Superspec: Design and Preparation for Telescope Deployment

Joseph Redford
Pete Barry, Matt Bradford, Scott Chapman, Jason Glenn, Steven Hailey-Dunsheath, Reinier Jansen, Kirit Kirkare, Henry G. LeDuc, Ryan McGeehan, Erik Shirokoff, Jordan Wheeler, Jonas Zmuidzinas

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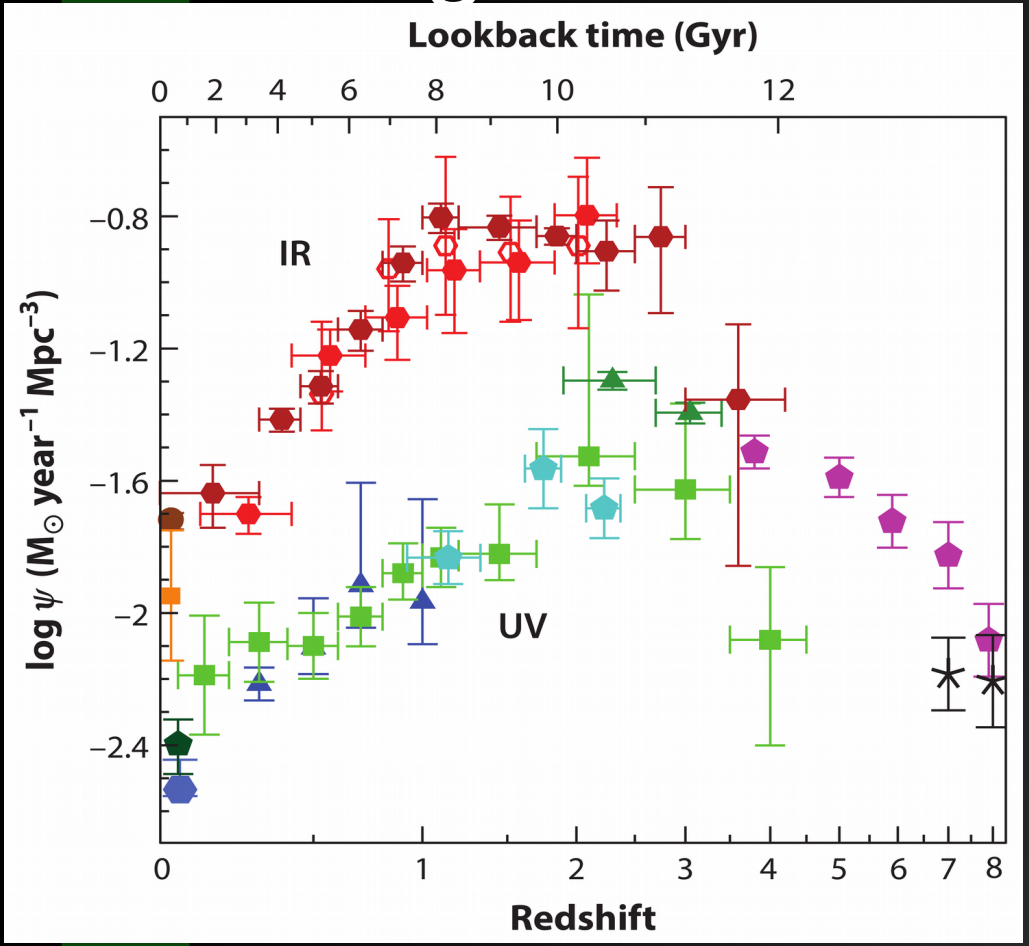
LTD-18

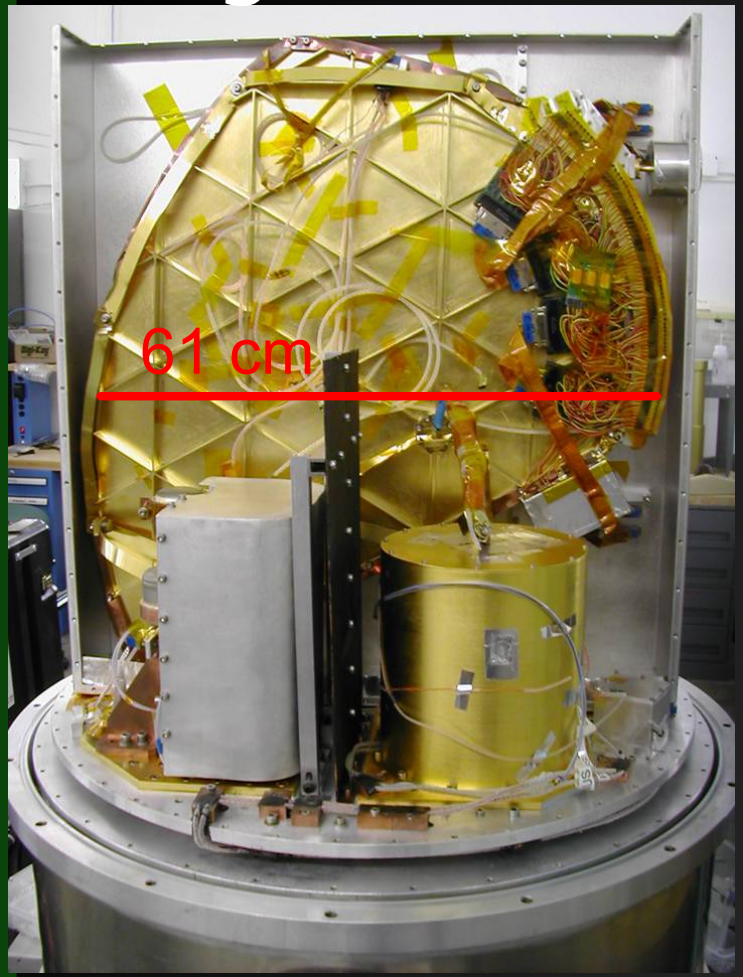
Filling In Star Formation History

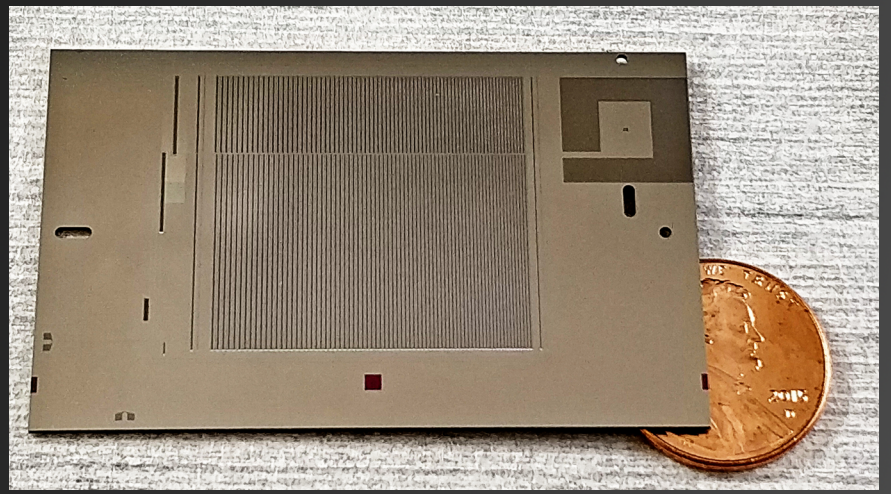


- Majority of star formation is only visible in the IR due to dust
- Star formation in the IR at high redshift is under-explored
- Star formation was gradually increasing until about 10 Gyr ago (redshift ~2) at which point it started decreasing
- With spectroscopy we can assign redshift to observed dusty star forming galaxies in the early universe
- With spectral band of 190-315 GHz, the bright C+ is observable at high redshifts (z ~5-8)

