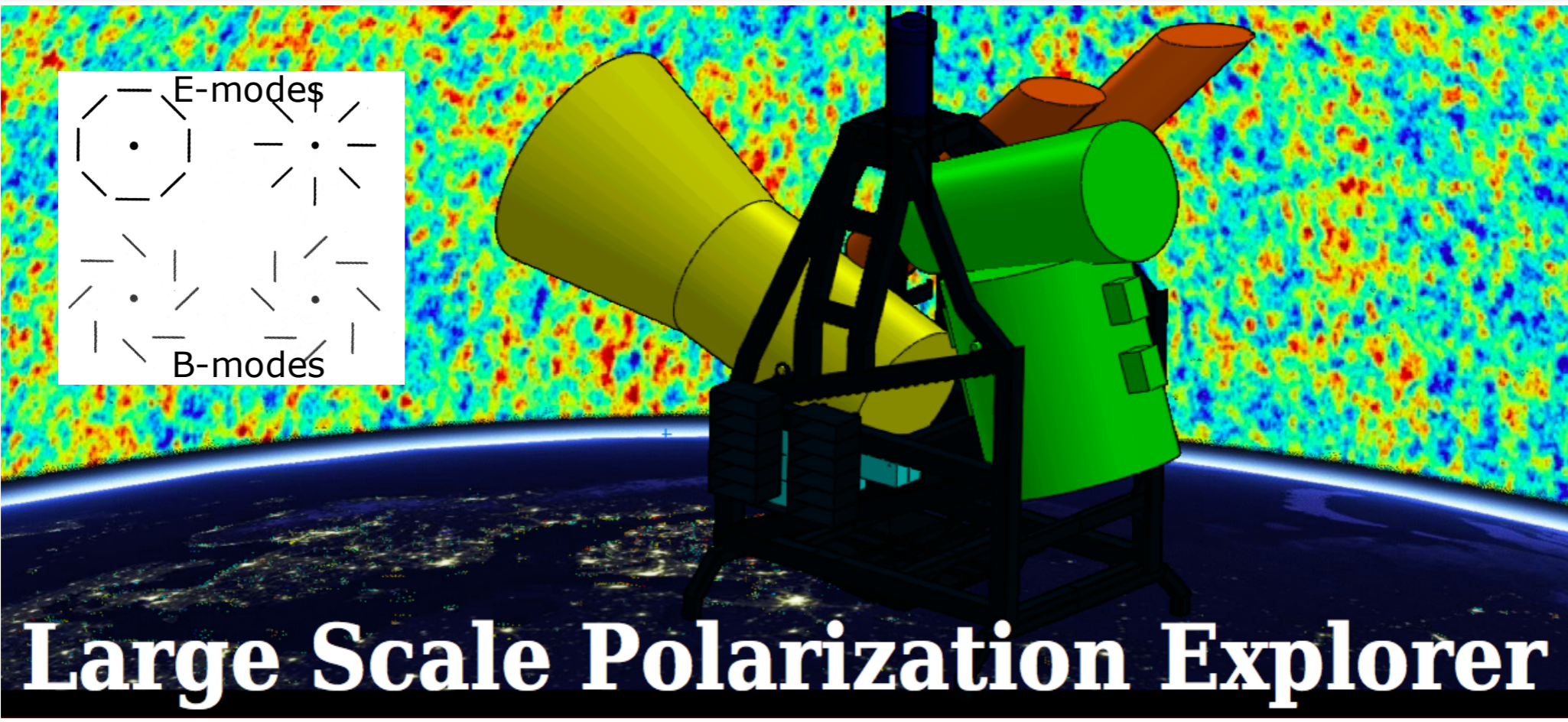
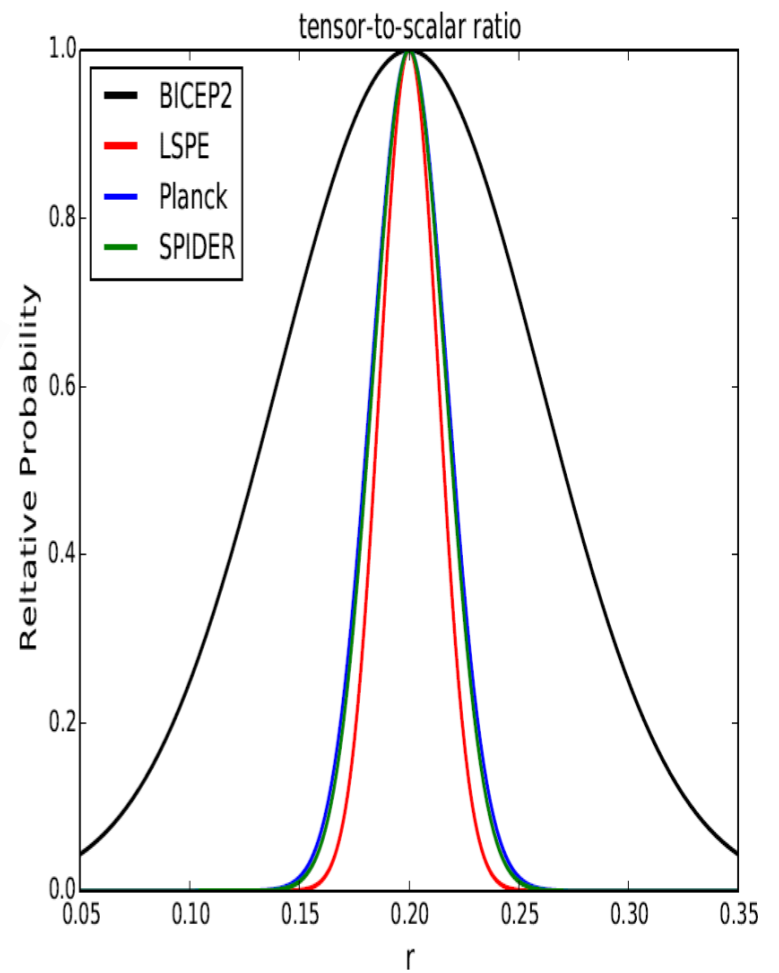
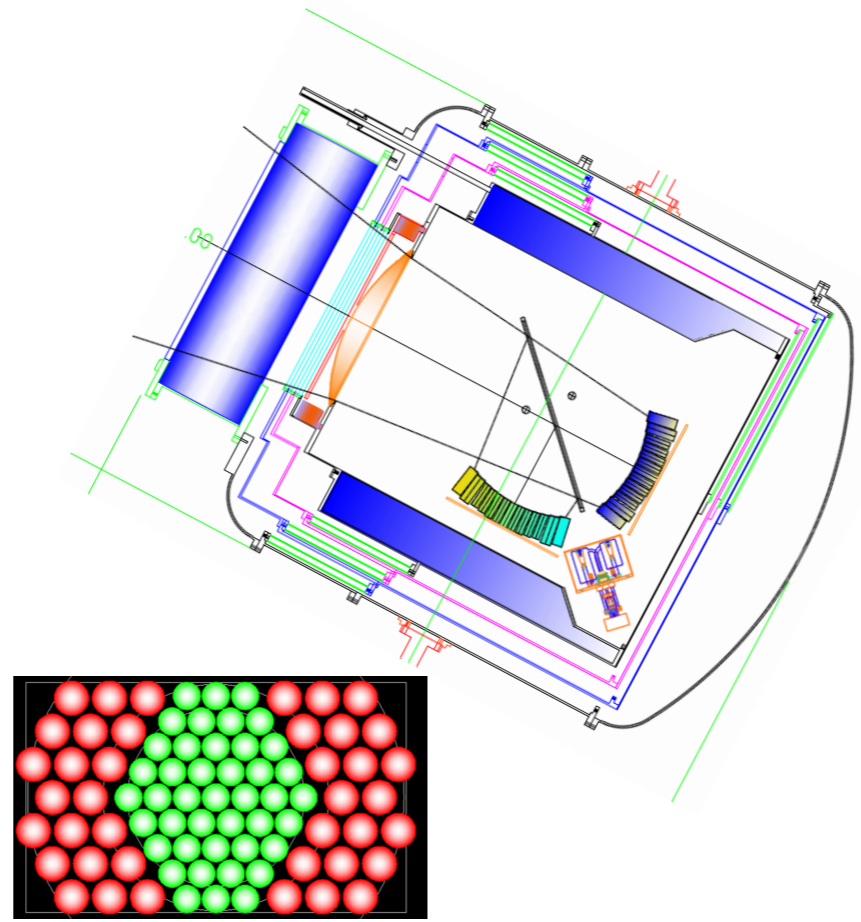
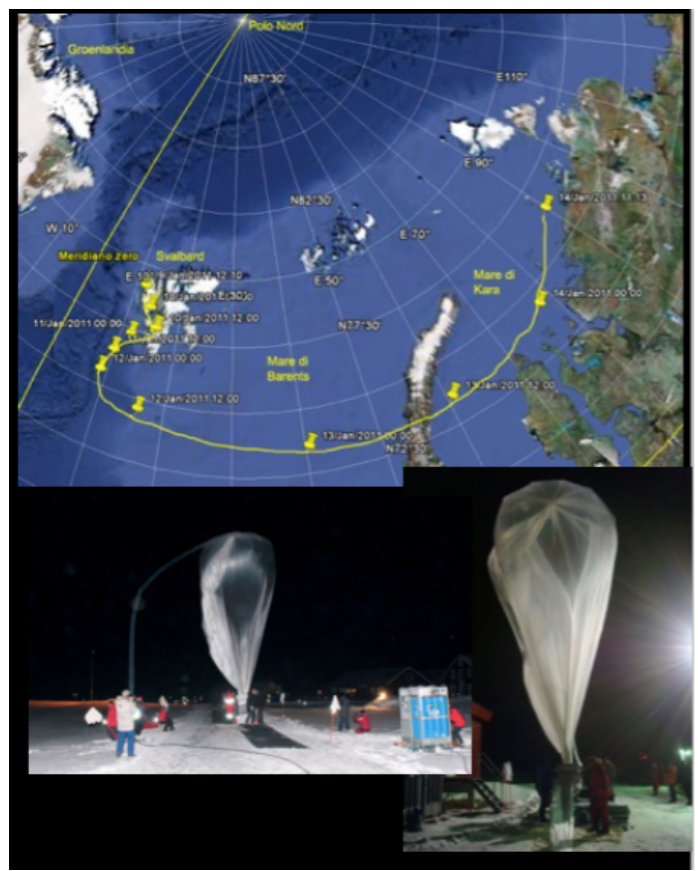


