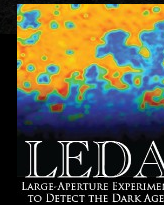


OVRO-LWA Data Processing

Stephen Bourke
Caltech



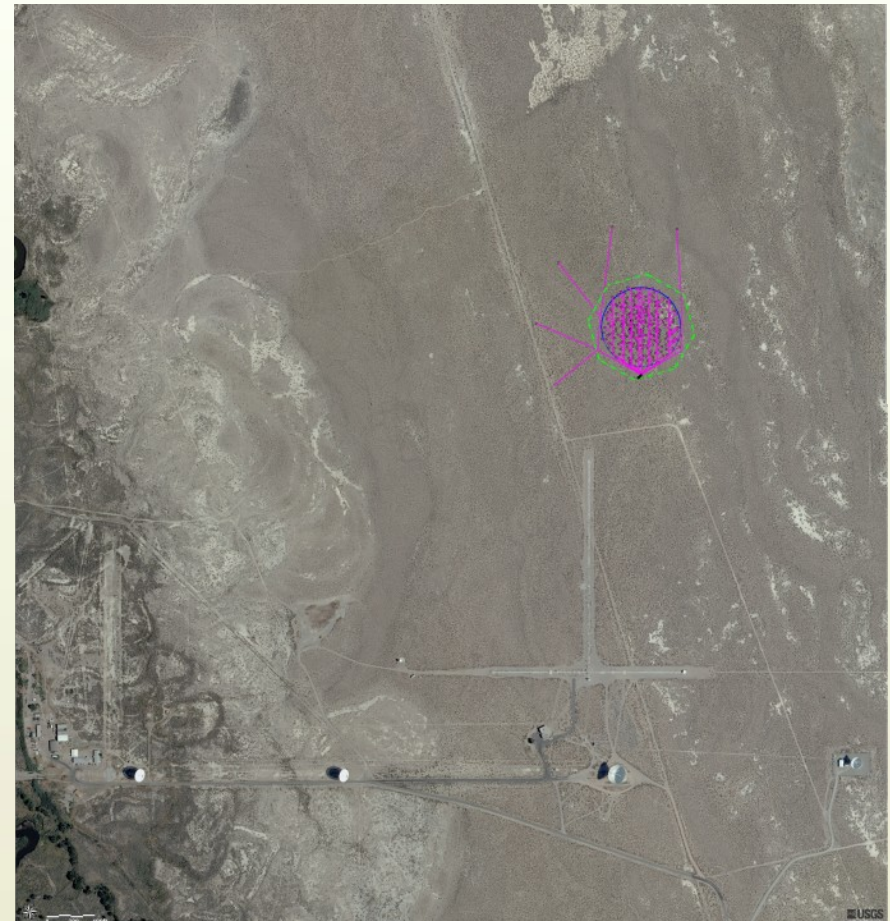
Array Overview

CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA
CMYK TOLERANCE



Array Overview

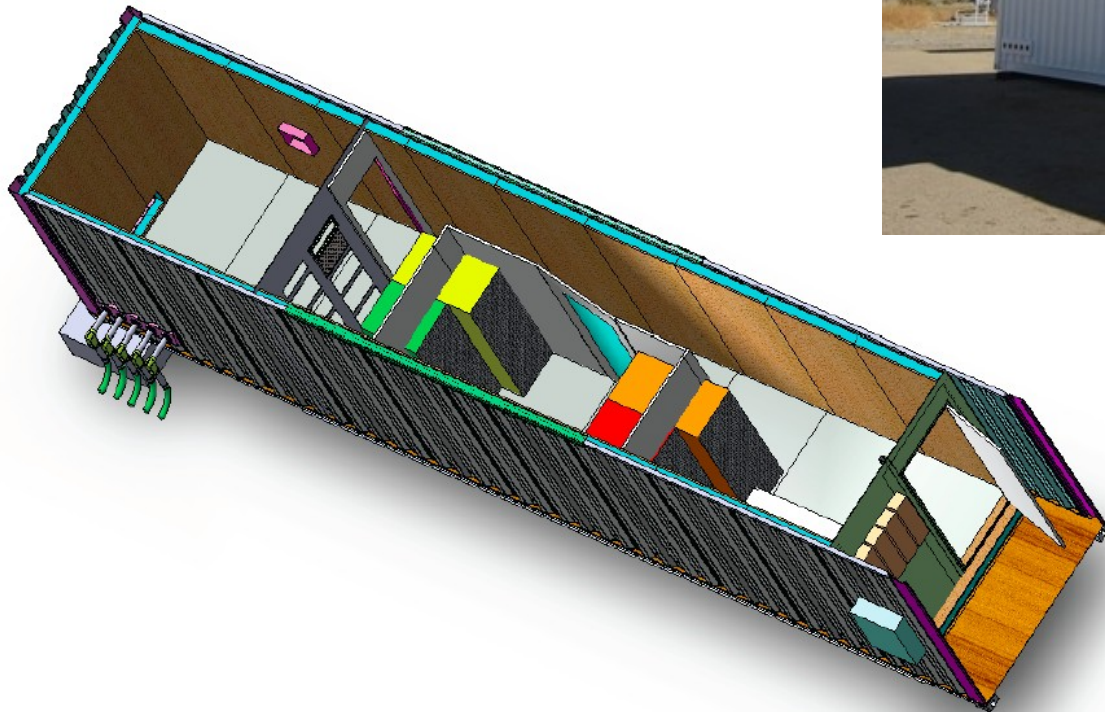
- 288 dual-polarization antennas
 - 32640 baselines
- 58 MHz bandwidth
 - 30 - 88 MHz
 - 2400 x 24 kHz channels
- 2.5 GB / integration
 - Typically 9 sec
 - 24 TB / day



Array Overview

CONTROLLED COLOR RANGE
COMPLETE PCB CAMMD
CMVH TOLERANCE

Full size shipping container with room for expansion (space and cooling)



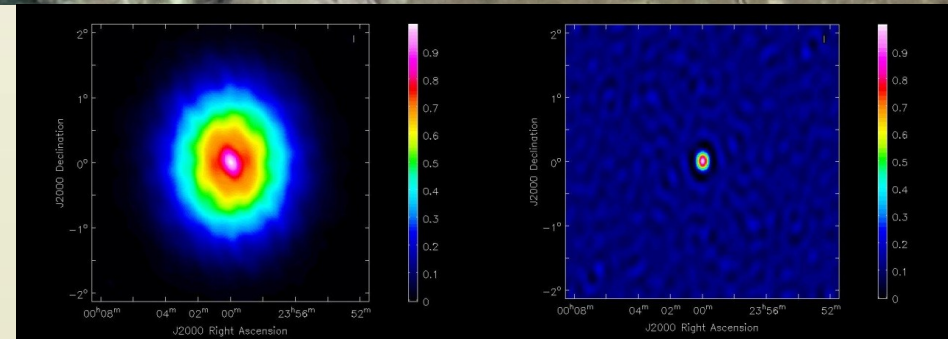
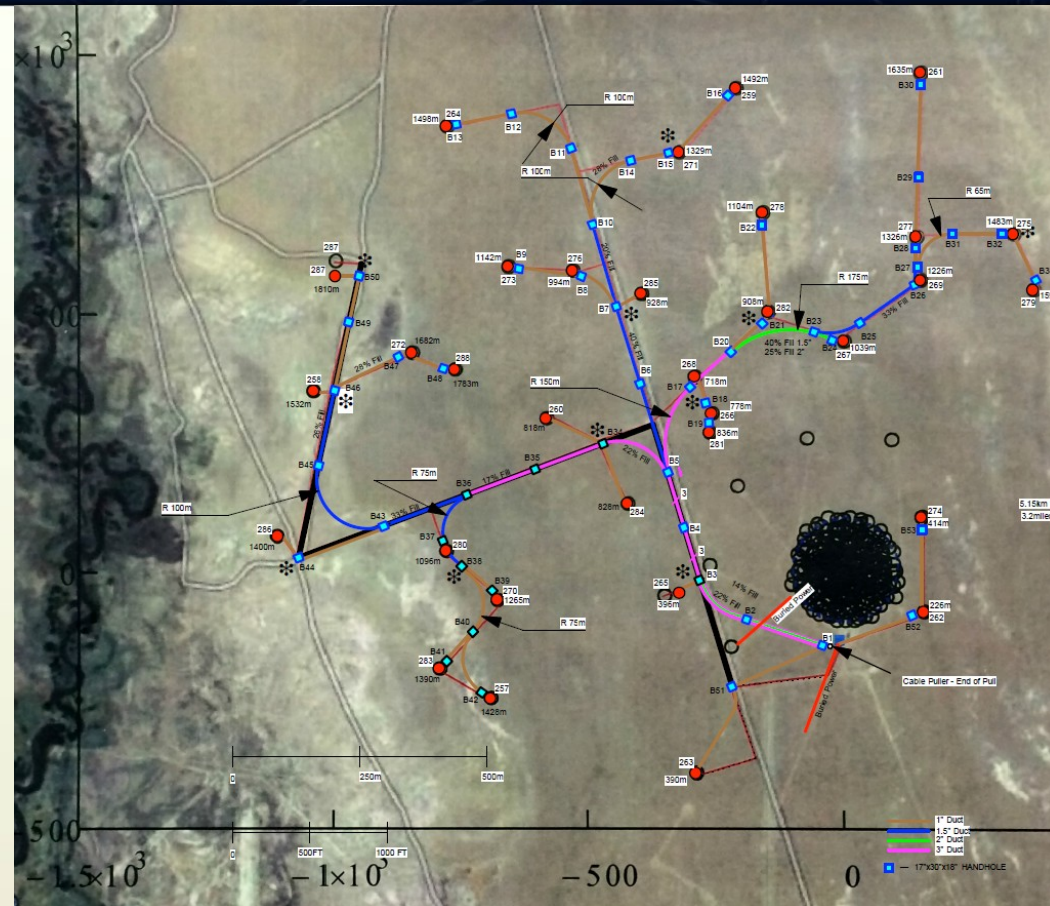
Array Overview

CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA
CMYK TOLERANCE



Array Expansion

- 32 additional antennas
- Optical fiber signal path
- Image size ~ 4k x 4k
- Includes capacity for further expansion



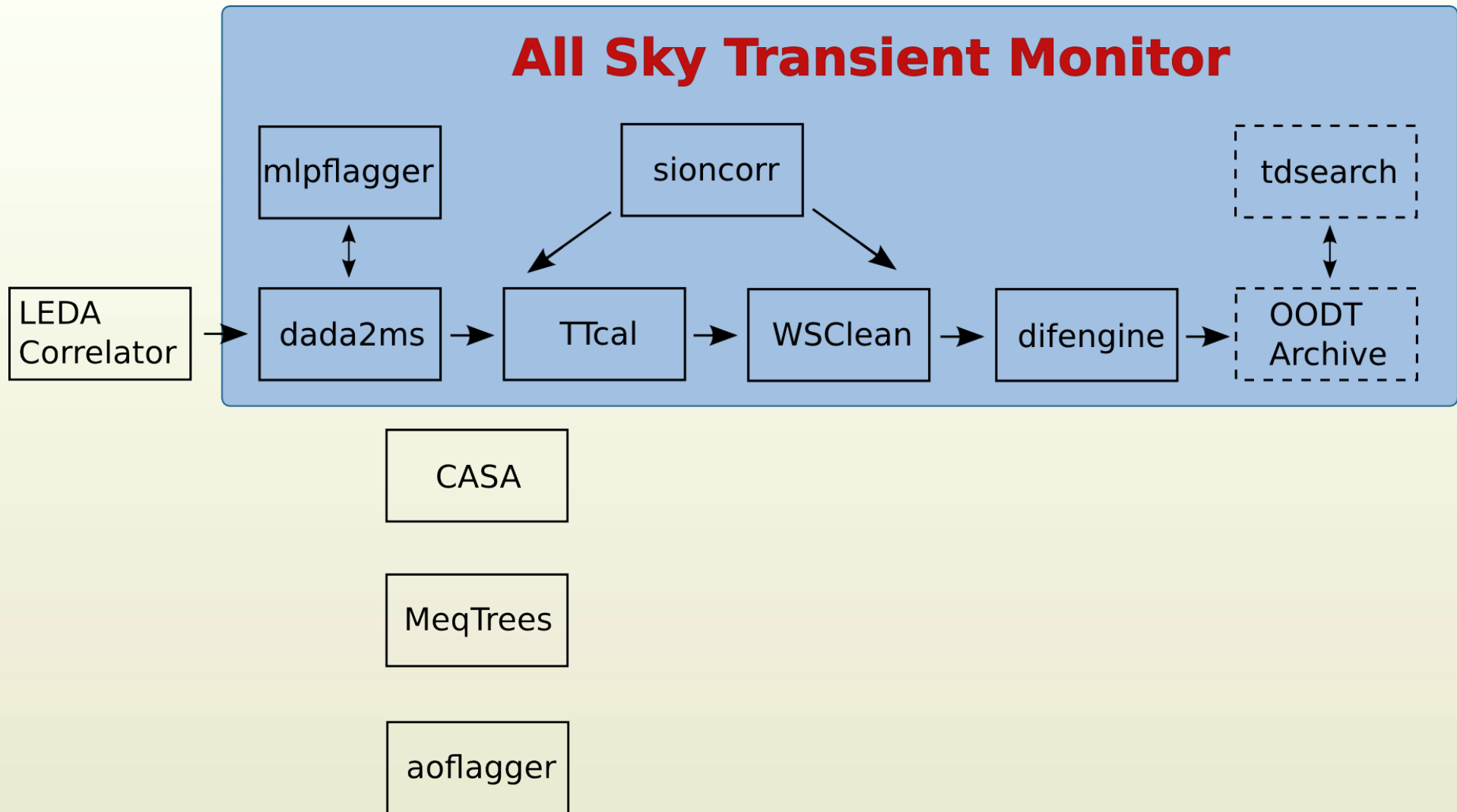
All Sky Transient Monitor



- 208 CPU cores, 832 GB of RAM
- Data to be processed and archived in real time
- 32768 x 4P x 2400 channels (60 MHz) x 32b+32b = 2.7 GB per integration
- Resolution ~ 10 arcmin -> image data ~ 800 MB per integration (Stokes I and V)
- Can monitor the entire sky continuously to detect transients, including CME's from stars and associated aurorae from planets