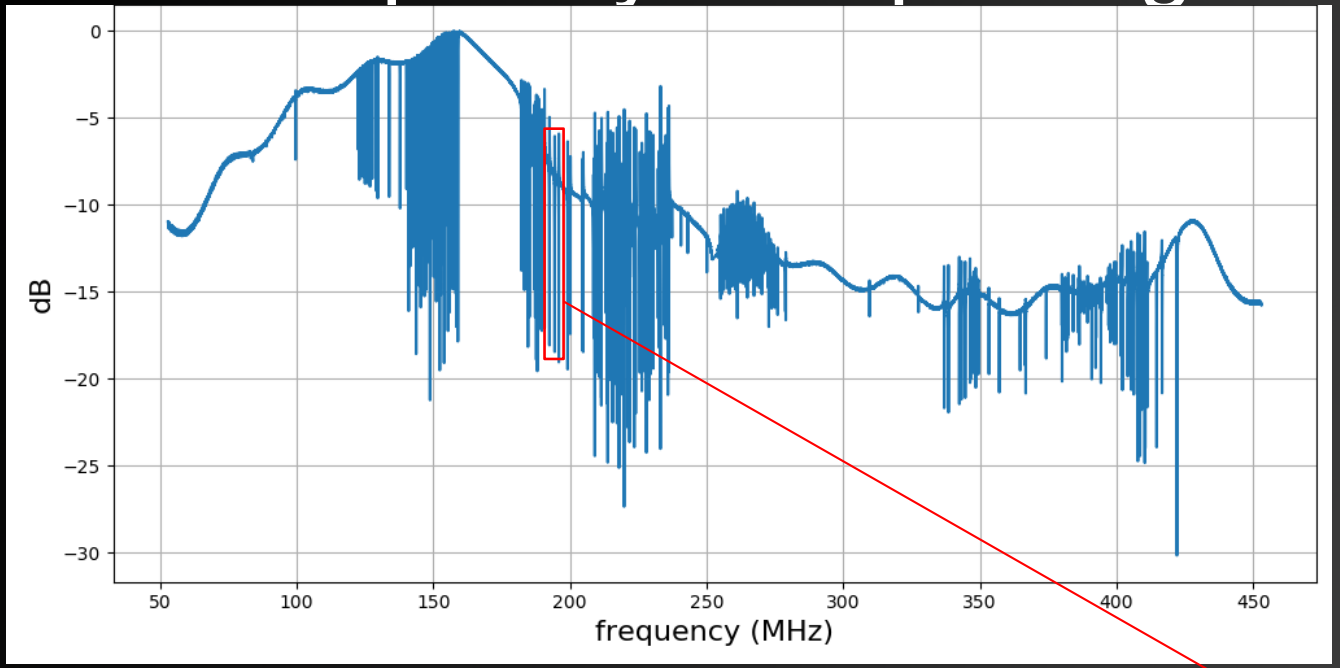
Madau & Dickinson, 2014

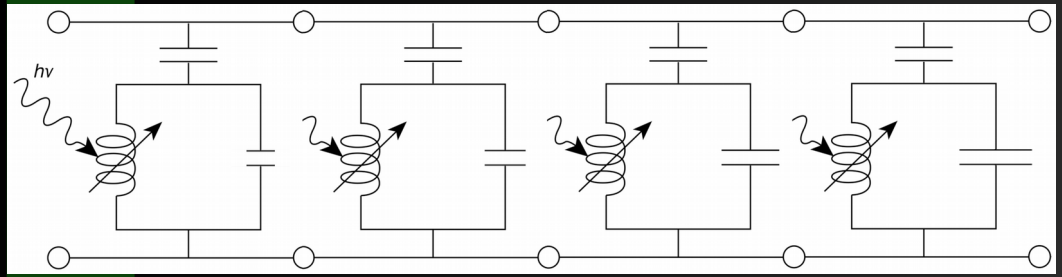
Integrated On-Chip Spectrometer

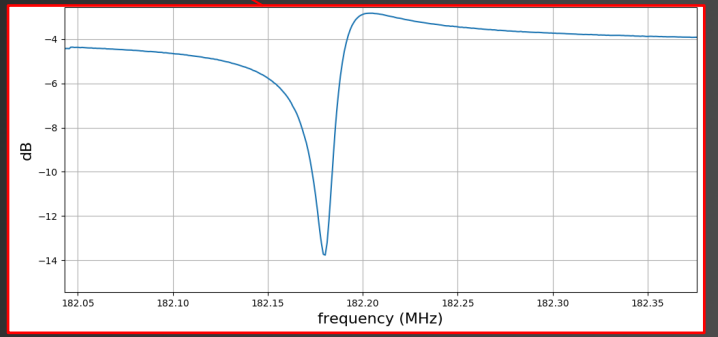




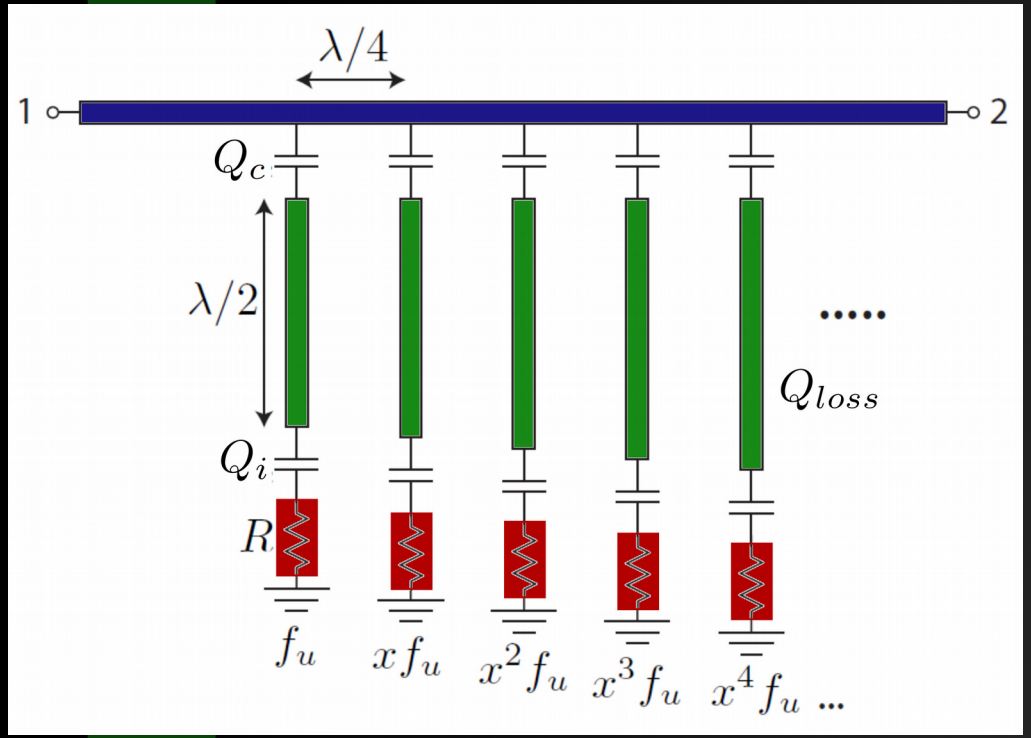
Frequency Multiplexing





