

OMaA - One Millimeter Array for Astronomy

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- *Vern Fath*
- *Sandra Bustamante**



Outline

- Motivation for OMAyA
- Specifications
- Details of the Instrument
- Description of Capabilities
- Software Pipeline
- Status and Timeline

OMaYA People



Gopal Narayanan



Neal Erickson



Ron Grosslein



Vern Fath



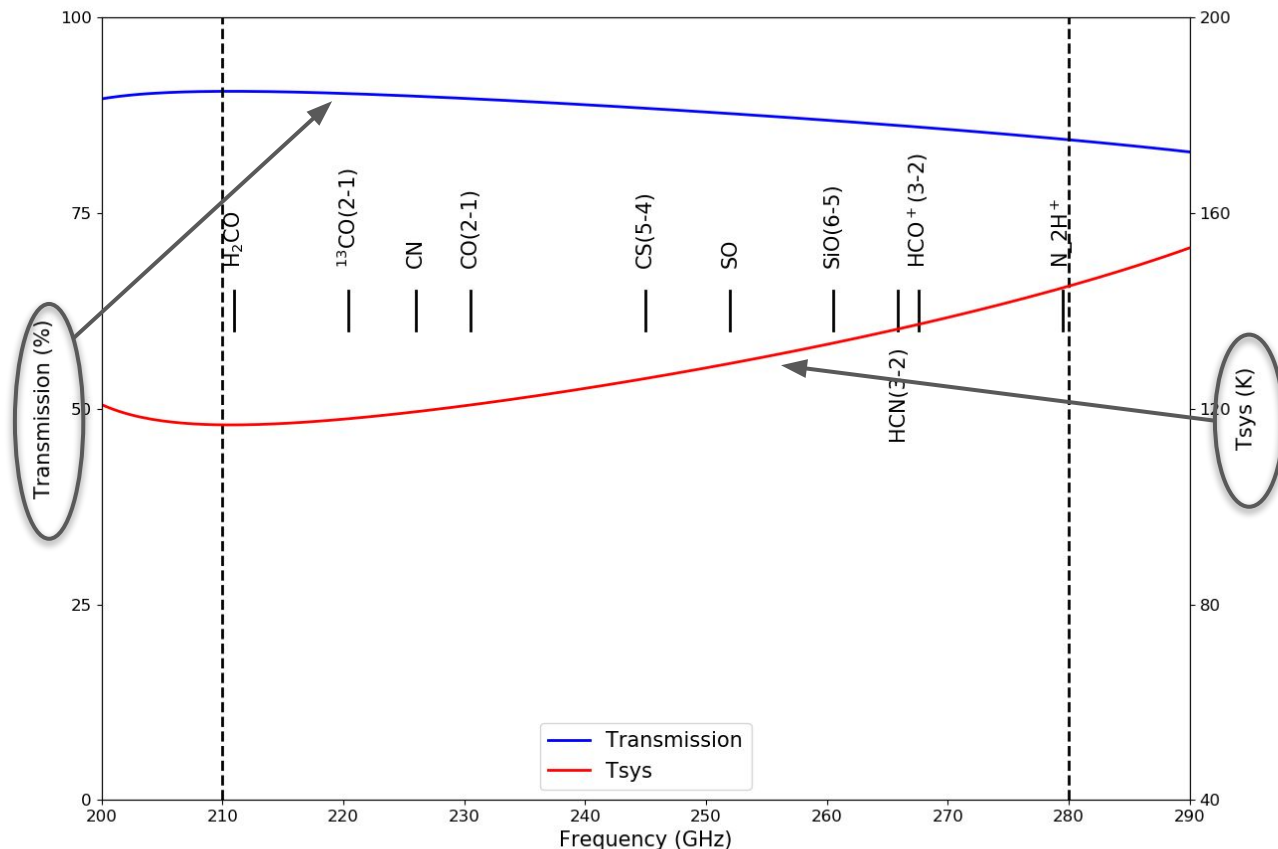
Alan Parrish



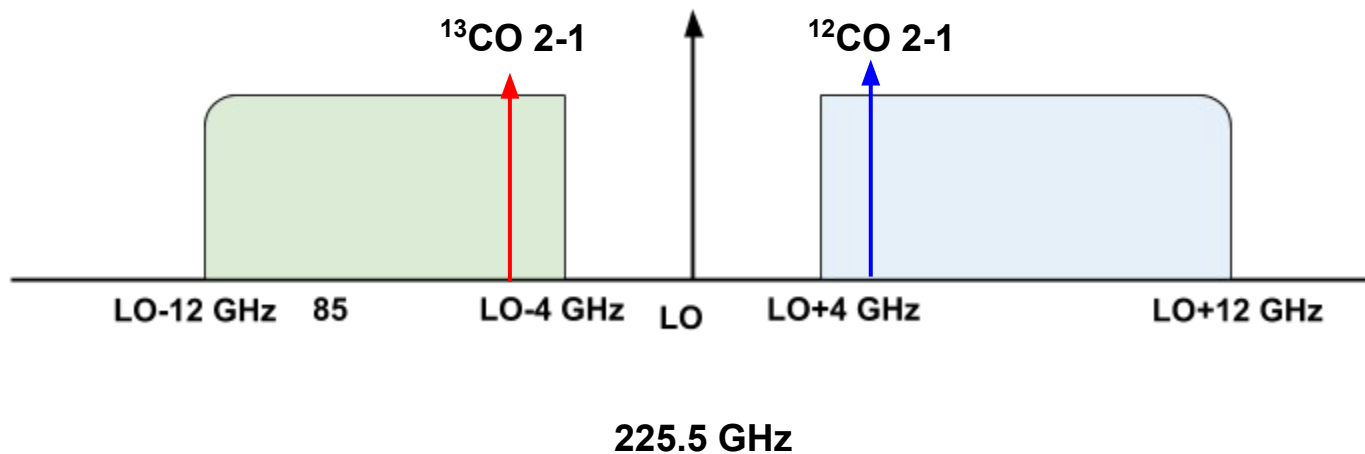
Sandra Bustamante

The 1.3mm wavelength atmospheric window

- 1mm Band has good transmission - workhorse band for LMT
- With sideband separation and dual-polarization receivers - excellent sensitivity even in modest format arrays
- Astrophysically important lines in both sidebands - couple with WARES backend



Multiple Lines with Sideband Separation



OMaYA Specifications

Number of Beams	4 x 2 ; Beam separation ~14"
Number of Polarizations	2 in each beam
Number of Sidebands	2 ; 32 Output IFs
RF Frequency Range	210 - 280 GHz
IF Frequency Range	4 - 12 GHz
Receiver Noise Temperature	60 - 75 K
Spectrometer (WARES) Modes	32 Spectrometer Inputs 800 MHz - 2048 channels (Res: 0.5 km/s @230) 400 MHz - 4096 channels (Res: 0.12 km/s @230) 200 MHz - 8192 channels (Res: 30 m/s @230)

