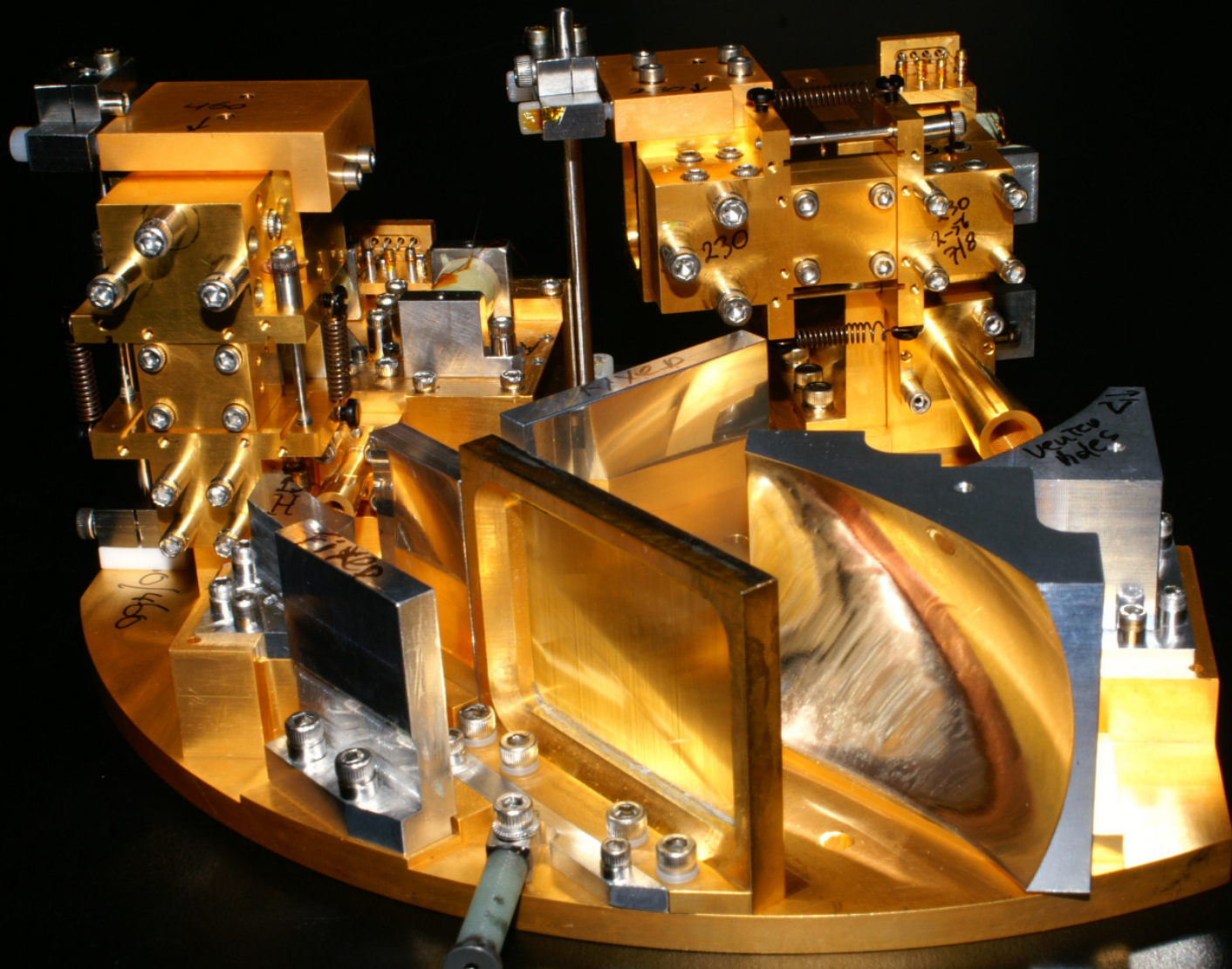


230/460 Dual Color Receiver 'first light' Performance

22 Feb 2012

J. W. Kooi, R. A. Chamberlin



Some Notes

- This is the first fully synthesized/automated data set. Based on these results Richard/myself are fine tuning/updating the data acquisition software to:
 - Auto tune the magnets at each frequency setting
 - Servo Isis rather than Vd
- There is NO evidence of excess LO noise or major spurs in the synthesized LO.
- IF passband 4-8 GHz.
- LHe Boil off is 0.9-1.0 liter/day (5.5-6 day hold time).
- Only asymmetric bias had been investigated so far.

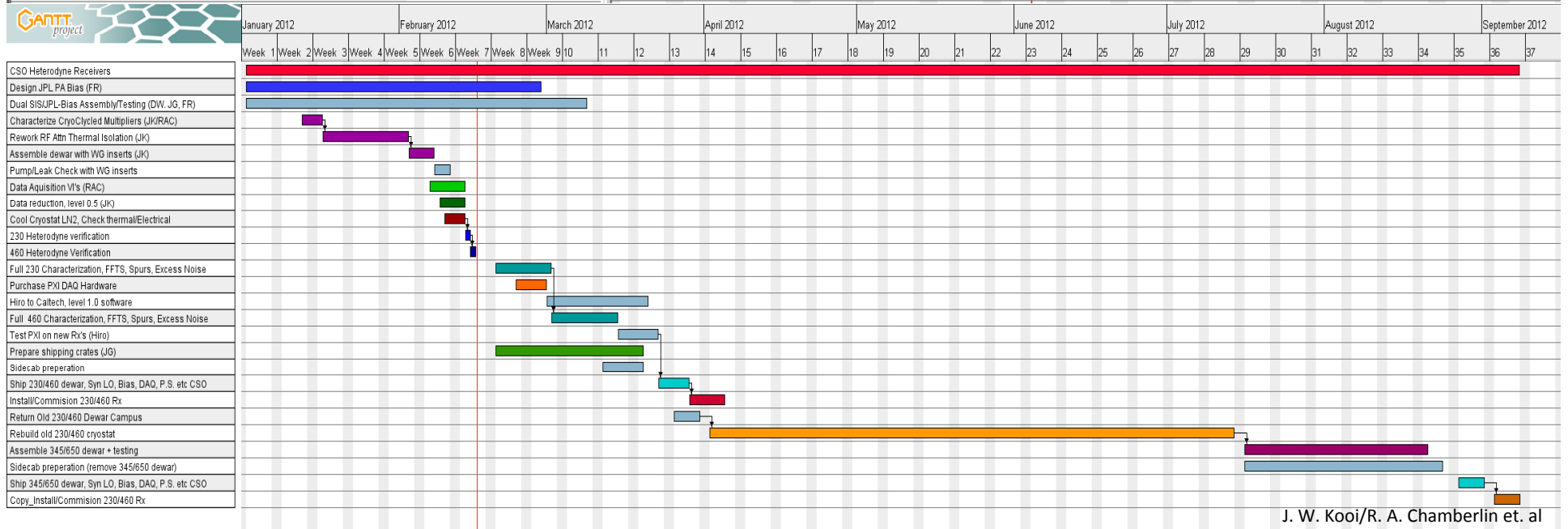
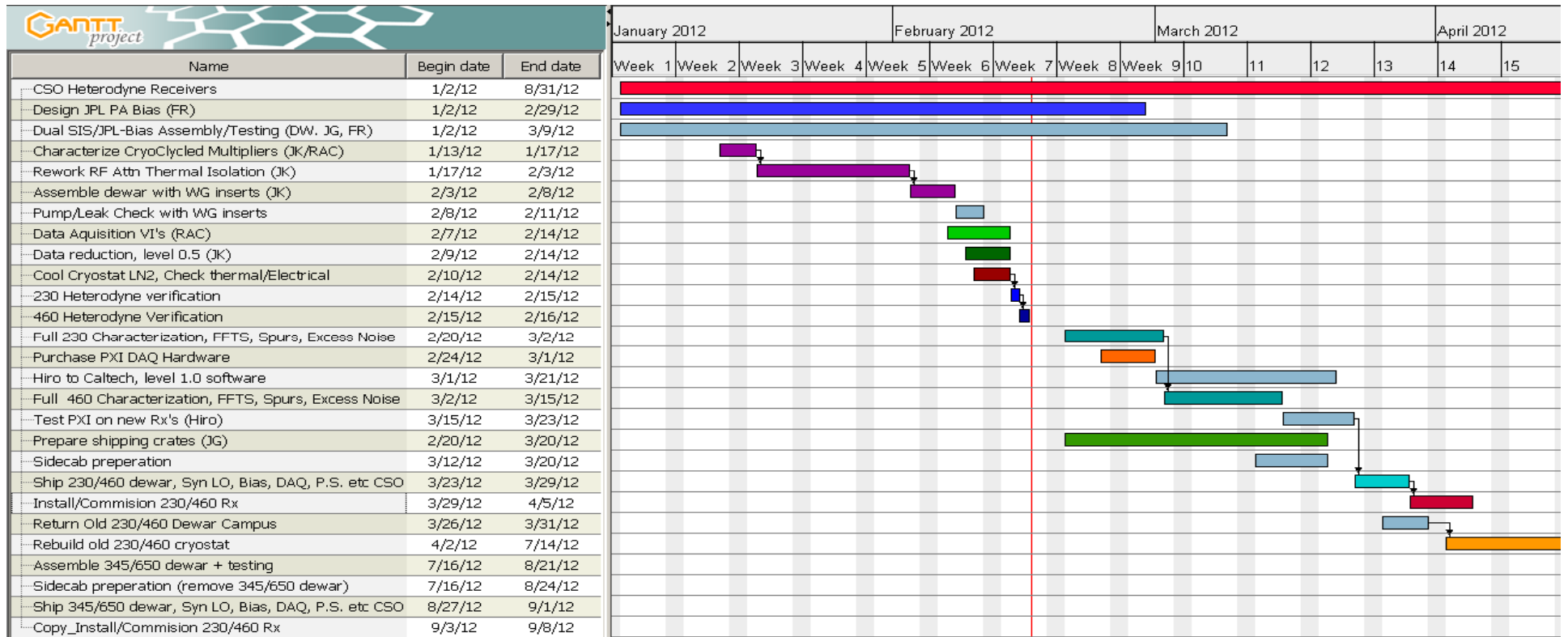
To still be characterized/understood:

- Receiver performance as a function of non-symmetric bias. Some performance gain may be expected still as the individual LO pumping of the SIS mixers is quite asymmetric.
- Effect of magnet tuning (There is evidence of Josephson mixing with 2nd/3rd LO harmonics)
- Spur characterization (FFTS)
- AM/spur rejection reduction properties (FFTS)
- Allan variance *FFTS)
- Beam co-alignment measurements?

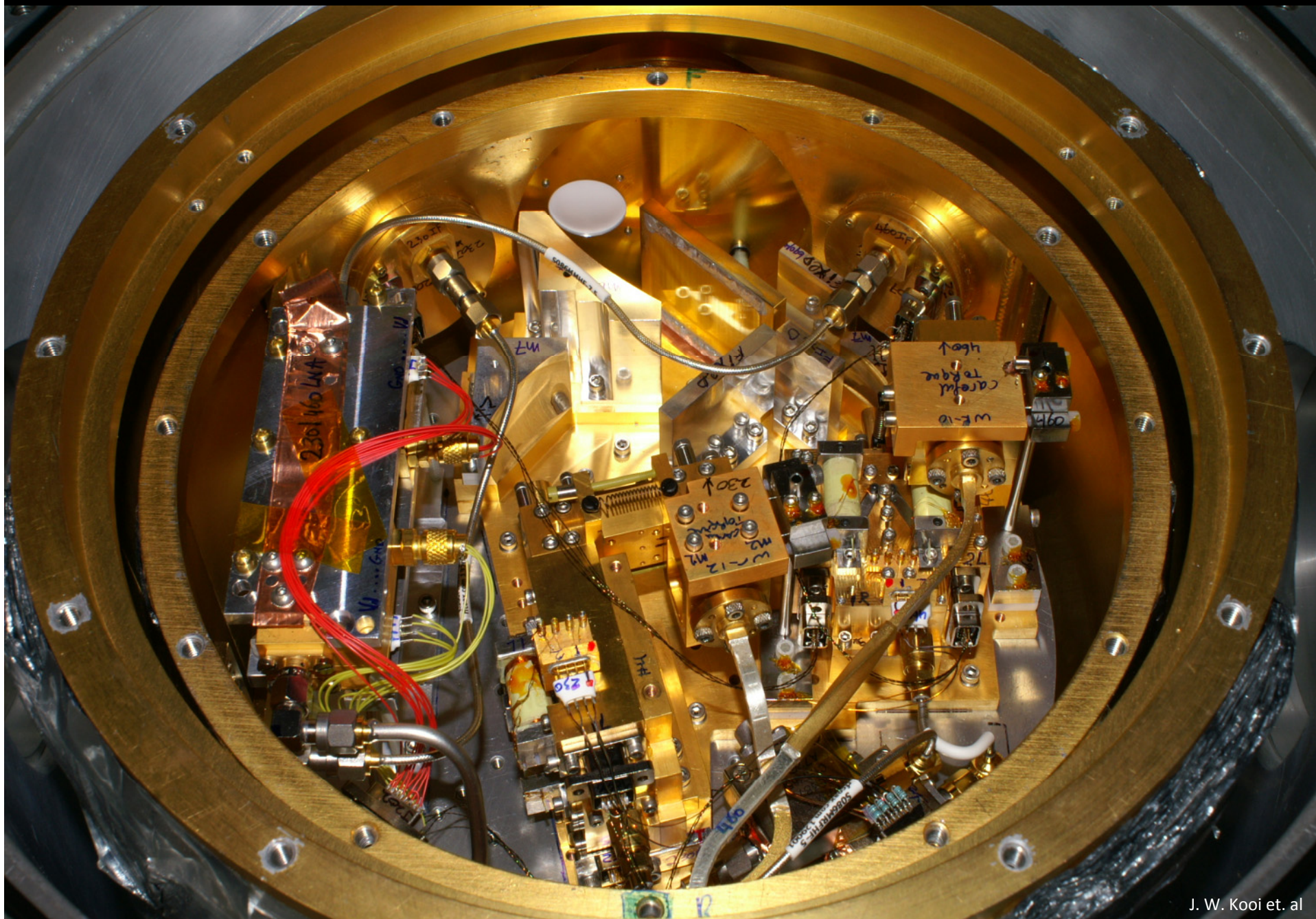
Schedule: See slide 3.

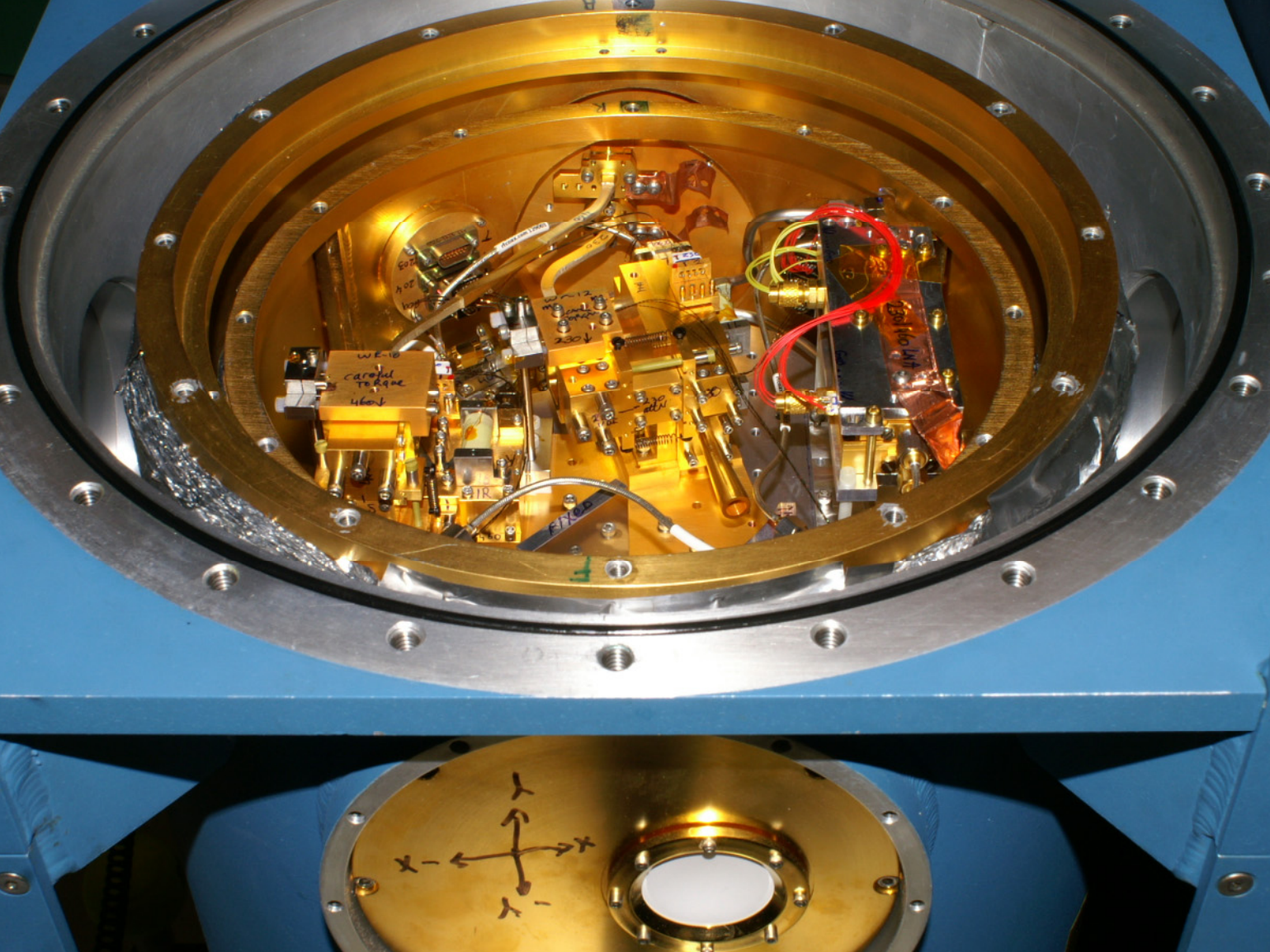
Critical path items:

- Finish design/assembly/testing of JPL PA bias box. 254 step digital Pot (FR)
- Hiro to come to Caltech ~ 01 March to:
 - 1) Setup dual boot computer
 - 2) Start programming the PXI crate and bias hardware (black boxes) with dummy loads.
Software layout has been provided.
 - 3) Be ready to try software on Rx's 2nd week March