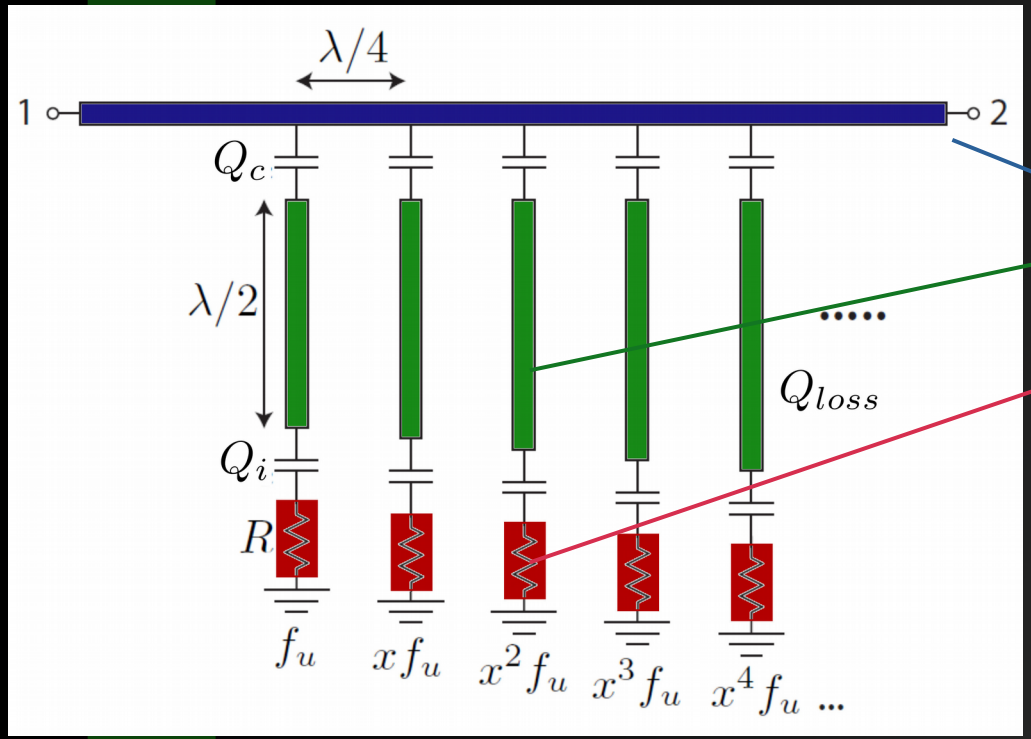


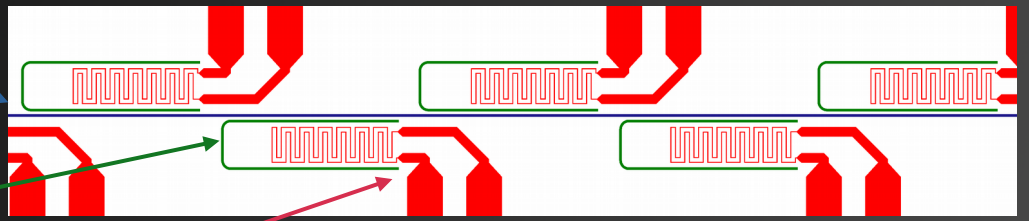
Spectral Selection

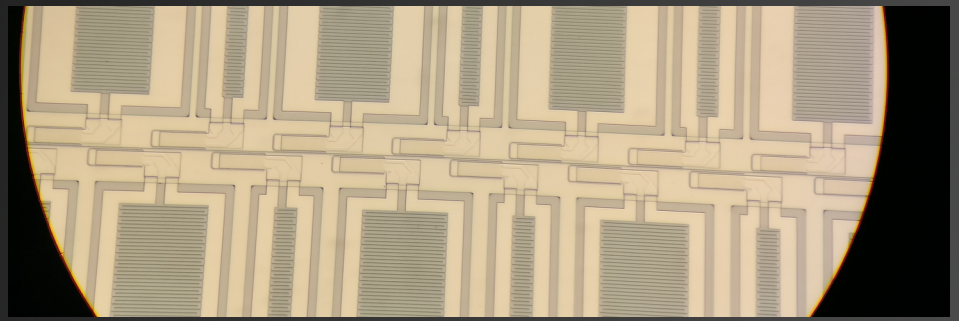


$$\frac{1}{Q} = \frac{1}{Q_c} + \frac{1}{Q_i} + \frac{1}{Q_{loss}}$$

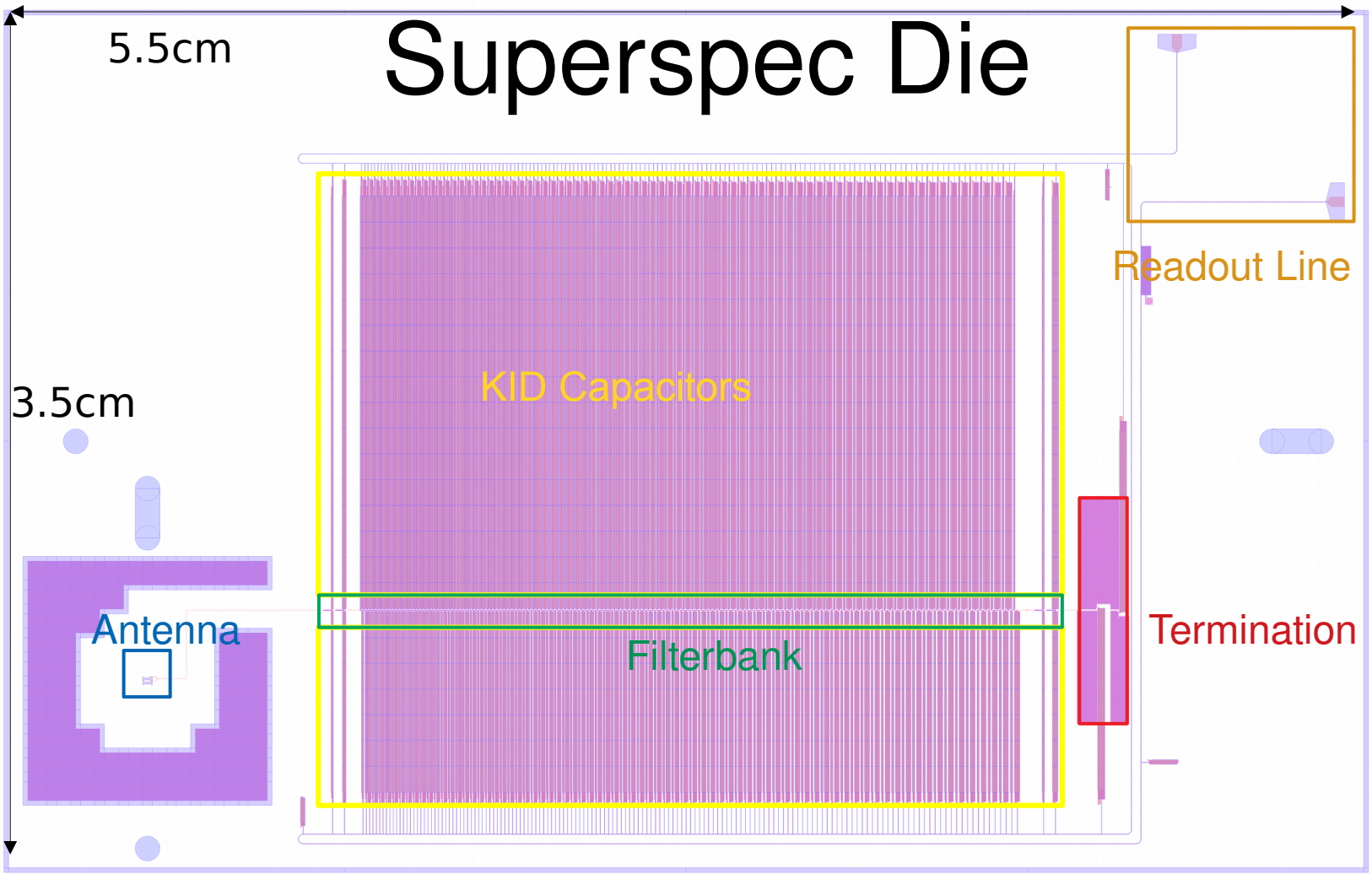
