



LWA Low Frequency Tutorial

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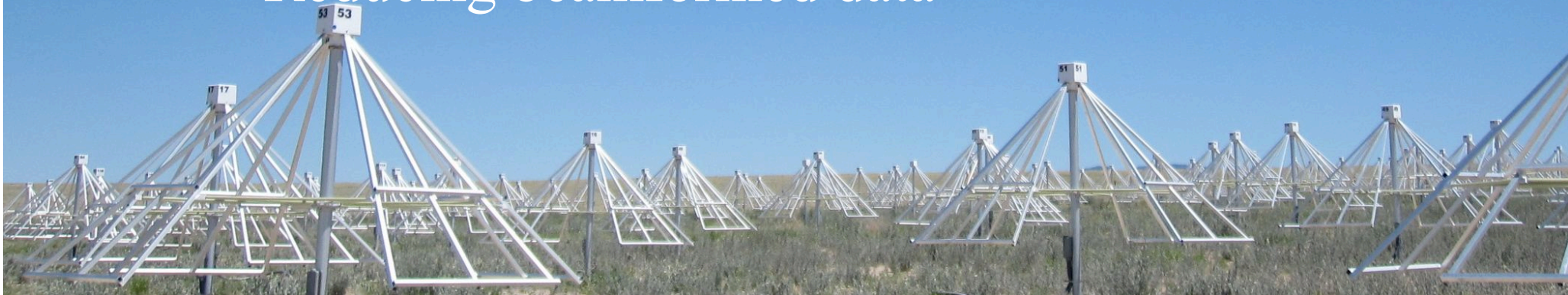
LWA Users Meeting

August 2, 2019



Goals

- Introduce observing with the LWA
- Introduce LWA Software Library
- Introduce working on the command line
- Data reduction tutorials
 - Scheduling observations
 - Reducing beamformed data