230/460 Cryostat Bottom View

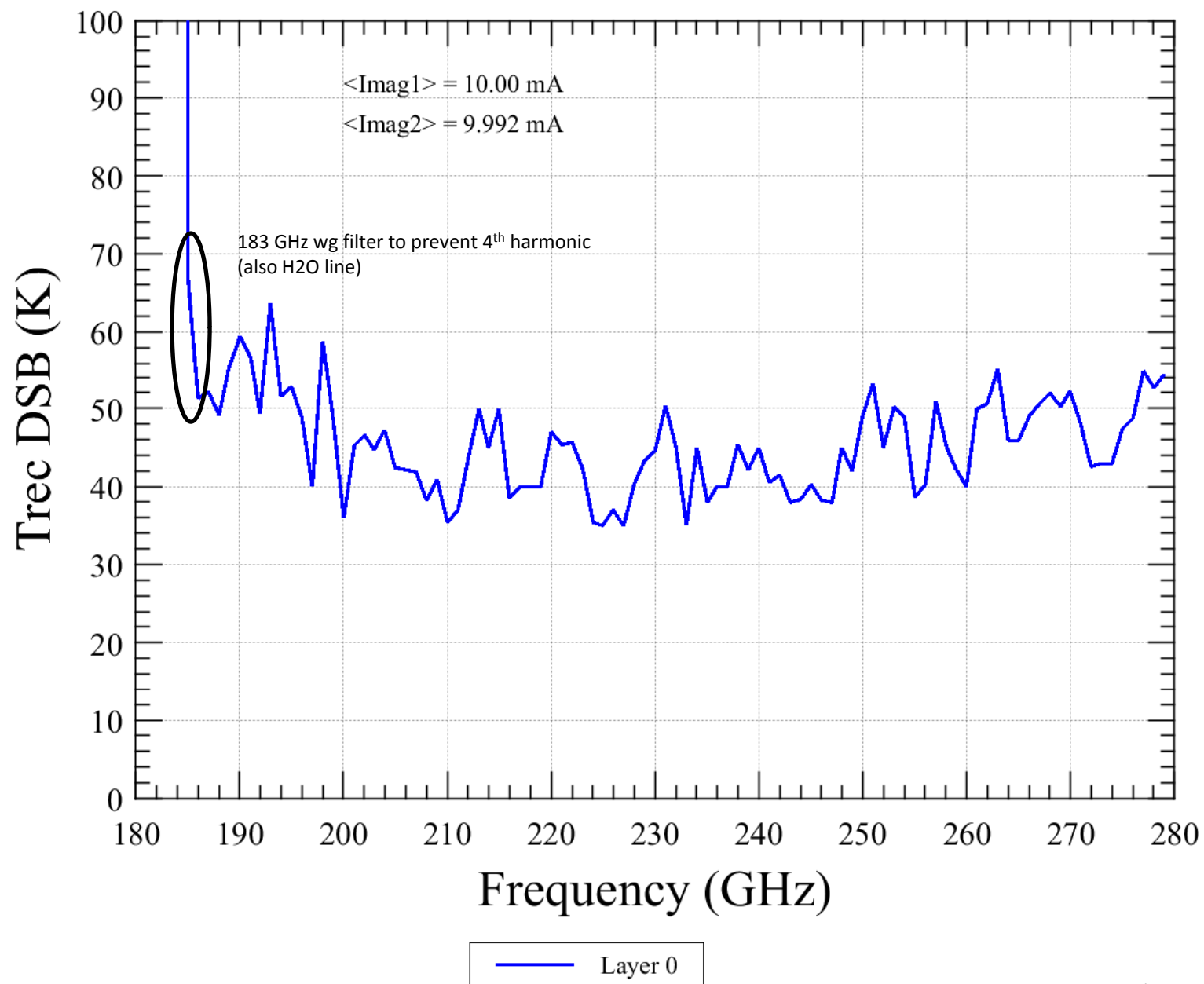




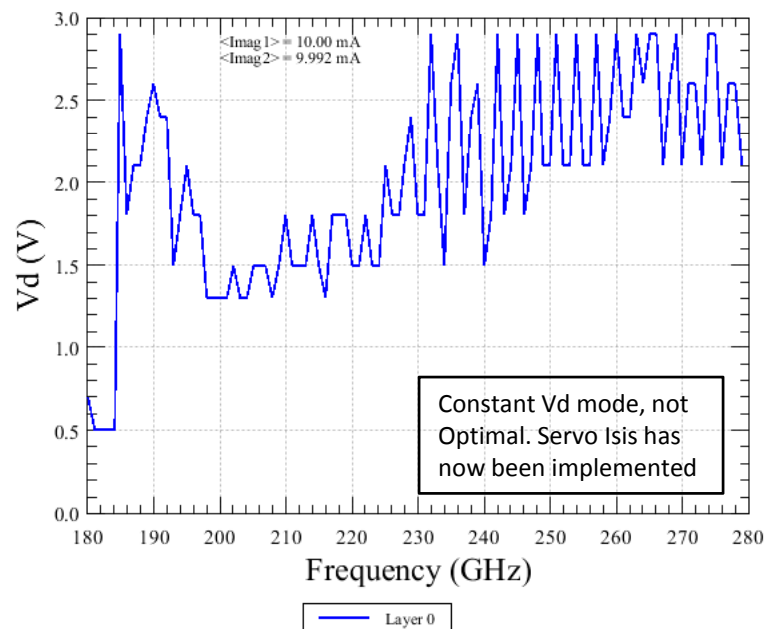
230/460 Cryostat Front View

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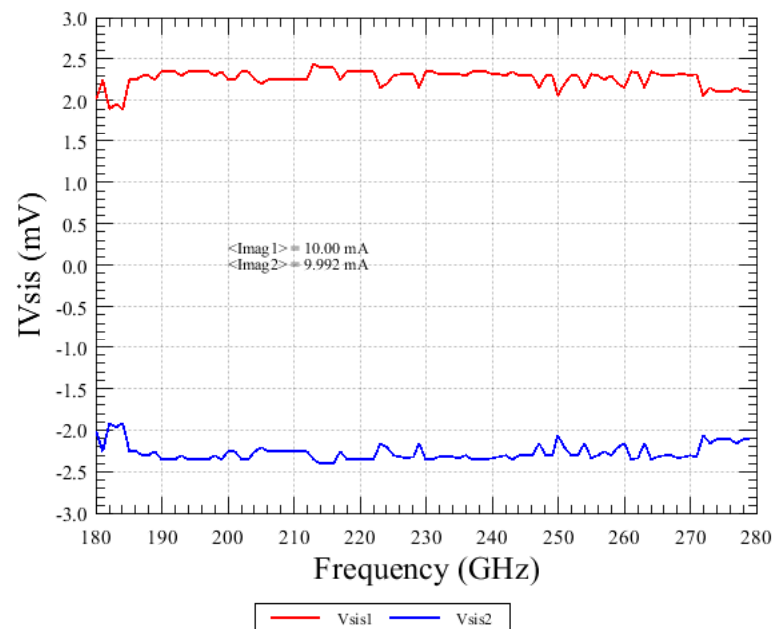
230 Balanced Receiver Sensitivity



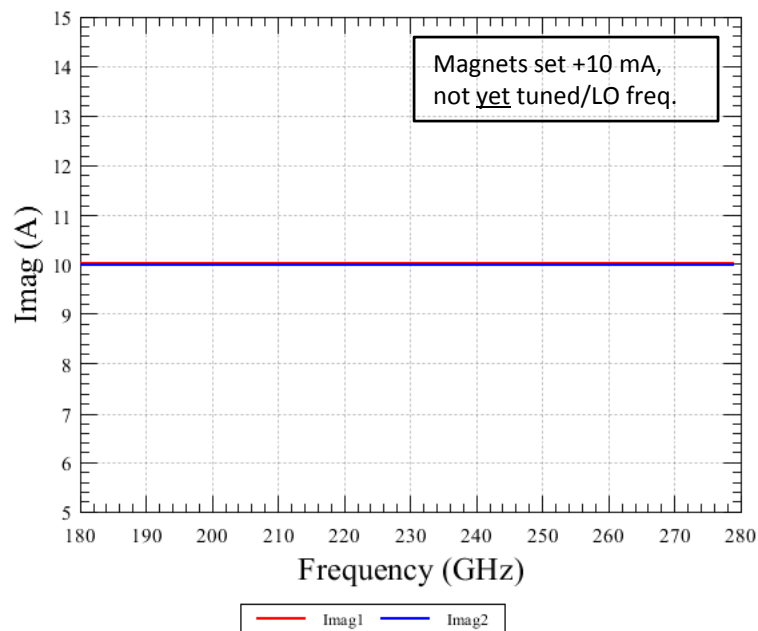
230 JPL Balanced P.A. Drain Voltage Range



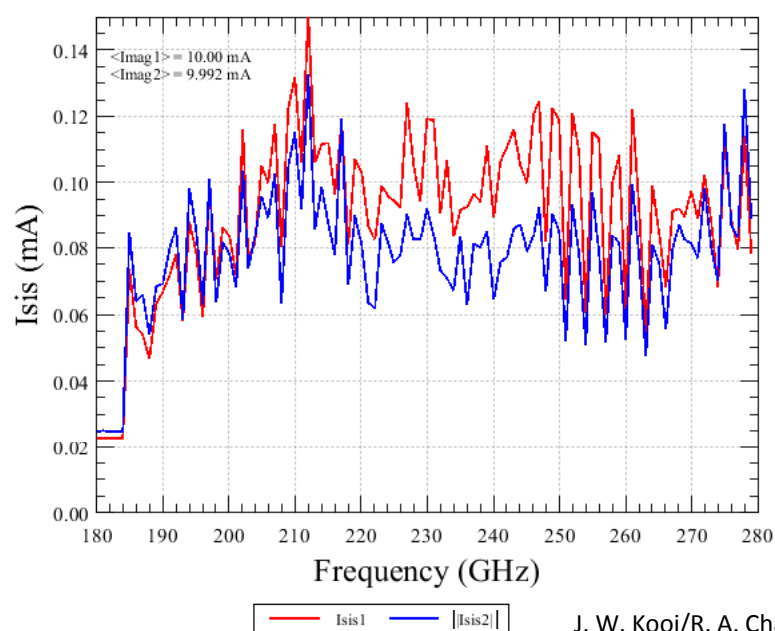
230 Balanced Receiver SIS bias Voltage



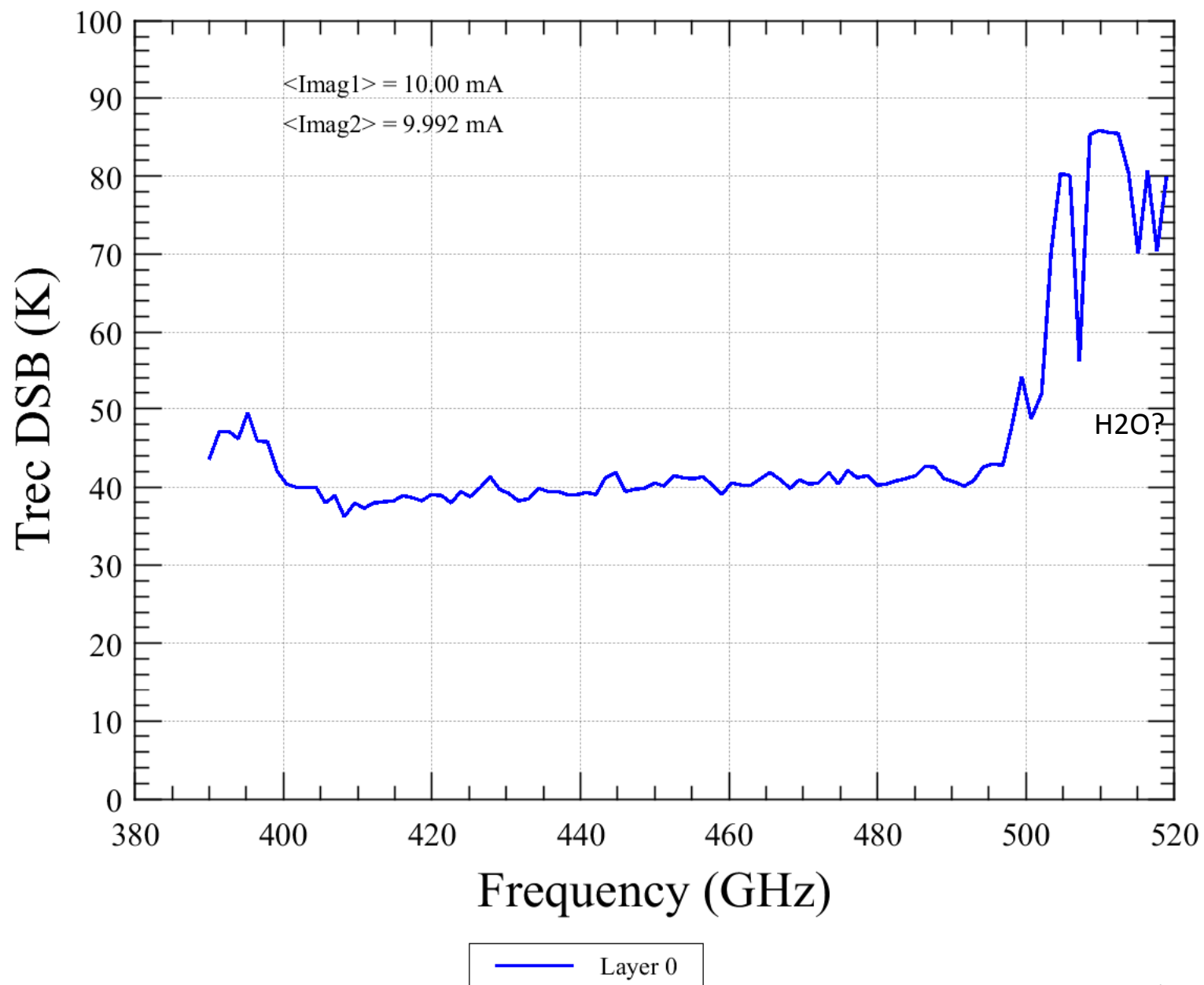
230 Balanced Receiver Magnet Current



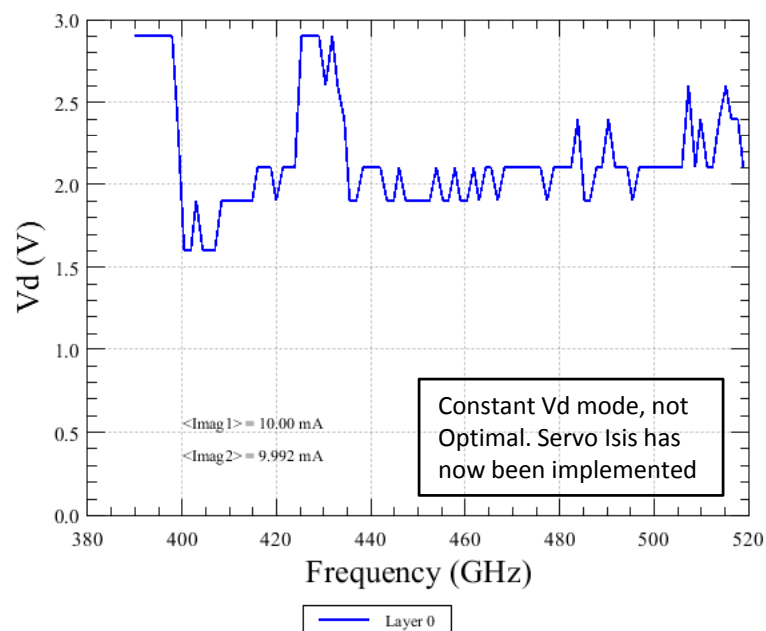
230 Balanced Receiver SIS bias current



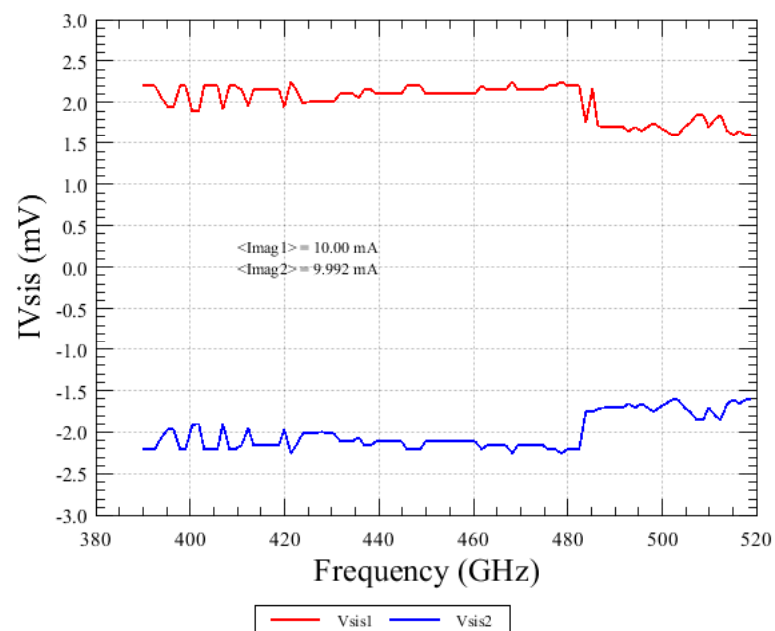
460 Balanced Receiver Sensitivity



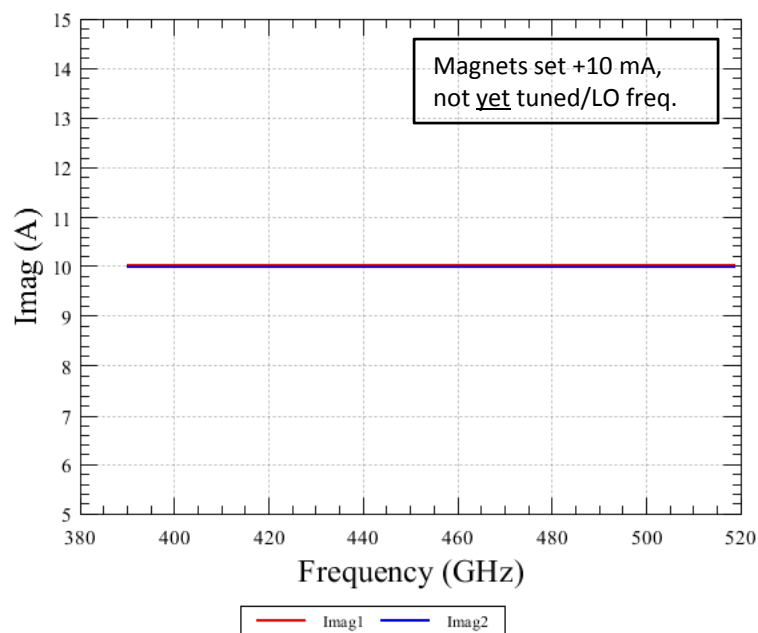
460 JPL Balanced P.A. Drain Voltage range