What a Filterbank Looks Like



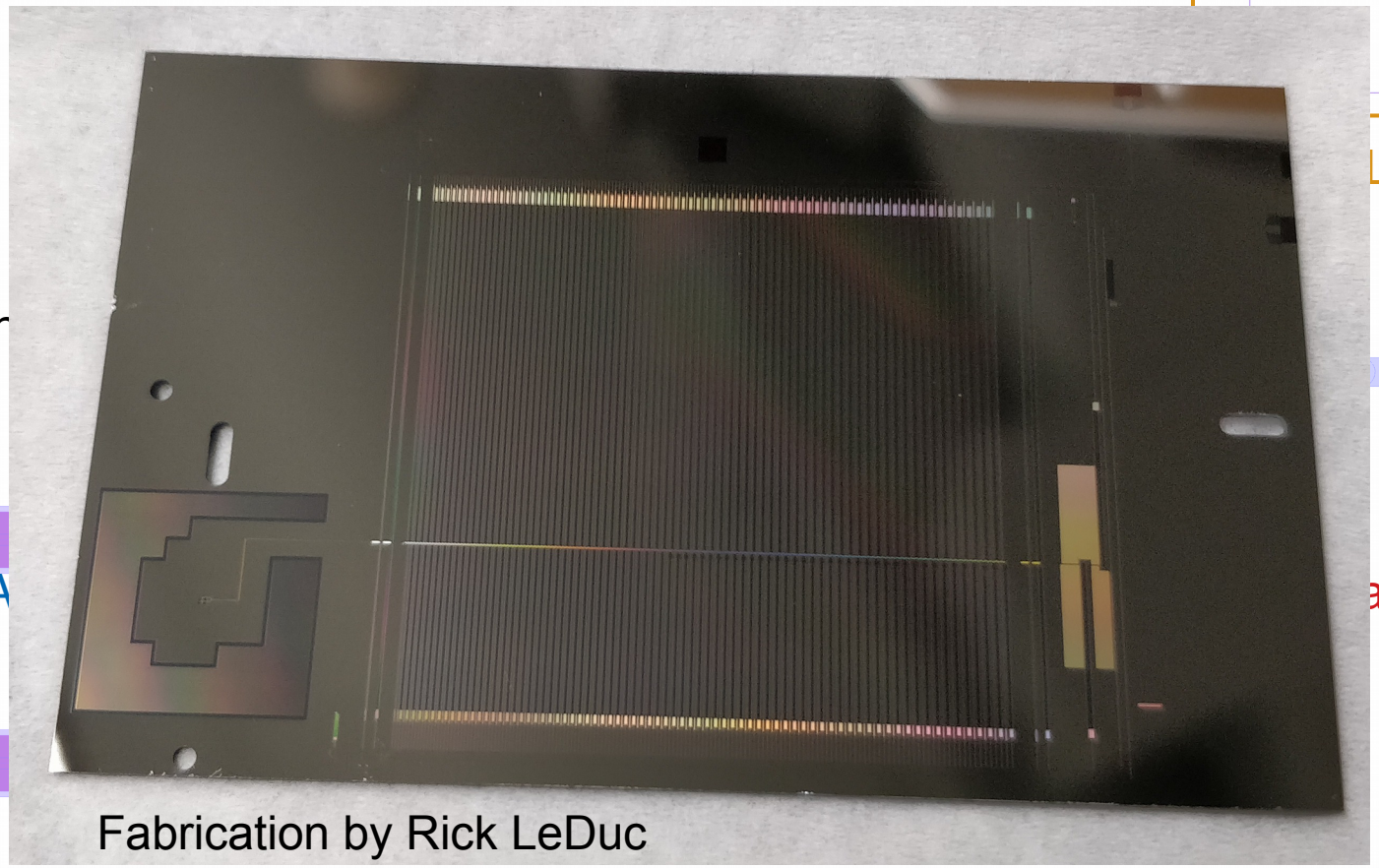




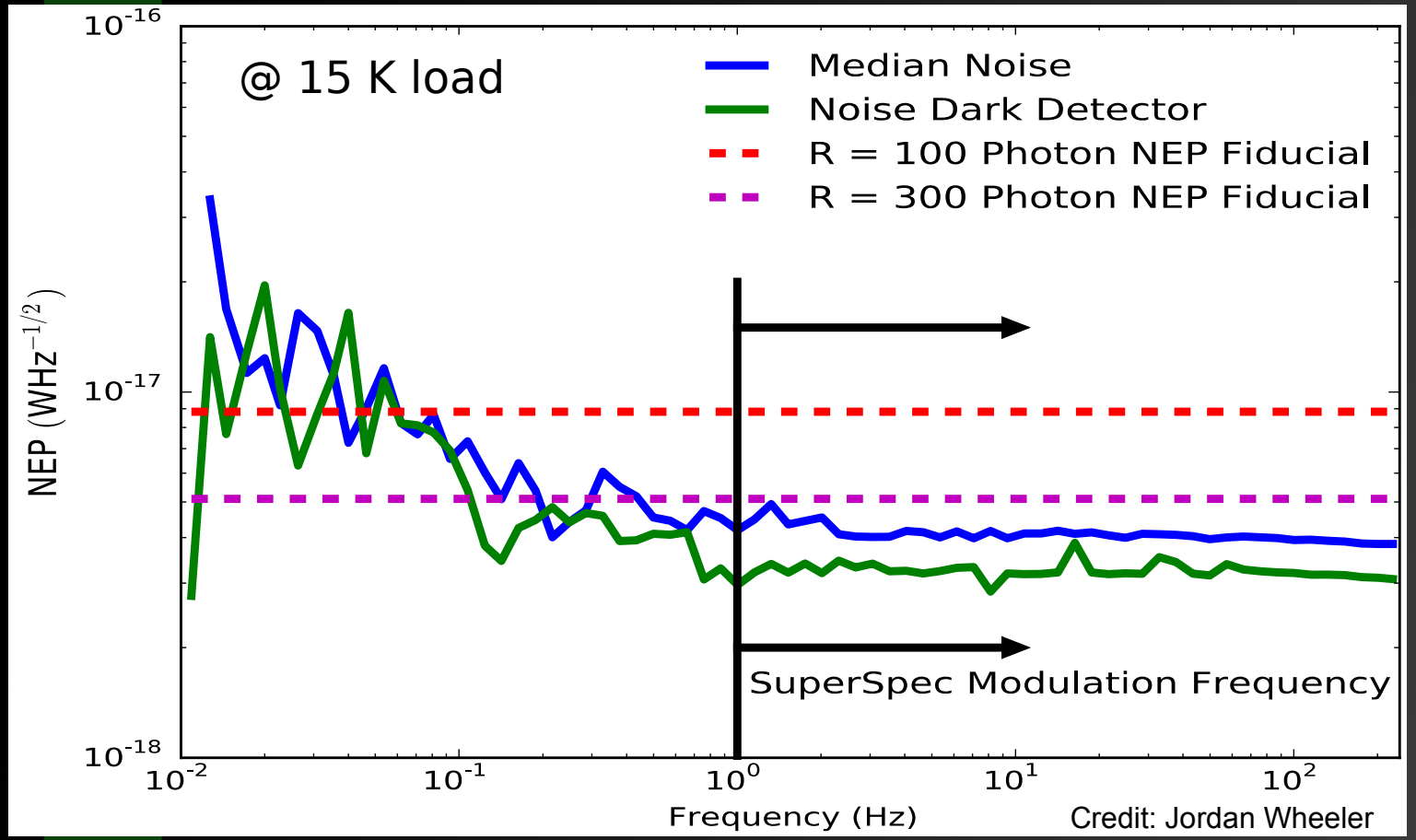
$$\frac{1}{Q} = \frac{1}{Q_c} + \frac{1}{Q_i} + \frac{1}{Q_{loss}}$$


Superspec Die
5.5cm
3.5cm
Readout Line
KID Capacitors