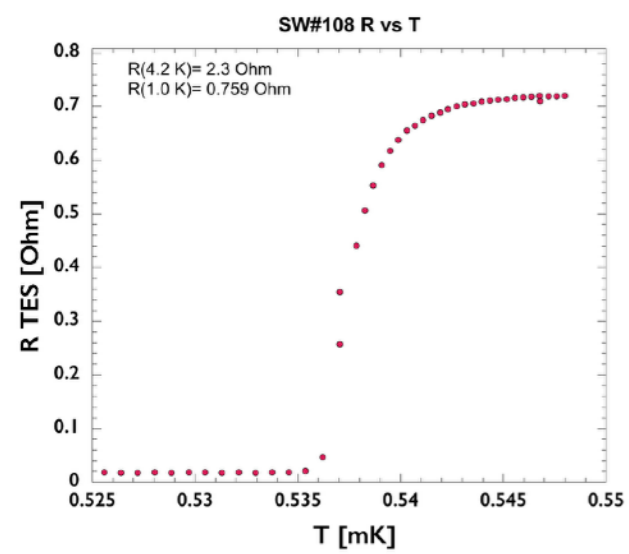
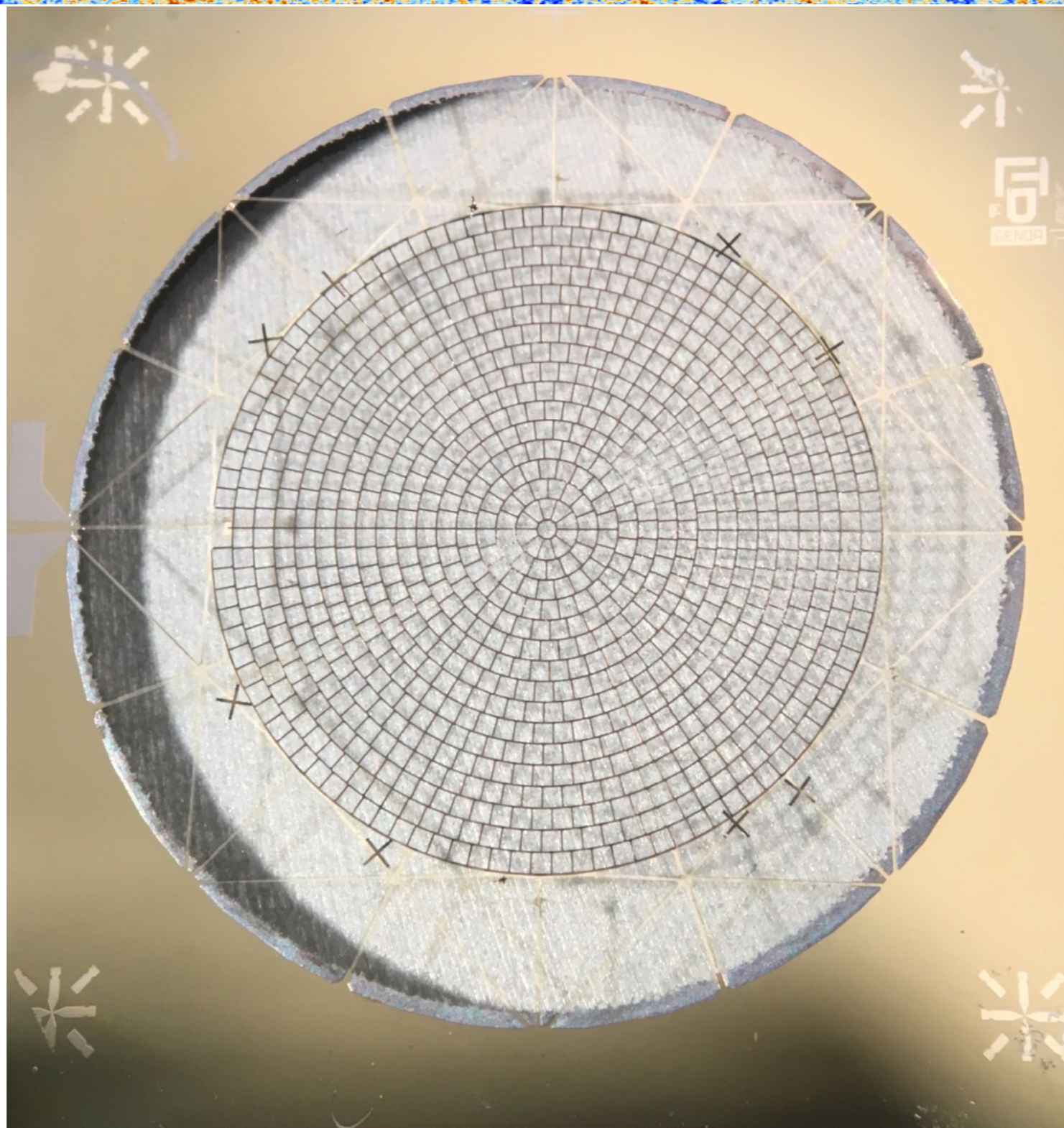
LSPE
F.Gatti
CdS, 1 Luglio 2019

