

The LWA Software Library (LSL)

Jayce Dowell
LWA Current and Future Users Meeting
May 12, 2011



What is LSL?

- It is:

- A Python module for working with LWA data
- A collection of utilities for performing basic data manipulations (FFT, manual beam forming, etc.)
- A framework that allows for more complicated data analysis

- It is not:

- A complete end-to-end data analysis package, e.g., AIPS

What is LSL?

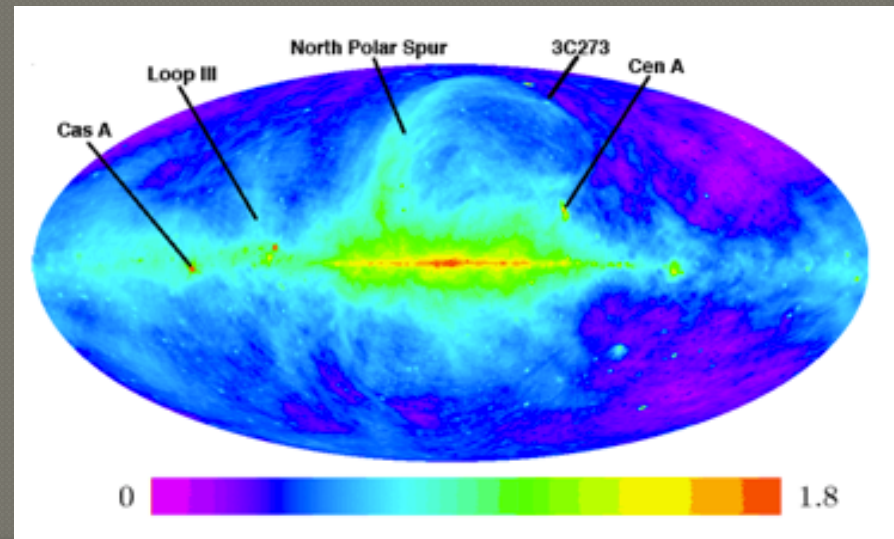


Core Modules

- ◉ **Common**
 - Tasks common to a variety of tasks
- ◉ **Reader**
 - Reading the raw DP formats/dealing with interleaved data frames
- ◉ **Analysis**
 - Basic analysis “building blocks”
- ◉ **Writers**
 - Export data to other formats, e.g., FITS files
- ◉ **Miscellaneous**

Common Routines

- Build a representation of a LWA station as a collection of Python objects
 - Stand locations
 - Cable losses/delays
- Retrieve standard DP parameters
 - Digitizer sample rate
- Paths to included data
 - GSM models, testing data sets, etc.
- Progress bar



Reader Routines

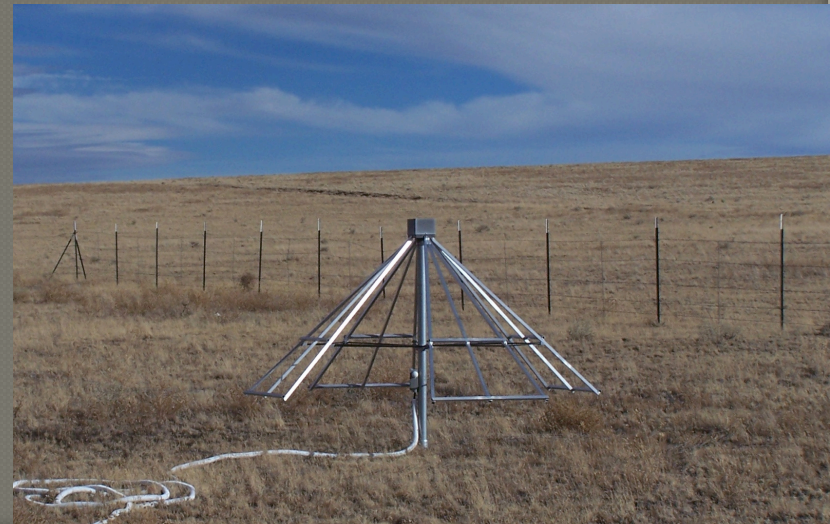
- TBW, TBN, & DRX readers to Python objects
 - Complete representation of all header and data values in the raw frames
 - Conversion functions to convert raw values (samples at f_s since 1970) to “useful” quantities (seconds since 1970)
- Ring buffer to re-order interleaved TBN data
- Auxiliary functions
 - Determine sample rate of TBN file from time tag flow