The LWA Observing Process: Single Station

Proposal

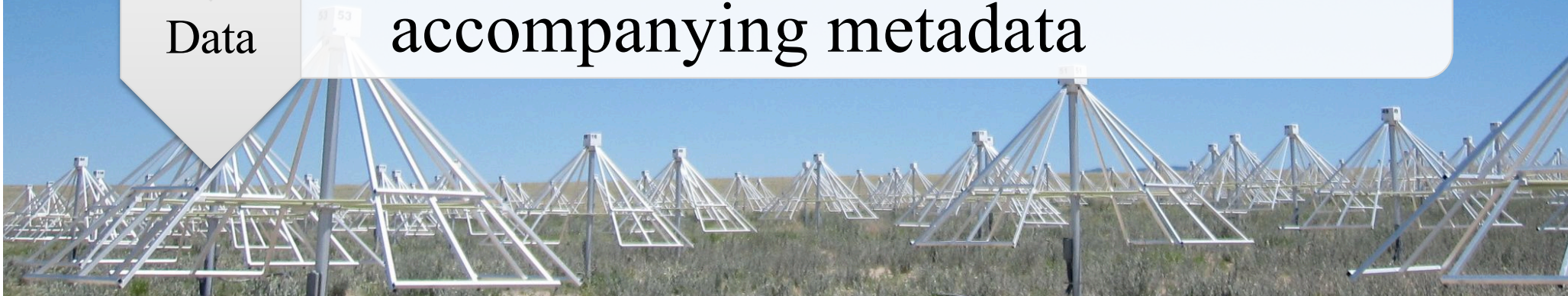
- Defines the scientific context

SDFs

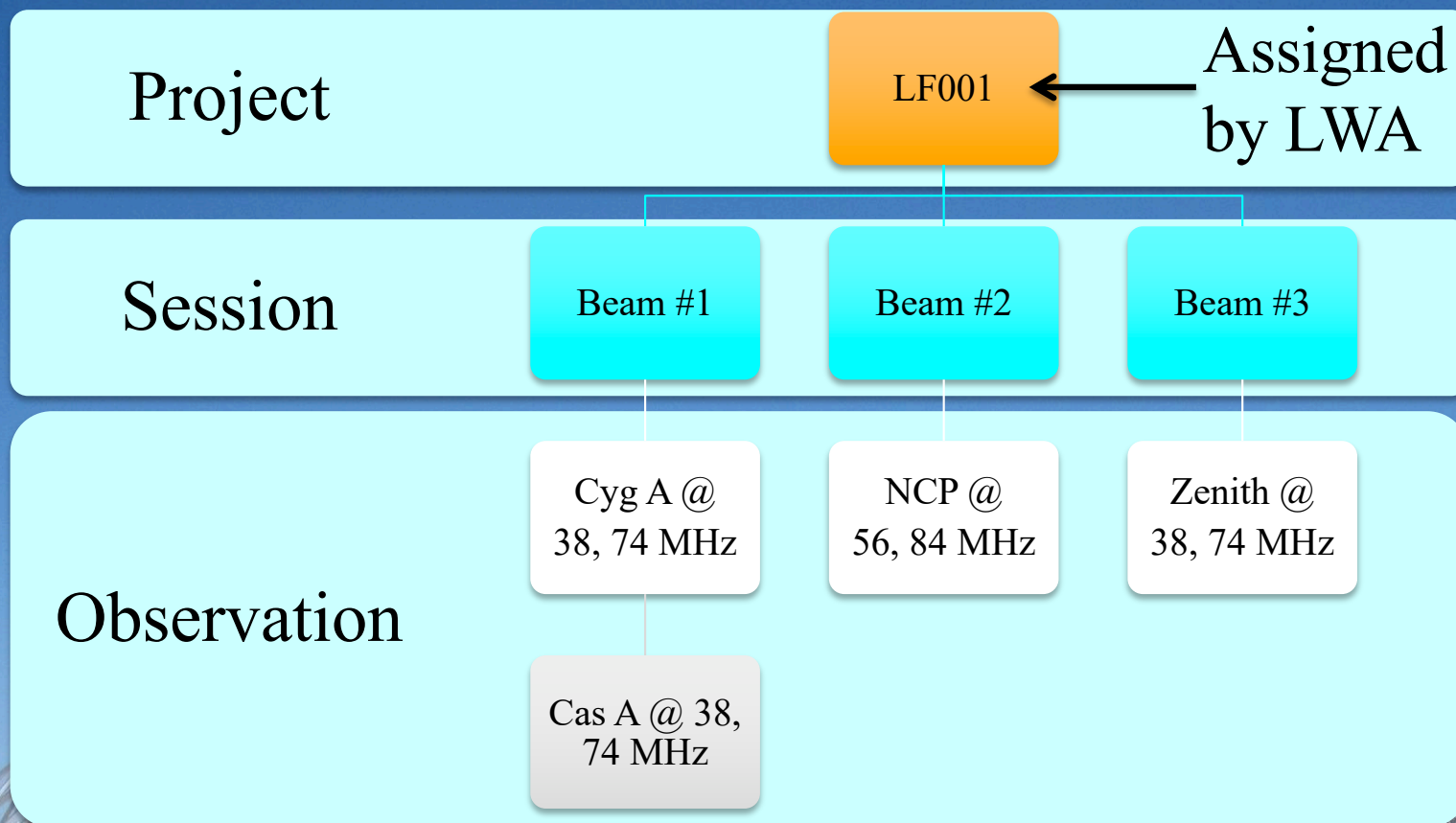
- Defines the exact sequence of observations

Data

- Raw or reduced data plus accompanying metadata



Observation Nomenclature: Single Station



Observations to Observer: Single Station

Observations

Raw Data

Binary formats

Bare HDDs

Copied to
LWAUCF

You decide!