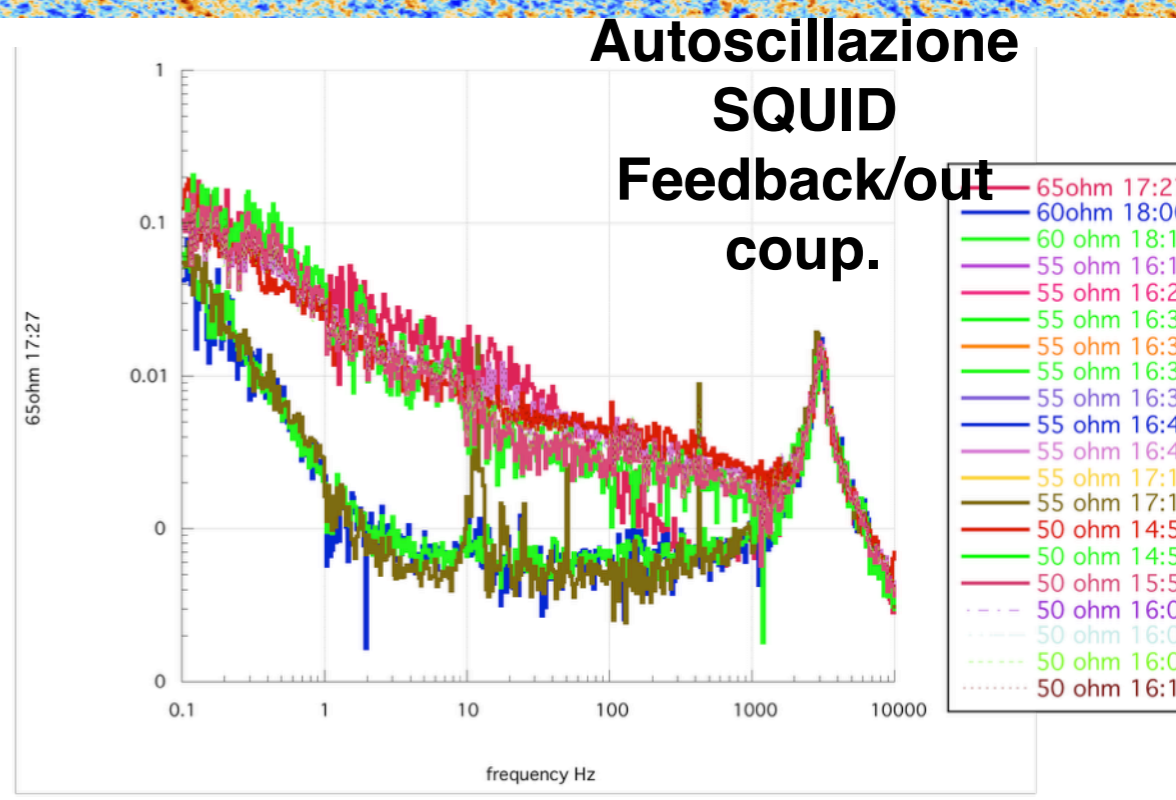
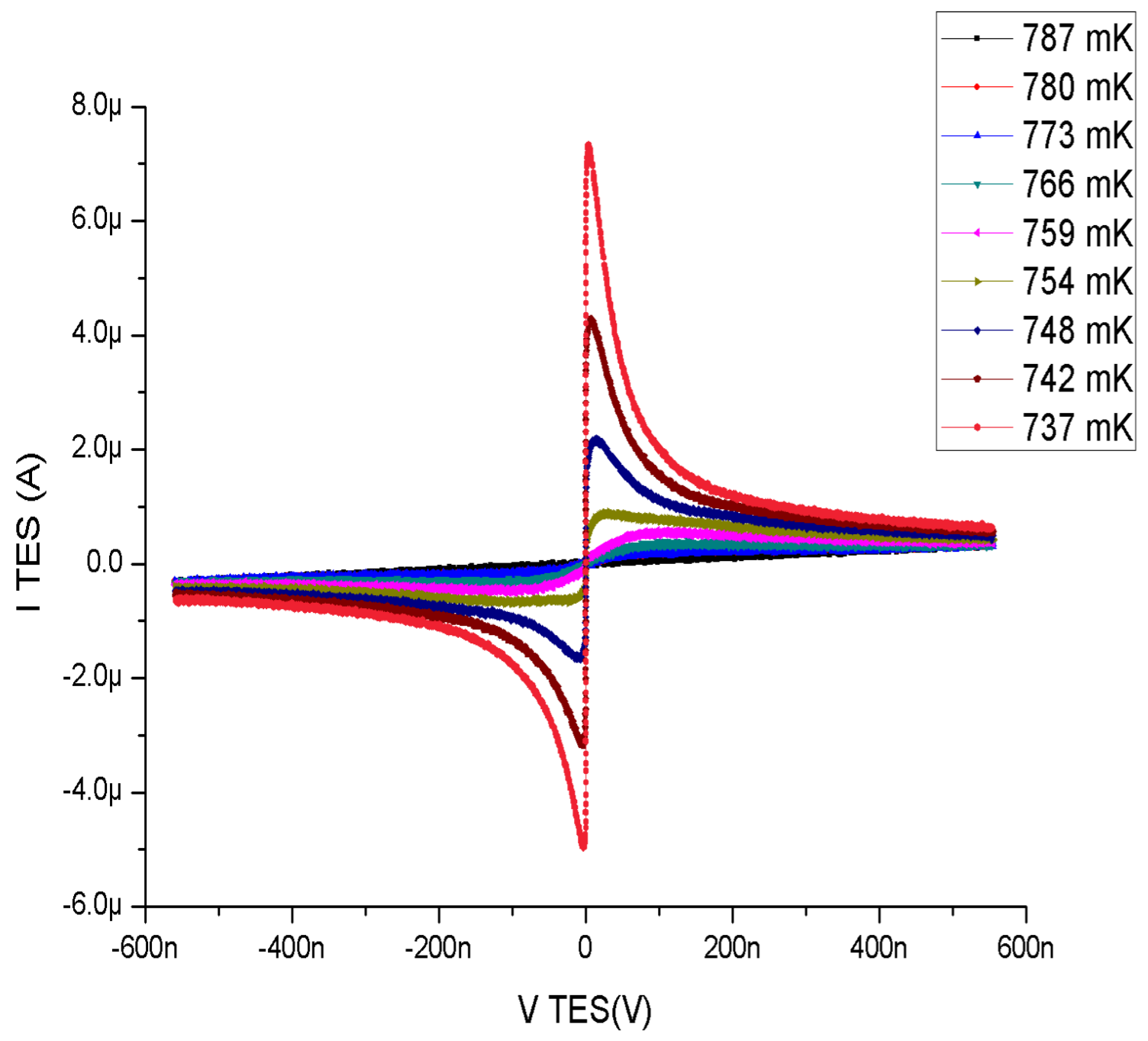
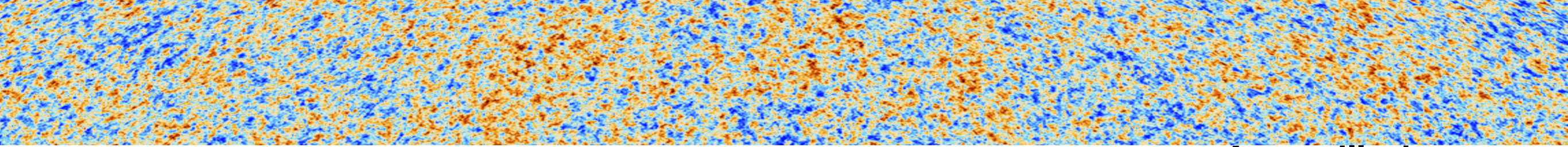