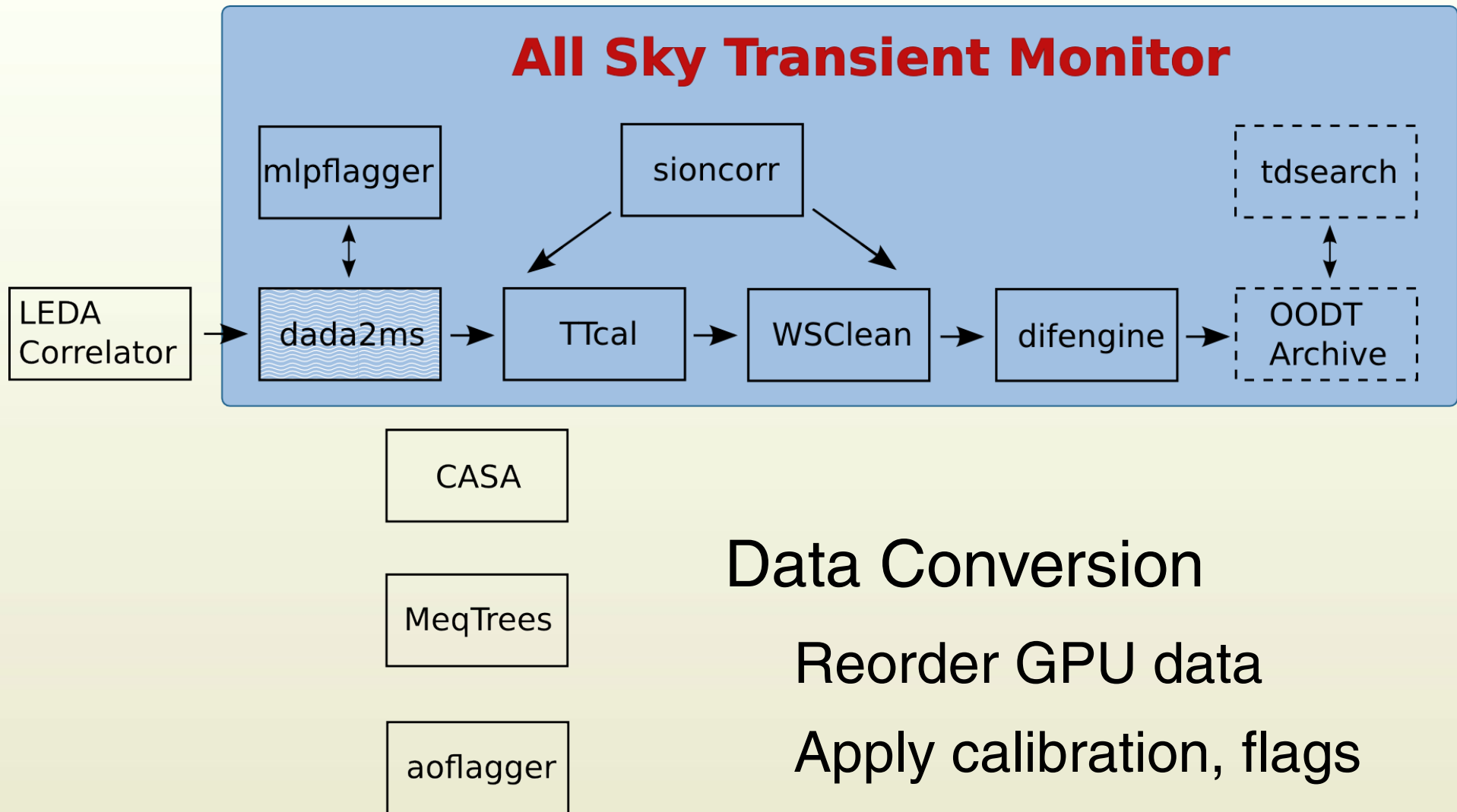
Data Processing

All Sky Transient Monitor



Data Processing

All Sky Transient Monitor



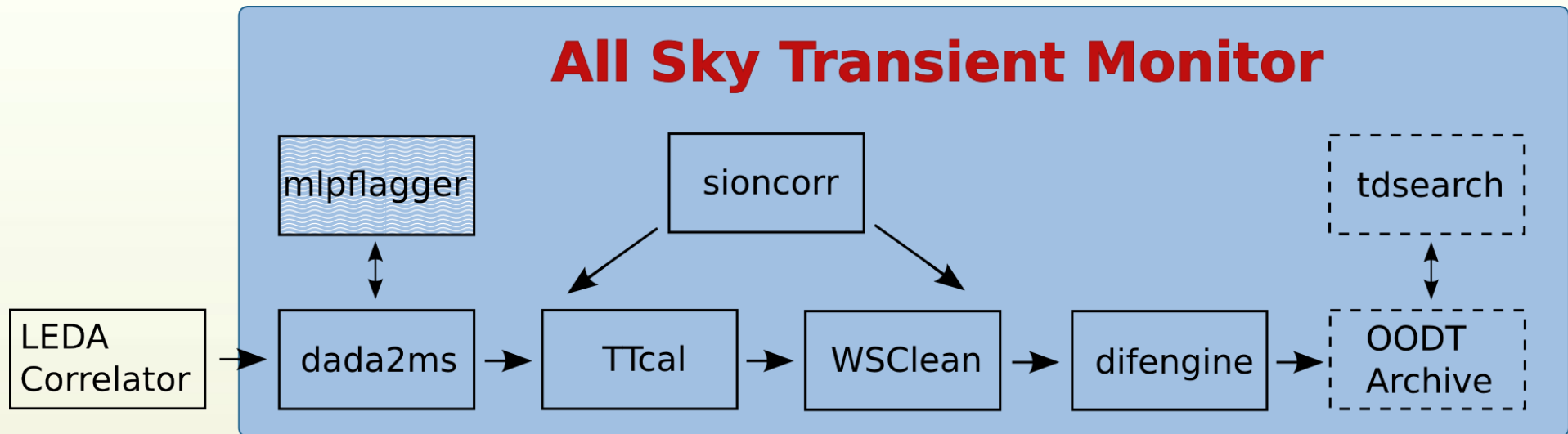
Data Conversion

Reorder GPU data

Apply calibration, flags

Data Processing

All Sky Transient Monitor



CASA

MeqTrees

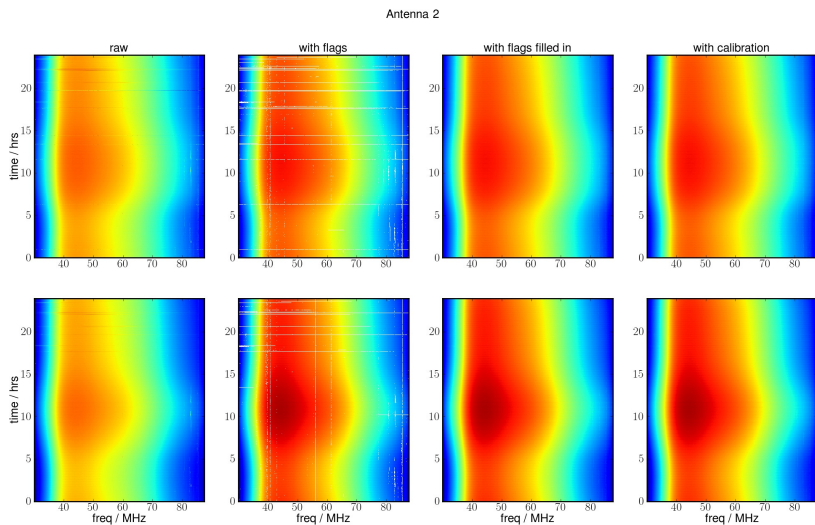
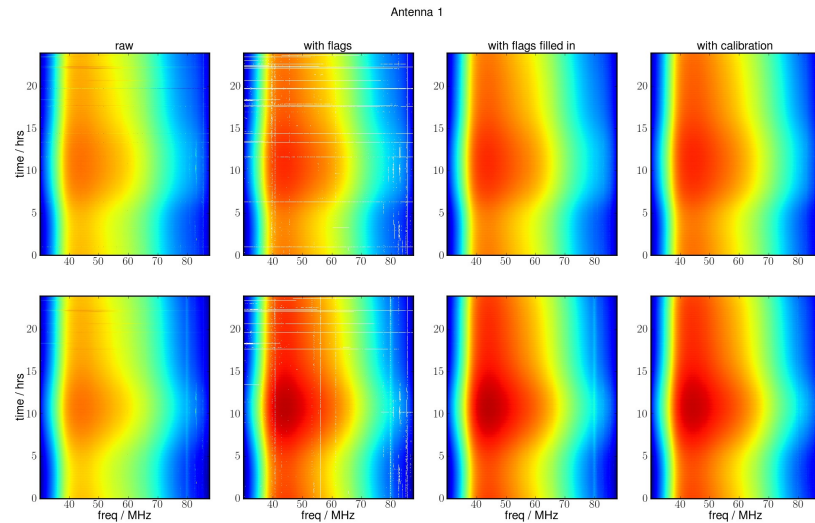
aoflagger

MLPflagger

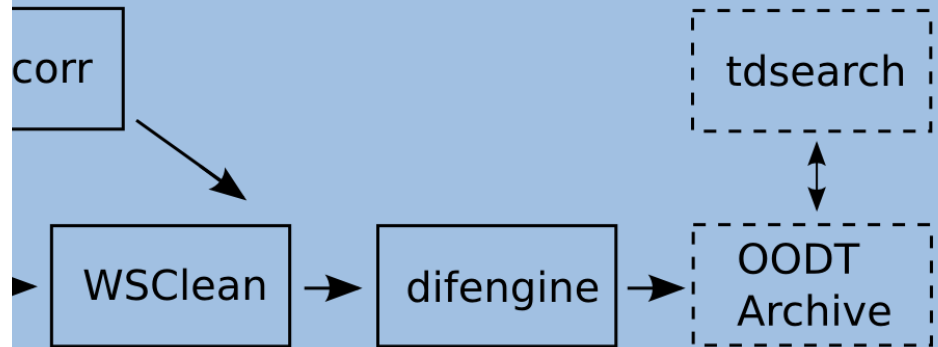
Limited support surface fit to autocorrelations used to flag visibilities

Data Processing

CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA
CMYK TOLERANCE



Transient Monitor

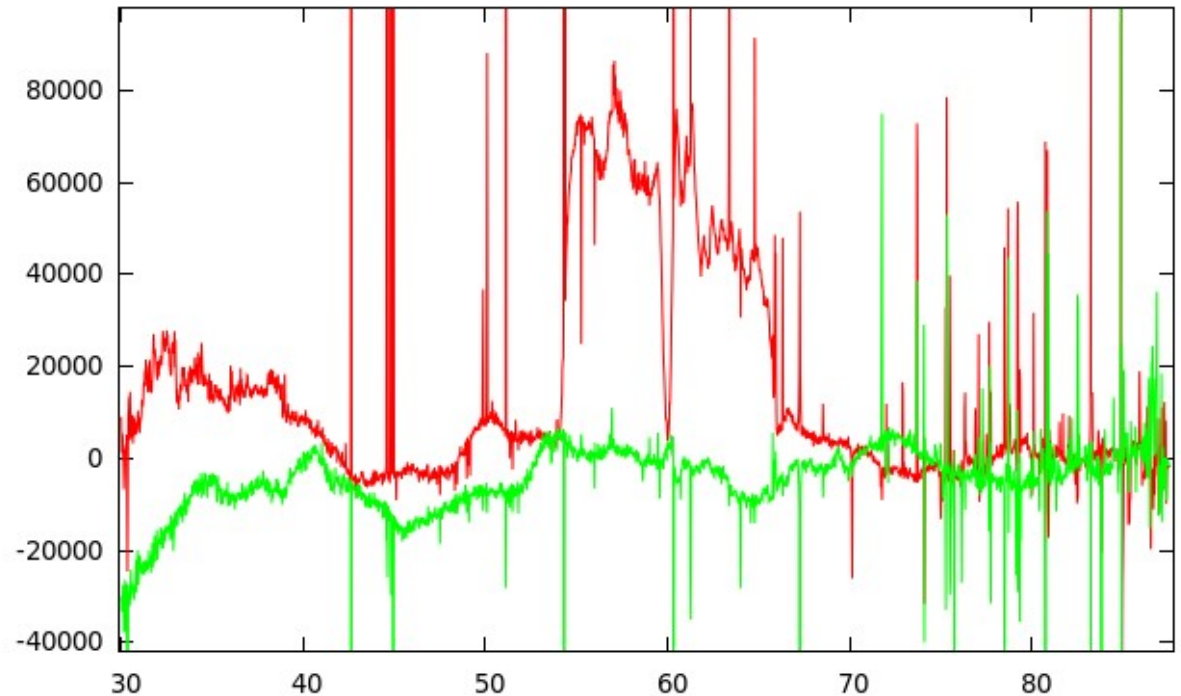
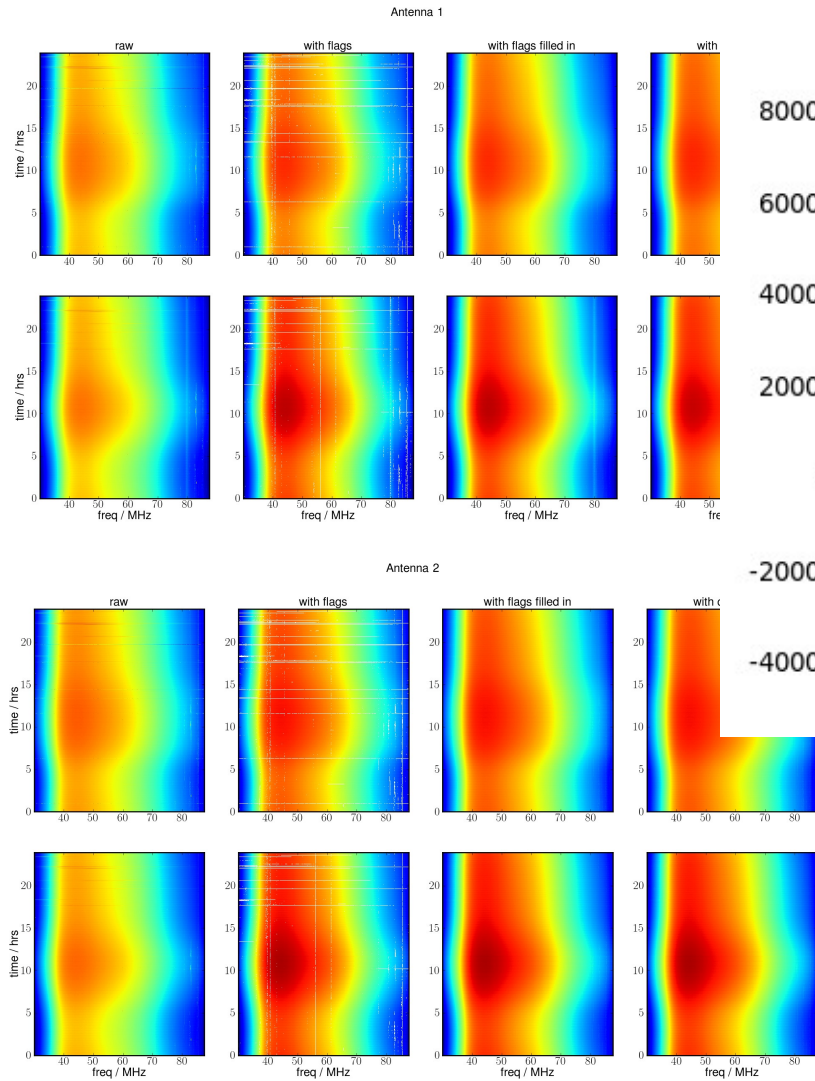