Mapping Speed

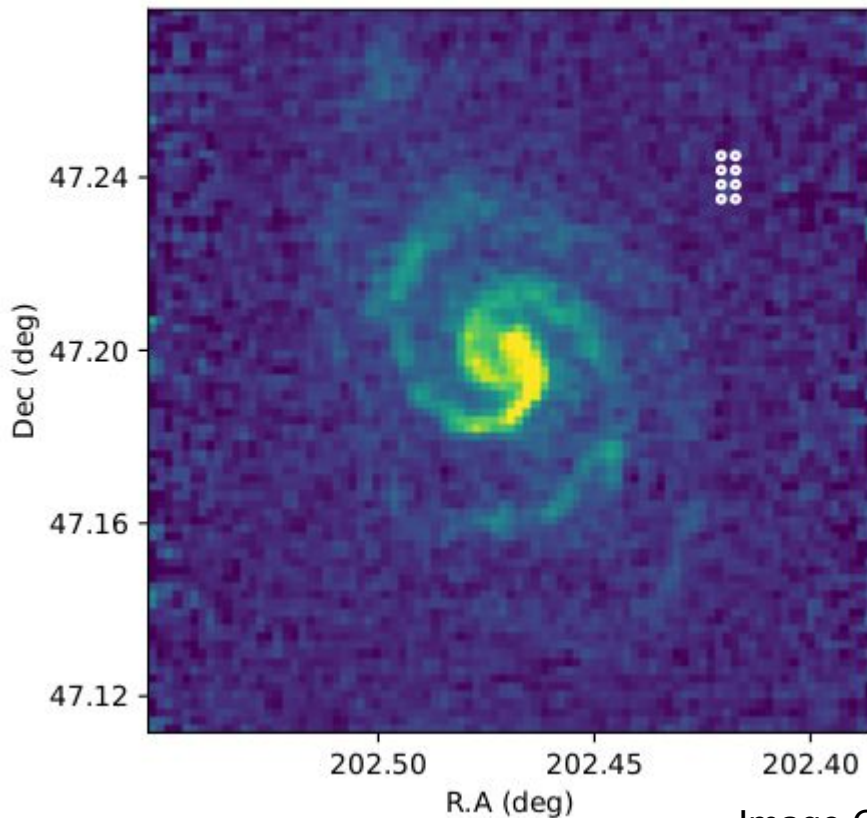


Image Credit: Mark Heyer

Nearby Galaxies

- With 8 beams / 2 polarizations / 2 sidebands can make rapid OTF maps with OMAyA
- 10' x 10' map of M51 can be made in 1 hour to a rms of 70 mK with 0.5 km/s resolution

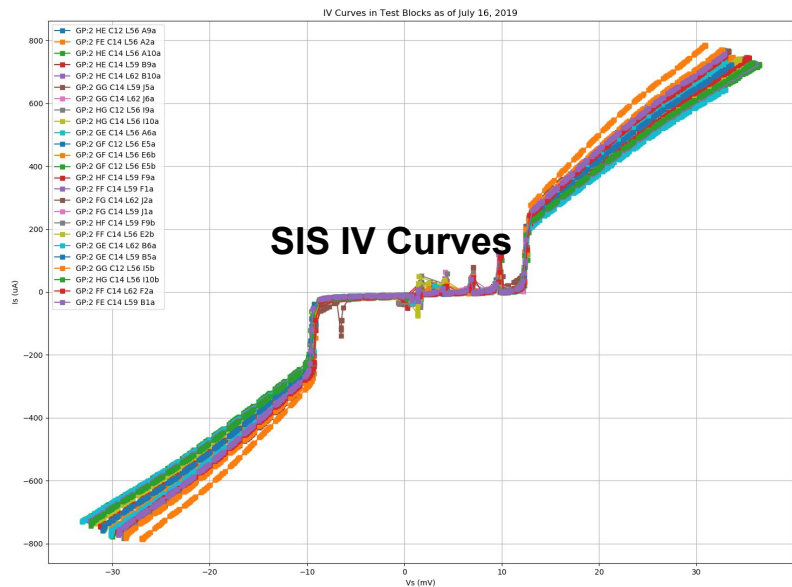
Galactic Cold Cores

- 10' x 10' map of galactic cold cores in 2 hours to a rms of 200 mK with 32 m/s resolution

