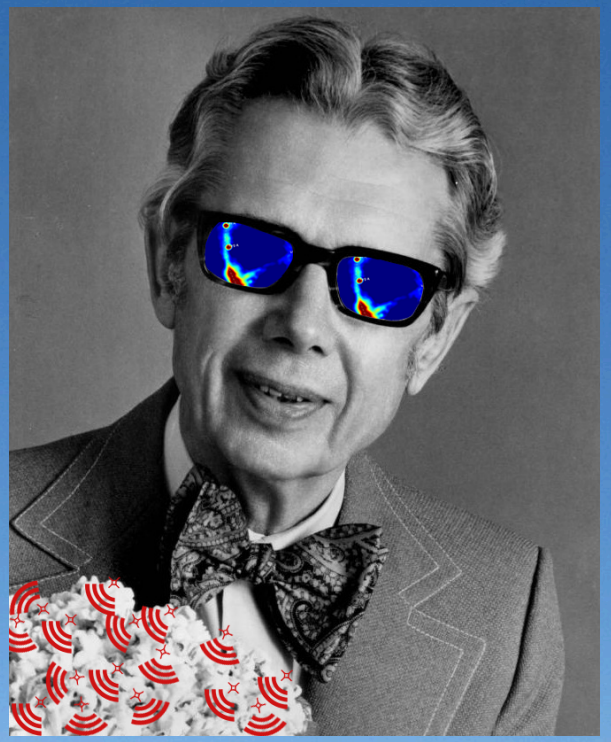
The Prototype Wideband Imager

- New capability at LWA-SV that uses the wideband correlator output
- Realtime imaging of 10.8 MHz of bandwidth
  - Full Stokes images with a 10 s integration time
  - 100 times the bandwidth of LASI-SV
- Runs concurrently with LASI-SV
  - Storage for ~2 weeks of images in a circular buffer
    - Not currently archived



The Future

- LWA-SV bandwidth expansion to 19.6 MHz
  - Enabled by new RTX2080 Ti GPUs and Bifrost "Project Orville"
  - Beam tunings still tied together
  - Needs new hardware to upgrade the wideband imager to support more bandwidth
  - Needs better network connectivity out to LWA-SV for data transport



The Future

Join the Swarm!

- LWA Swarm
  - Array composed of LWA stations operated by different universities that work together
  - New approach for signal processing at the station with a goal of removing the limit of two tuning
  - Greg will talk more about this tomorrow