MLPflagger

Limited support surface fit to autocorrelations used to flag visibilities

Data Processing

CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA
CMYK TOLERANCE

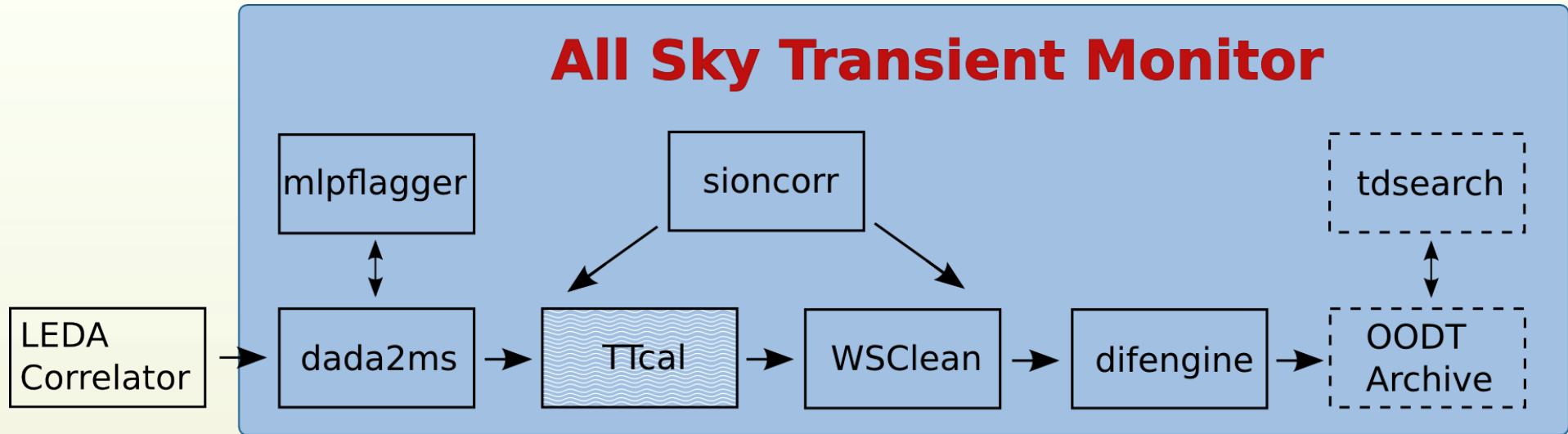


Limited support surface fit to autocorrelations used to flag visibilities

Data Processing

CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA
CMYK TOLERANCE

All Sky Transient Monitor



CASA

MeqTrees

aoflagger

TTcal

Sky model inversion

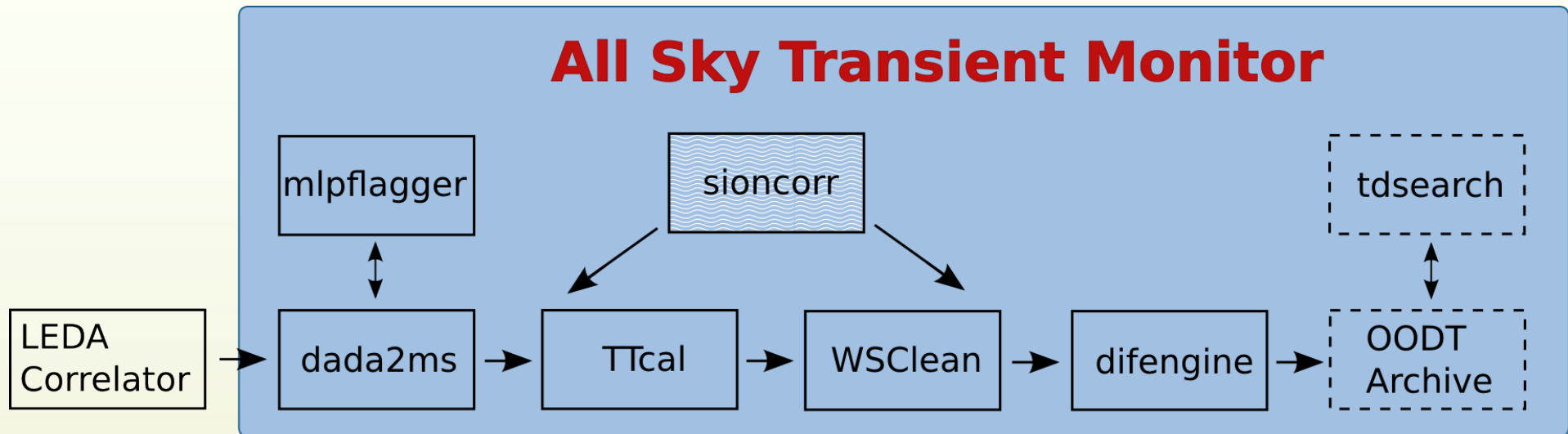
STEFcal based calibration

≥ casa, 3-5x faster

Direction dependent calibration and source subtraction

Data Processing

All Sky Transient Monitor



CASA

MeqTrees

aoflagger

sioncorr

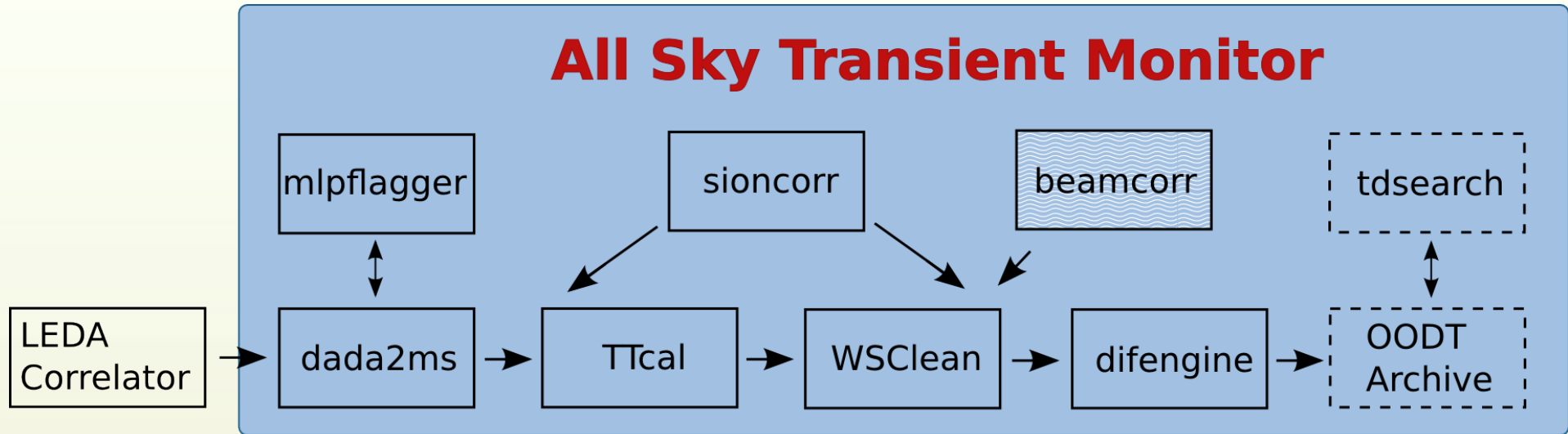
TEC based static ionosphere correction

Apply to calibration

Remove from image

Data Processing

All Sky Transient Monitor



CASA

MeqTrees

aoflagger

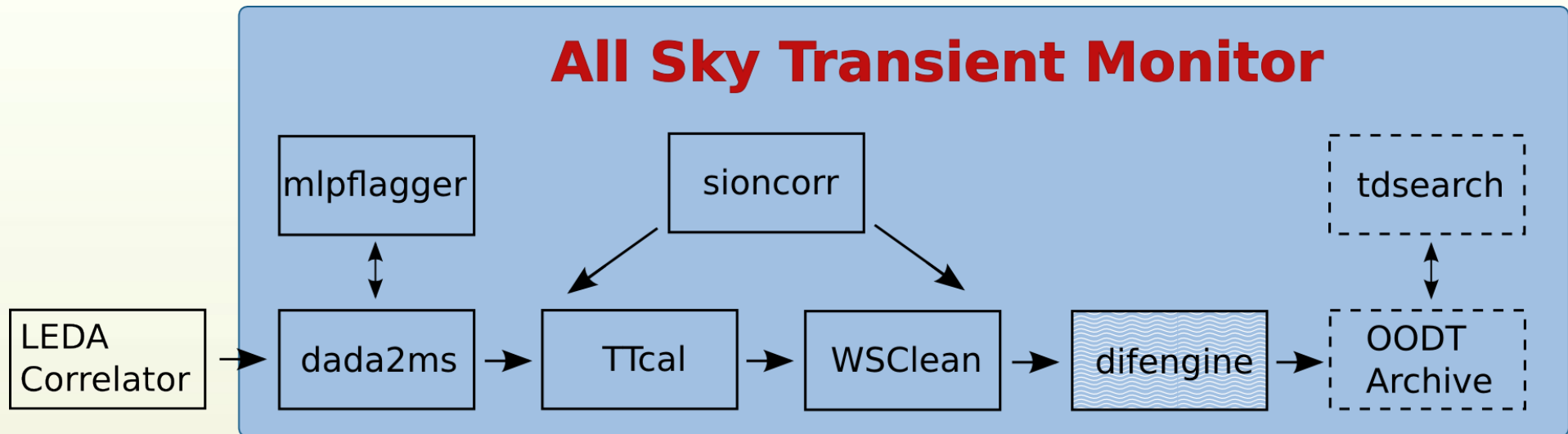
beamcorr

Apply antenna beam model