Antenna
Filterbank
Termination

Superspec(V11)



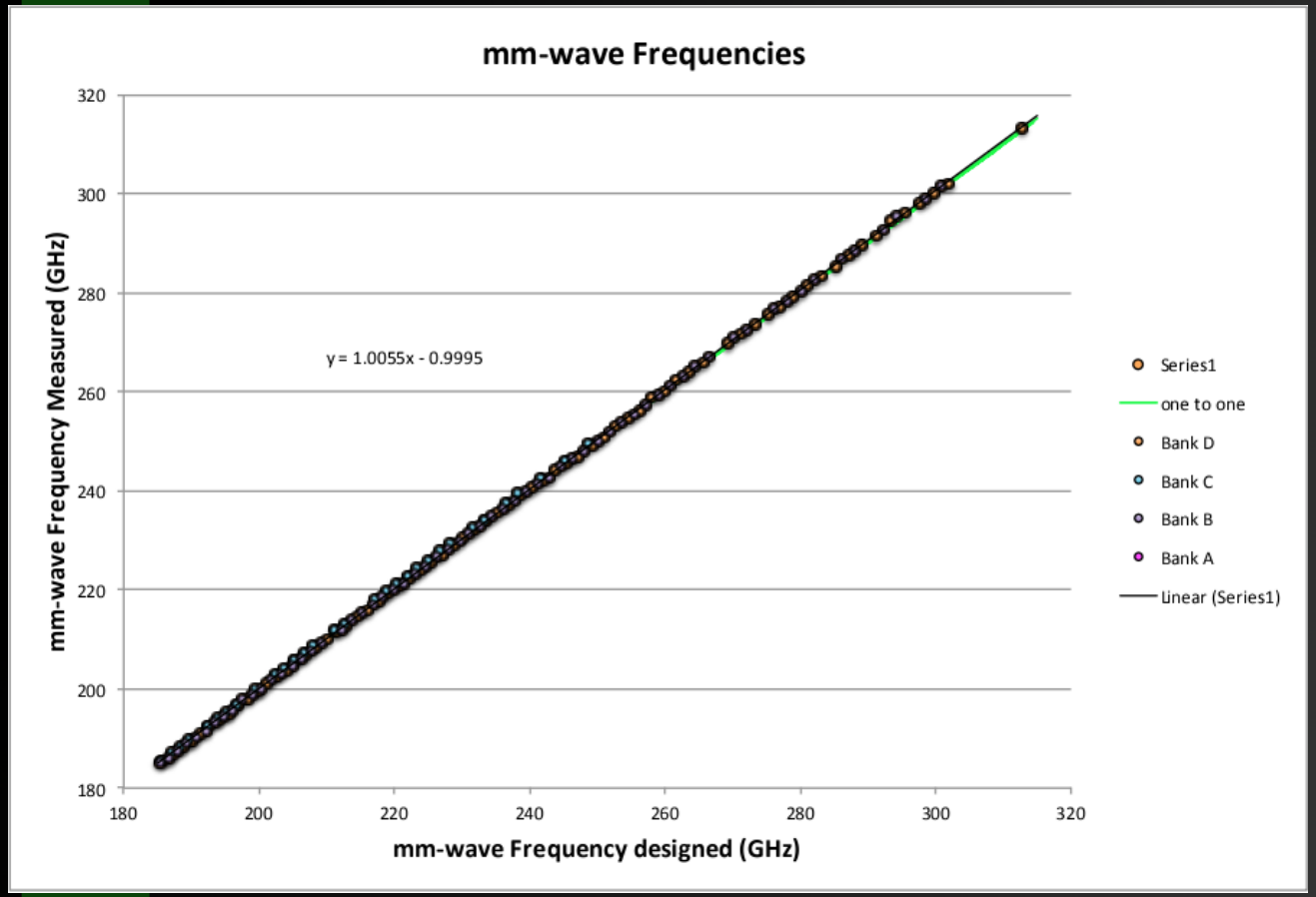
Detectors are at Background Limit



- We have achieved the required sensitivity to be photon noise limited at the LMT
- 2.6 μm^3 inductor volume
- TiN inductors