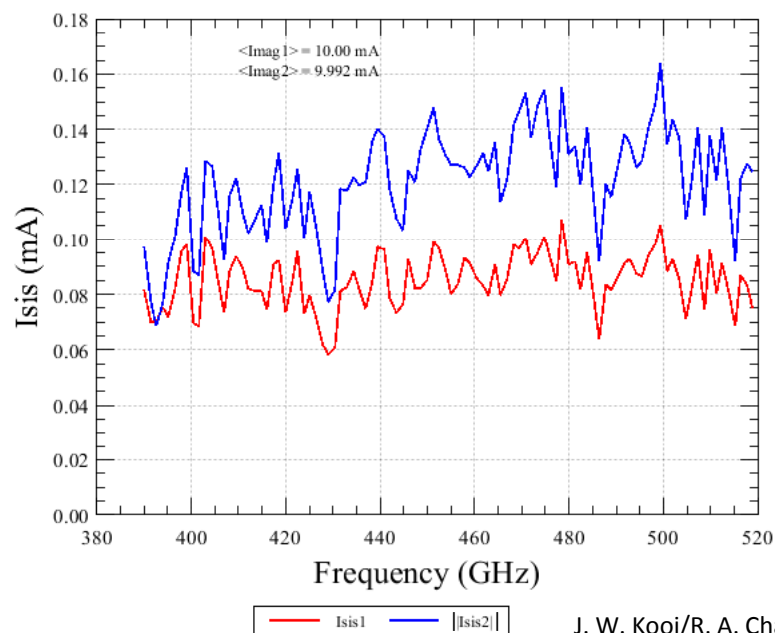
460 Balanced Receiver SIS bias Voltage



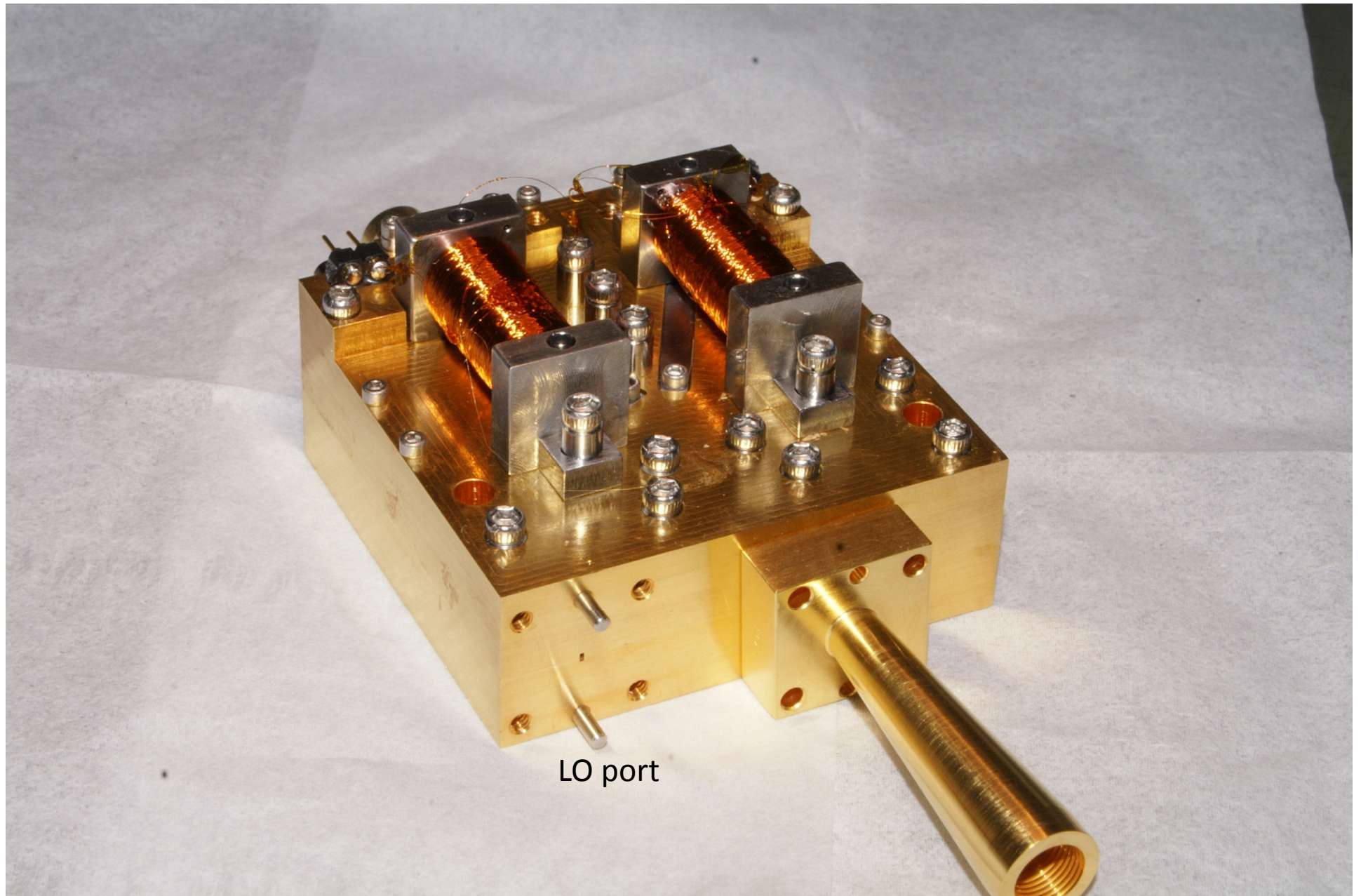
460 Balanced Receiver Magnet Current



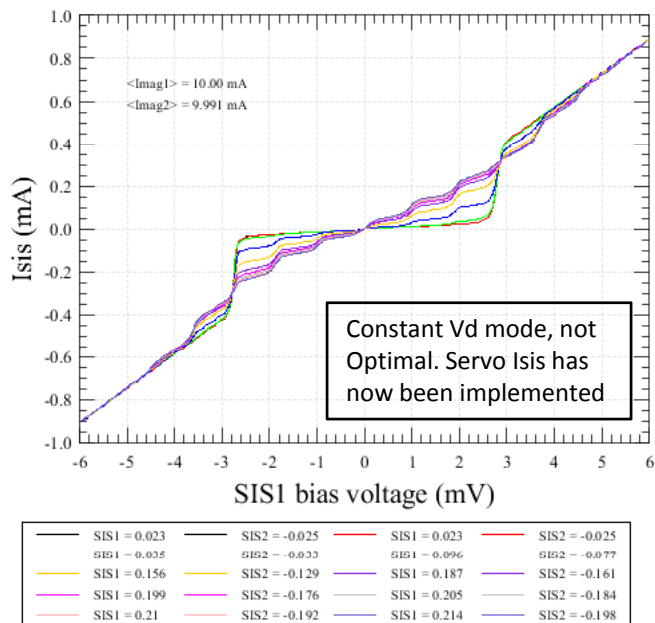
460 Balanced Receiver SIS bias current



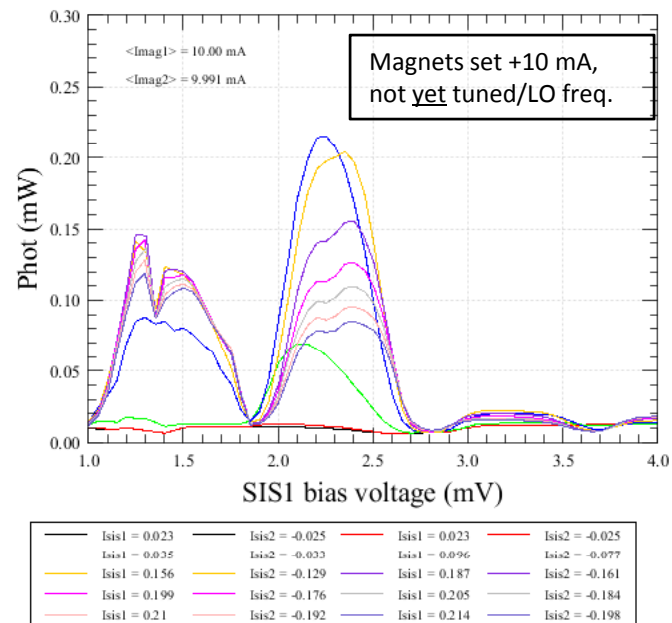
230 balanced Receiver performance examples
(first reduced dataset only)



LO pumped I/V curves, $f = 216.0$ GHz

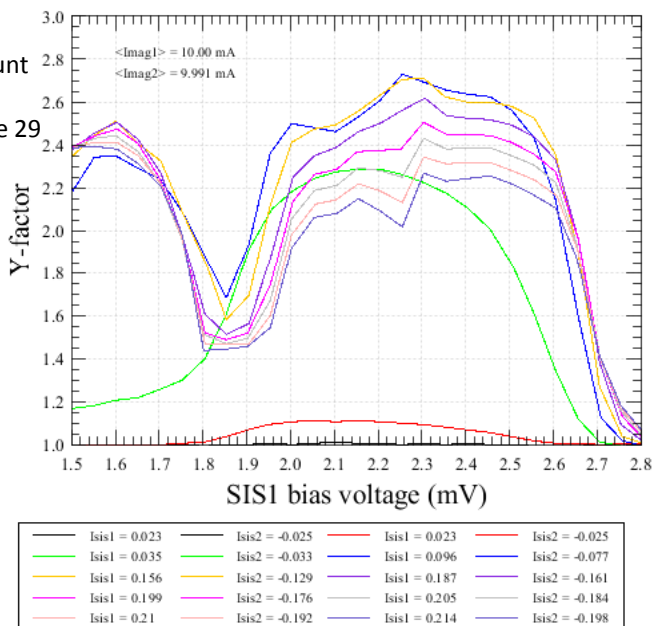


Phot curves (297 K), $f = 216.0$ GHz

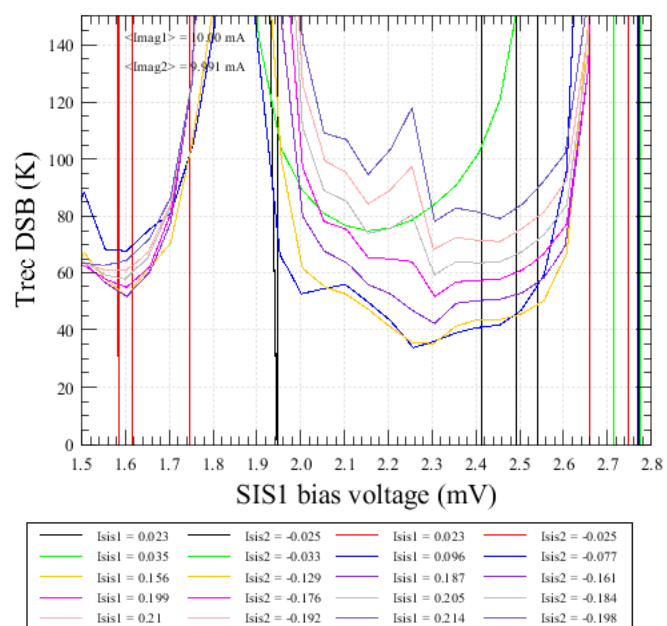


Y-factor curves (297, 77K) K, $f = 216.0$ GHz

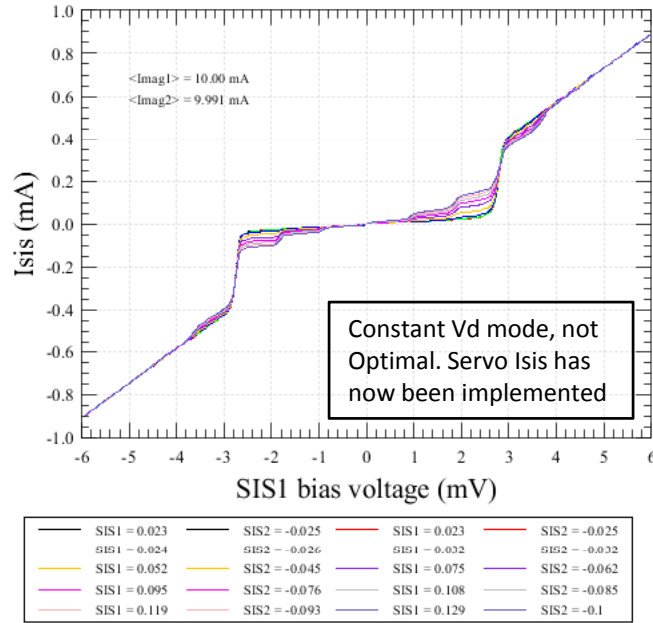
Tcold adjusted to account fast beam vignetting (hot spill over, see slide 29)



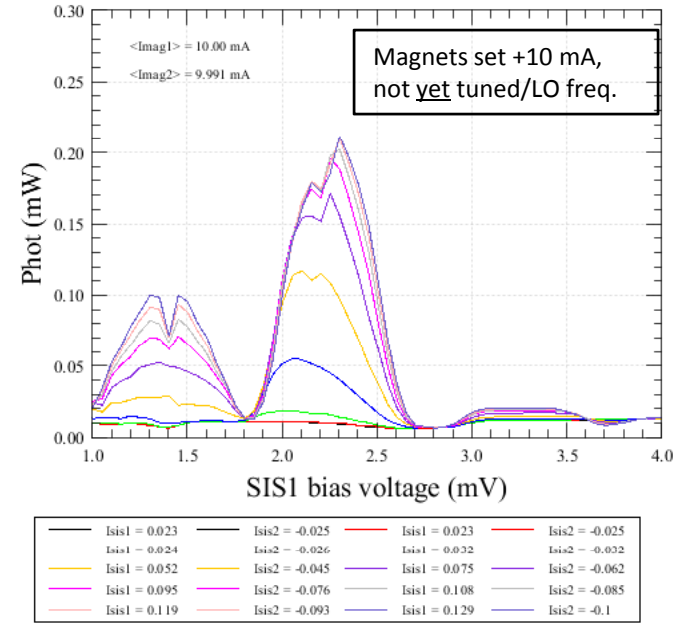
Trec, $f = 216.0$ GHz



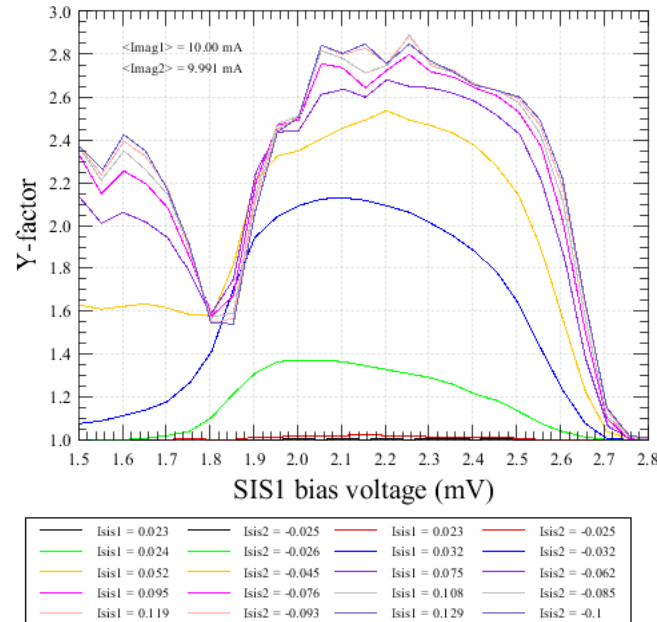
LO pumped I/V curves, $f = 225.0$ GHz



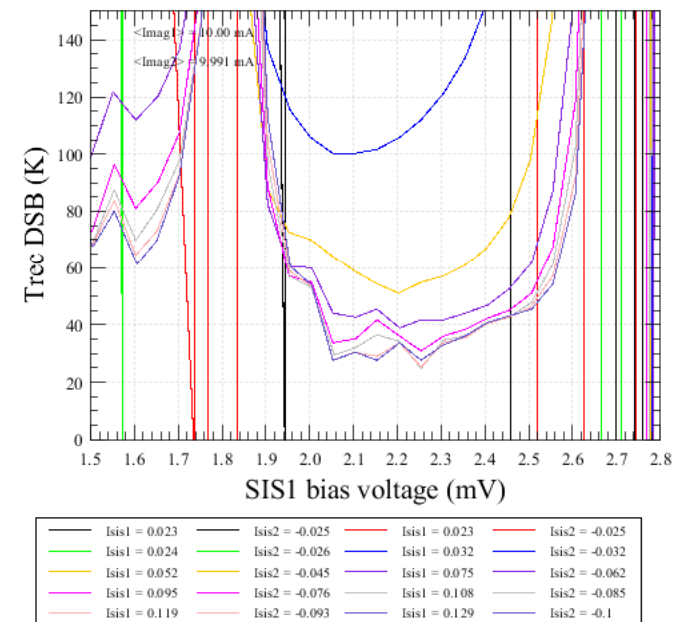
Phot curves (297 K), $f = 225.0$ GHz

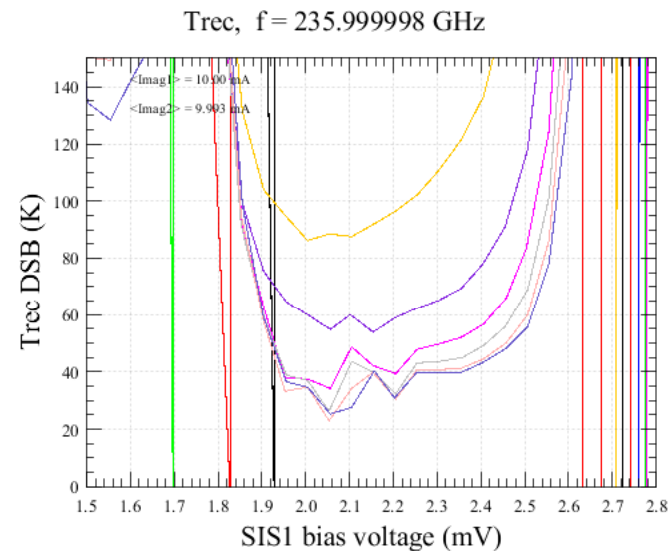
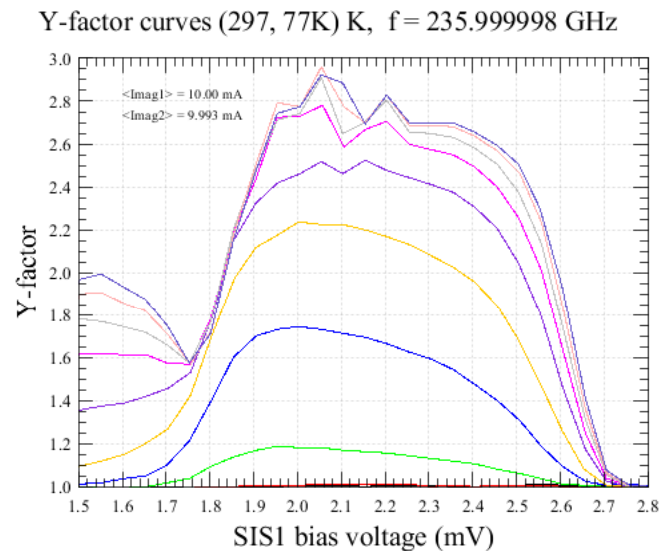
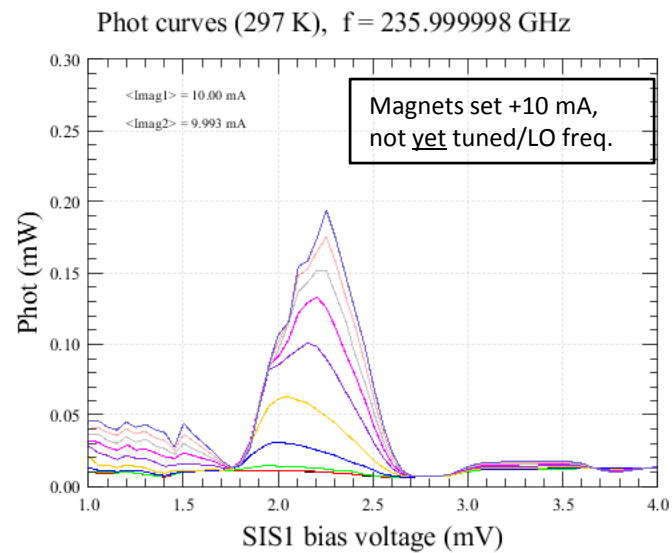
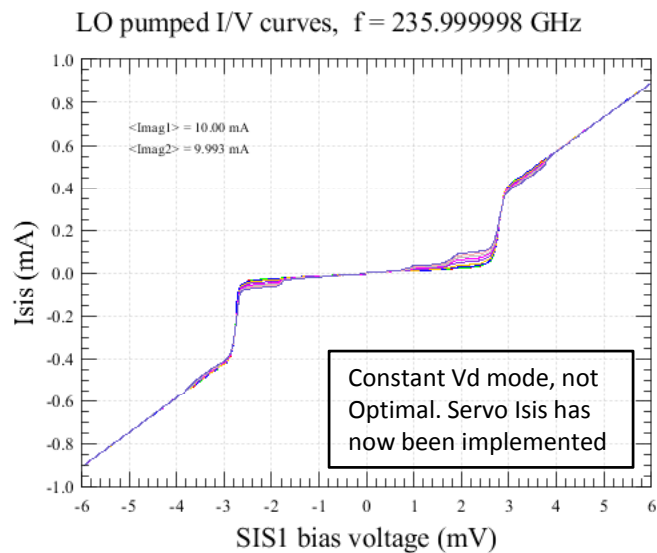


Y-factor curves (297, 77K) K, $f = 225.0$ GHz

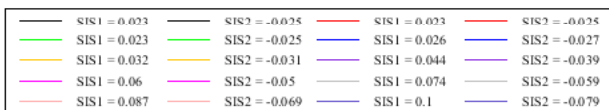
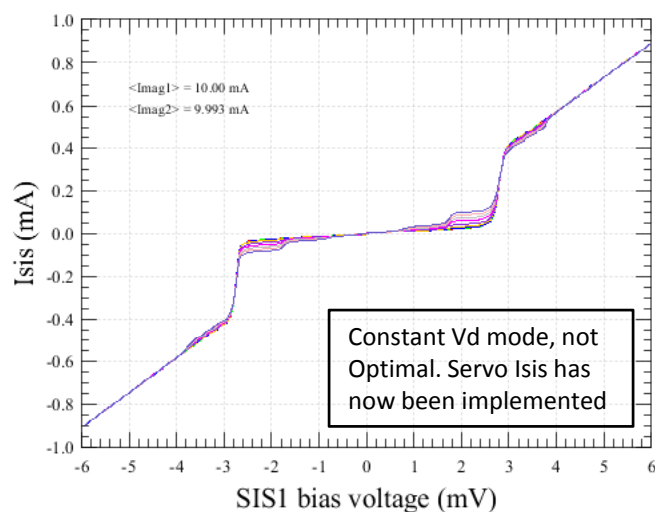