Analysis Routines

- Power spectral density and cross-correlator
 - Both real (TBW) and complex data (TBN/DRX)
 - Basic filterbank for PSD calculation
- Post acquisition beam forming of TBW/TBN data
- Limited imaging support via AIPY interfaces

Writer Routines

- Time series FITS
 - Custom FITS format (binary tables) to directly export time series LWA data
- FITS IDI
 - Export format for the correlator
 - Includes an AIPS-compatible writer that is self-limited to 99 stands
- SDFITS
 - In development
 - Included but not complete or tested
- Python/Numpy NPZ files

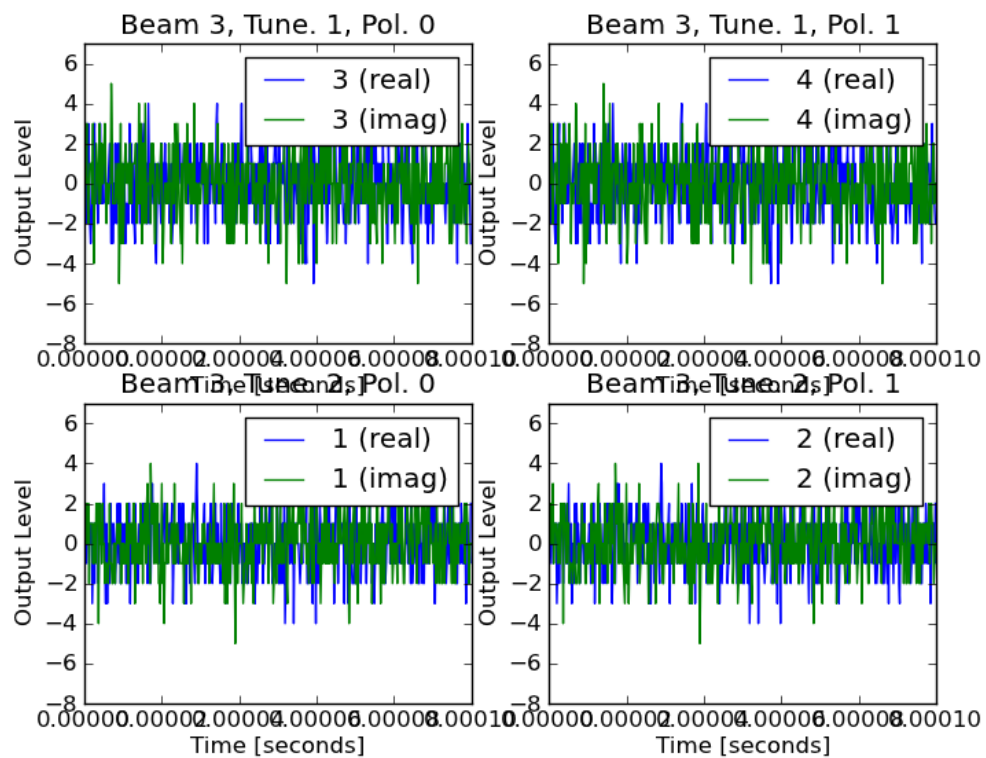
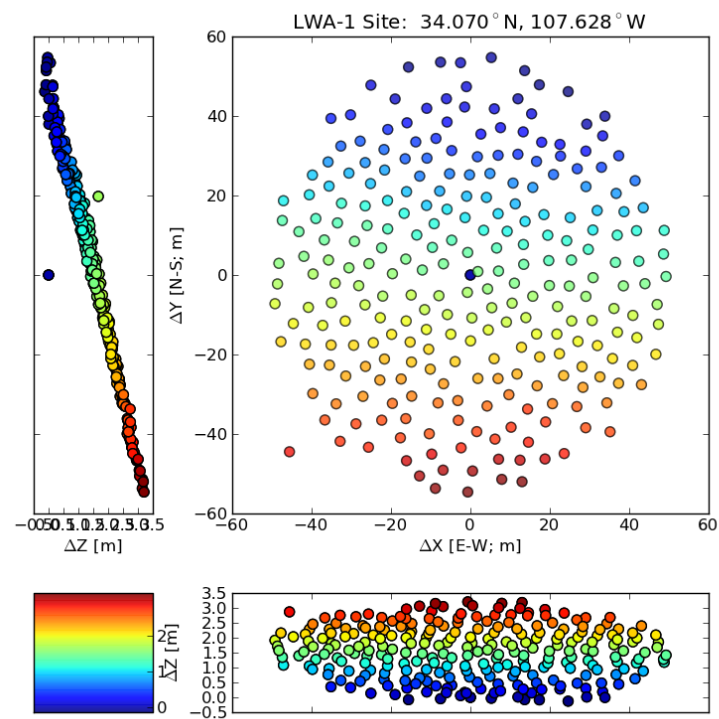
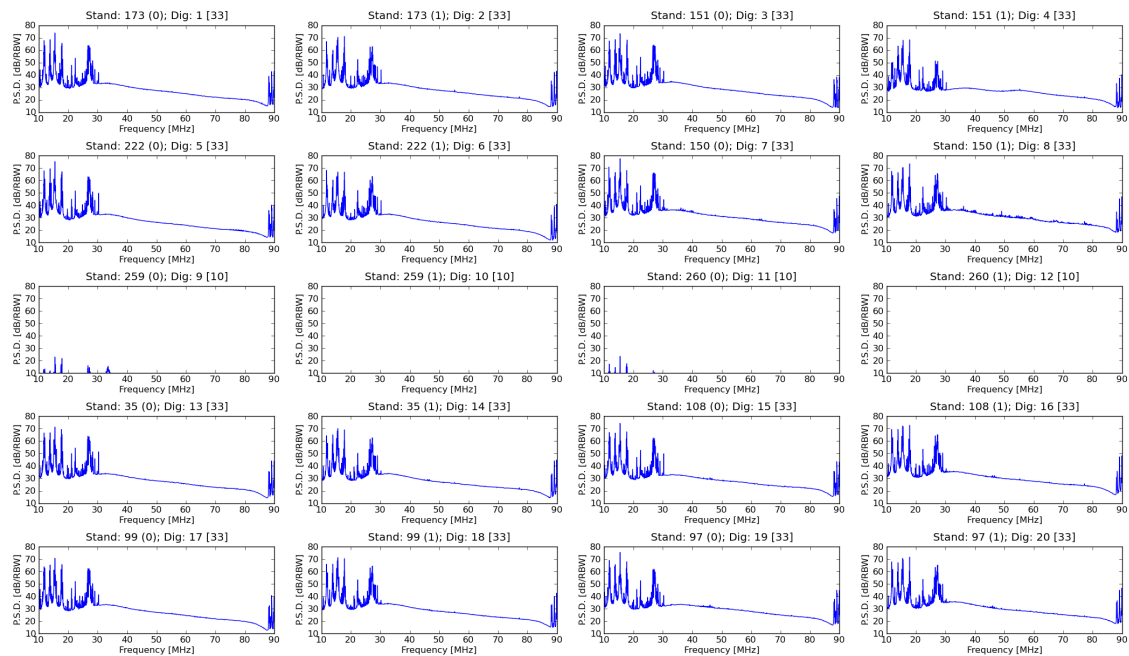