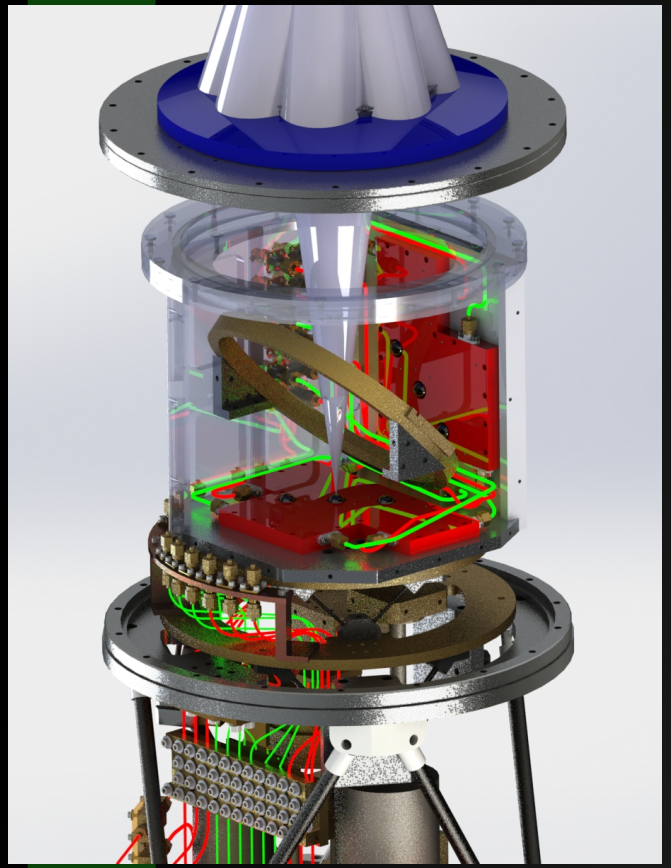
For more details on device noise, see Jordan Wheeler's poster (40-219)

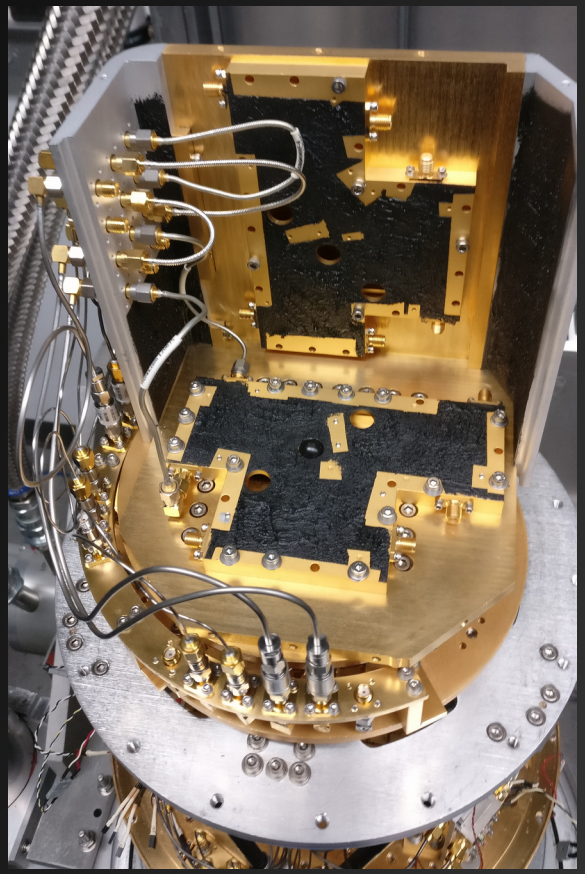
Filterbank Targeting

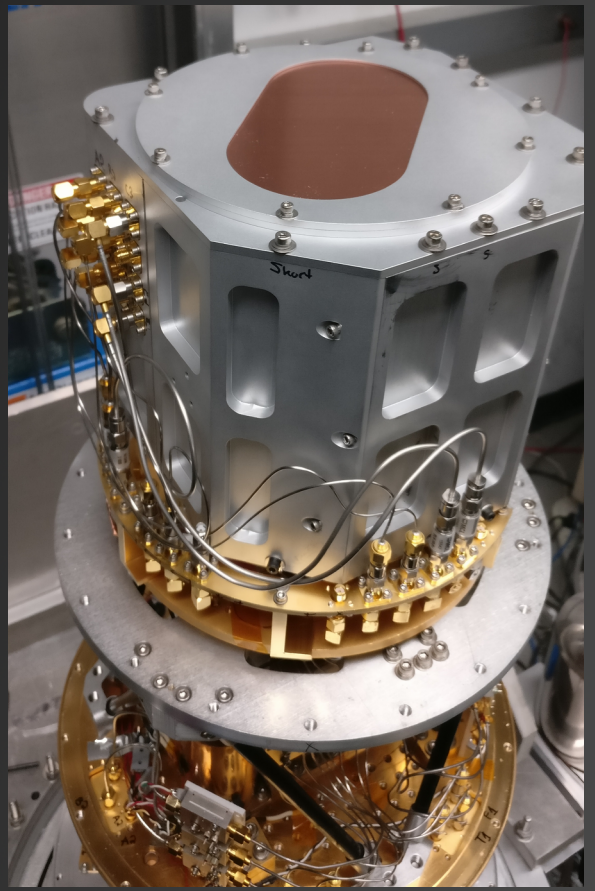


- We have now demonstrated an ability to produce the resonators at the design frequency over the full range of frequencies

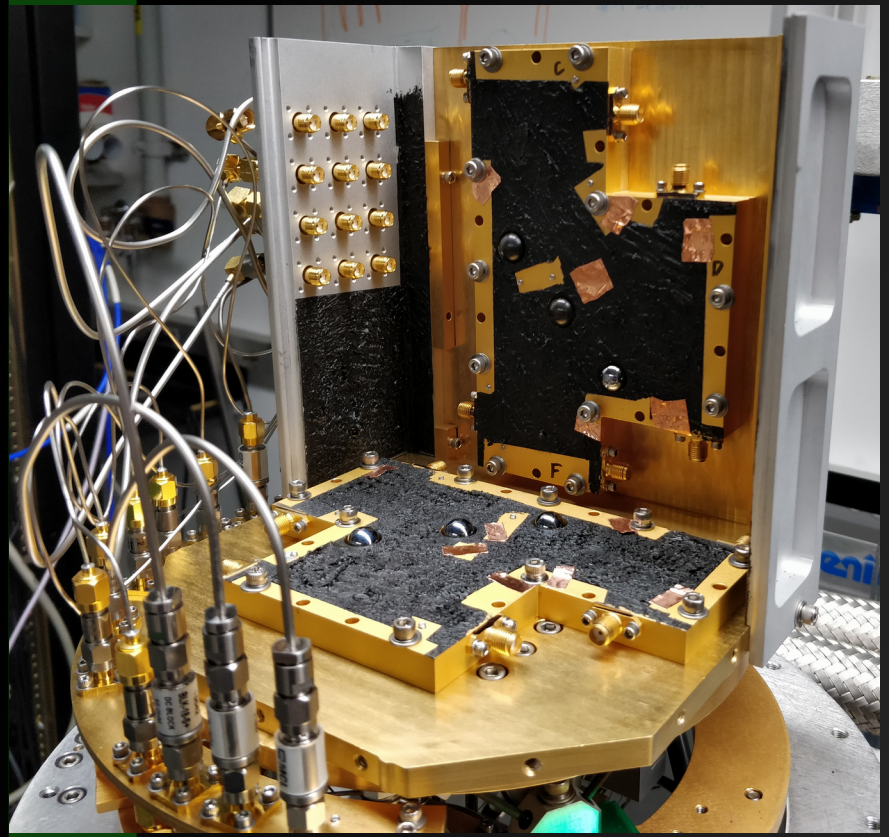
Device Mounting, 3 pixels dual-polarization