Spectrometer
Mode

Download
through archive



Webpages

- Validator
 - <https://fornax.phys.unm.edu/lwa/validator/index.html>
- LWADB
 - <https://lwalab.phys.unm.edu/lwadb>
- OpScreen
 - <https://lwalab.phys.unm.edu/OpScreen/os2.php>
- LDA
 - <https://lda10g.alliance.unm.edu>



The LWA Observing Process: Interferometer

Proposal

- Defines the scientific context

IDFs

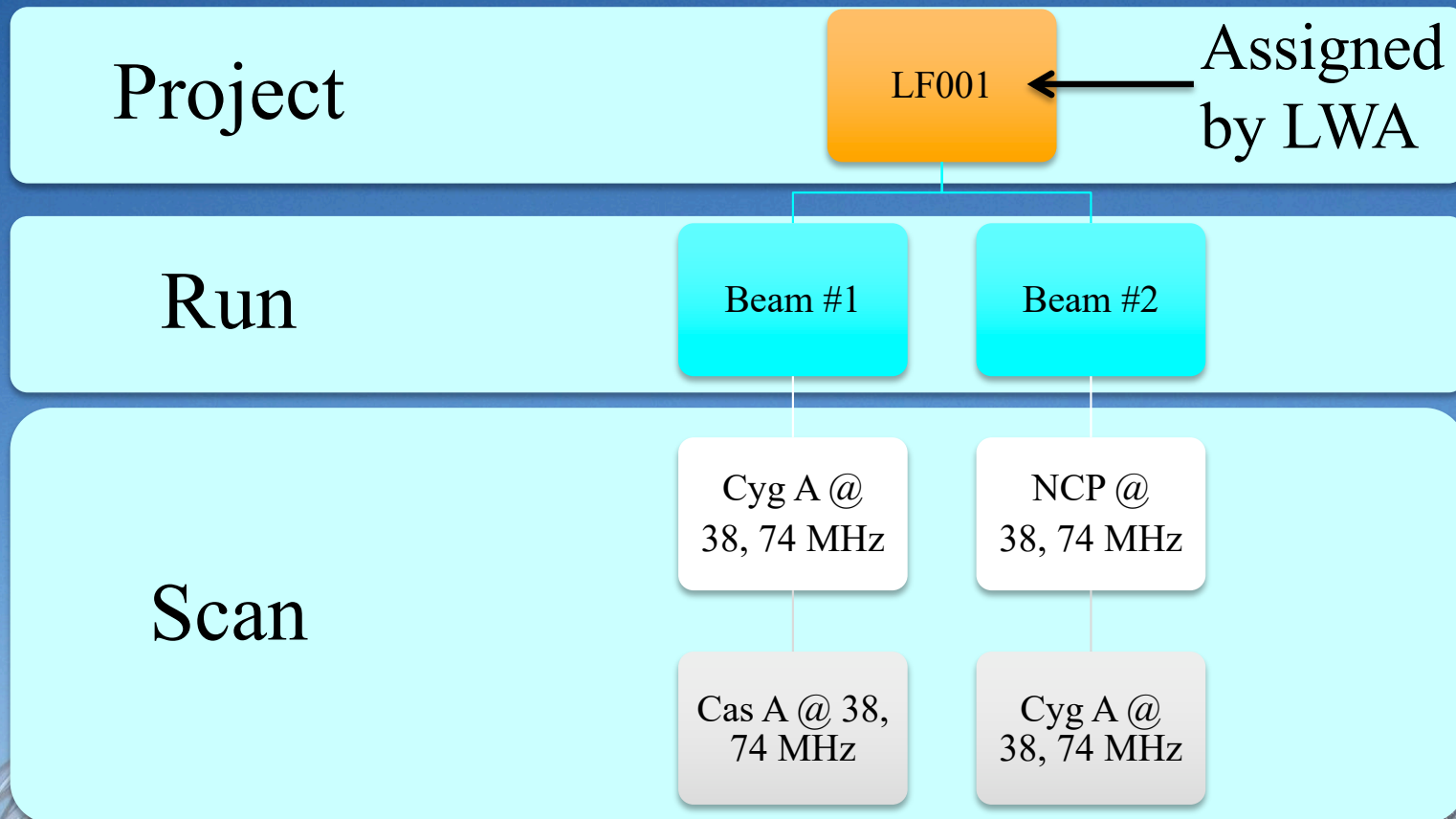
- Defines the exact sequence of scans and how the data are to be correlated.