Large Scale Polarization Explorer



330 bolometri



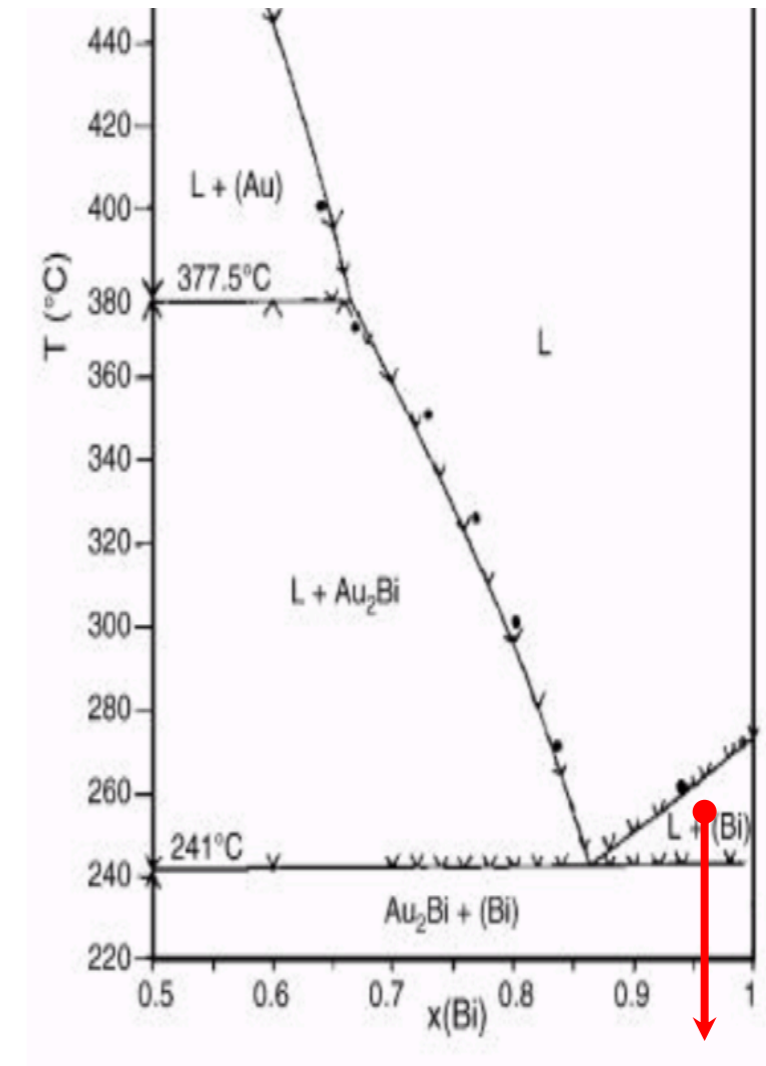
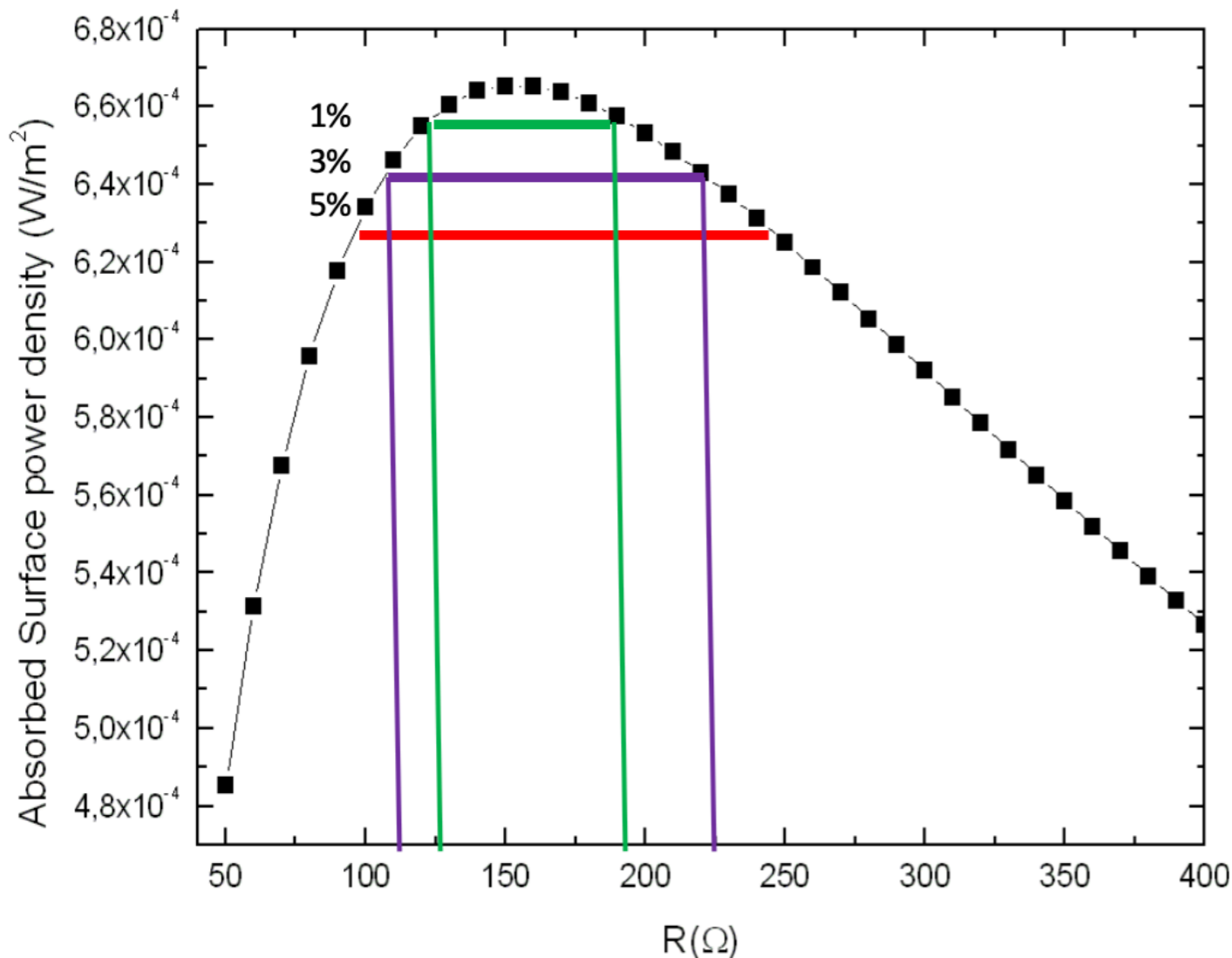


