The LWA Software Library Update

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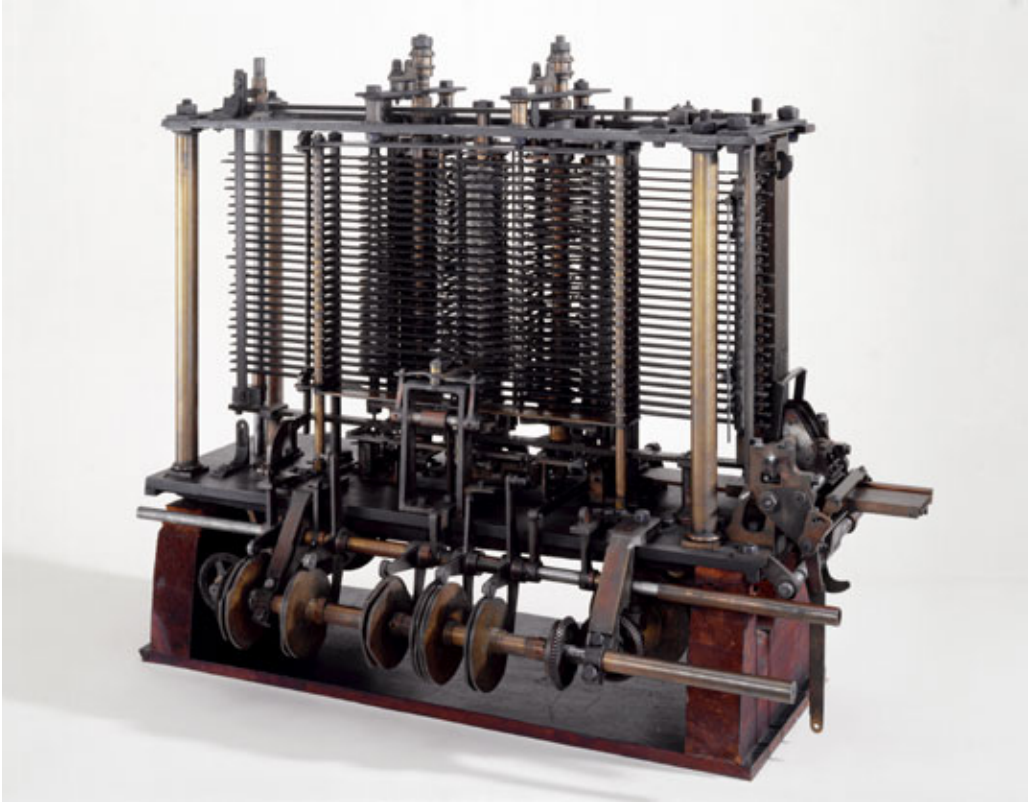
LWA Users Meeting

July 11, 2014



Recent Additions - LSL

- Current version is 1.0.1
- Added support for PyFFTW in the dedispersion and filterbank modules
- Switched the extensions over to the single precision FFTW library
- Added LSL-specific FFTW/PyFFTW wisdom
  - Wisdom available inside of LSL and within the Pulsar extension

Recent Additions - LSL

- Fast visibility simulations with the new lsl.sim._simFast extension
  - Runs baselines in parallel to obtain speedup
  - Supports:
    - Multiple frequencies
    - Point source models
    - Uniformly illumination disk models
    - Corrections for the primary beam
- New image overlay module

Recent Additions - LSL

- Cleanup of ATLAS/BLAS support
  - setup.py now uses the NumPy ATLAS discovering functions
  - Also allows for environment variables to be set that control the ATLAS path
- LSL Developer Primitives module
  - Provide an easier way to work with LWA1 data files
- Various bug fixes

Recent Additions - Extensions

- Pulsar
  - 4-bit PSRFITS files
  - Switched over to single precision FFTW
  - Support for converting HDF5 files to PSRFITS
  - Support for combining multiple beams together

Recent Additions - Extensions

- Commissioning
  - Several visualization improvements to plotWaterfall.py and plotHDF.py
  - New tools for decimation in time/frequency of HDF5 data
  - New tools for incoherent dedispersion of HDF5 data
- SessionSchedules
  - Support for the new beam-dipole mode

Tutorials

- New tutorials available
  - Basic data reduction tutorials to provide information on setting up SDFs and basic analysis
    - http://lda10g.alliance.unm.edu/tutorial/
  - IPython Notebooks for basic scripting
    - http://fornax.phys.unm.edu/lwa/trac/wiki/WikiStart#LSLIPythonNotebookTutorials
  - Advanced processing tutorials
- Meet after lunch (~1:10 pm) for data reduction tutorial over at Physics & Astronomy