Data

- Correlated FITS-IDI files



Observation Nomenclature: Interferometer



Observations to Observer: Interferometer

Scans

Correlated on
LWAUCF by LWA

FITS-IDI

Download through
archive

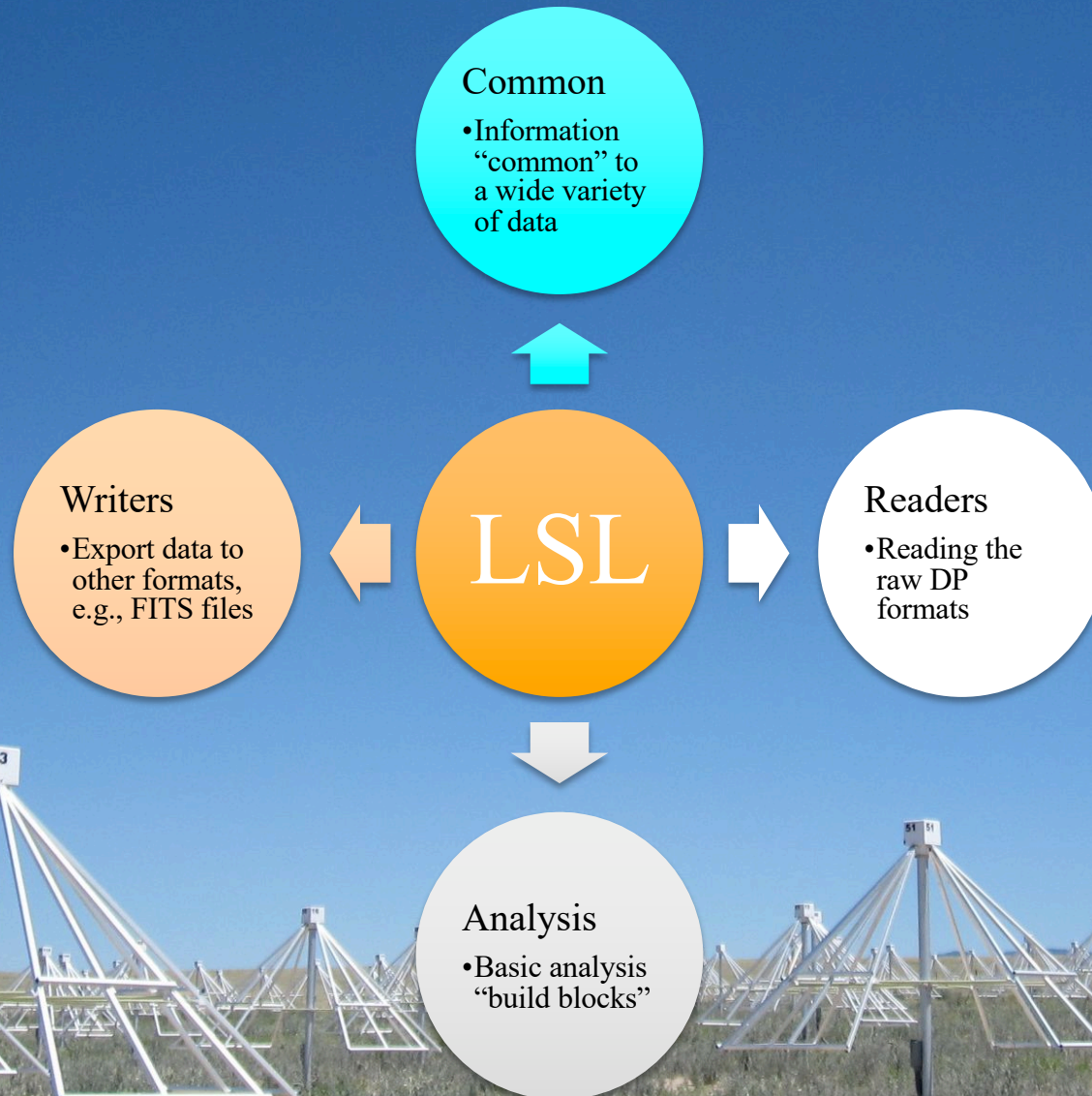


LWA Software Library (LSL)