Vbias (μV)	G (10^{-11} W/K)	NEP 10^{-17} W/ Hz $^{0.5}$
0.5	5	2.6
1.0	10	3.8
1.5	20	5.3
2.0	28	6.3

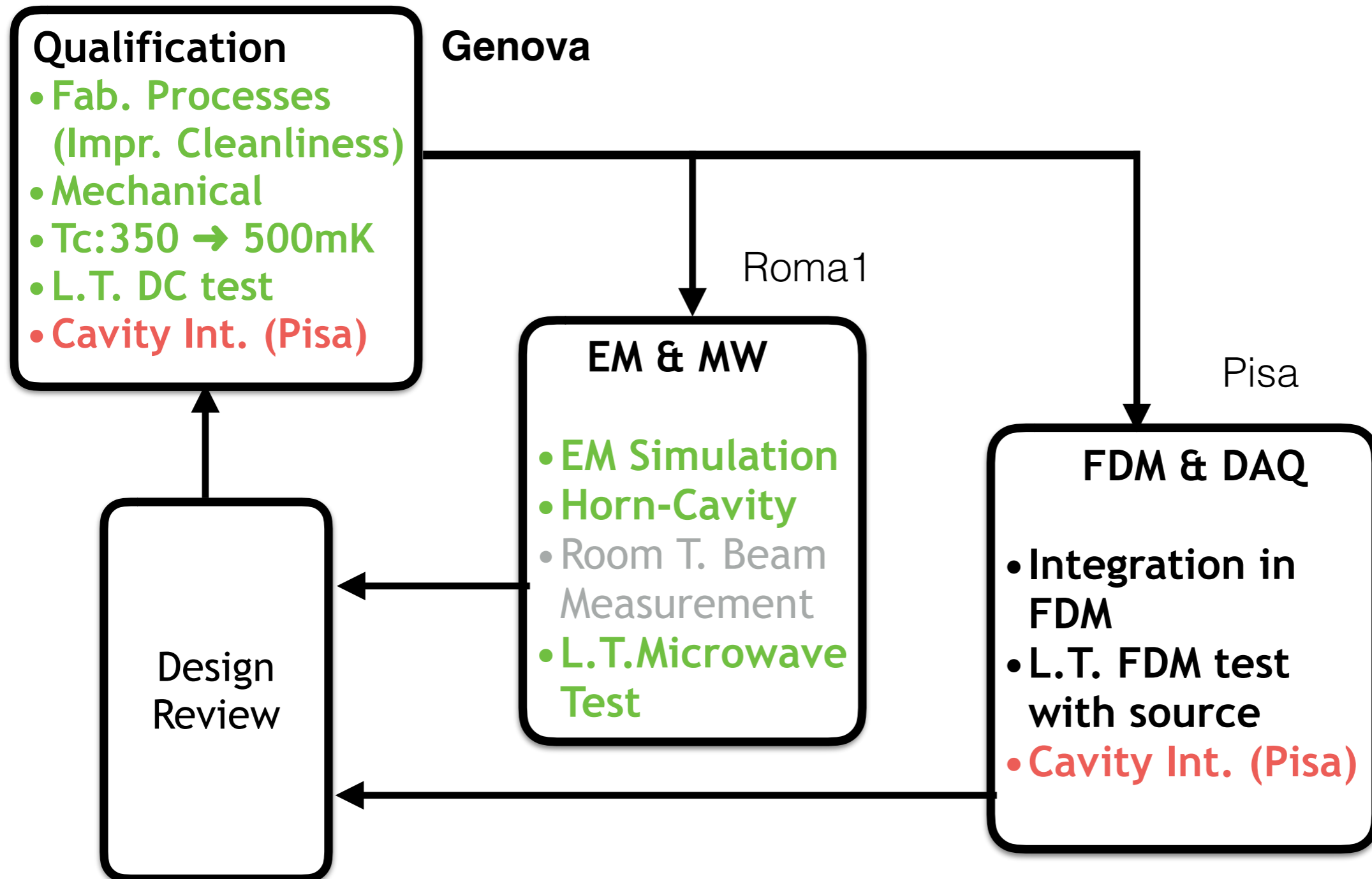
Tuning the thermal time constant

Parameters for Gold	Expct/meas. factor	Effect on heat capacity
RRR	1.5	1.5
3% Match.	1.8	1.8
G factor	2	-
Expctd Tau fact.	5	

Parameter for Bismuth	Expctd/meas. factor	Effect on heat capacity
Resistivity Ratio	50(expec.)-70(meas.)	3,4(expec.)-2,4(meas.)
Specific G fact.	1/170	
G fact.	2	
Expectd. Tau fact	5(meas.)-7(expec.)	