Future Development

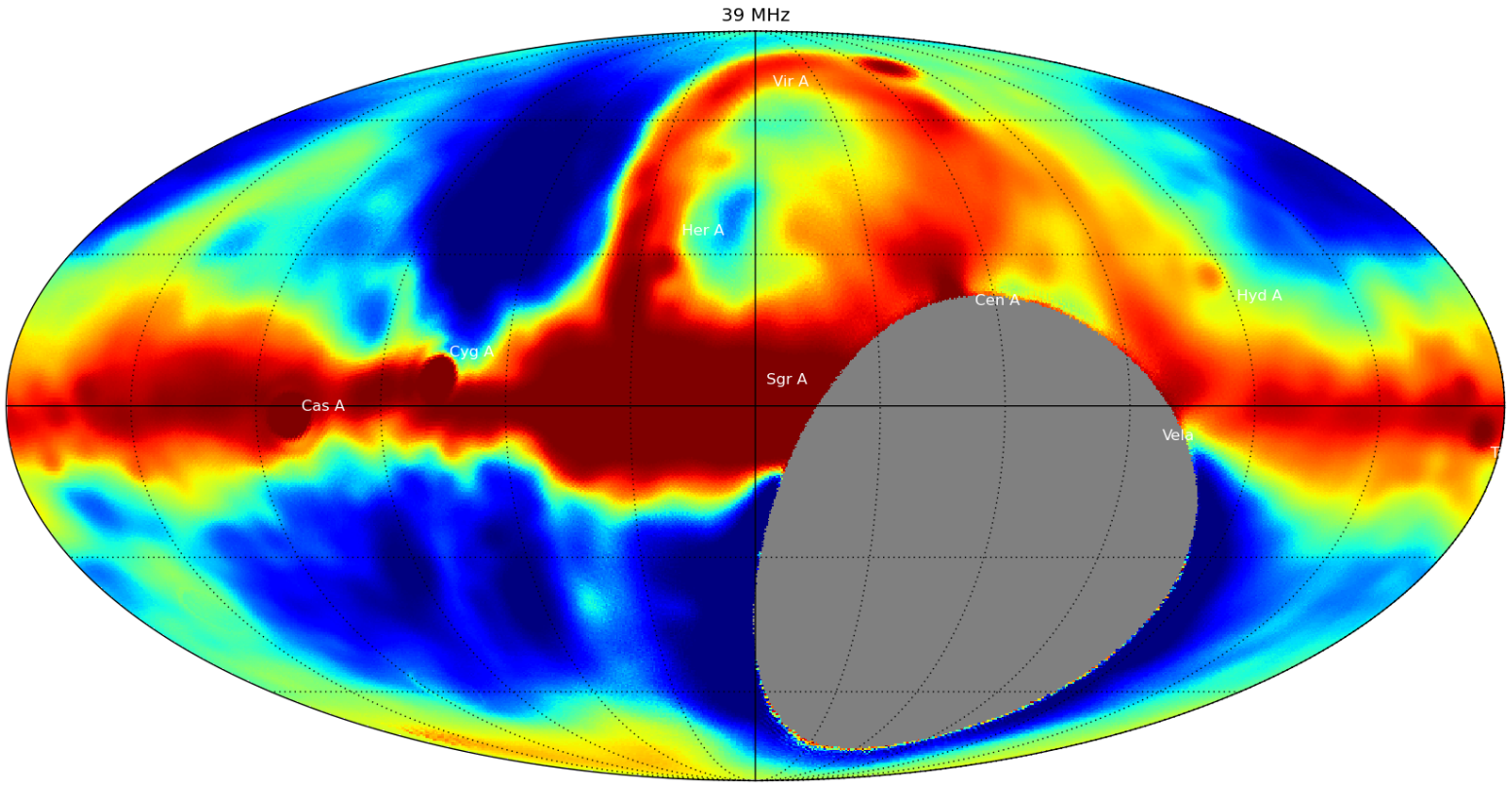
- Improved bandpass models
- Array simulation package
  - Supports several default geometries
  - Beam shape/efficiency analysis
  - Optimization based on self-organizing neural networks (Keto 1997)
- New deconvolution module
  - Forward modeling/least squares approach
  - Currently in testing with the LWA1 Low Frequency All-Sky Survey