Calculate true Stokes

Data Processing

All Sky Transient Monitor



CASA

MeqTrees

aoflagger

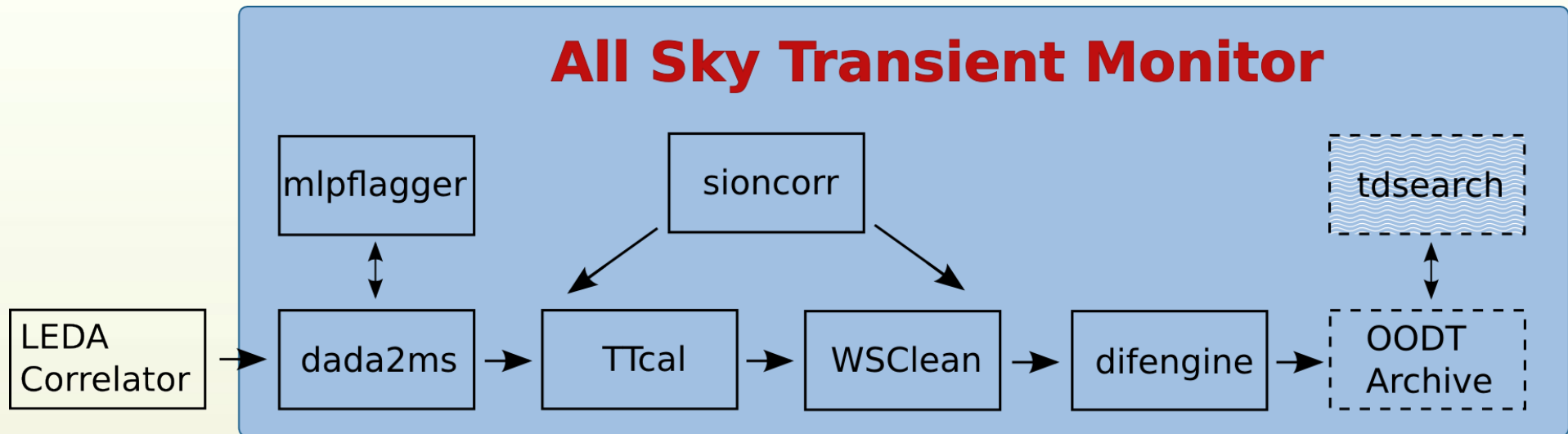
difengine

Sky statistics collection

Short duration transient detection

Data Processing

All Sky Transient Monitor



CASA

MeqTrees

aoflagger

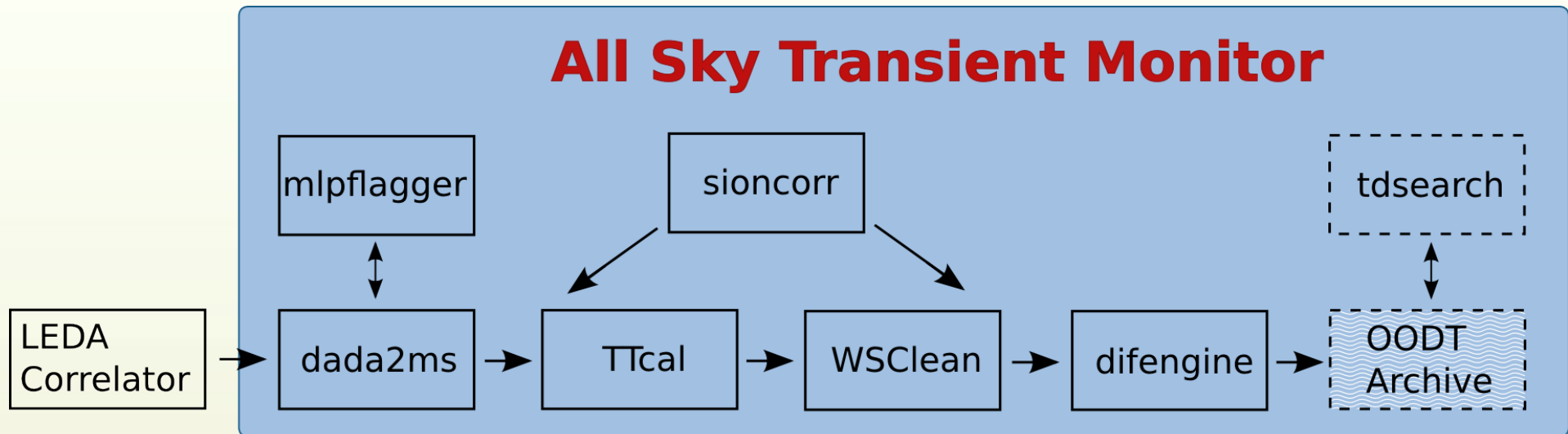
Tdsearch

HealPix like data

Search for long duration transients and periodic signals

Data Processing

All Sky Transient Monitor



CASA

MeqTrees

aoflagger

Archive and User interface

Apache OODT based

Meta data storage via hooks

Flexible query system

Processing Hardware

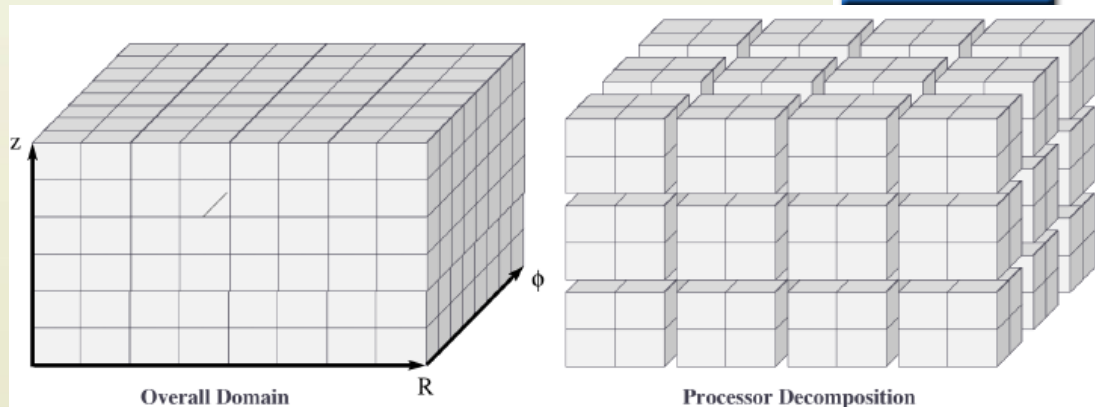
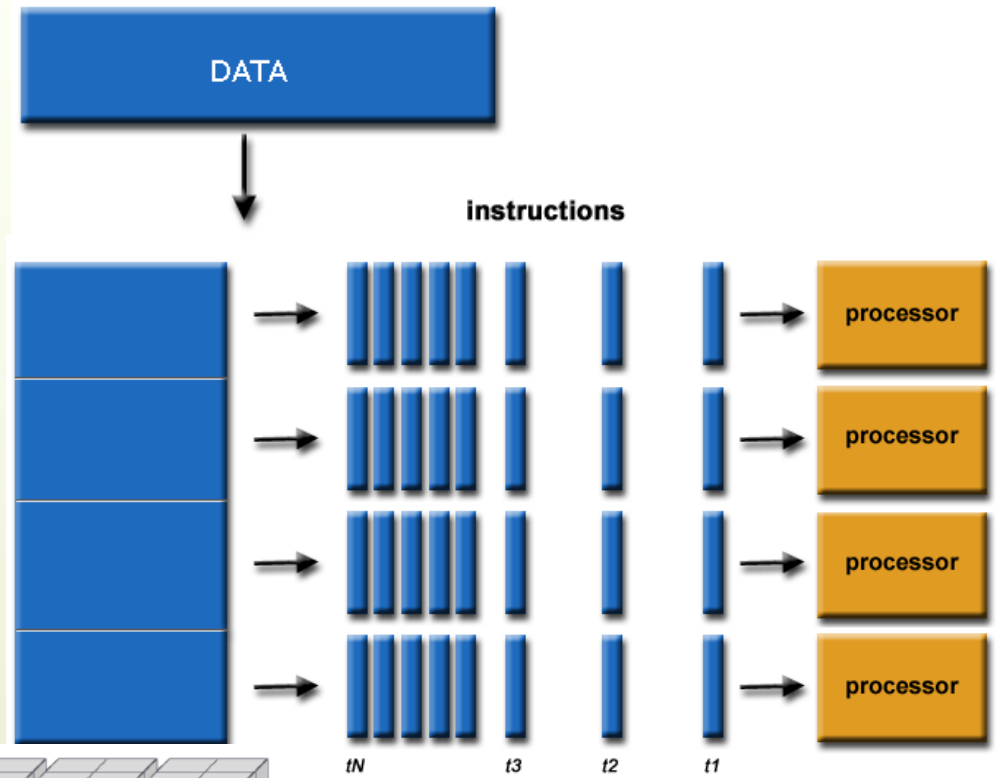
- HP SL270s Gen8
- 2 rack units (4 x 0.5)
- 8 GPU per node
 - (4 / rack unit)
- ConnectX-3 Pro
 - Dual 56 Gb/s Infiniband
- Also 2 x 1 GbE



- ASA Supermicro 1U compute
- 2 x XEON E5-2630V3
- 64 GB RAM
- ASA Supermicro 4U storage
- 200 TB Lustre storage