OMaA Details

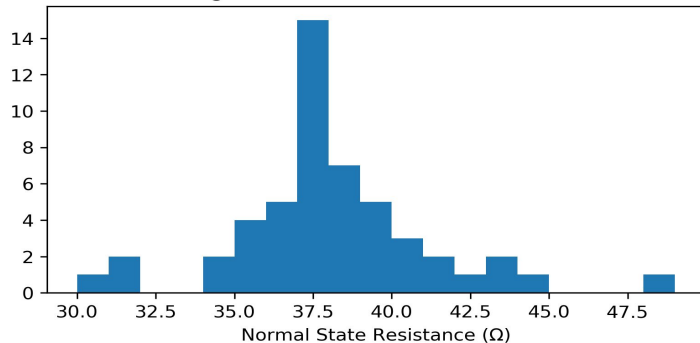
- Based on heritage of ALMA Band-6 SIS junction technologies, wafer fabricated at UVA. Collaboration with NRAO
- UMass has a large selection of Band-6 SIS junctions fabricated at UVA
- Tested and identified matched junctions based on DC IV-curve testing
- Novel design for Integrated dual-pol, sideband separation mixer block with horn and OMT sections integrated with receiver
- New bias system controls and monitors all aspects of SIS, LNA and magnet bias

Identifying Matched SIS Junctions



- 50+ SIS Junctions Tested in DC Test Blocks
- Identify sets of 4 matched devices with similar geometry and normal state resistances