The LWA1 Low Frequency All-Sky Survey

- TBW-based survey of the sky above -40° declination
- Various frequencies used:
  - 40 through 80 MHz in 10 MHz steps
  - Radio astronomy protected bands at 38 and 74 MHz
  - "Edge" maps at 35 and 85 MHz?
- All done with LSL
  - Correlation, calibration, imaging, deconvolution

The LWA1 Low Frequency All-Sky Survey

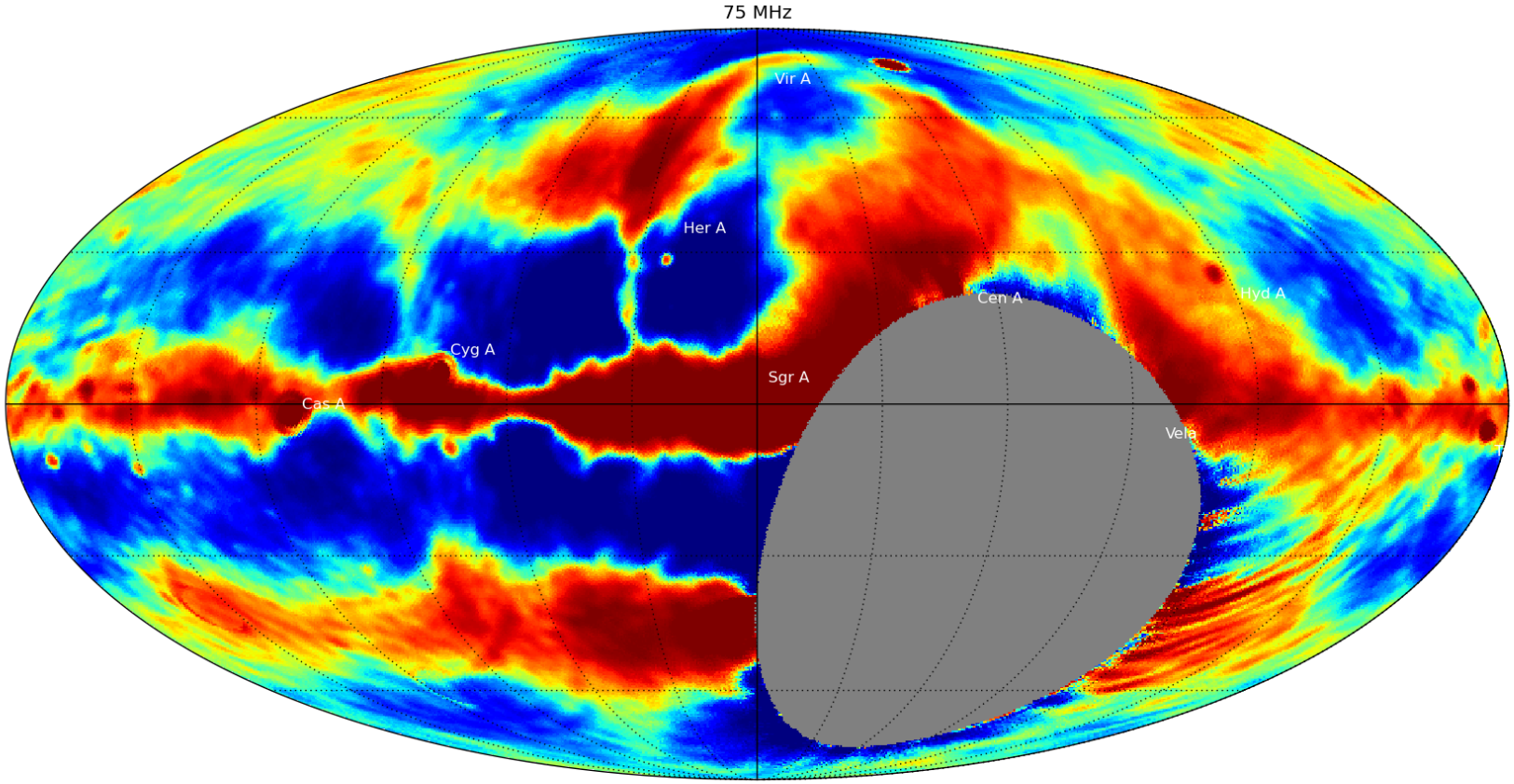
- The need for deconvolution



38 to 39 MHz

The LWA1 Low Frequency All-Sky Survey

- The need for deconvolution



74 to 75 MHz

The LWA1 Low Frequency All-Sky Survey

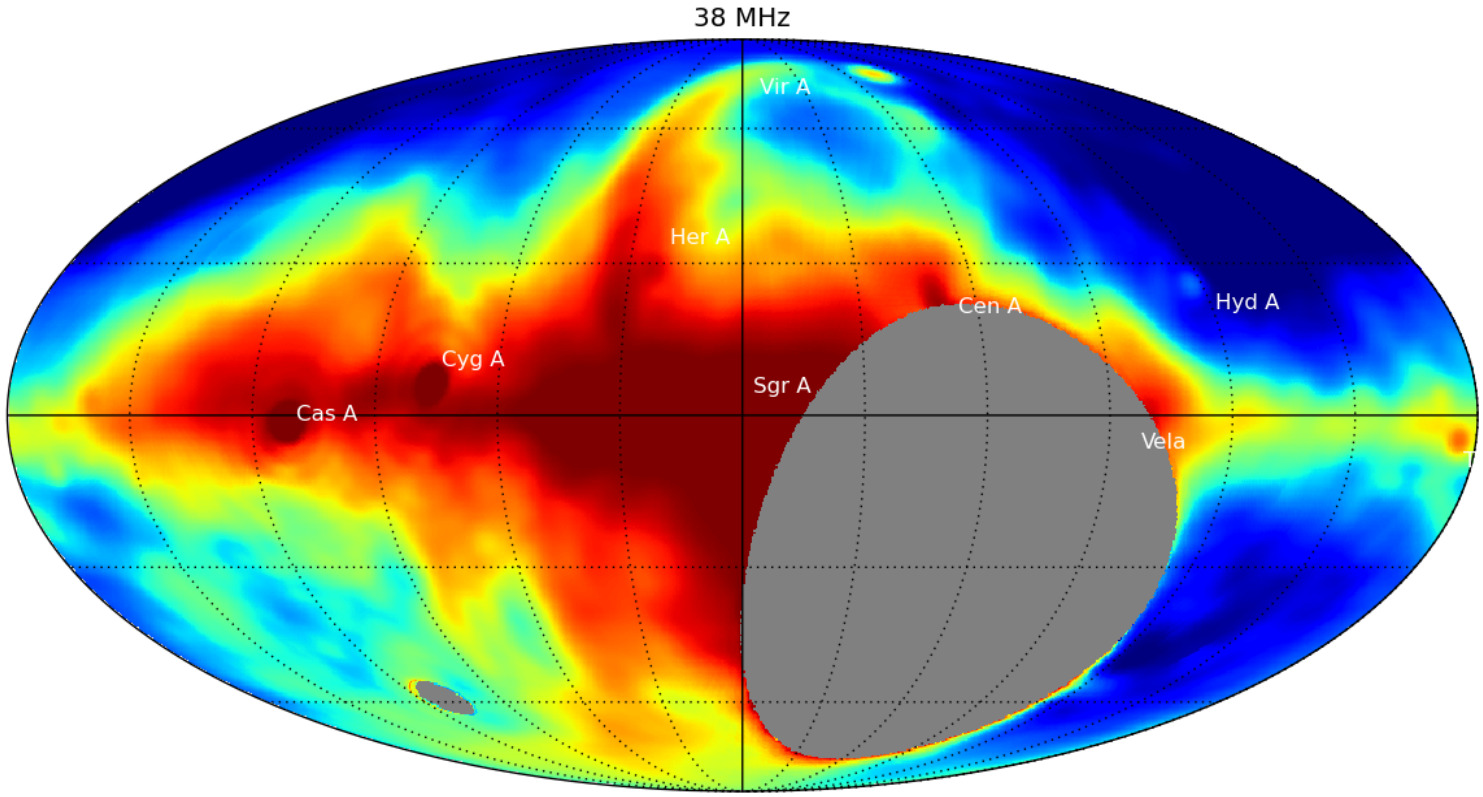
- Deconvolution options
  - CLEAN
    - Classic or multi-scale
  - Maximum Entropy
  - Multi-Scale – Multi-Frequency Synthesis
- Implementation Options
  - AIPS
  - CASA
  - Miriad

The LWA1 Low Frequency All-Sky Survey

- Option (E) – None of the above
  - LSL + forward modeling with least squares
  - Forward modeling:
    - Break sky into pixels and take each as a point source
    - Model the visibilities for point sources on every baseline
    - ~50,000 point sources on ~28,000 baselines
  - Least squares:
    - Image plane differencing to update fluxes for each point source