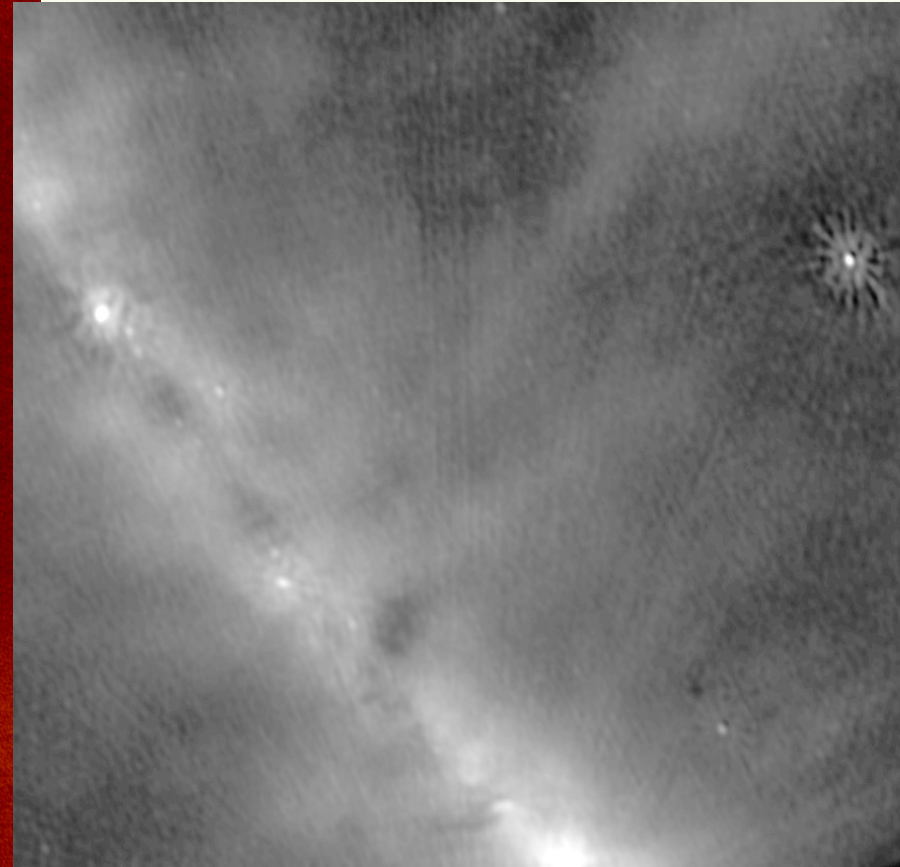
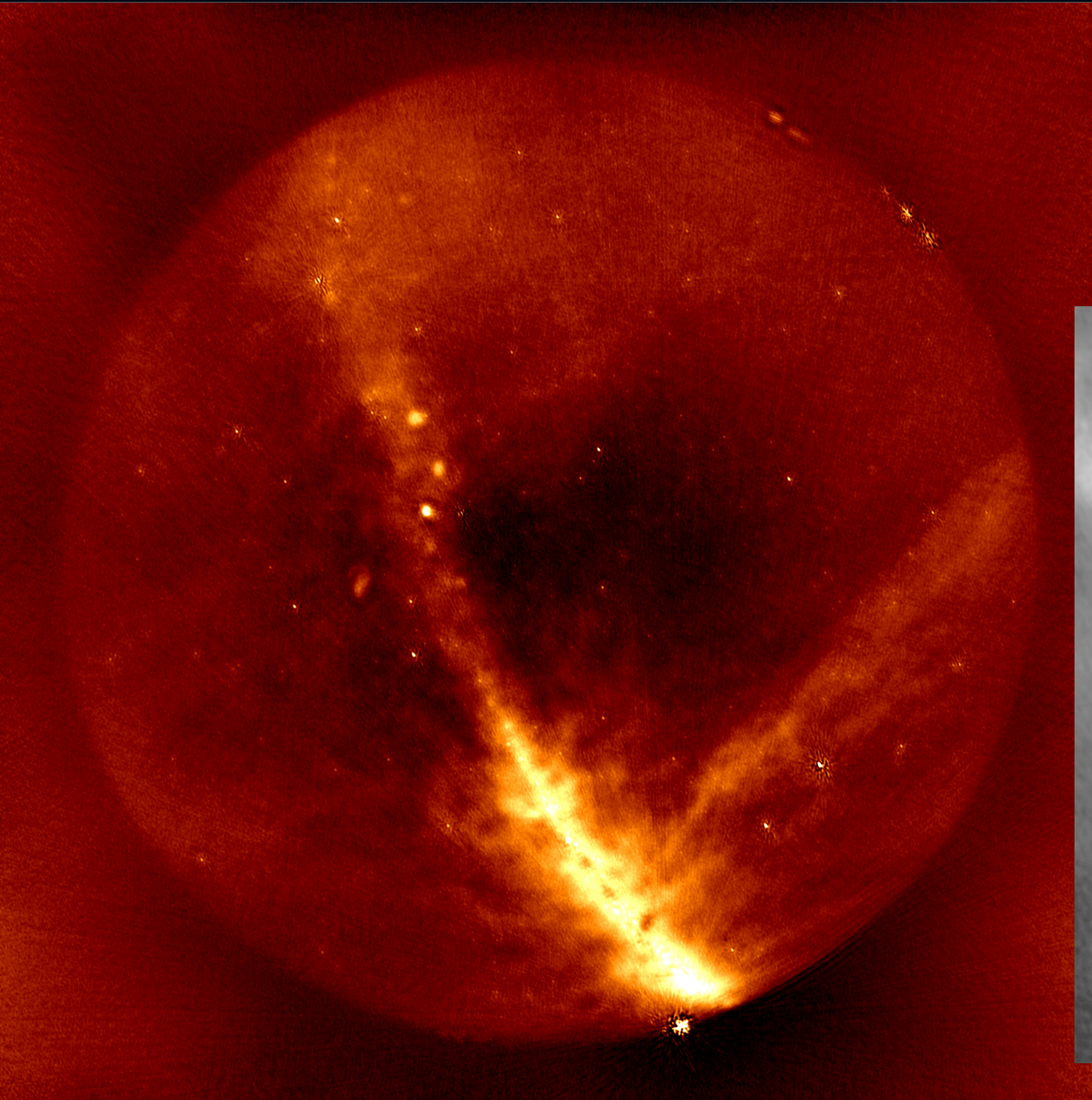
Processing Infrastructure

- Decompose in time & frequency
- Queue jobs for execution
- Python management
- PBS & ssh backends