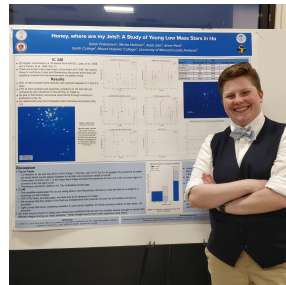
Histogram of Normal State Resistances



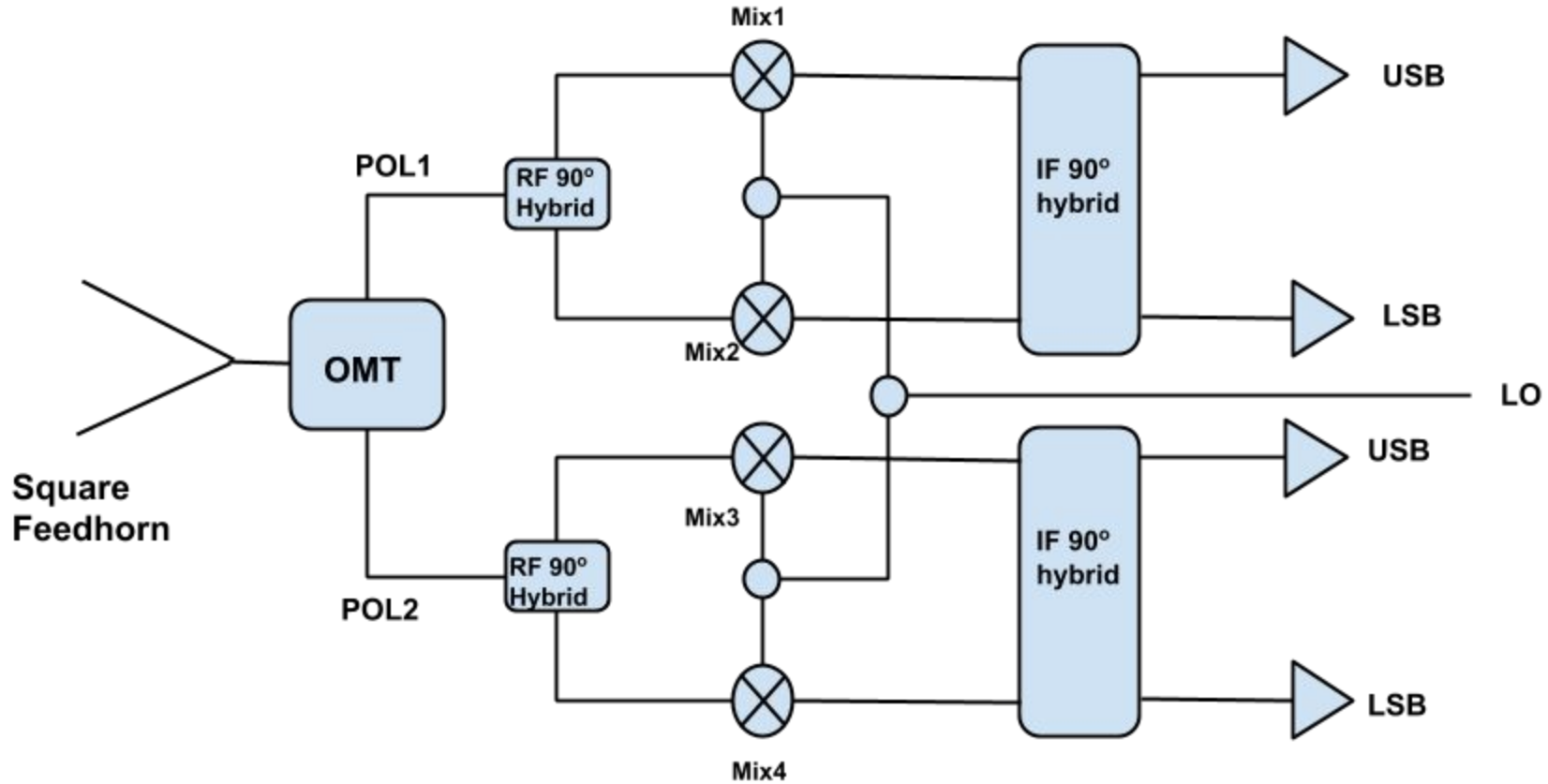