- 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 complicated analysis



LWA Software Library (LSL)



LWA Software Library (LSL)

- Software and On-line Documentation
 - <https://fornax.phys.unm.edu/lwa/trac/wiki>
- Included Scripts and Extensions
 - Demonstrate a variety of data formats and processing options



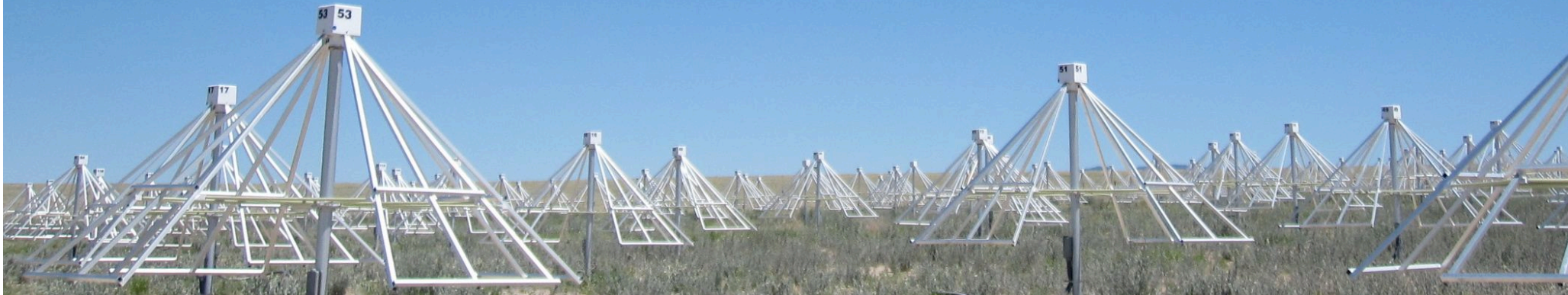
LSL Extensions

- SessionSchedules
 - Collection of tools for working with session definition files (SDFs) and interferometer definition files (IDFs)




LSL Extensions

- Commissioning
 - Scripts for various types of data analysis developed during LWA1/LWA-SV commissioning
- Pulsar
 - Tool for converting beamformer data into PSRFITS files



Working with the Command Line

- Most of LSL and its scripts are accessed through the command line
- Usage:
 - command options arguments
 - Options like -h or --help
 - Arguments separated by spaces

A screenshot of a terminal window. The title bar shows a home icon, the username 'jaycedowell', and the shell '-bash' with window dimensions '80x24'. The terminal content shows the last login time: 'Last login: Tue Apr 30 20:10:52 on ttys000'. Below that, the prompt 'ziz:~ jaycedowell\$' is followed by a cursor.

```
jaycedowell — -bash — 80x24
Last login: Tue Apr 30 20:10:52 on ttys000
ziz:~ jaycedowell$
```



Working with the Command Line

- cd
- pwd
- ls
- mkdir
- rm
- mv
- cp
- man
- ps
- kill
- cat
- less
- grep
- |, >, and >>



Working with the Command Line

- Files
 - Everything starts with root (/), and paths are separated by /
- Permissions
 - ziz:~ jaycedowell\$ ls -l test.py
-rw-r--r-- 1 jaycedowell staff 987 Mar 25 21:43 test.py



Working with the Command Line

- More Information:
 - http://chuzzlewit.co.uk/utp_book-1.1.pdf chapter 2
 - <http://linuxcommand.org/>
 - <http://tille.garrels.be/training/tldp/index.html>
 - <http://tldp.org/LDP/Bash-Beginners-Guide/html/index.html>
 - https://the-eye.eu/public/Books/HumbleBundle/learningthebashshell_3rdedition.pdf



Data Reduction Tutorials

- Pulsar observation with LWA1
 - PSR B1133+16
 - Reduced on the cluster once the data is copied over
- Reduce an “unknown” pulsar
- Jovian/Solar bursts
- CGPs

<https://lda10g.alliance.unm.edu/tutorial/low-frequency-tutorial.pdf>