Trec, $f = 225.0$ GHz

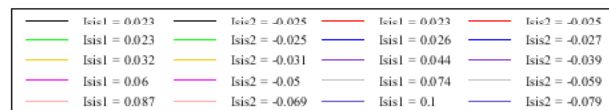
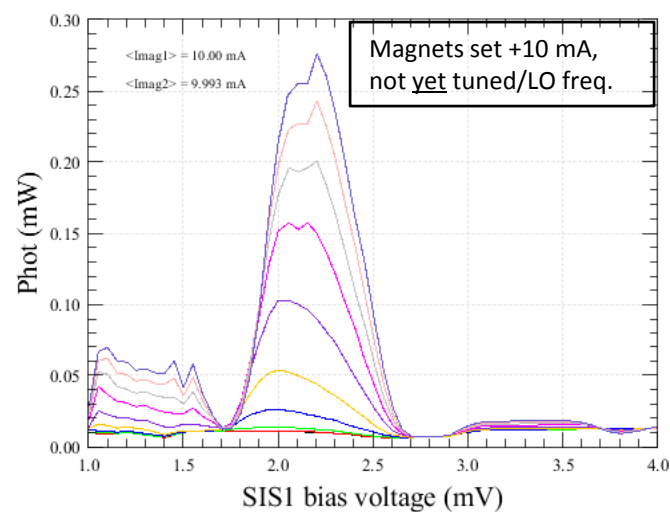




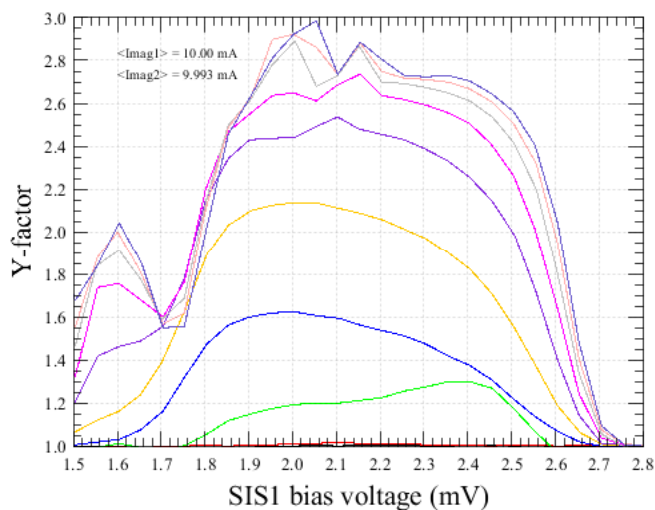
LO pumped I/V curves, $f = 244.999998$ GHz



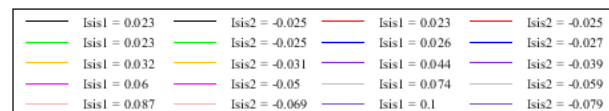
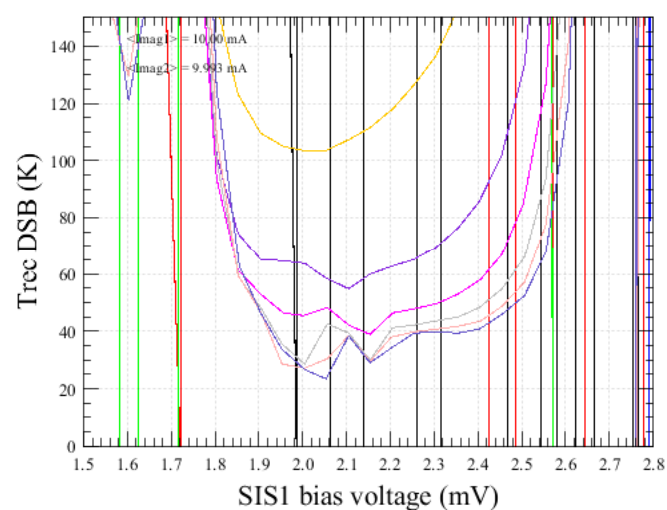
Phot curves (297 K), $f = 244.999998$ GHz



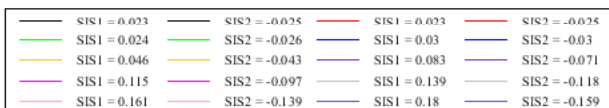
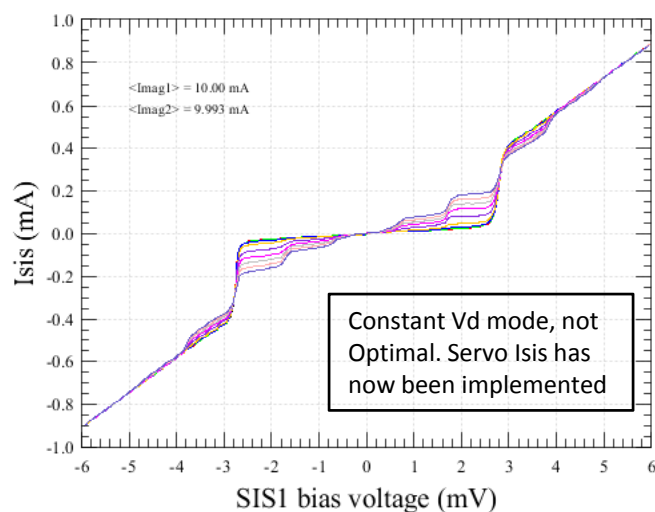
Y-factor curves (297, 77K) K, $f = 244.999998$ GHz



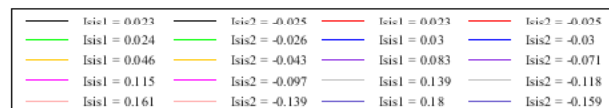
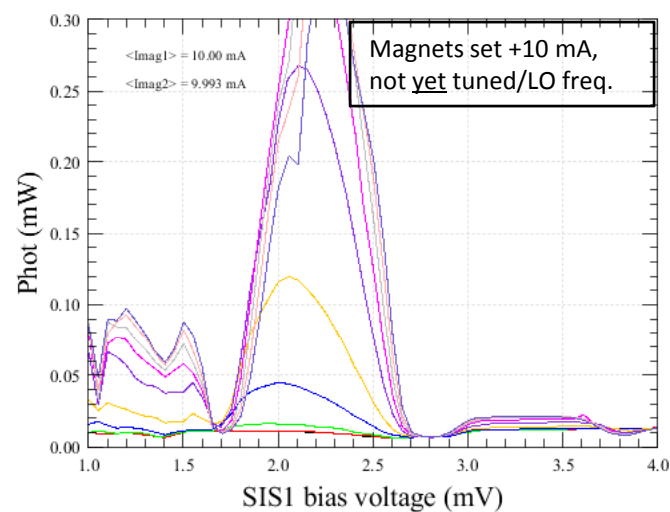
Trec, $f = 244.999998$ GHz



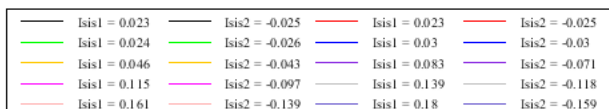
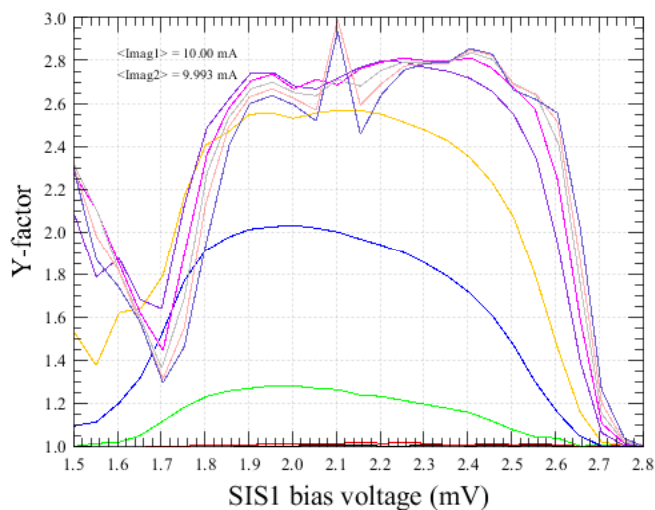
LO pumped I/V curves, $f = 254.999997$ GHz



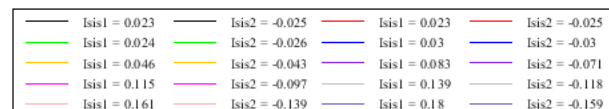
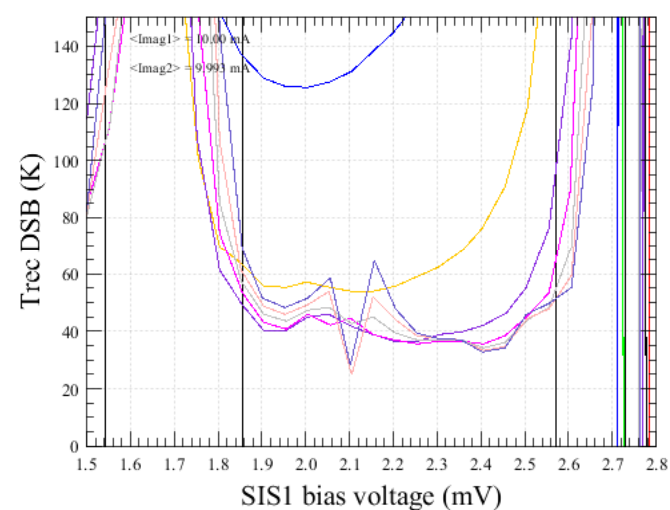
Phot curves (297 K), $f = 254.999997$ GHz

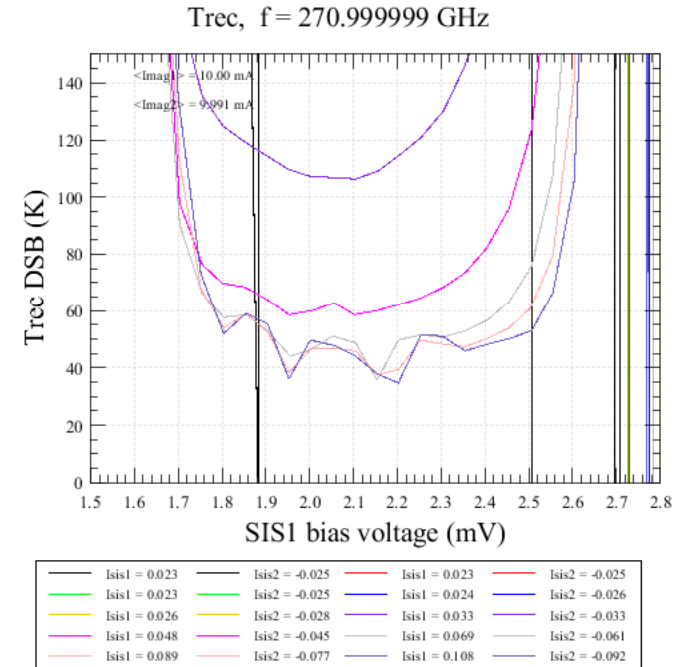
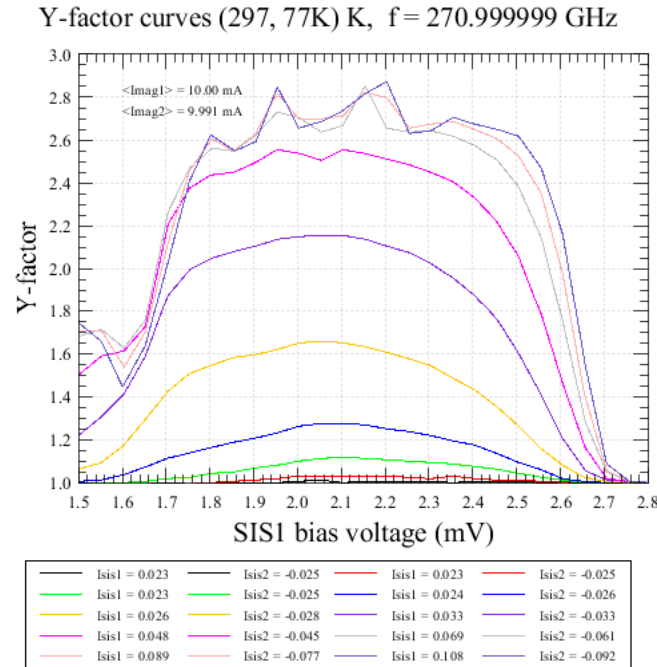
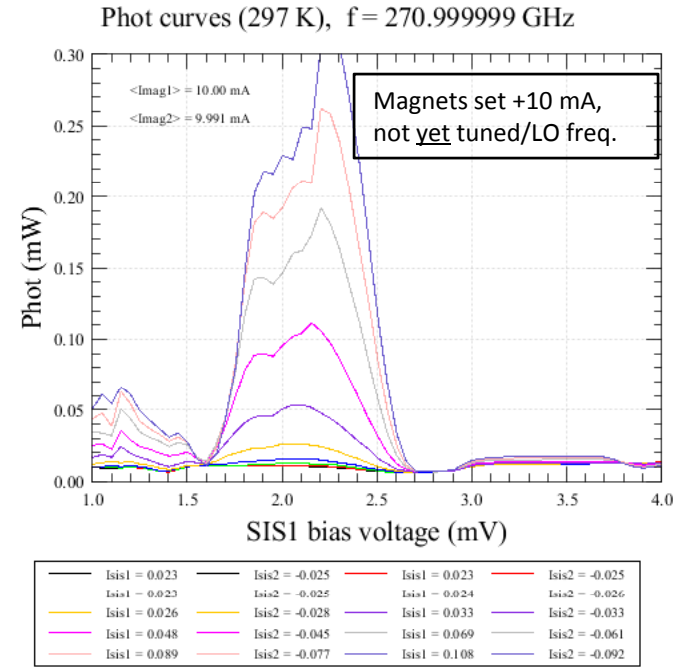
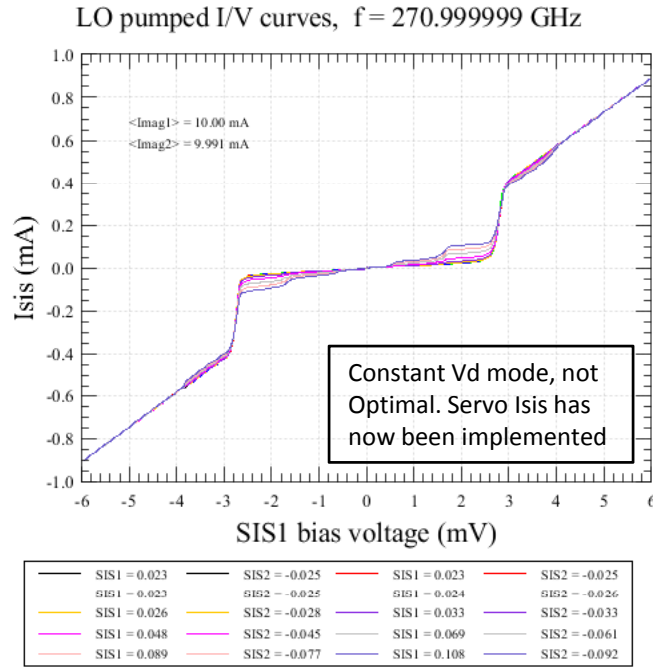


Y-factor curves (297, 77K) K, $f = 254.999997$ GHz



Trec, $f = 254.999997$ GHz

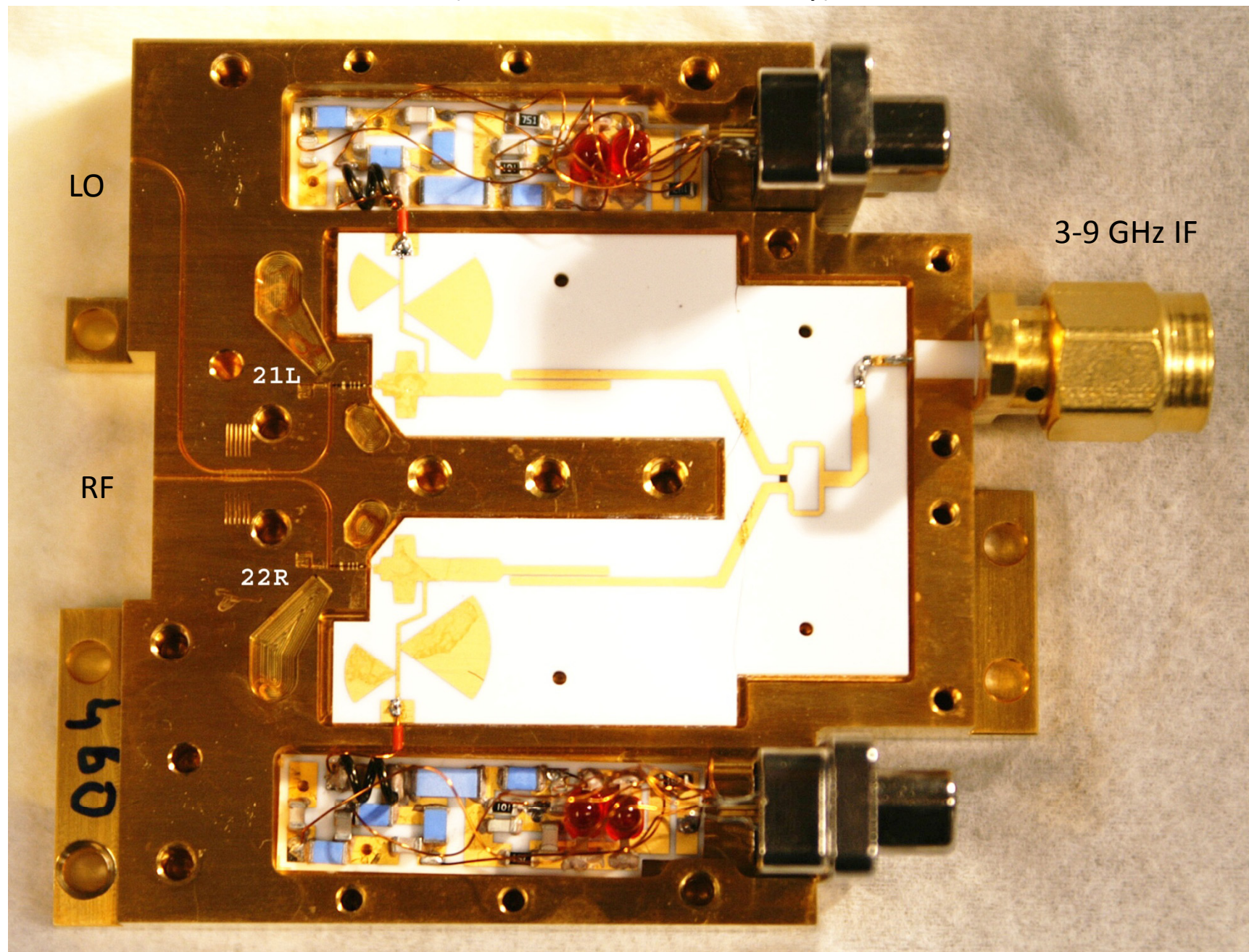




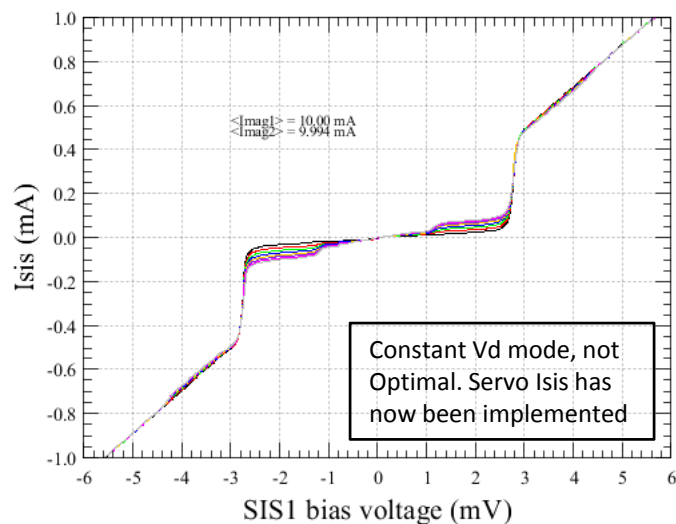
Screen shot 230 IF hot/cold. Not at optimal bias
Spectra will be taken with FFTS