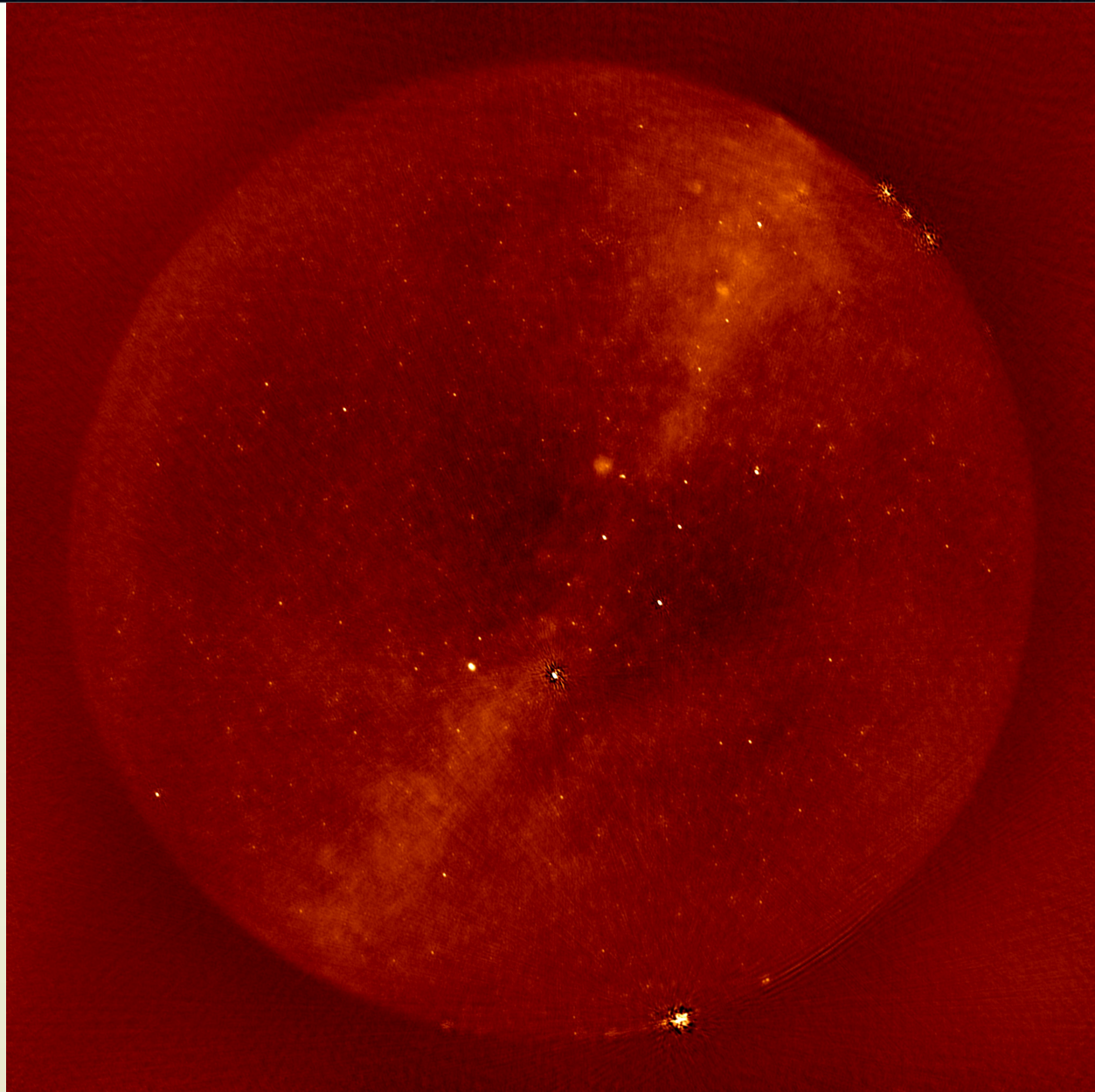
Current Output

CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA
CMYK TOLERANCE



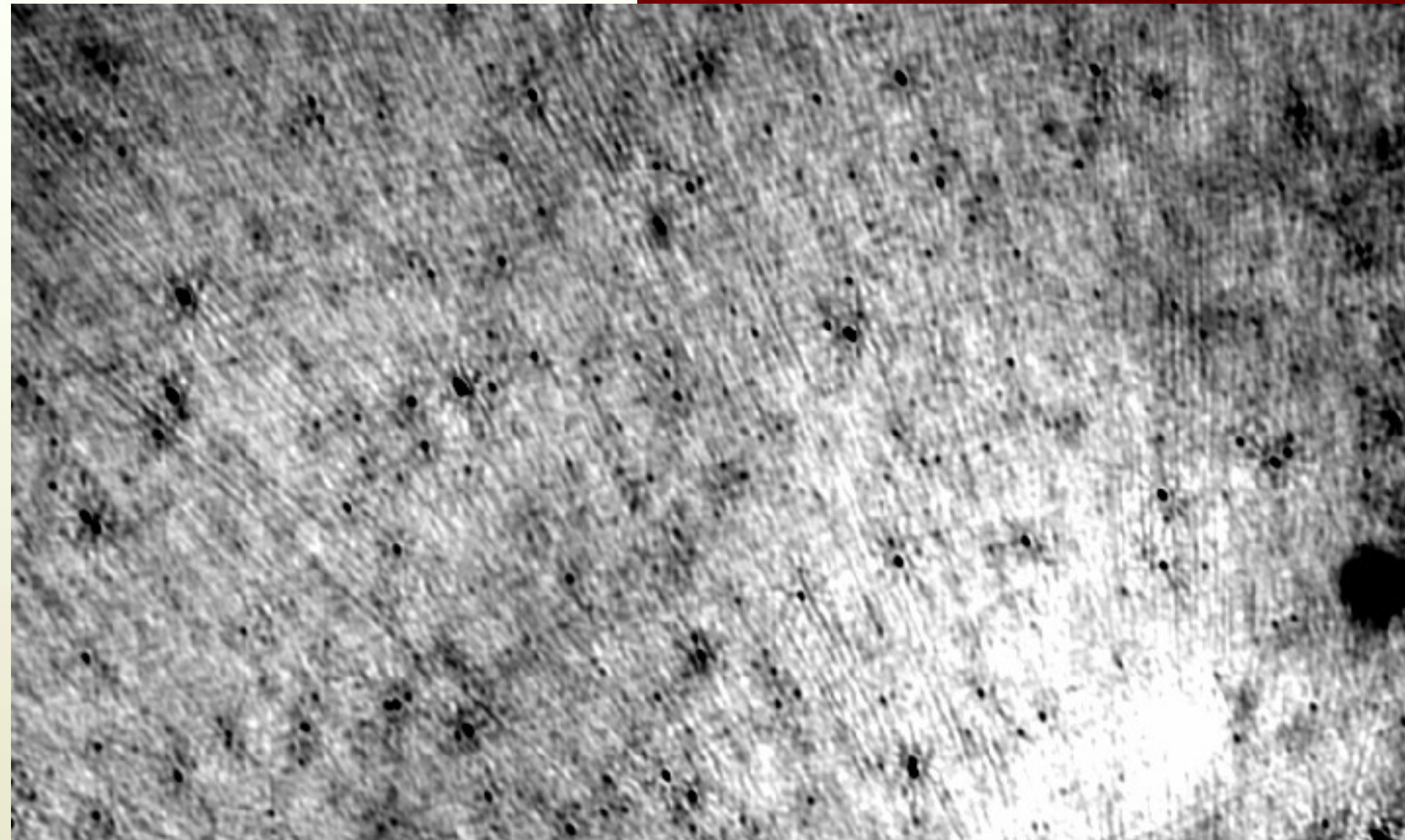
Current Output

CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA
CMYK TOLERANCE

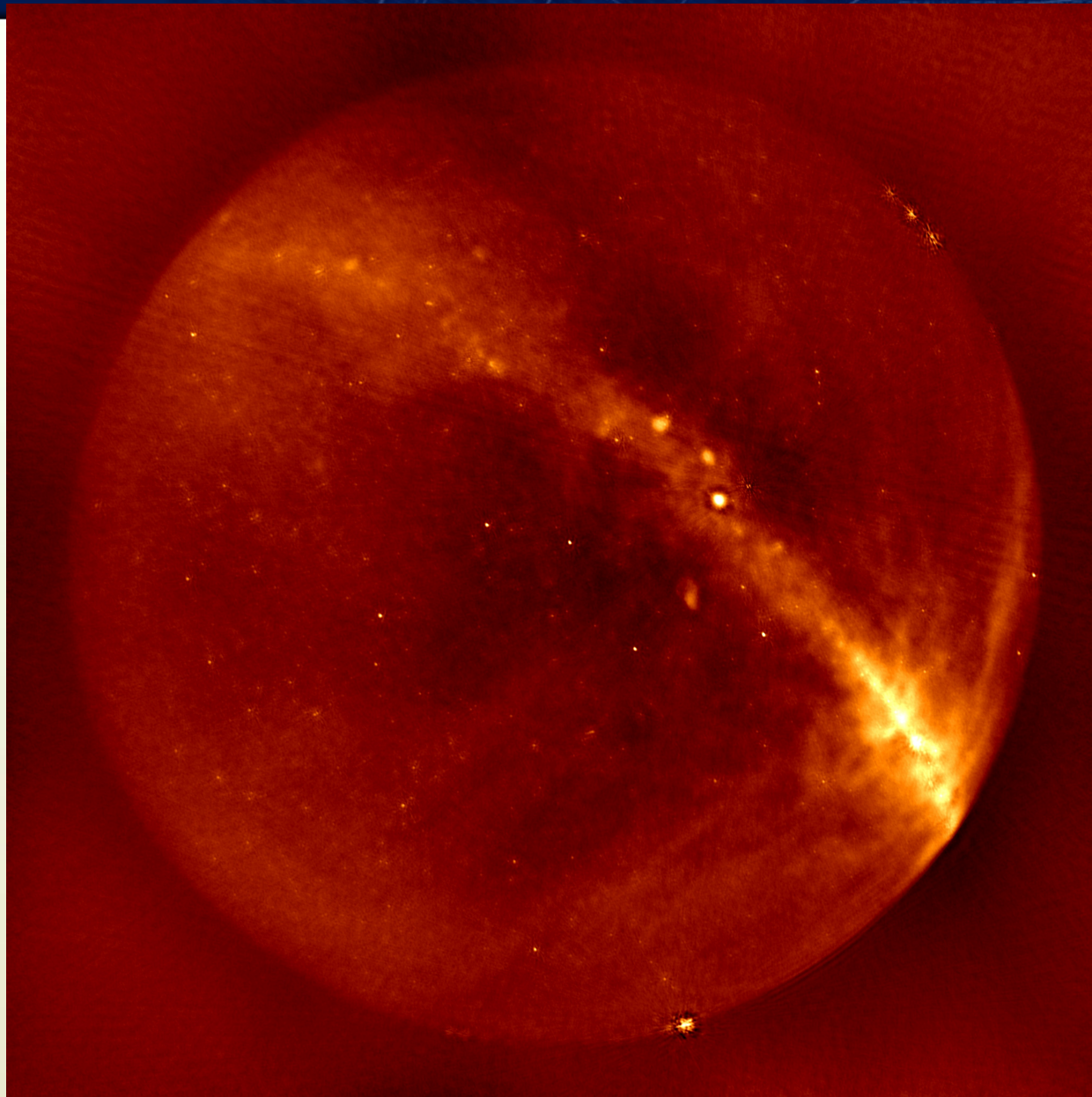


Current Output

CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA
CMYK TOLERANCE

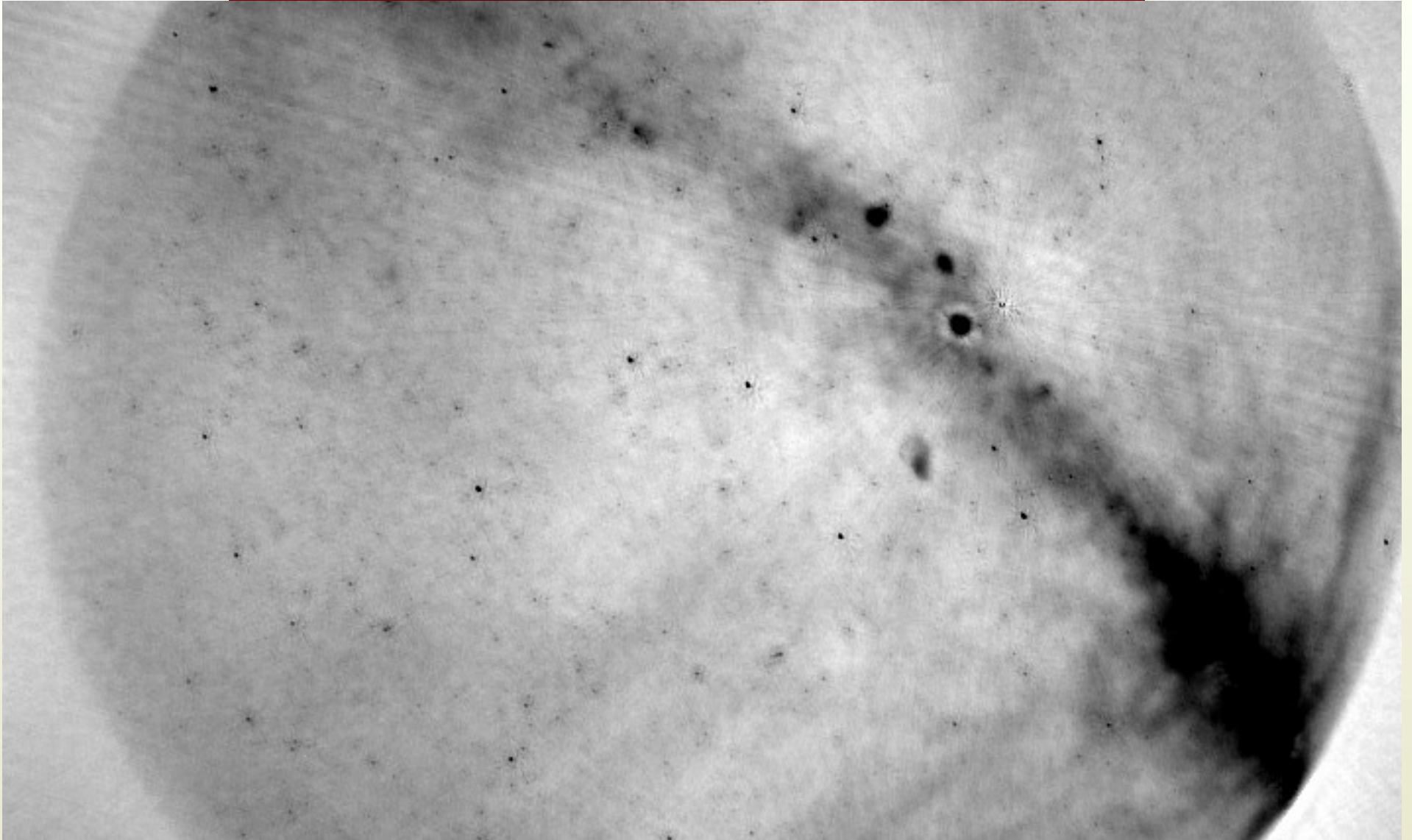