Miscellaneous Routines

- ◉ Various math utilities
 - Robust statistics, smoothing, Gaussian fitting, etc.
- ◉ Earth orientation parameter retrieval
- ◉ Limited simulation support
 - “Fake data” writers
 - Simulated time series and visibility data
 - Modeling dipole response via NEC models

Putting it All Together

- Several example scripts are included to show how to interface with LSL
 - Plot the locations of stands in the station
 - Simulate single dipole drift curves from sky models
 - TBW, TBN, and DRX PSD plotters
 - Plot DRX time series data
 - “Possm” like Python script for FITS IDI files
 - Many more...



Current Version and Status

- Current version is 0.4.1
 - Features described in this talk
- LSL 0.5 and beyond
 - Better imaging support with self-calibration and deconvolution routines
 - Standard package for LWA data on-site reductions?
- Extensions
 - Not part of LSL but use LSL to accomplish particular tasks
 - sessionGUI, stationMaster, etc.

Where do I Get LSL?

- ◉ LSL version 0.4 (current)
 - <http://fornax.phys.unm.edu/lwa/trac/wiki>
- ◉ On-line Documentation:
 - <http://fornax.phys.unm.edu/lwa/doc/lsl-0.4.x/index.html>
- ◉ Help:
 - Ticket system on the Trac page
 - Request new features
 - Report bugs