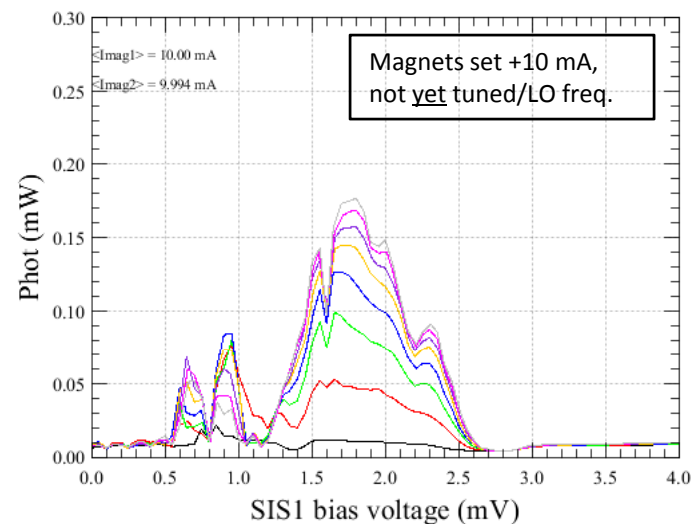
460 Balanced Receiver Performance Examples
(first reduced dataset only)



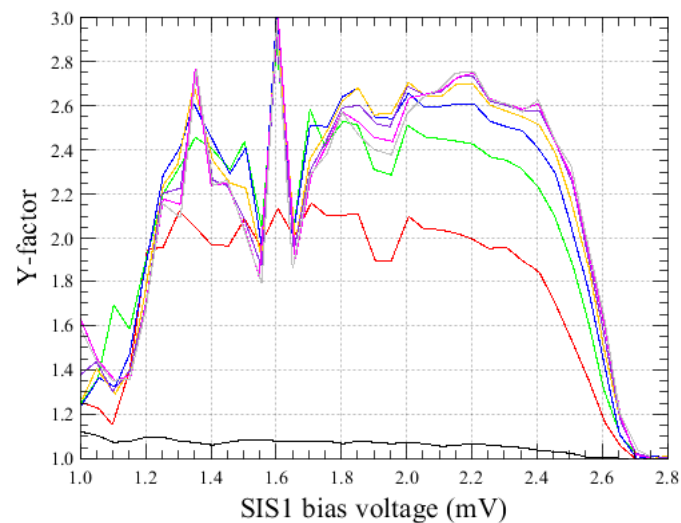
LO pumped I/V curves, $f = 390.0$ GHz



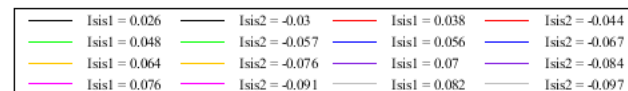
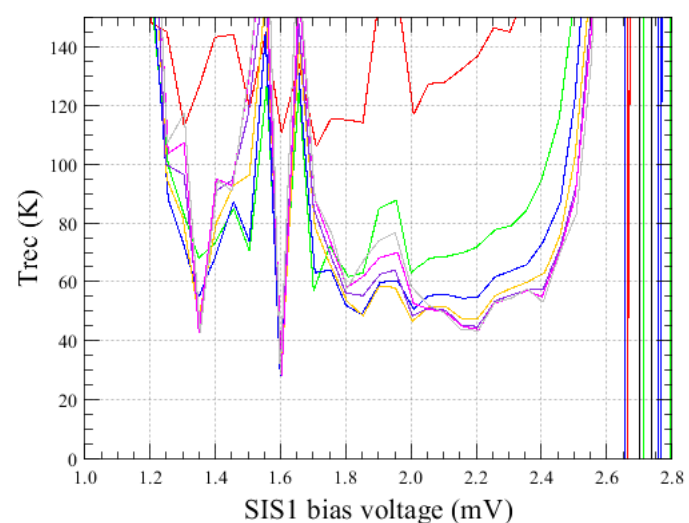
Phot curves (297 K), $f = 390.0$ GHz



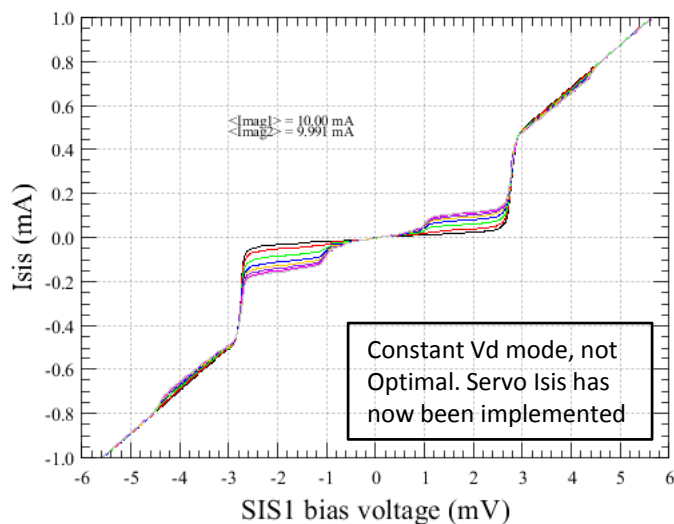
Y-factor curves (297, 77K) K, $f = 390.0$ GHz



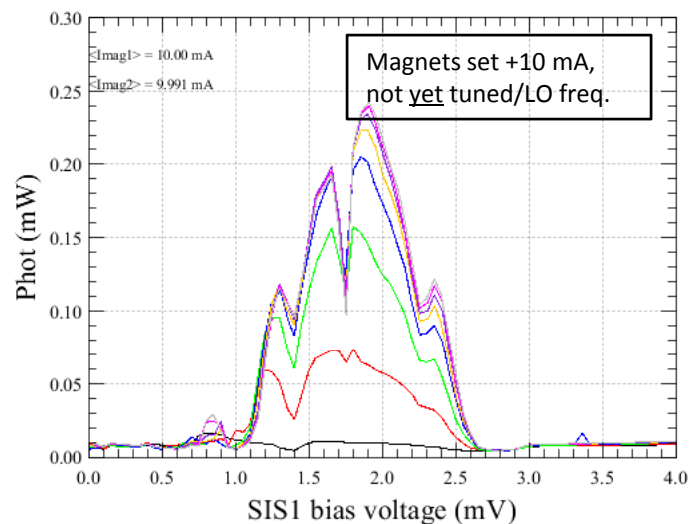
T_{rec} , $f = 390.0$ GHz



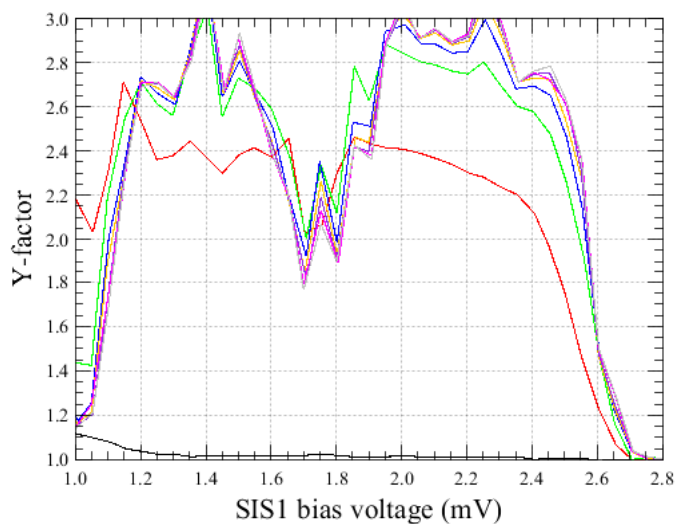
LO pumped I/V curves, $f = 422.575755$ GHz



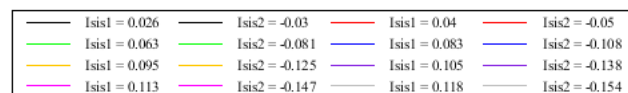
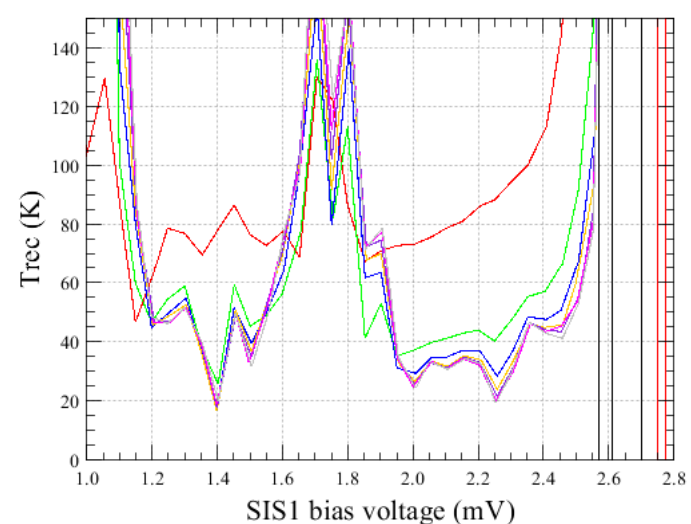
Phot curves (297 K), $f = 422.575755$ GHz



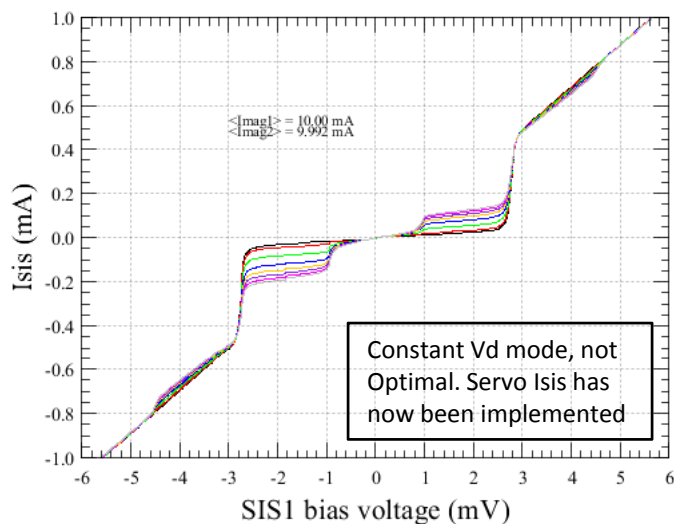
Y-factor curves (297, 77K) K, $f = 422.575755$ GHz



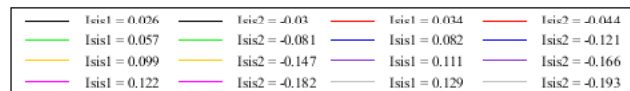
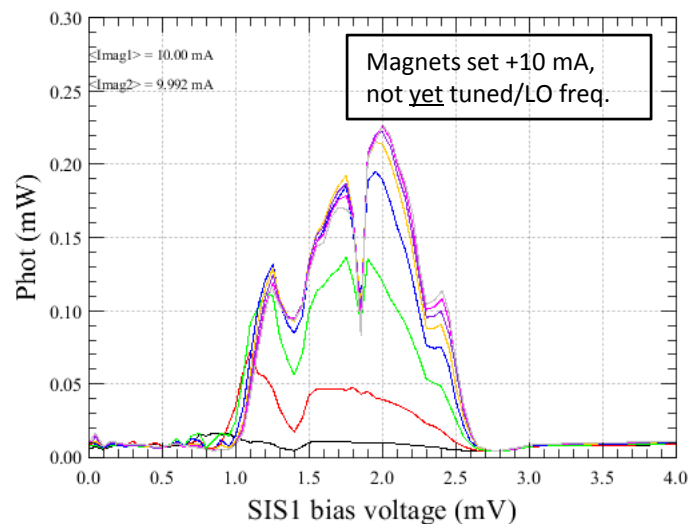
T_{rec} , $f = 422.575755$ GHz



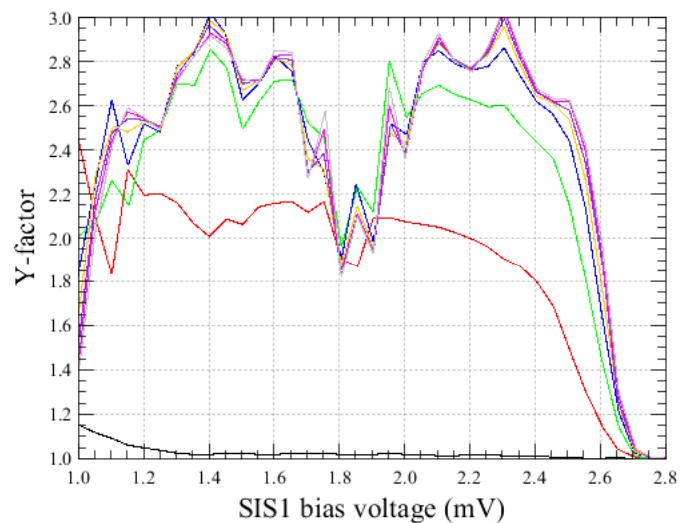
LO pumped I/V curves, $f = 447.33333$ GHz



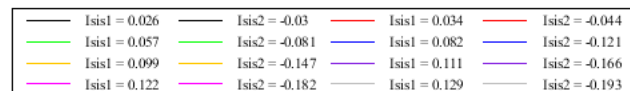
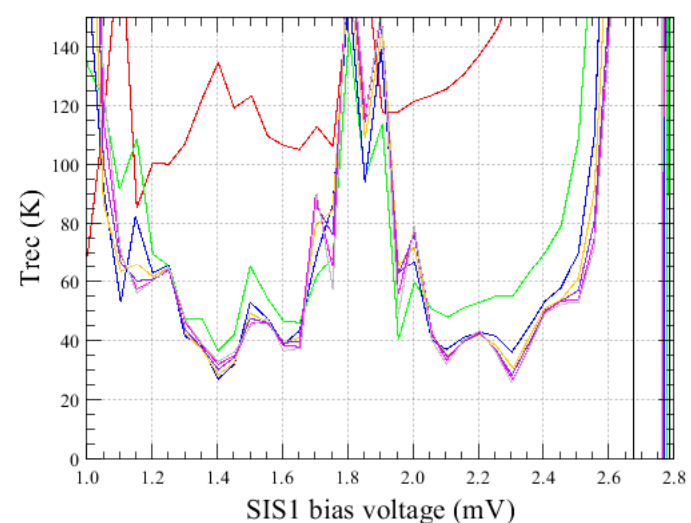
Phot curves (297 K), $f = 447.33333$ GHz



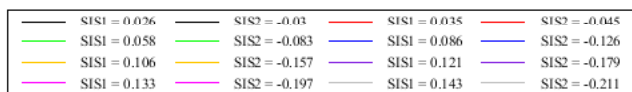
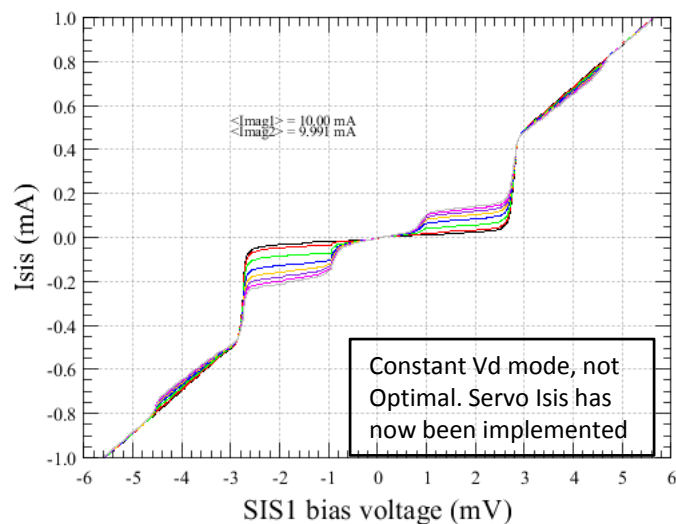
Y-factor curves (297, 77K) K, $f = 447.33333$ GHz



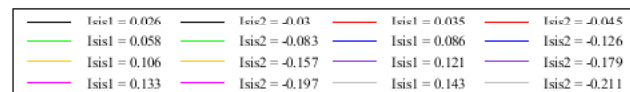
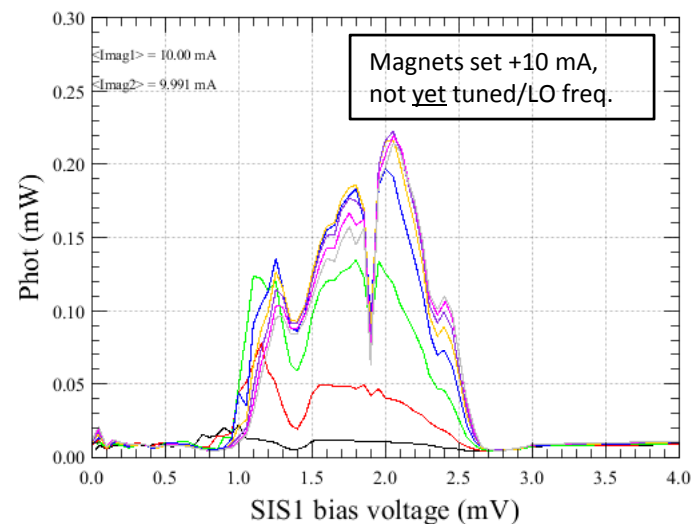
Trec, $f = 447.33333$ GHz



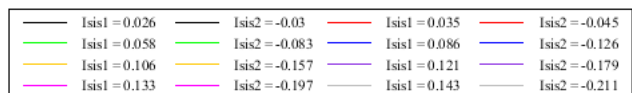
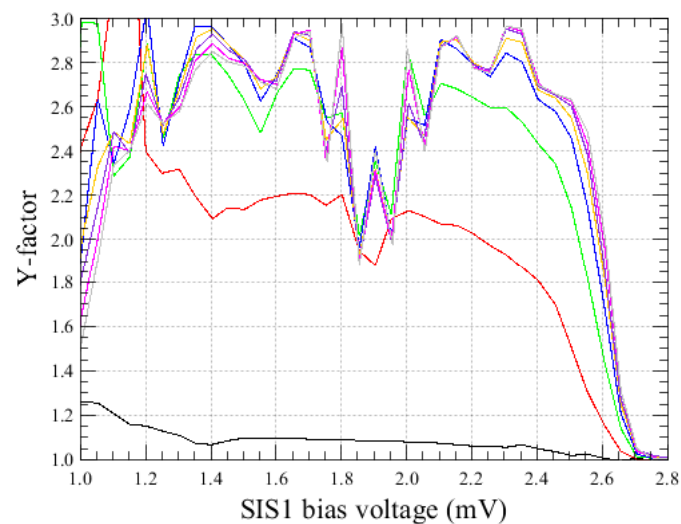
LO pumped I/V curves, $f = 460.363635$ GHz