BOLOMETER PROCESS FLOW



Fabrication Plan

TES Fab Process

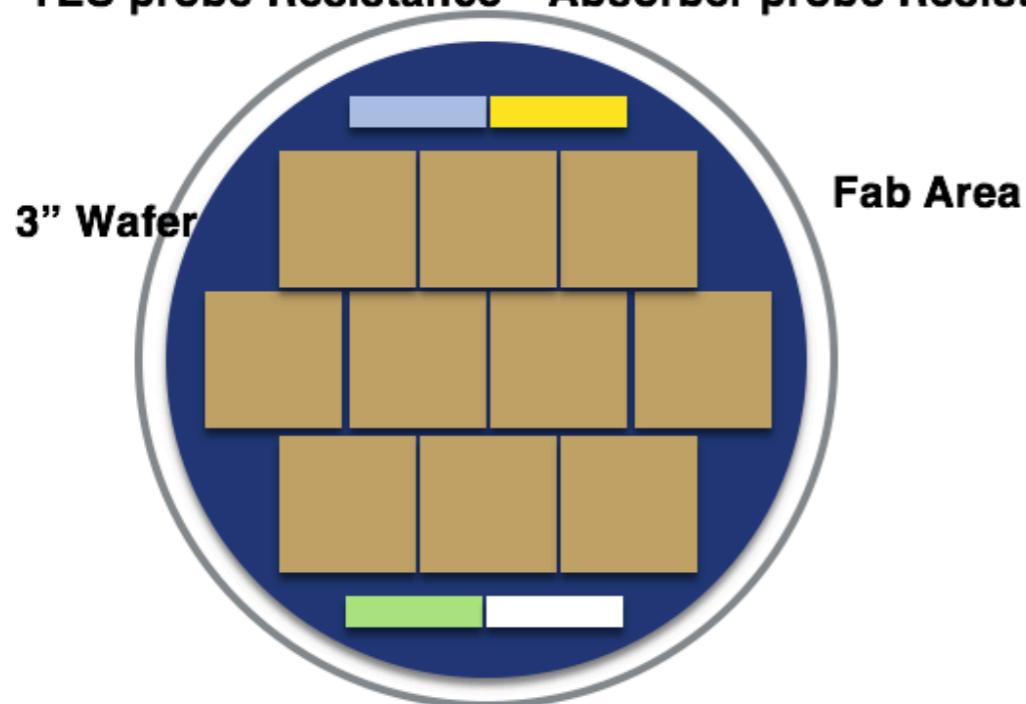
3 teams:

2 teams (2 techs) alternating at Fab

1 team (2 techs) Qualification

Fab Yield >70%

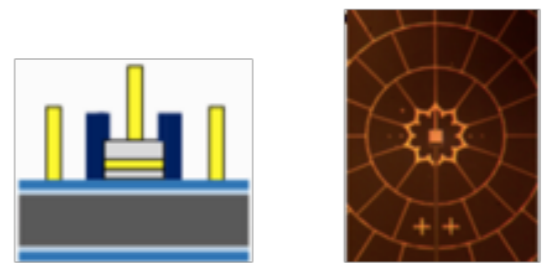
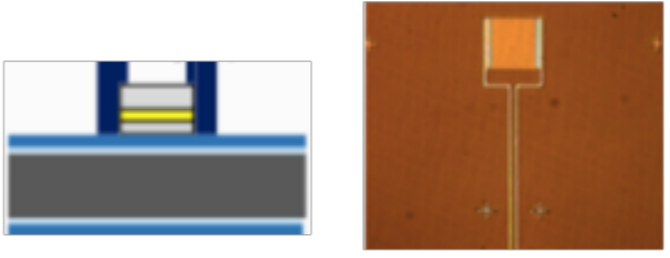
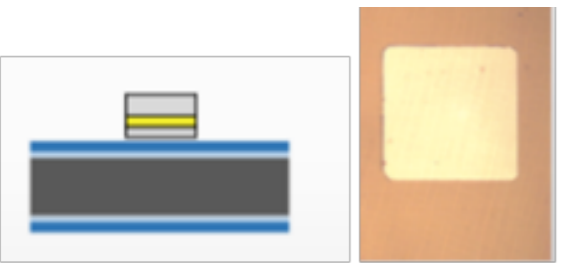
TES probe Resistance Absorber probe Resistance



	week 1	week 2	week 3	week 4	week 5	week 6	week7	week8
Fab	10 x10 bol	10 x10 bol	10 x10 bol	10 x10 bol	10 x10 bol			
Inspec		10 x10 bol	10 x10 bol	10 x10 bol	10 x10 bol	10 x10 bol		
El test		10 x10 bol	10 x10 bol	10 x10 bol	10 x10 bol	10 x10 bol		
0.5 K			10 x1	10x1	10 x1	10 x1	10 x1	
Q.fied			10x10	10x10	10x10	10x10	10 x1	
bol #			100	200	300	400	500	
70% Y			70	140	210	270	340	

Wires probe Resistance Not Assigned

Qualification of Bolometer Fab Process (1)



4 x chips
2 x 3" wafers

4 chips
2 x 3" wafers

4 chips
2 x 3" wafers

Wafer cleaning 15'

TopSide Clean. 5'

TopSide Clean. 5'

TES Litho N 25'

Wires Litho N 30'

Abs. Litho N 20'

TES deposition 30'

Wires deposition 30'

Abs. deposition 30'

TES lift-off 15'

TES lift-off 15'

Abs. lift-off 15'