Current Output



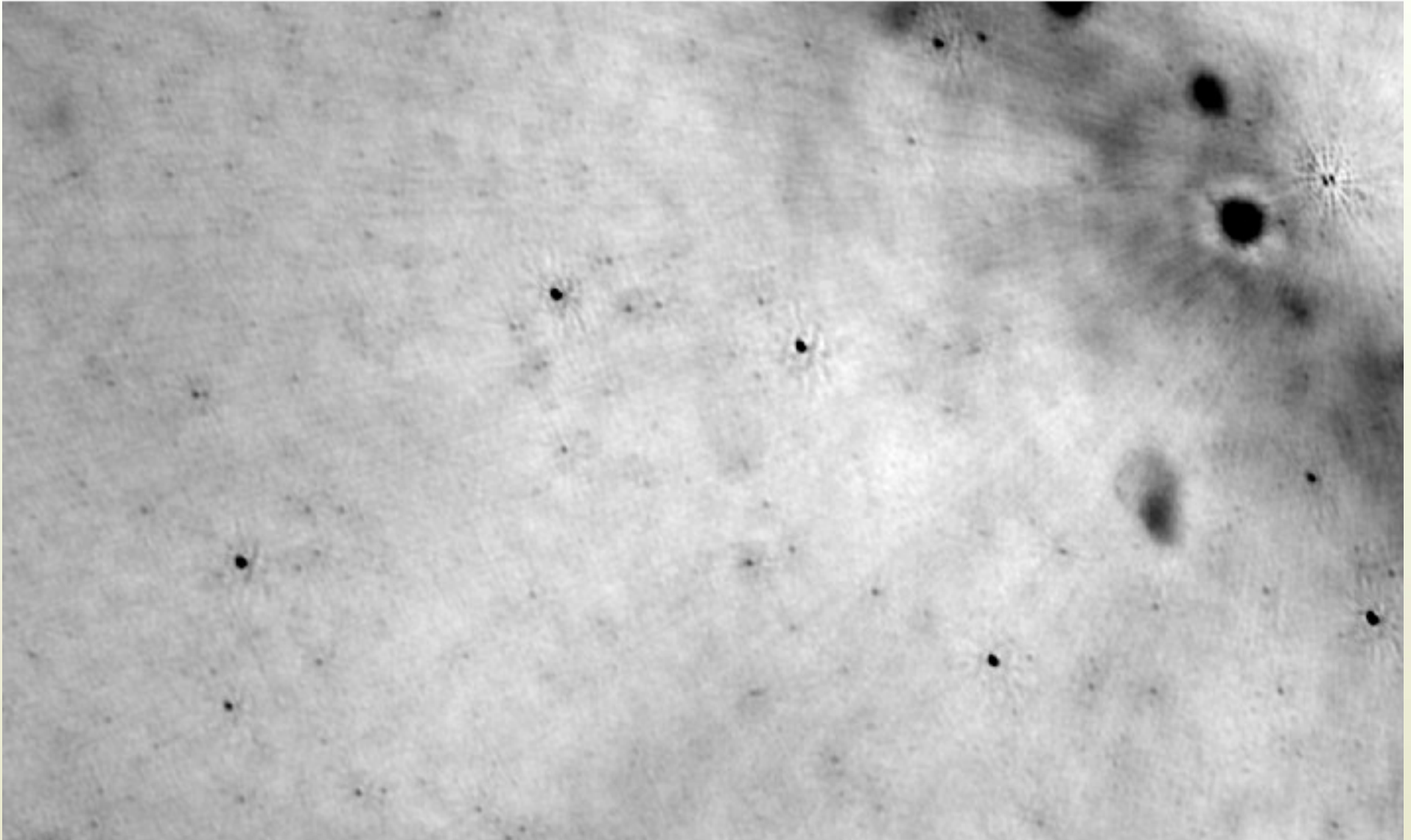
Current Output

CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA



Current Output

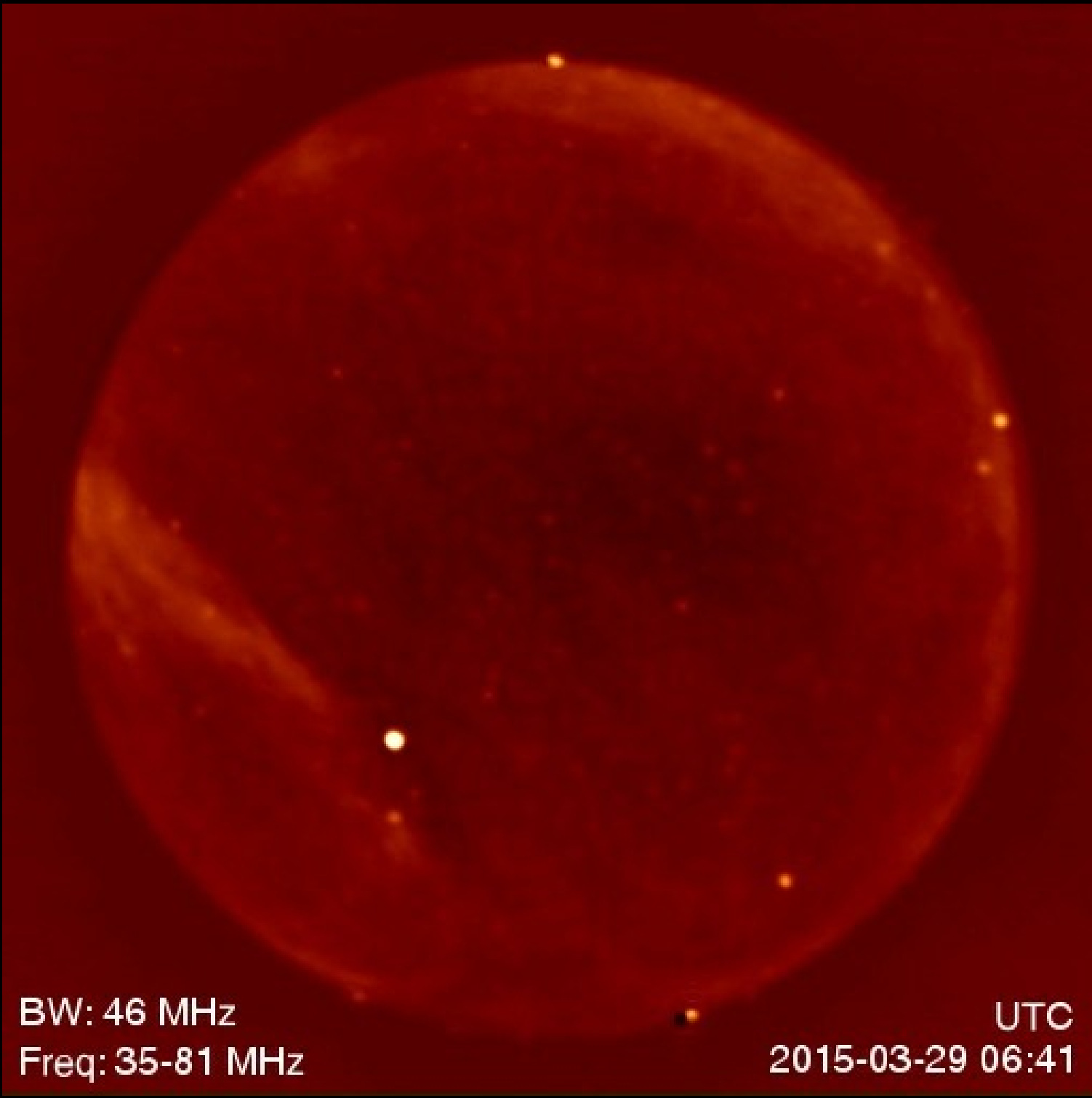
CONTROLLED COLOR RANGE
COMPLETE RGB GAMMA





BW: 46 MHz
Freq: 35-81 MHz

UTC
2015-03-29 06:04



BW: 46 MHz
Freq: 35-81 MHz

UTC
2015-03-29 06:41



BW: 58 MHz
Freq: 30-88 MHz

UTC
2014-04-30 19:00:02



BW: 58 MHz
Freq: 30-88 MHz

UTC
2014-04-30 19:11:17