Micha
Heilman,
Mt Holyoke



Selah
Finkelstein,
Smith College

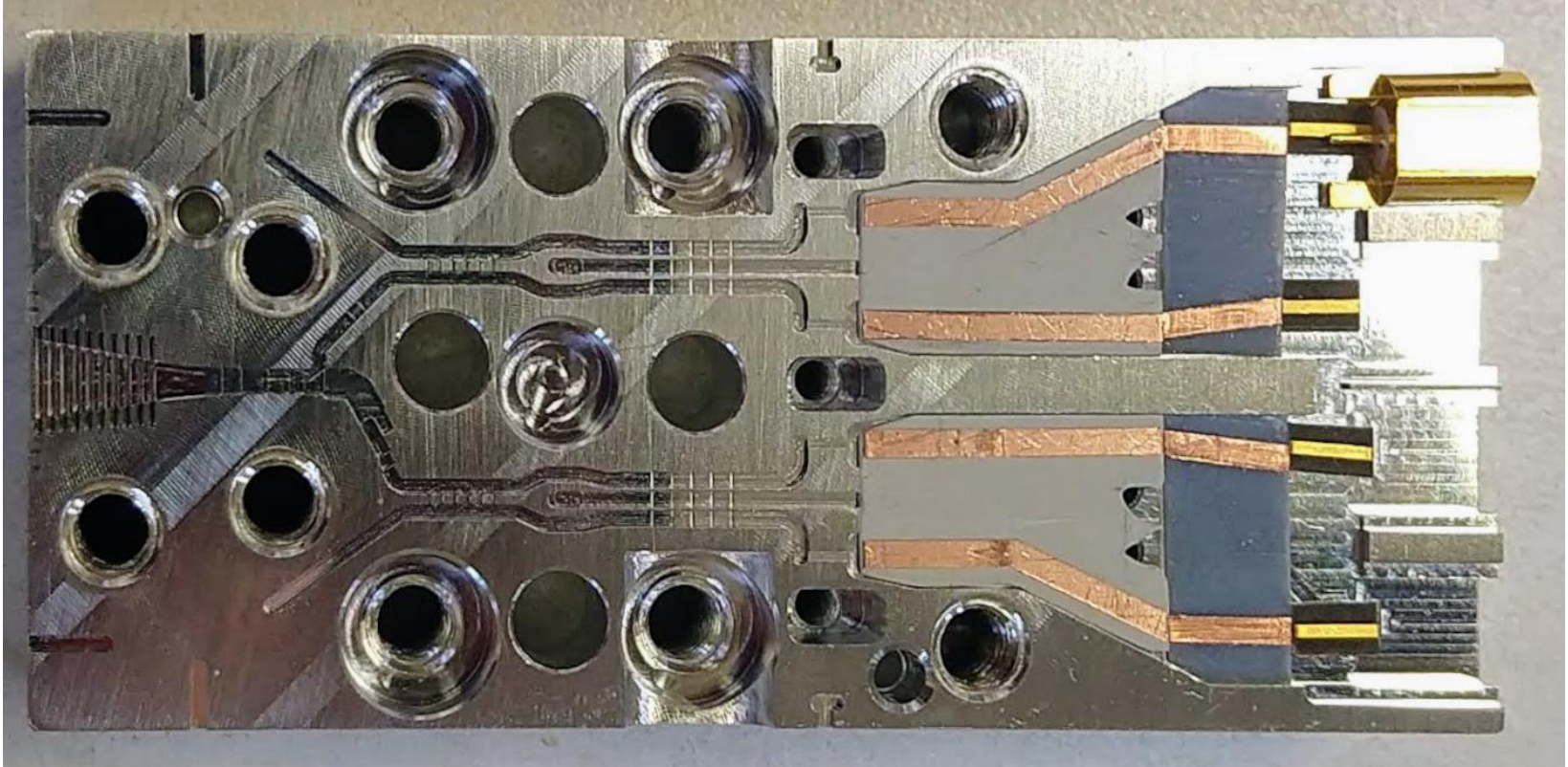