< 1 h 25 m

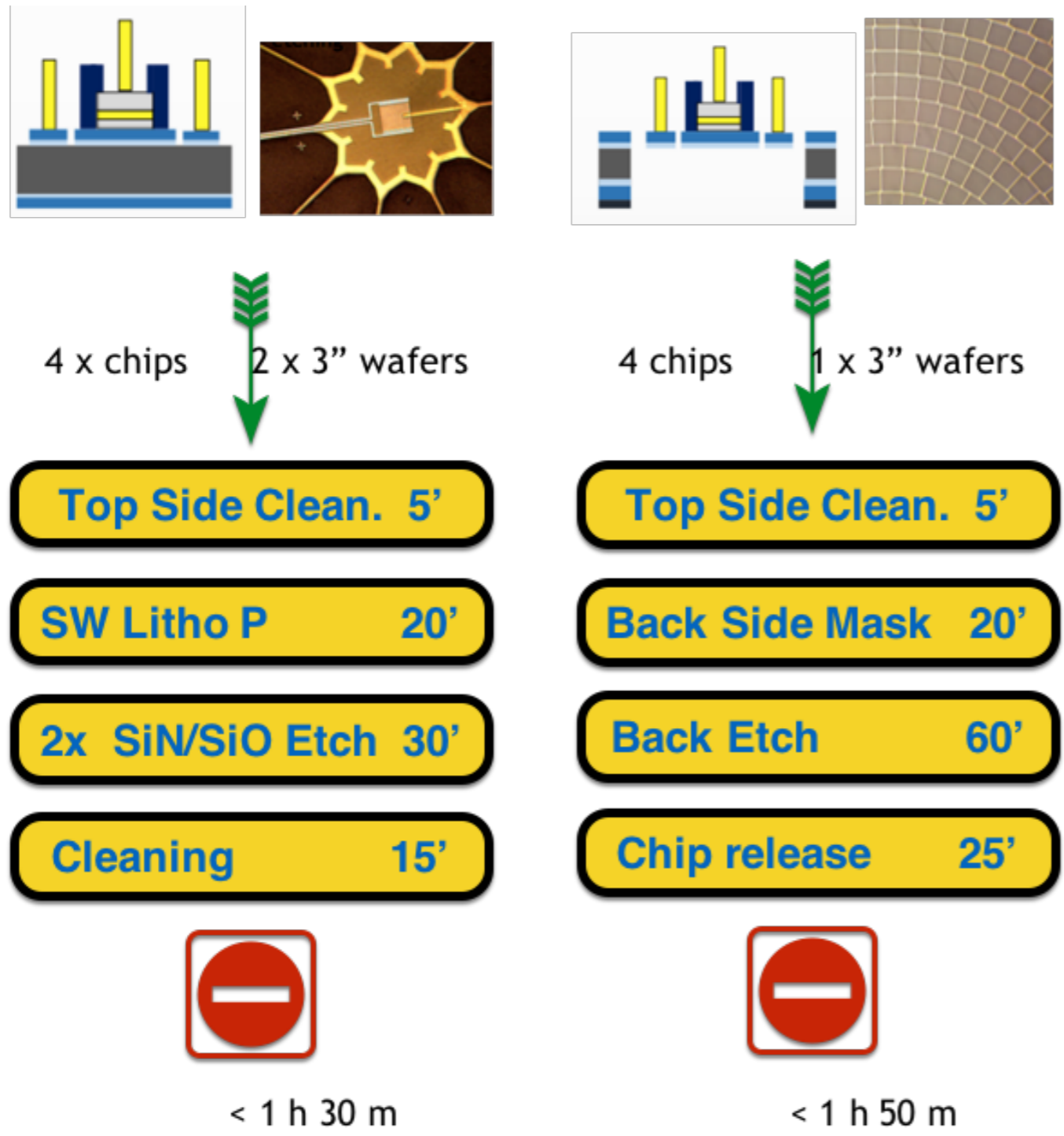


< 1 h 20 m



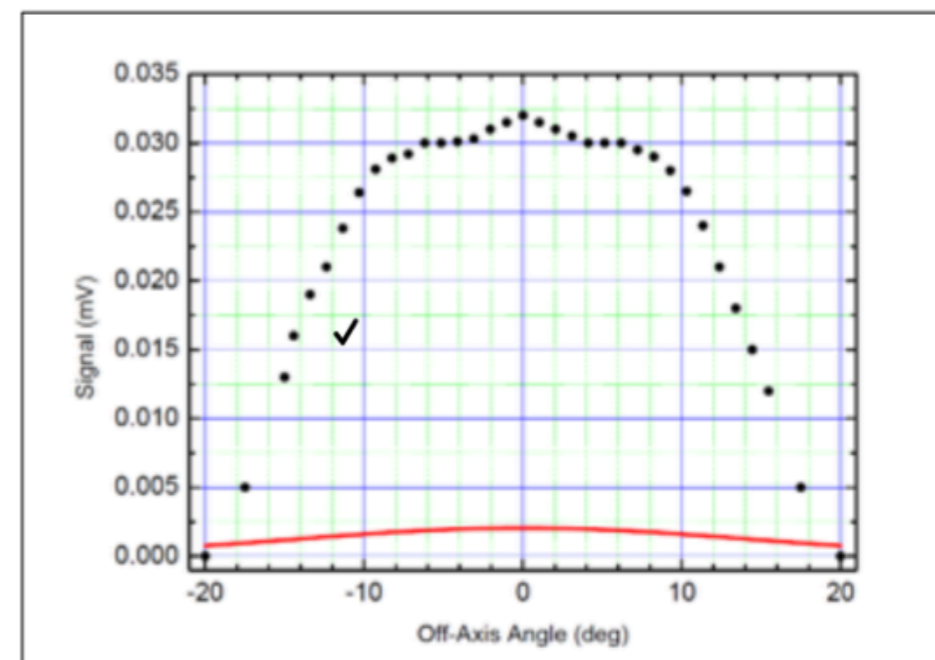
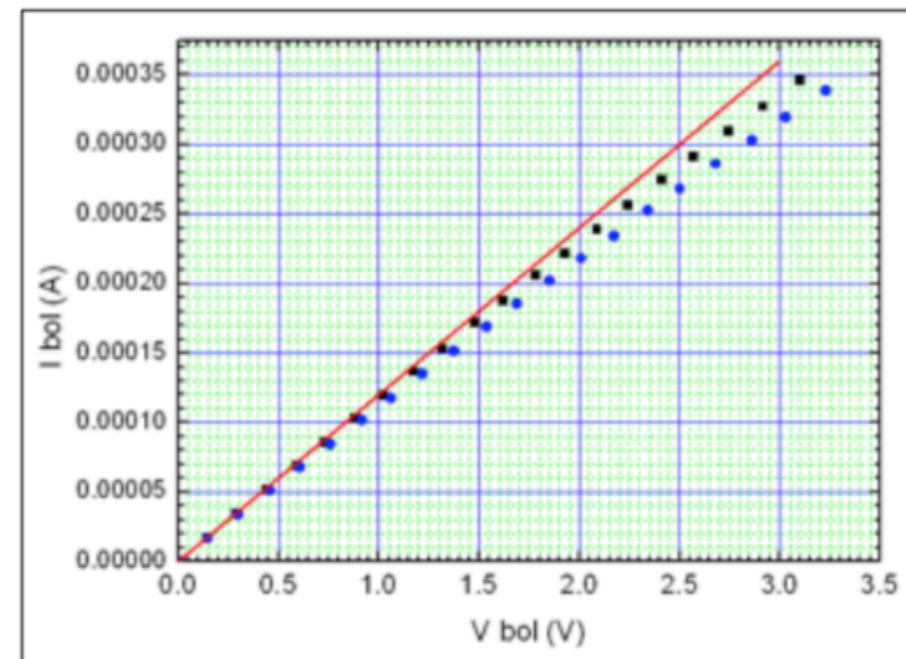
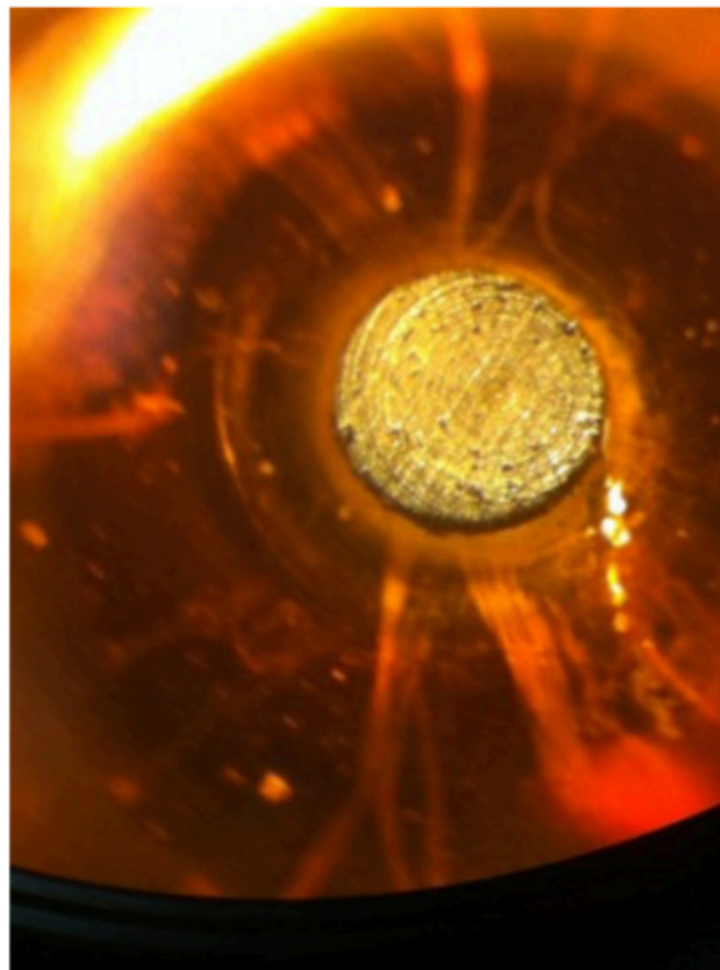
< 1 h 10 m