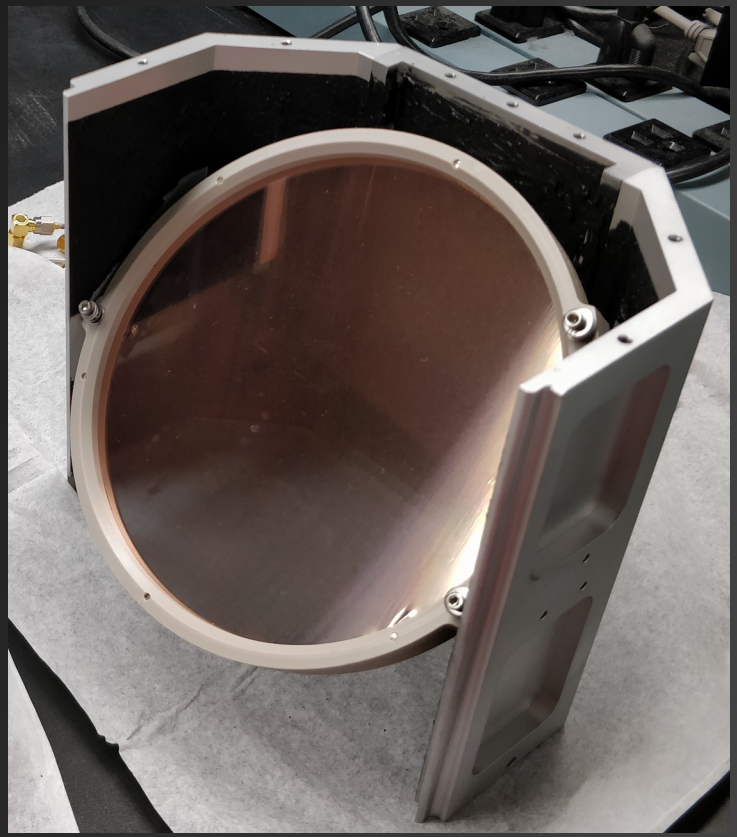




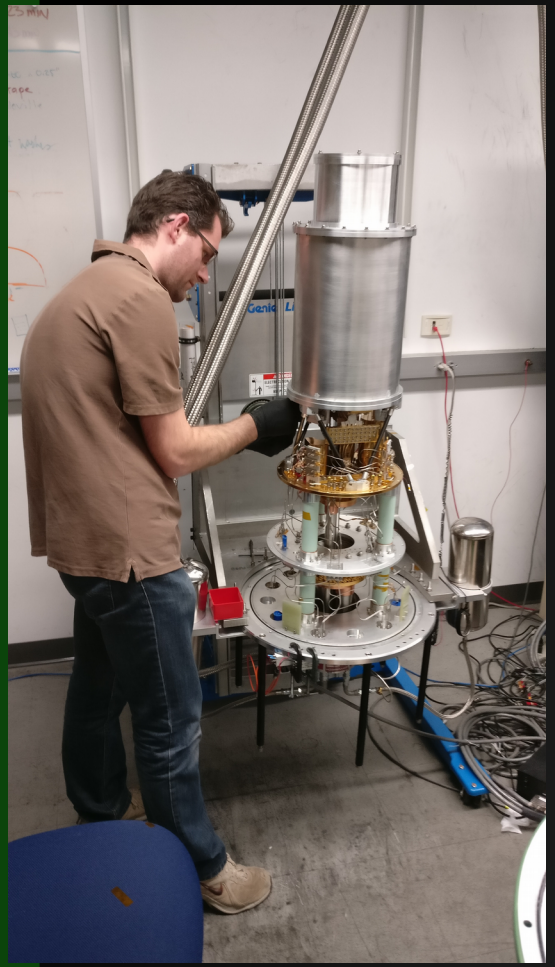


Polarizing Grid



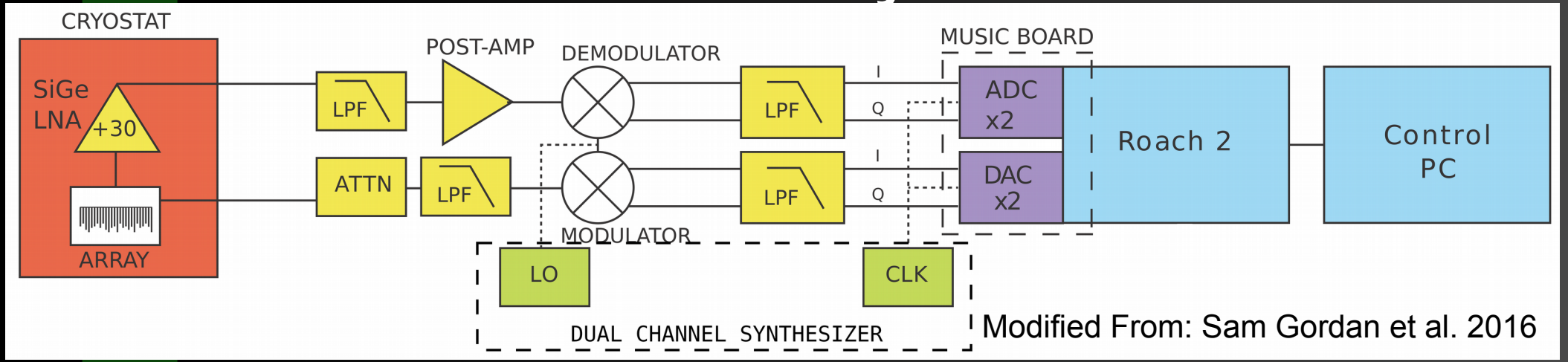


Full Cryostat



- 3 stage He10 sorption cooling system
- Can cool devices below 220mK

Readout System



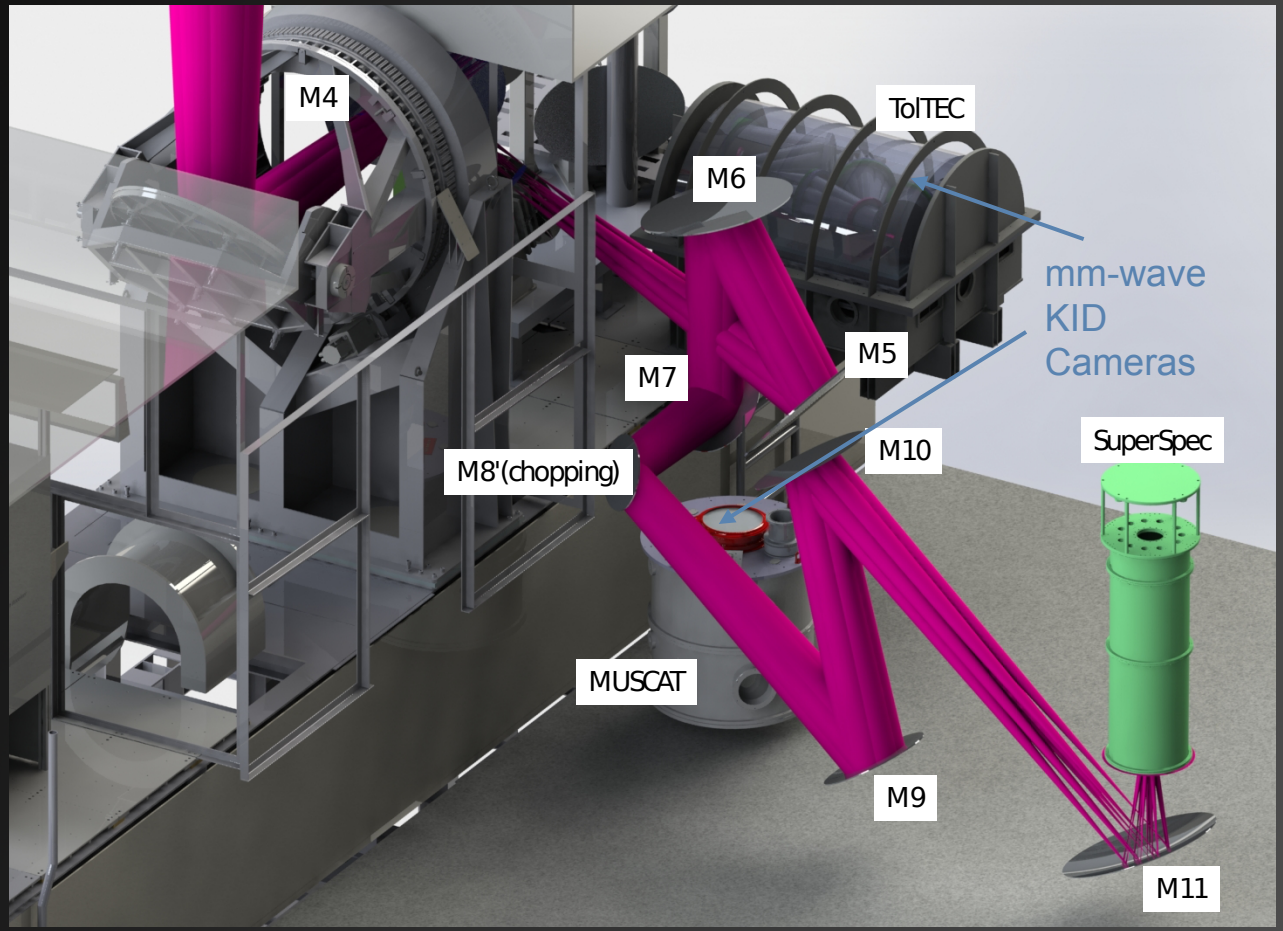
- Using a ROACH2 multitone readout system similar to BLAST-TNG and using the same FPGA firmware
- Wait for the next talk for more details

Deployment at the Large Millimeter Telescope

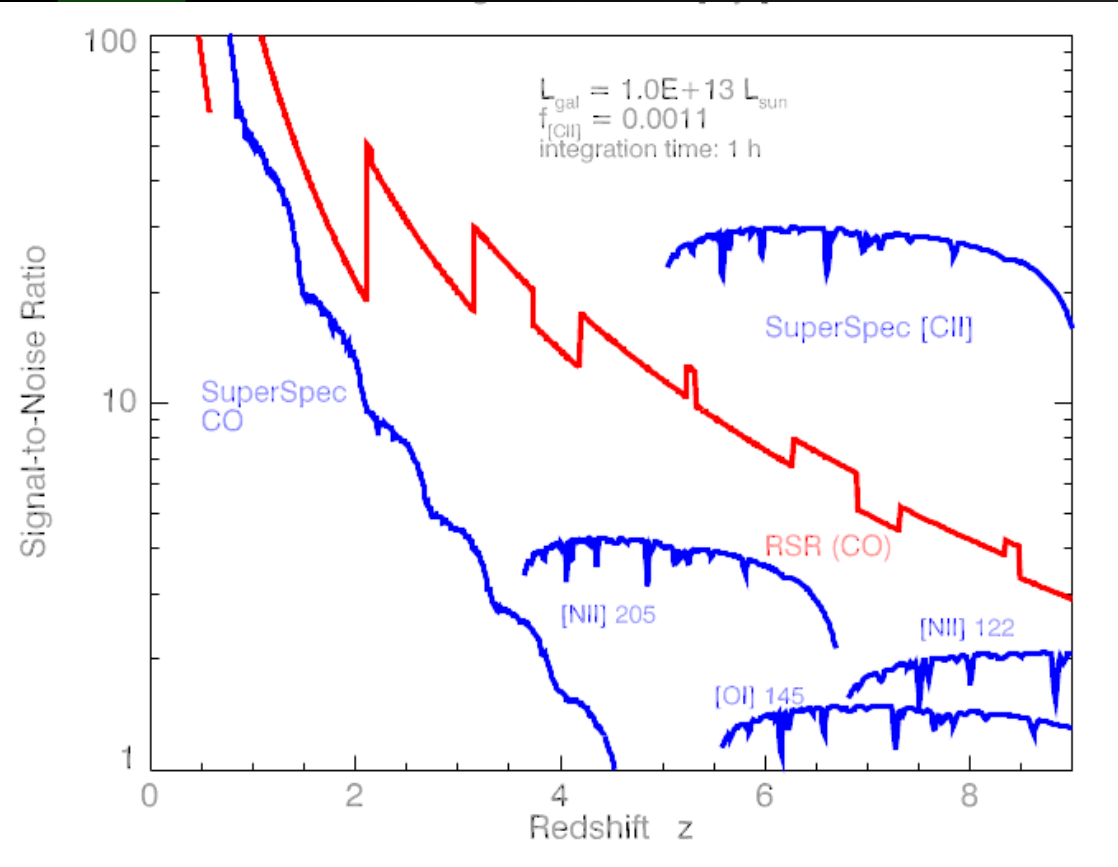
- SuperSpec will have an engineering demonstration at the LMT on Sierra Negra in Puebla, Mexico this fall
- 50 meter primary mirror
- 4600m elevation

Optics at the LMT

- Will use a pickoff mirror (M7) to share optics path with MUSCAT
- Will have a chopping mirror switching between the three beams, so should have a beam on source majority of the time. (~80%)



Expected On-Sky Sensitivity



- Assumes 10% emissivity, 260K atmosphere
- Chopping between multiple beams
- Background limited detectors

The SuperSpec Team

Caltech/JPL
C. M. Bradford
M. Alonso
S. Hailey-Dunsheath
R. Janssen
H. G. LeDuc
J. Redford
J. Zmuidzinas

University of Chicago
E. Shirokoff
P. Barry
K. Karkare
R. McGeehan

Arizona State University
P. Mauskopf
G. Che
S. Gordon
E. Lunde

University of Colorado/NIST
J. Glenn
C. McKenney
J. Wheeler

Dalhousie University
S. Chapman
K. Halaseh
C. Ross

Cardiff University
S. Doyle
C. E. Tucker

Conclusions

- Will Deploy at the LMT later this year
- Cryostat fully upgraded
- We have a design for a full band R ~ 300 chip for observing
- Screening for best SuperSpec chips for observing
- Mirrors currently in fabrication