OMaYA Mixer Block Schematic



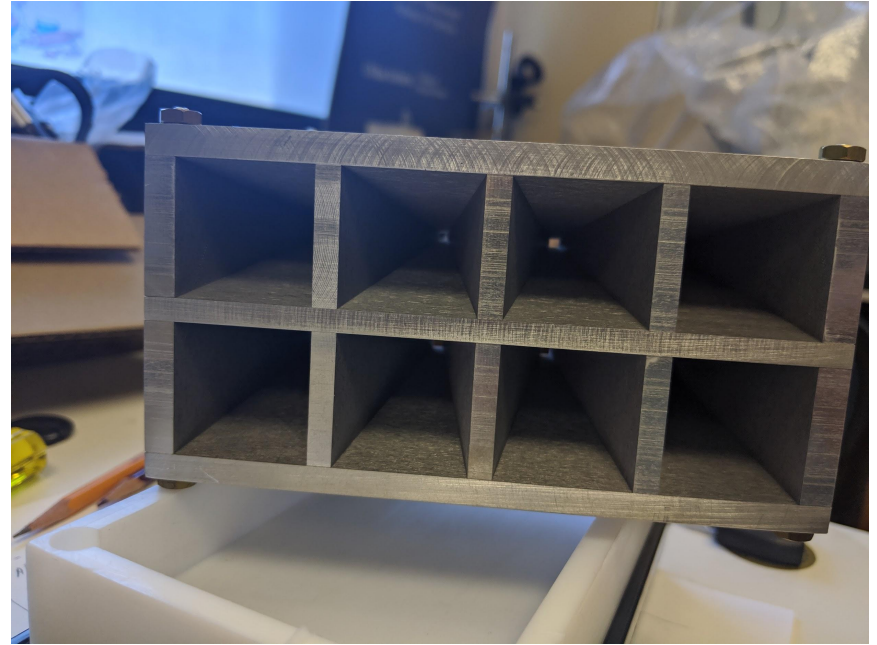
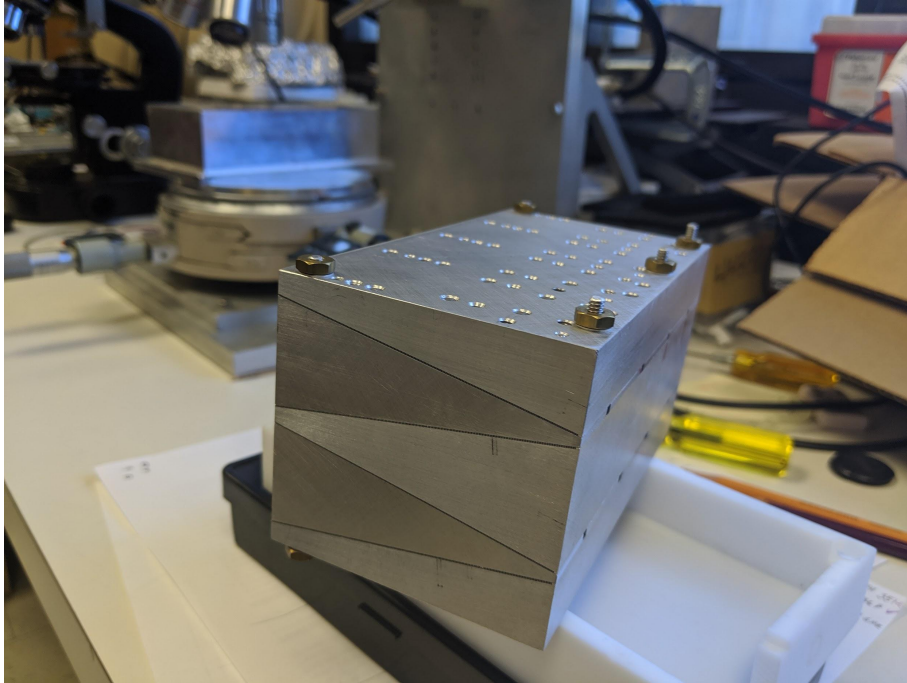
X 8