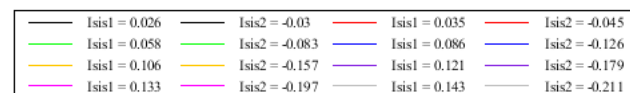
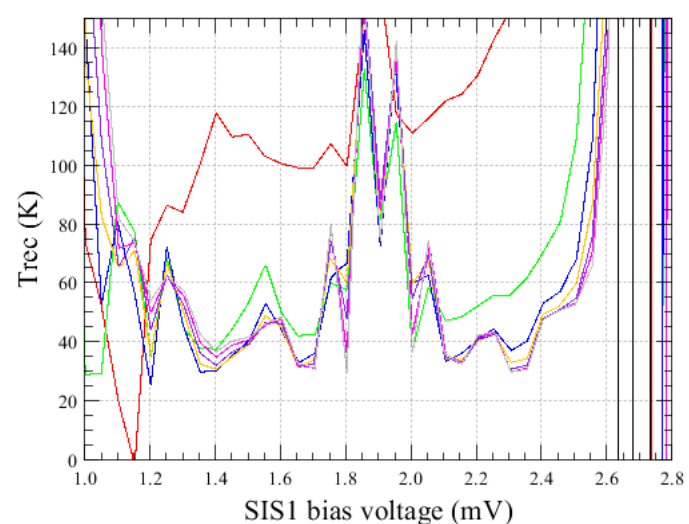
Phot curves (297 K), $f = 460.363635$ GHz



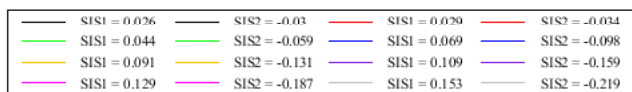
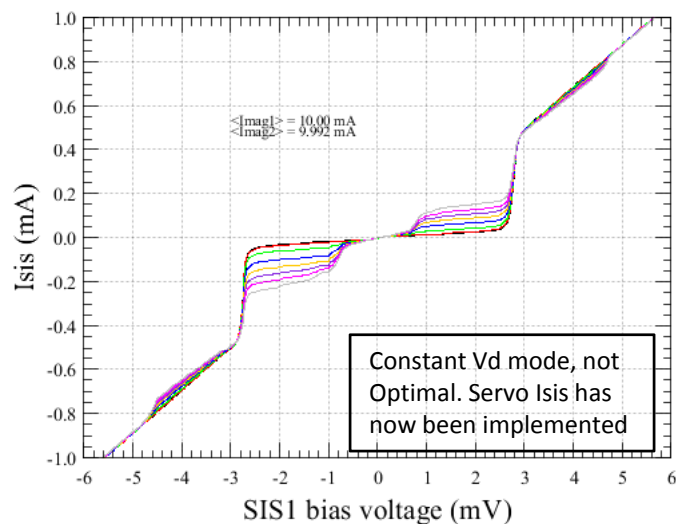
Y-factor curves (297, 77K) K, $f = 460.363635$ GHz



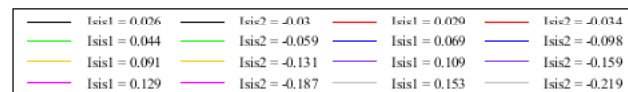
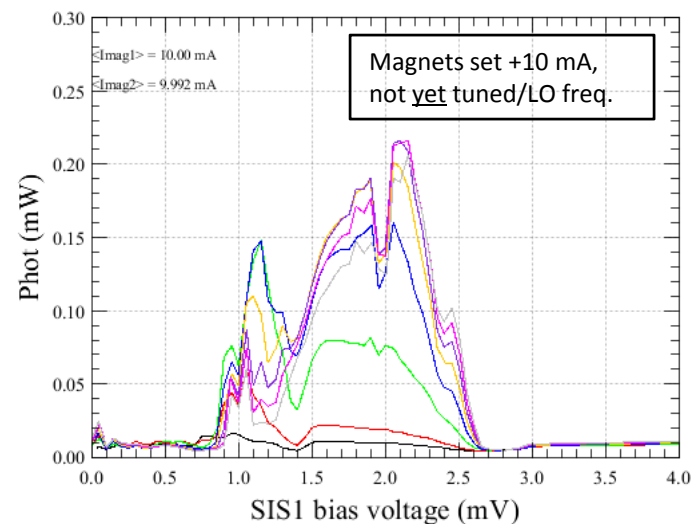
Trec, $f = 460.363635$ GHz



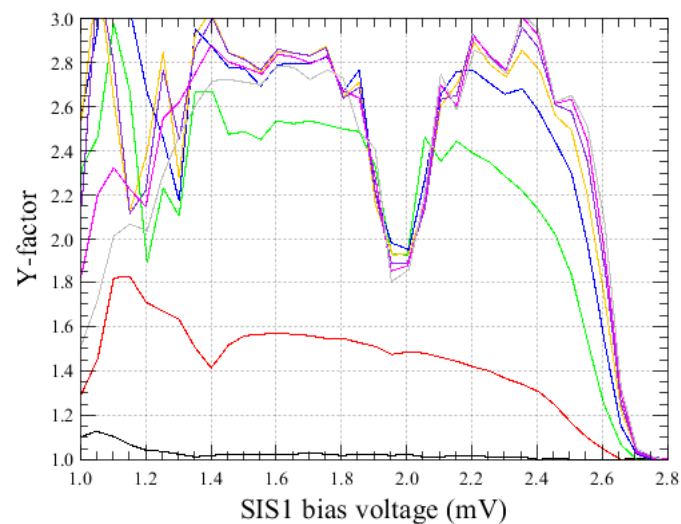
LO pumped I/V curves, $f = 479.909085$ GHz



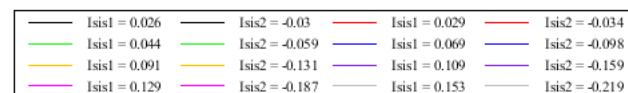
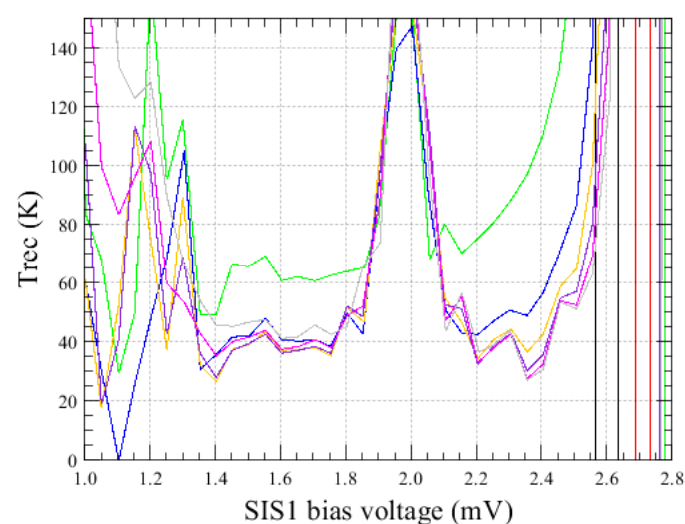
Phot curves (297 K), $f = 479.909085$ GHz



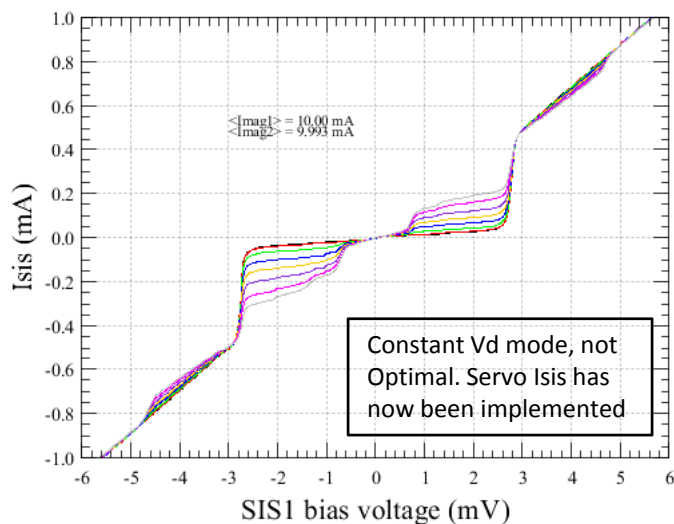
Y-factor curves (297, 77K) K, $f = 479.909085$ GHz



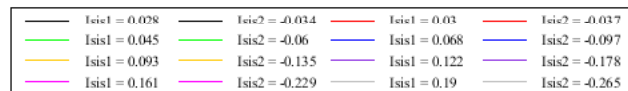
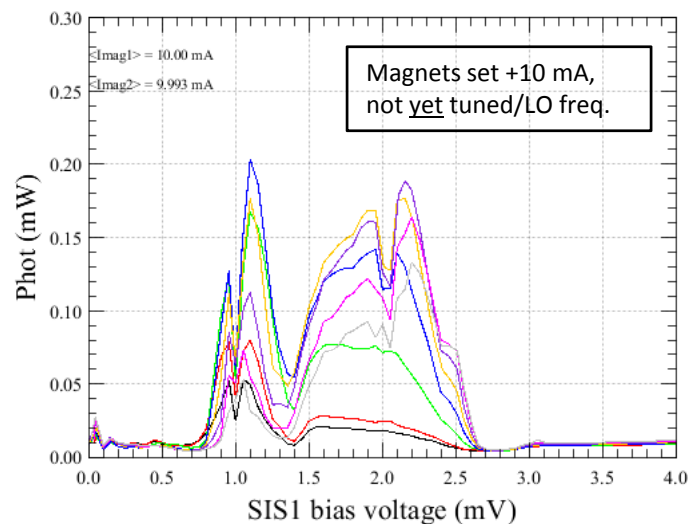
Trec, $f = 479.909085$ GHz



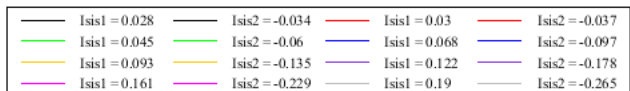
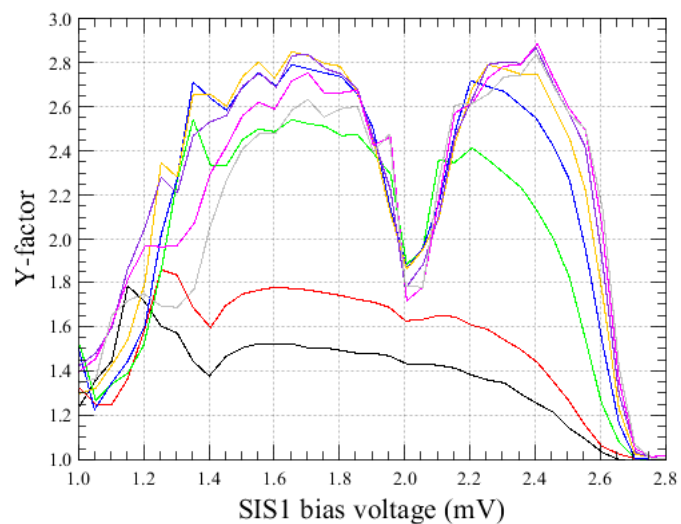
LO pumped I/V curves, $f = 492.93939$ GHz



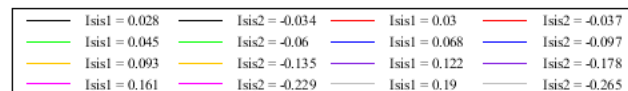
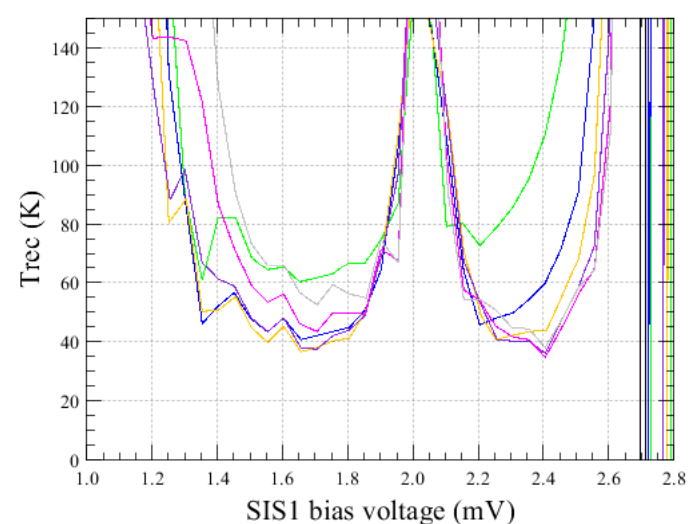
Phot curves (297 K), $f = 492.93939$ GHz



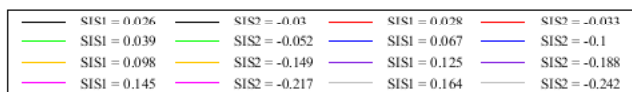
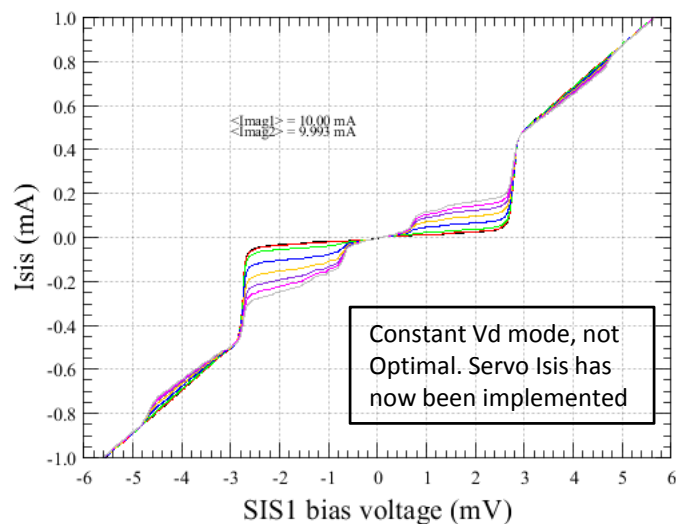
Y-factor curves (297, 77K) K, $f = 492.93939$ GHz



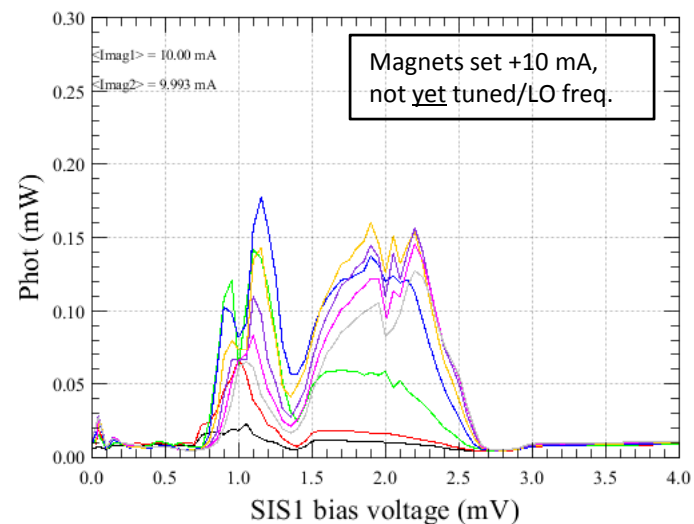
Trec, $f = 492.93939$ GHz



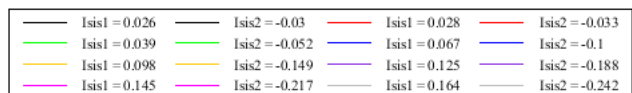
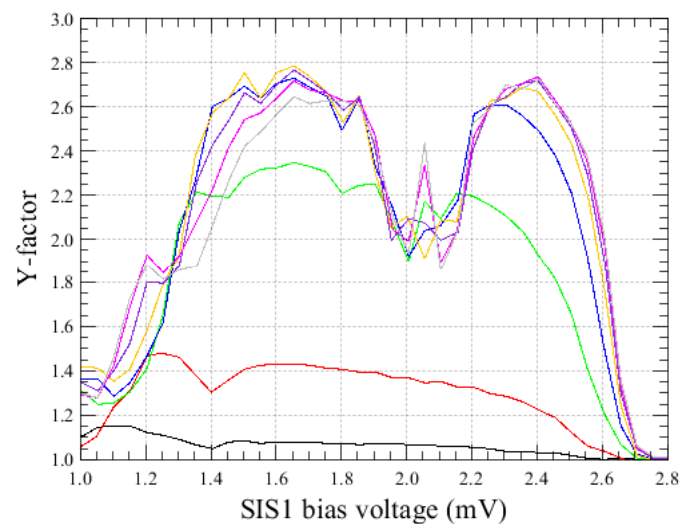
LO pumped I/V curves, $f = 498.151515$ GHz



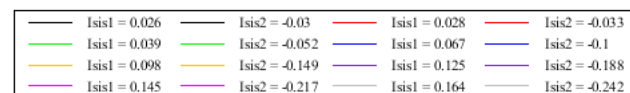
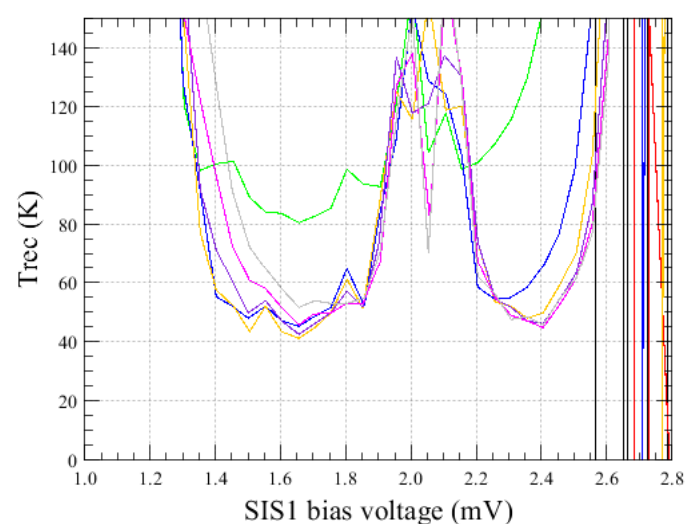
Phot curves (297 K), $f = 498.151515$ GHz