The LWA Low Frequency All-Sky Survey

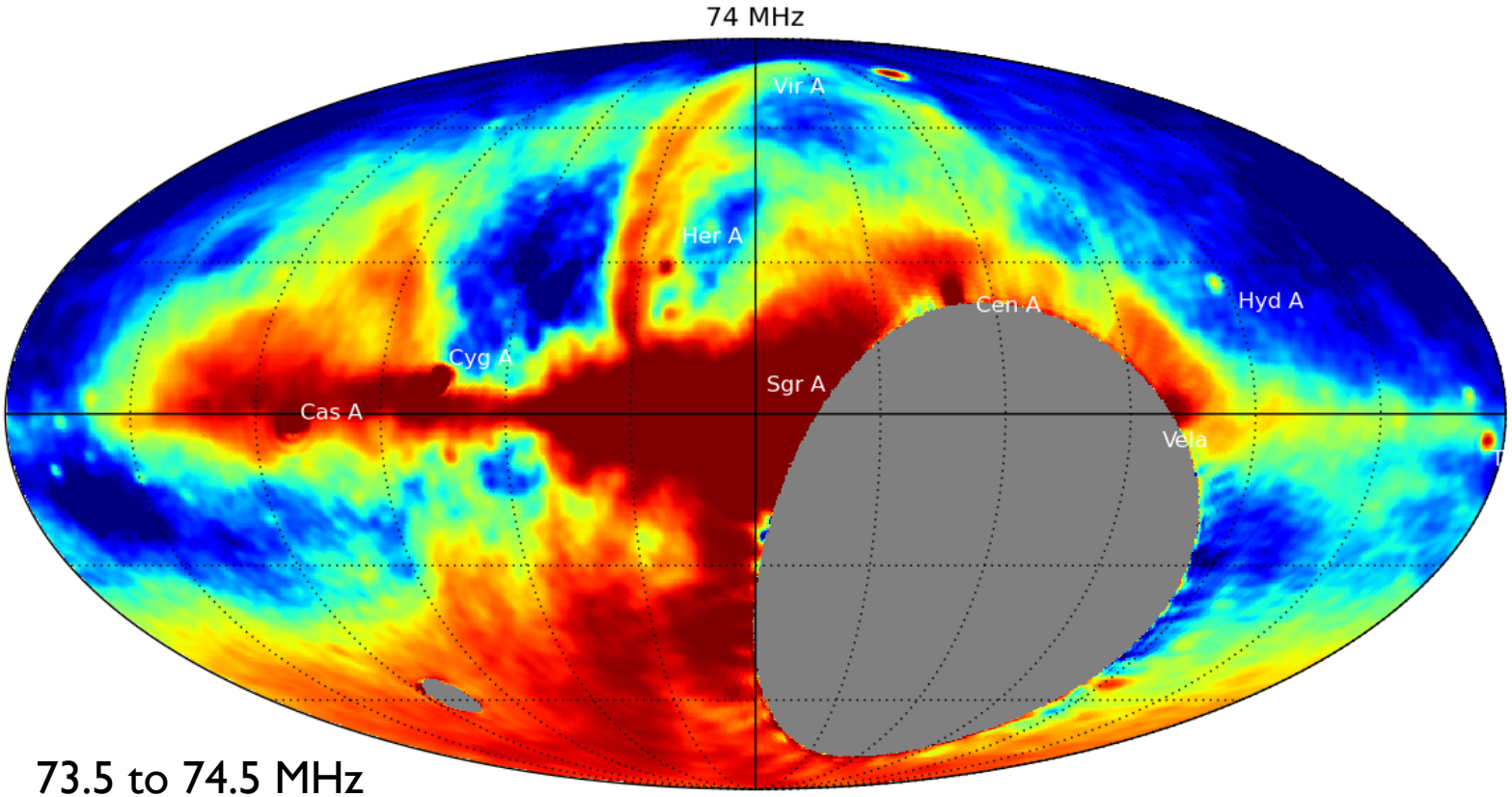
- Preliminary (50%) deconvolution



37.5 to 38.5 MHz

The LWA Low Frequency All-Sky Survey

- Preliminary (50%) deconvolution



73.5 to 74.5 MHz

The LWA1 Low Frequency All-Sky Survey

- Open questions:
  - How robust is the deconvolution method?
  - How can deconvolution be made faster?
  - What frequencies/declinations are confusion noise limited?
  - How do we do the flux calibration?
  - What, if anything, needs to be done about the zero spacing flux?