

ObsCore for LMT

Large Millimeter Telescope

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LMT

- 50m dish
 - Volcan Sierra Negra at 4600m altitude, about 200 km east of Mexico City
- Operates at 1mm-3mm (70GHz - 280GHz ; 5-20" resolution)
- Many instruments (often using instrument specific data) - e.g.
 - RSR single pixel @70-110 GHz -> **1D spectra**
 - TolTec continuum -> **2D maps**
 - Sequoia 16 multi-beam, mostly for OTF mapping -> **3D spectral line cubes**
- Raw data
 - netCDF taken at LMT
 - Calibrated spectra in netCDF or SDFITS (future plan)
 - Final maps and spectra in FITS
- Unified view of "LMT" data products, independent of instrument

LMT archive plans

- Currently DataVerse (<https://dataverse.org>)
 - Spectra, Images, Cubes - FITS
 - Spectra - SDFITS [unclear at this moment]
- ObsCore Calibration levels
 - Level-0: N/A
 - Level-1: our SDFITS spectra (unclear if archive accessible)
 - Level-2: calibrated Spectra/Images/Cubes
 - Level-3: mosaics (ToITec)
 - Level-4: ADMIT products (sources, lines, moment maps)
- Impact of DataVerse on implementing a TAP service
 - ??? has anybody done this before?
 - API: <https://guides.dataverse.org/en/latest/api/native-api.html>
 - Working container for pure dataverse access: dp.lmtgtm.org

ObsCore for LMT

- Questions:
 - Recommended units - **arcsec** vs. degrees (eg. s_resolution)
 - Minimal set/MANDATORY ?? - 28 in Appendix B - 30 in Table 1
- See our own [lmttoy/docs/obscore.csv](#) working document for a cross-walk
- Multiple spectral windows
 - see also interferometry proposal - markK has a separate table proposal
 - See **frequency_support** in astroquery.alma

TAP queries

- Can a TAP query return different width tables depending on the query?

Summary of formats discussed

- LMT: netCDF in raw, and maybe SDFITS intermediary; FITS at the end
- GBT: SDFITS
- Parkes : HDF5 + SDFITS headers
- INAF; hierarchy of FITS
- FAST: SDFITS with (npol,nchan)

ToI TEC FITS Specification

TolTEC Data Reduction Output Files

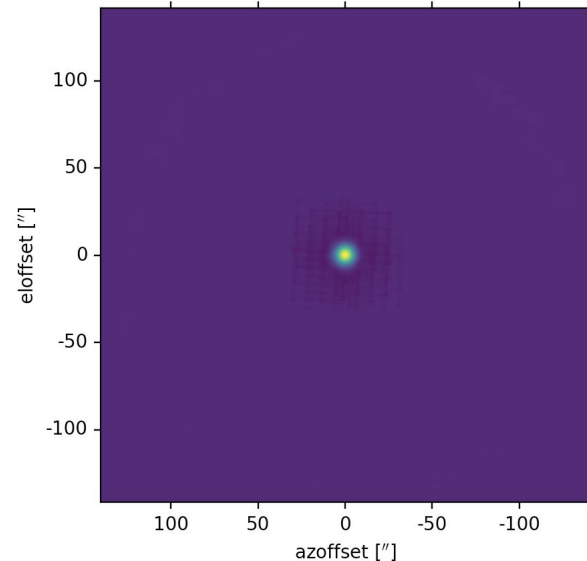
- TolTEC's data reduction pipeline, Citlali, outputs FITS files containing map data products.
- Individual observation files divided by array.
 - 3 files for 1.1, 1.4, and 2.0 mm arrays.
 - Each may contain signal, weight, coverage, kernel (simulated point source), S/N map.
 - Different polarizations included under each file.

```
redu00
├── 000001
│   ├── toltec_simu_a1100_science_000001.fits
│   ├── toltec_simu_a1400_science_000001.fits
│   └── toltec_simu_a2000_science_000001.fits
└── coadded
    ├── filtered
    │   ├── toltec_simu_a1100_filtered.fits
    │   ├── toltec_simu_a1100_noise_filtered.fits
    │   ├── toltec_simu_a1400_filtered.fits
    │   ├── toltec_simu_a1400_noise_filtered.fits
    │   ├── toltec_simu_a2000_filtered.fits
    │   └── toltec_simu_a2000_noise_filtered.fits
    └── raw
        ├── toltec_simu_a1100_noise_raw.fits
        ├── toltec_simu_a1100_raw.fits
        ├── toltec_simu_a1400_noise_raw.fits
        ├── toltec_simu_a1400_raw.fits
        ├── toltec_simu_a2000_noise_raw.fits
        └── toltec_simu_a2000_raw.fits
```


ToI TEC Data Reduction Output Files

- Each map type is stored as a FITS extension in file.
 - Common information stored in PrimaryHDU header.
 - Each layer also includes a copy of the WCS information and any fitted parameters.
- WCS units depend on reduction mode.
 - “Science” reduction mode outputs WCS in degrees (RA–TAN, DEC–Tan).
 - CRVAL1, CRVAL2 correspond to source Ra/Dec from telescope file.
 - “Pointing” and “Beammap” output in offset arcsecond units (AZOFFSET, ELOFFSET)

No.	Name	Ver	Type	Cards	Dimensions	Format
0	PRIMARY	1	PrimaryHDU	32	()	
1	signal	1	ImageHDU	23	(396, 392)	float64
2	weight	1	ImageHDU	23	(396, 392)	float64
3	kernel	1	ImageHDU	23	(396, 392)	float64
4	coverage	1	ImageHDU	23	(396, 392)	float64
5	sig2noise	1	ImageHDU	23	(396, 392)	float64



ToI TEC Data Reduction Output Files

- Key Header information
 - Units in MJy/sr or mJy/beam (user specified)
 - 2D Gaussian fit parameters (beammap and pointing modes)
 - Flux calibration (beammap)
 - Obsnum
 - Telescope parameters
 - Secondary mirror position, source RA/Dec, etc.
 - Want to exactly match netCDF file variable names
 - Copy of all config file inputs and paths