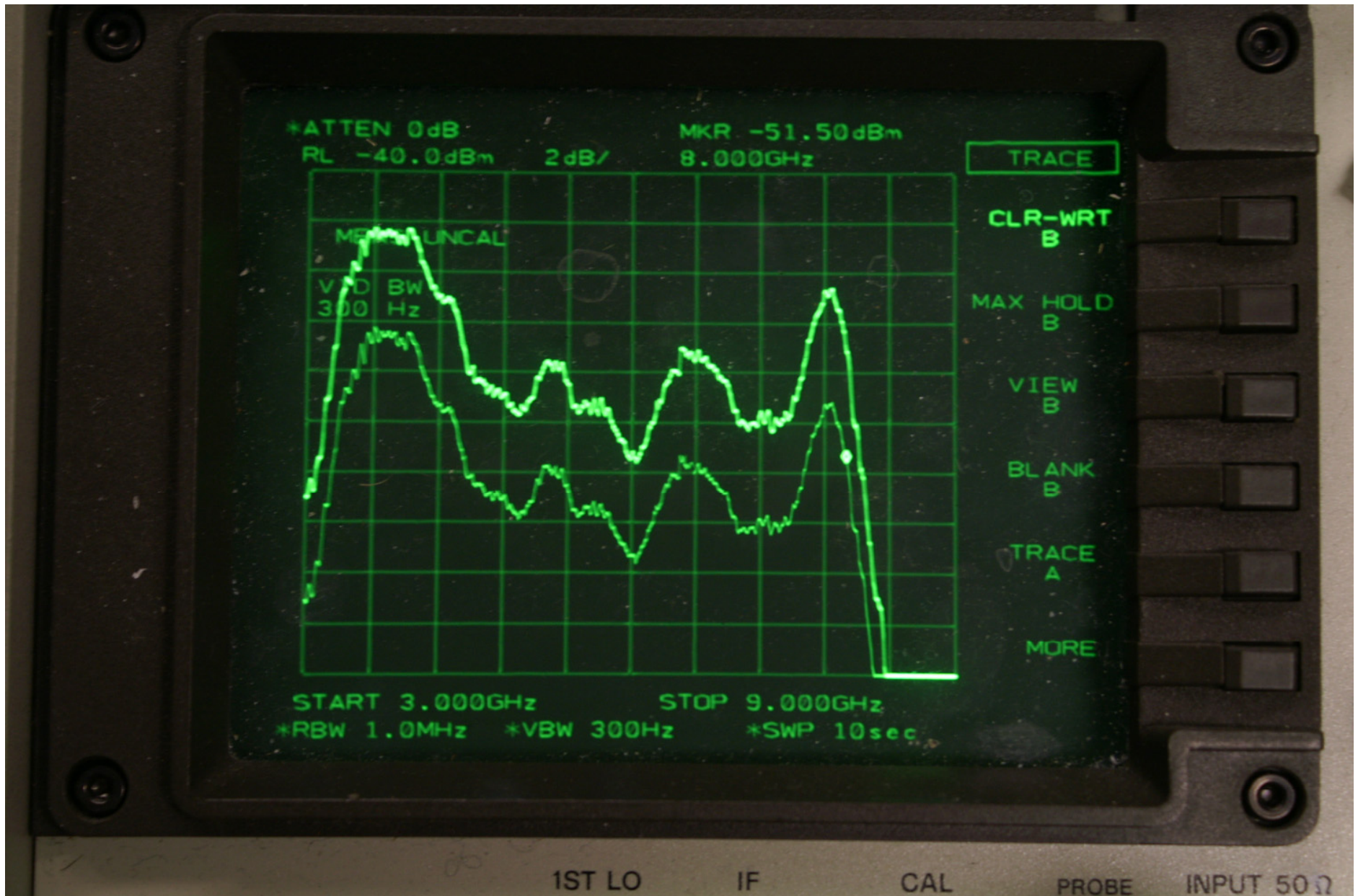
Y-factor curves (297, 77K) K, $f = 498.151515$ GHz



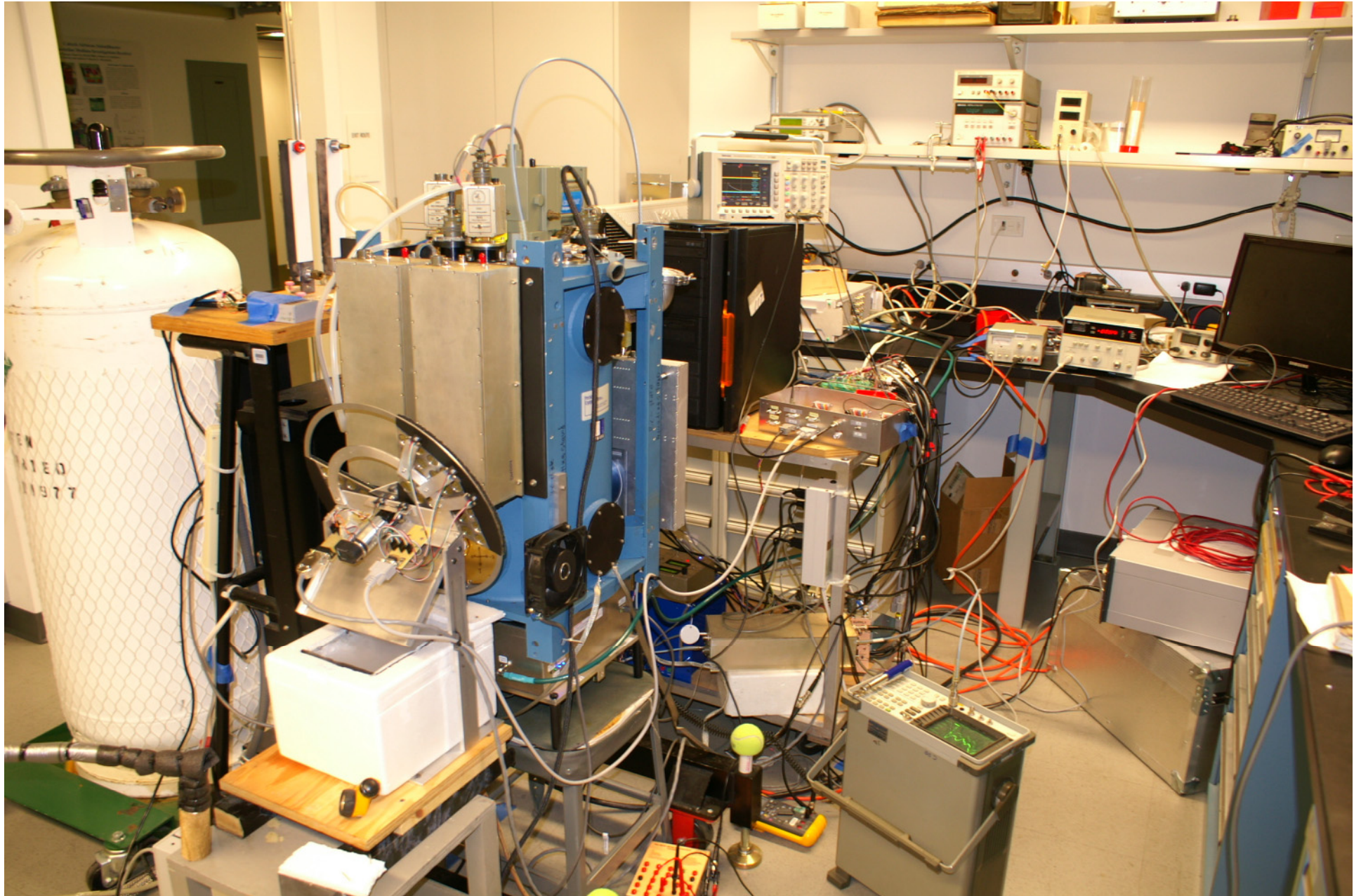
T_{rec} , $f = 498.151515$ GHz



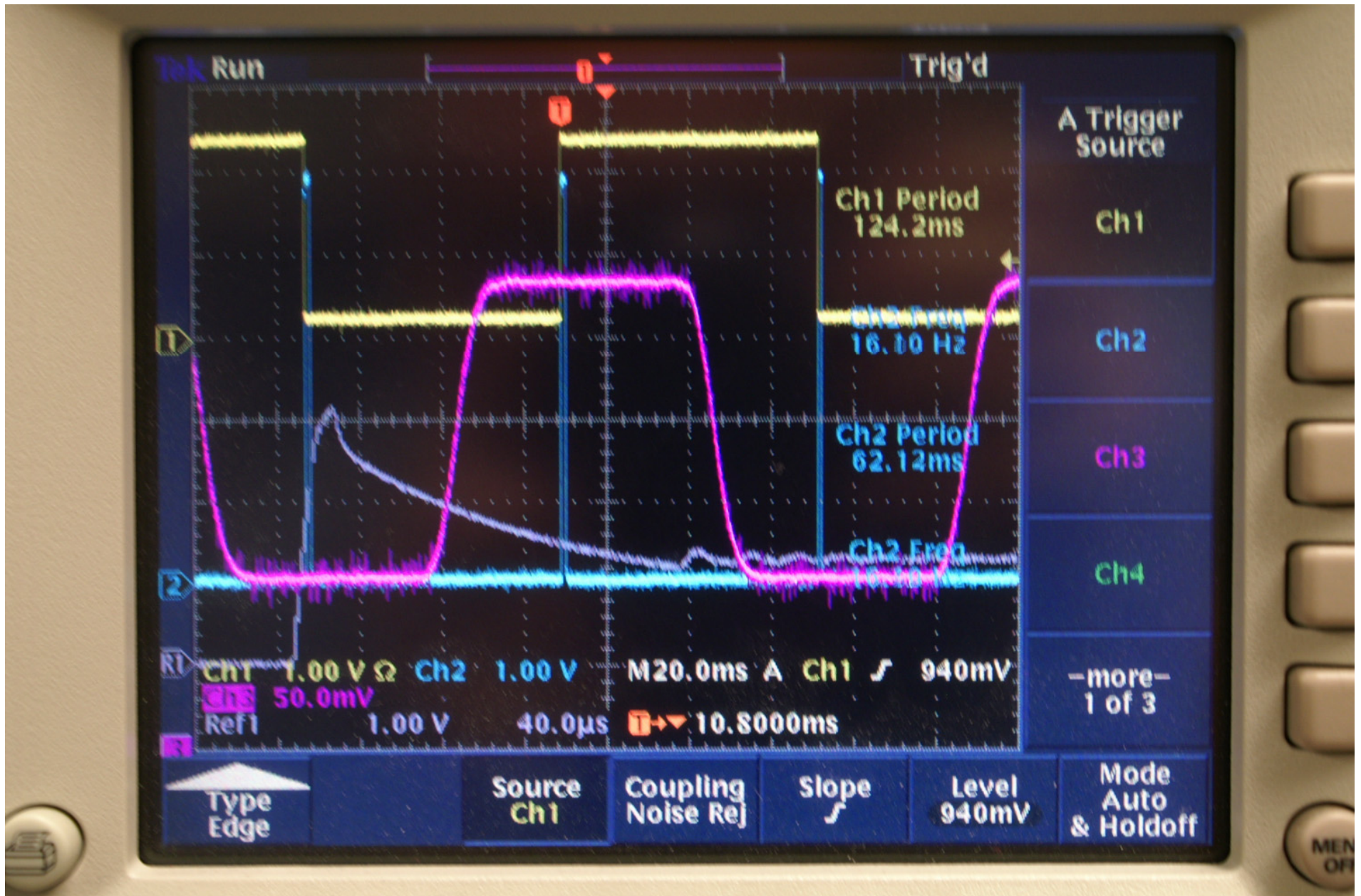
Screen shot 460 IF hot/cold. Not at optimal bias
Spectra will be taken with FFTS



Cahill 38



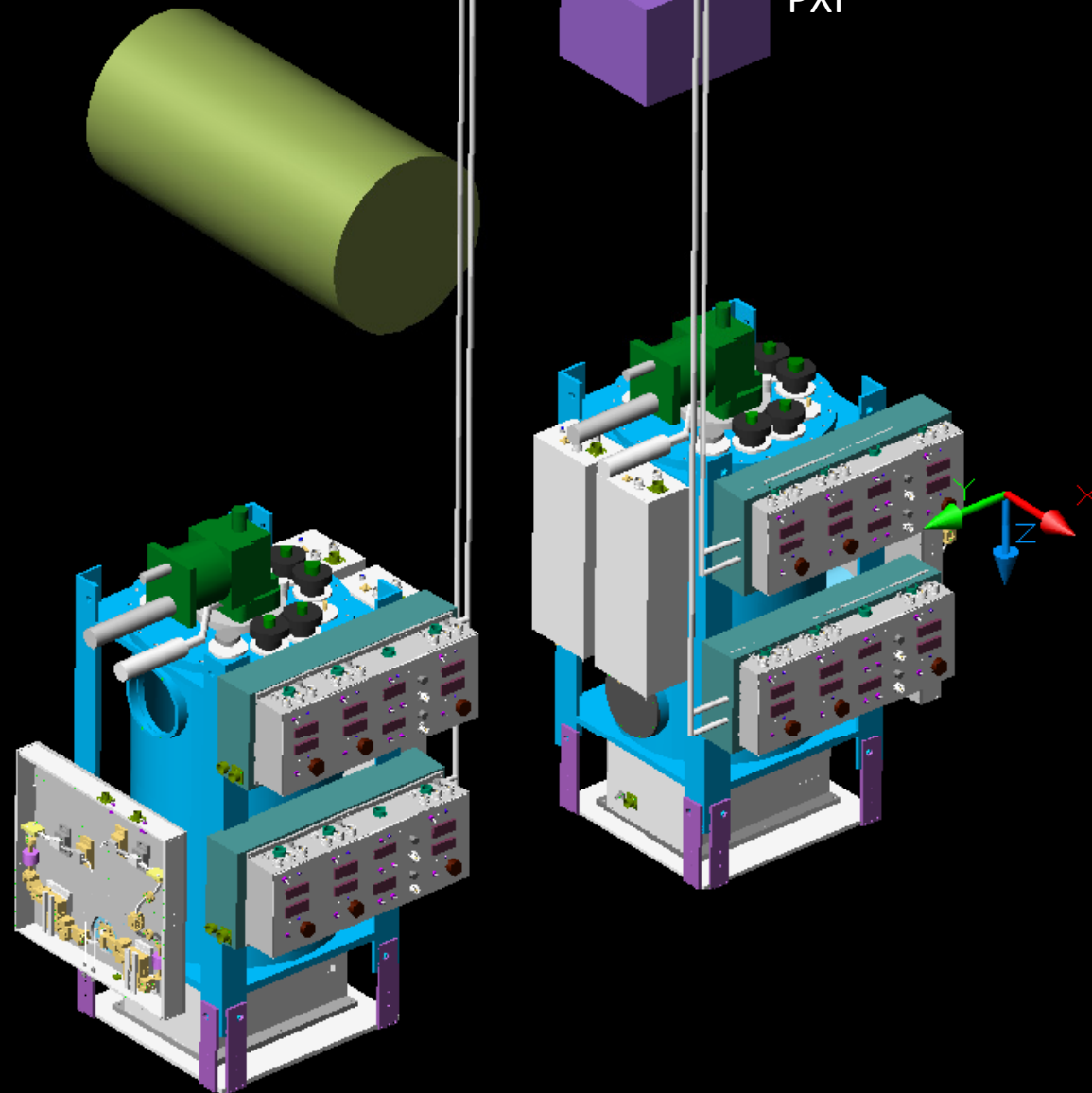
Chopper IF Total Power signal (purple)



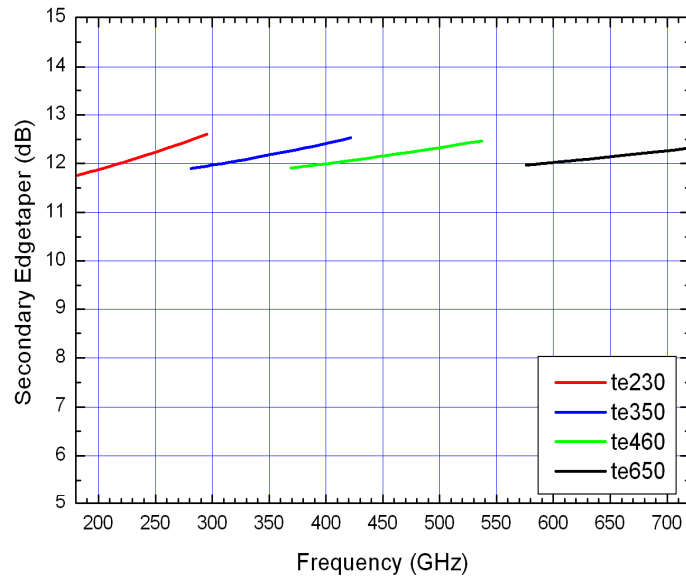
Sidecab Layout/Synthesized LO

CSO Sidecab, all to scale

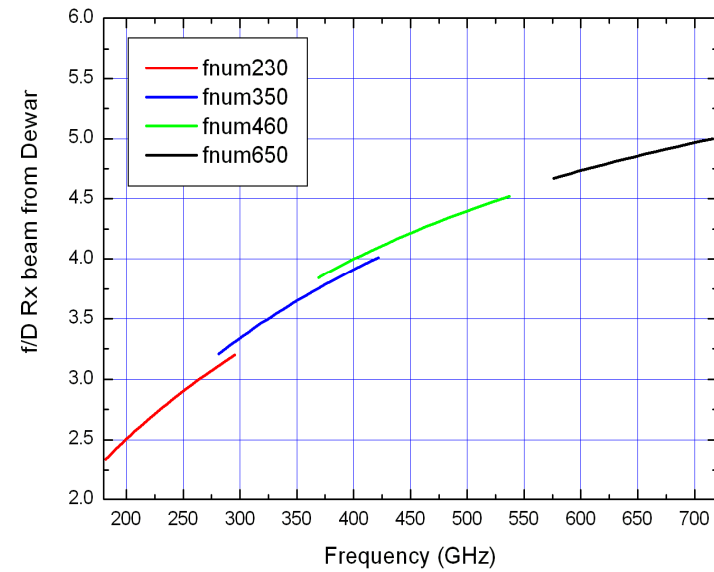
Elevation Tube



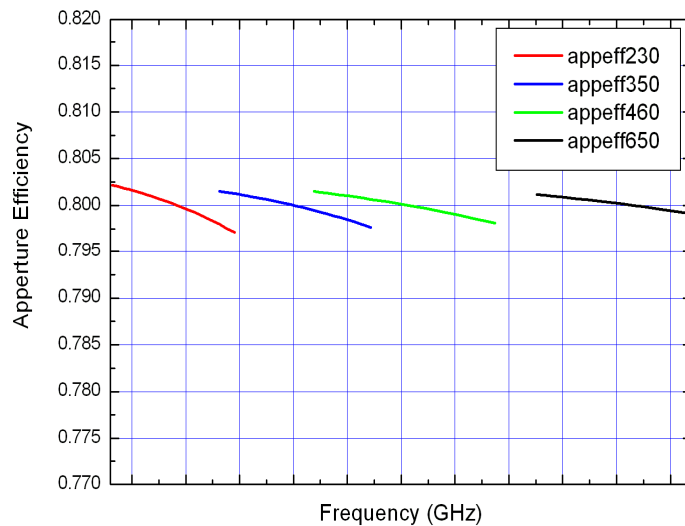
CSO Sidecab Rx Design Parameters



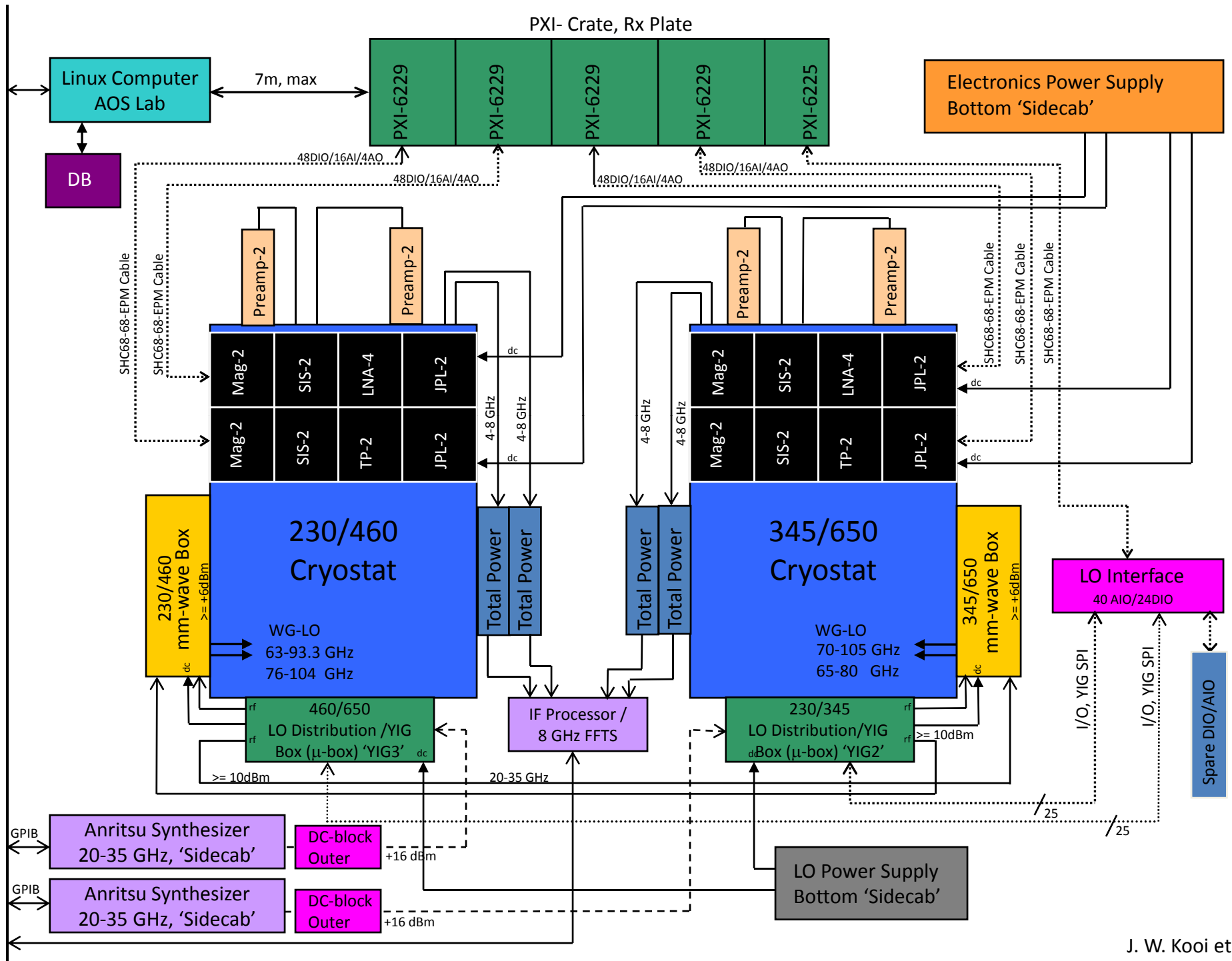
Secondary edgetaper of the proposed sidecab optics configuration.