OMAyA Integrated Mixer Block



Horn Array (warm)

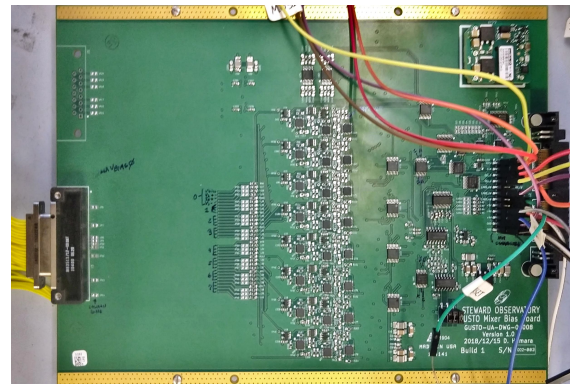
- Novel split block design for square corrugated feedhorn array



OMaYA Additional Details

- Features flexible YIG-based Phase-locked LO system that is continuously tunable across 215 - 275 GHz
- Coupled to SEQUOIA IF Processors and WARES - ROACH2 based spectrometer systems. Capable of 32 distinct IFs
- With flexible new bias system - auto-tune all mixers at every new frequency setting
- Frequency tracking of both sidebands with independent synthesizers
- Computer controlled IF Switching to easily change between SEQUOIA, MSIP1mm and OMaYA systems

New Bias Board



Data Reduction Pipeline

- **LMTSLR** - LMT Spectral Line Reduction Package - a versatile data reduction pipeline for LMT heterodyne receivers like SEQUOIA, MSIP1mm and OMAyA
- Combines RAW LMT netCDF4 spectral and telescope metadata files into final data cubes and spectra
- Final processed data elements (cubes, individual spectra) will be available in various radio astronomy standards like **FITS**, **CLASS**, etc.

Status & Timeline

- Currently assembling mixer block 1 for tests in lab
- Cryostat Design being finalized
- Bias System tested
- Lab Testing with full array and 8 mixer blocks - commence summer 2021
- Installation and commissioning late Fall 2021