f/D ratio of the Receiver beams just outside the cryostat. Below 230 GHz, there will be some vignetting ($\leq 1\%$) on the 5th mirror due to the fast beam



Aperture efficiency with a fixed 5th mirror – Cryostat focal distance



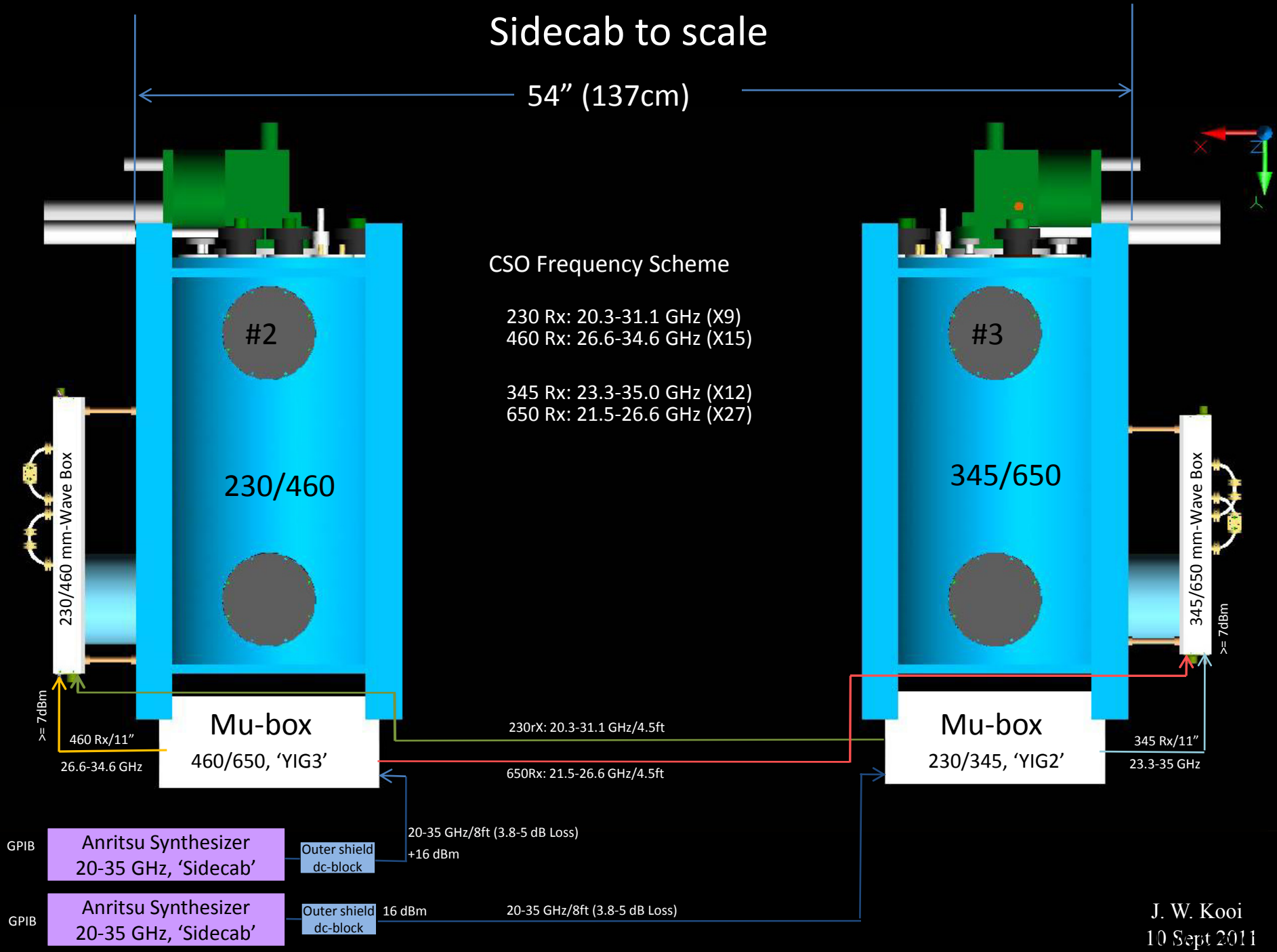
Sidecab to scale

54" (137cm)

CSO Frequency Scheme

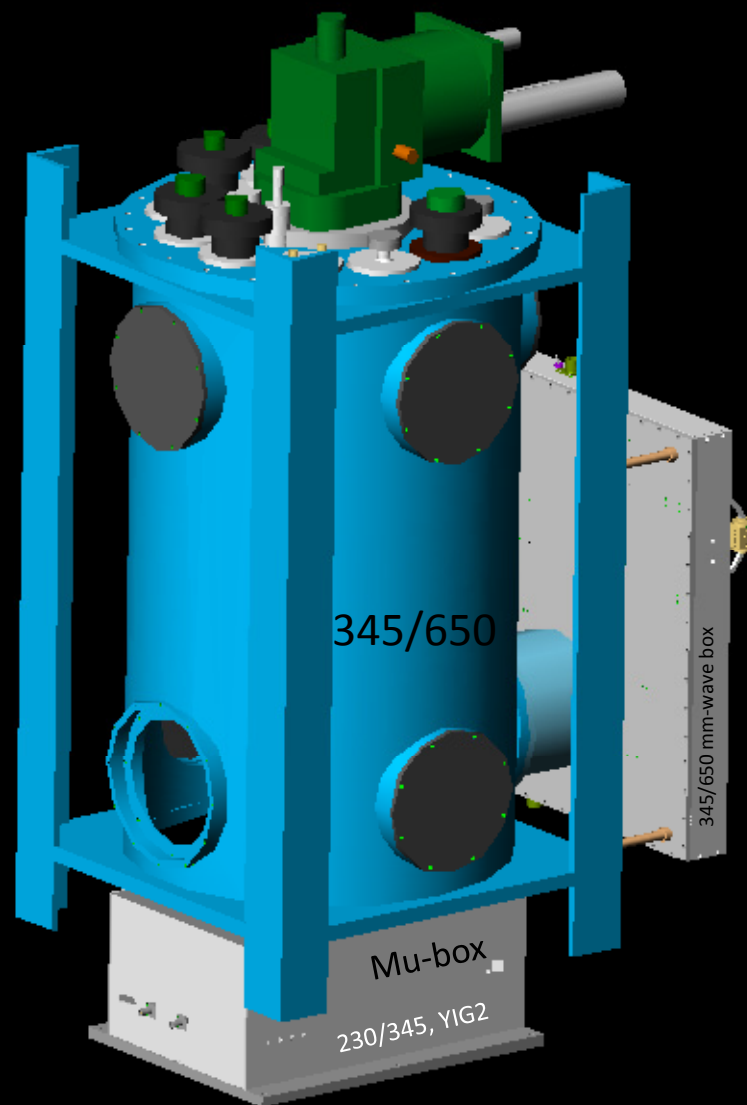
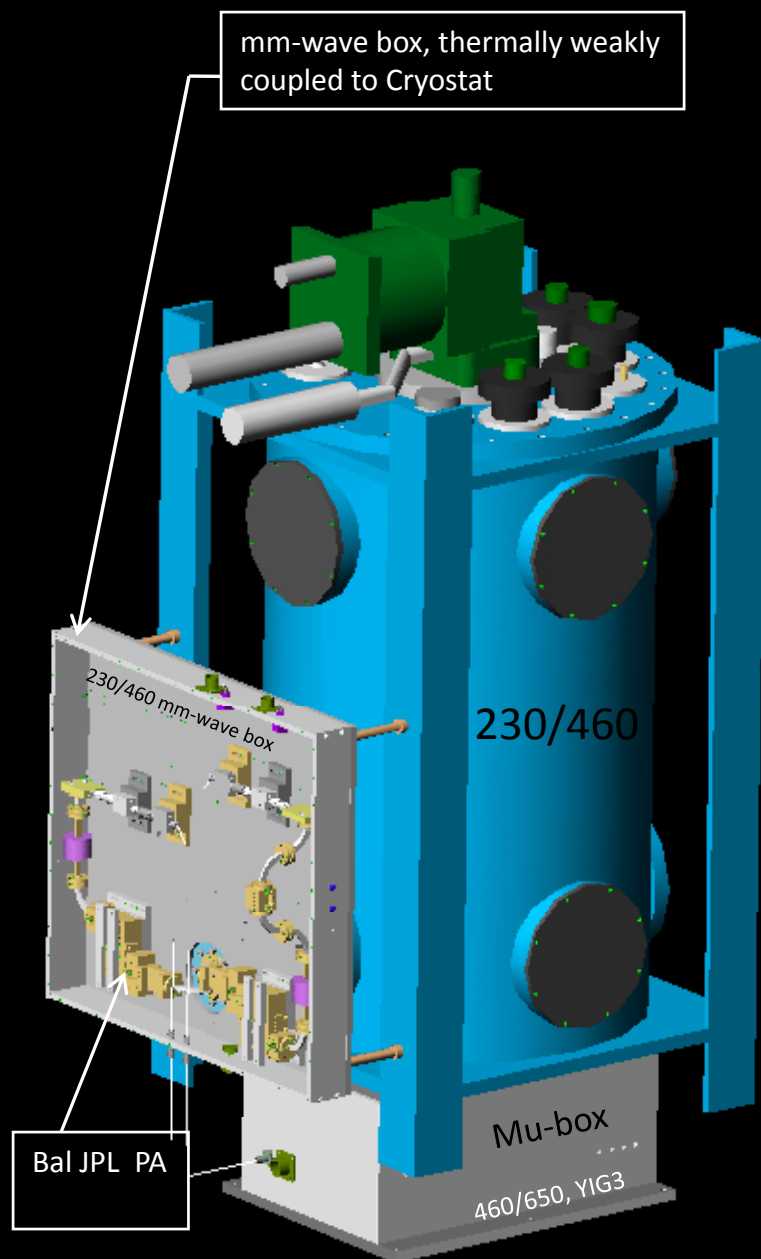
230 Rx: 20.3-31.1 GHz (X9)
460 Rx: 26.6-34.6 GHz (X15)

345 Rx: 23.3-35.0 GHz (X12)
650 Rx: 21.5-26.6 GHz (X27)

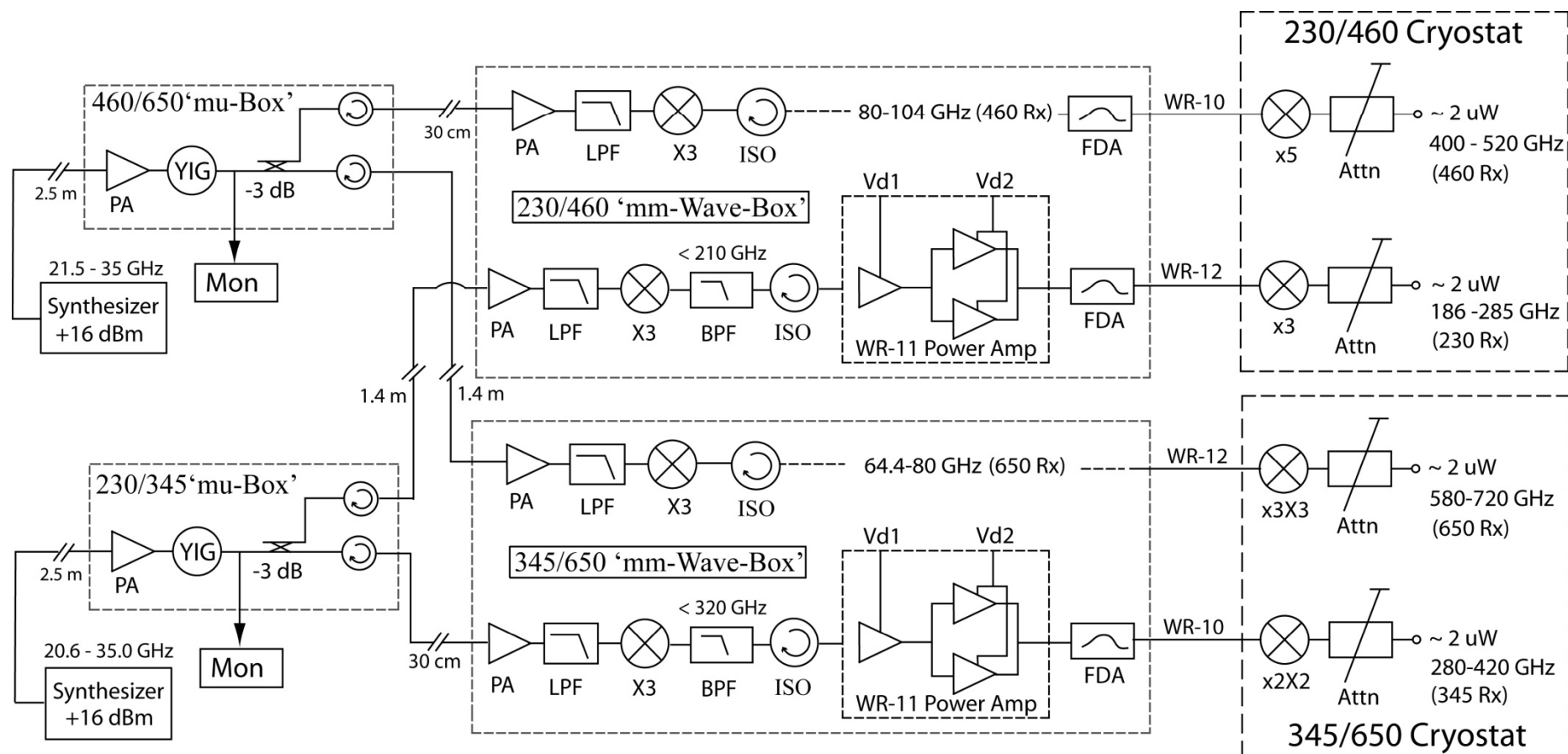


Optical beam
(from M4)

mm-wave box, thermally weakly
coupled to Cryostat



Synthesized LO layout

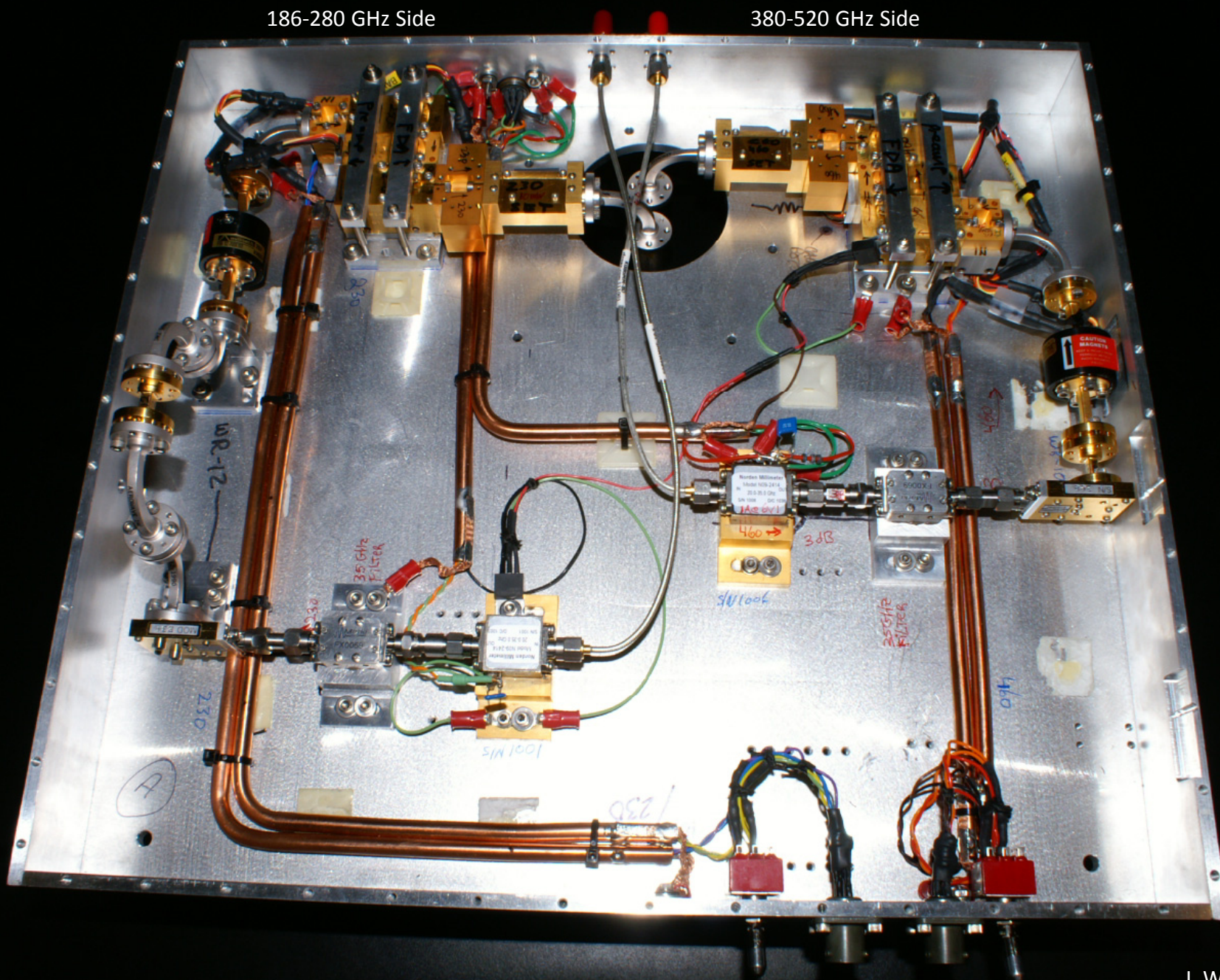


CSO dual-frequency synthesized local oscillator layout. At the input of the mu-Box the baseband frequency of 20.6-35.0 GHz (Ka-band) is amplified and drives the medium power amplifier into saturation. The LO signal is filtered by the YIG to remove low level spurious and harmonic content, passively multiplied (X3) to 63.9-105.0 GHz, once again amplified (WR-11 waveguide power amplifiers), signal conditioned (FDA), and finally injected into the cryostat where the carrier signal is multiplied up to the final submillimeter frequency (186.5-720 GHz) and injected into the balanced mixers via a cooled attenuator. Spectral line observations below 186 GHz will need to be in the mixer lower side band.

Synthesized LO 230/460 mmWave Box

186-280 GHz Side

380-520 GHz Side



Synthesized LO 20-35 GHz 'Mu-Box'