Qualification of Bolometer Fab Process (2)



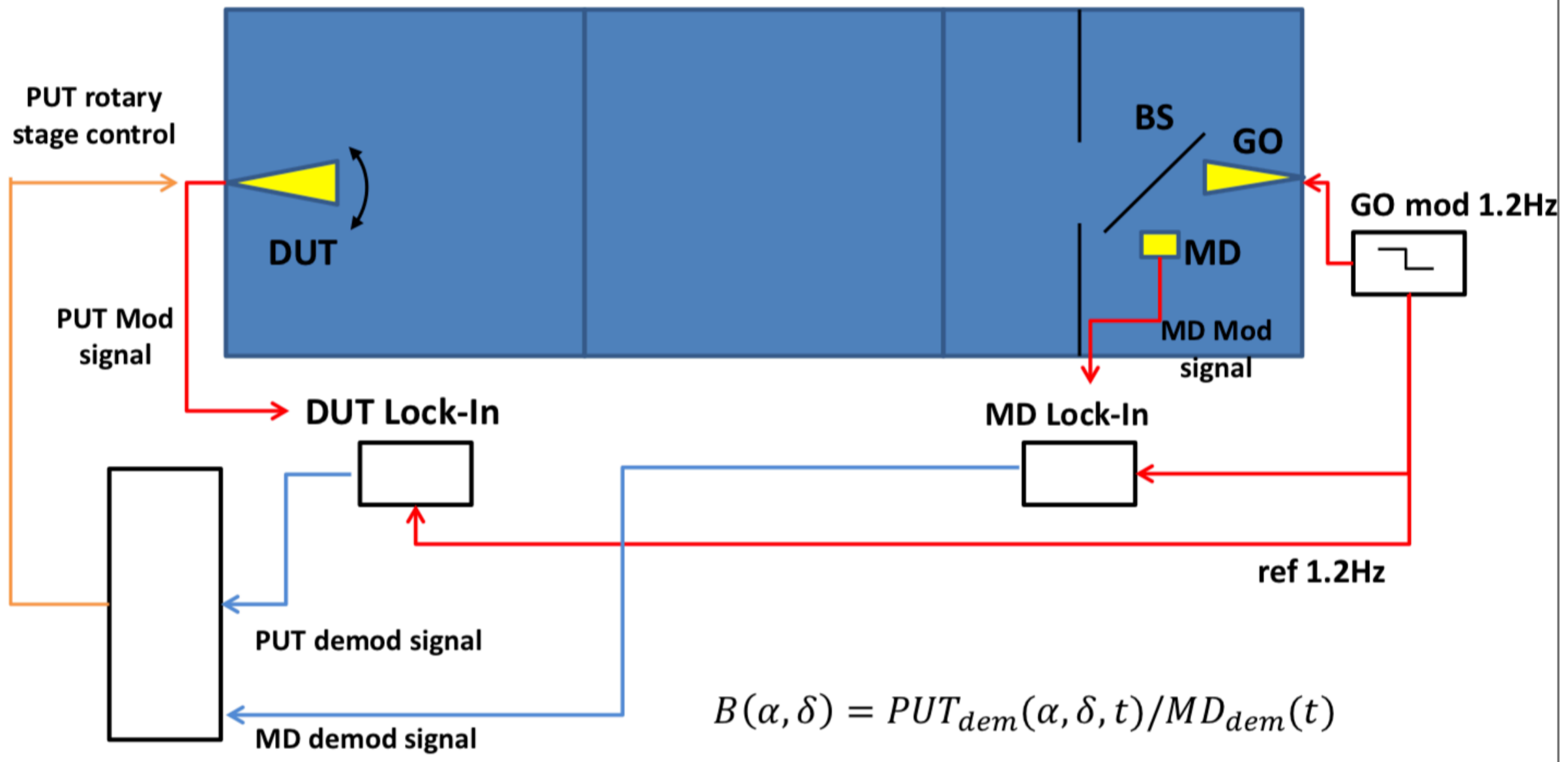
Room Temperature Beam Characterisation in multi-mode regime

First promising measurements



Slide CSN2 Set.14

Tests of the pixel assembly

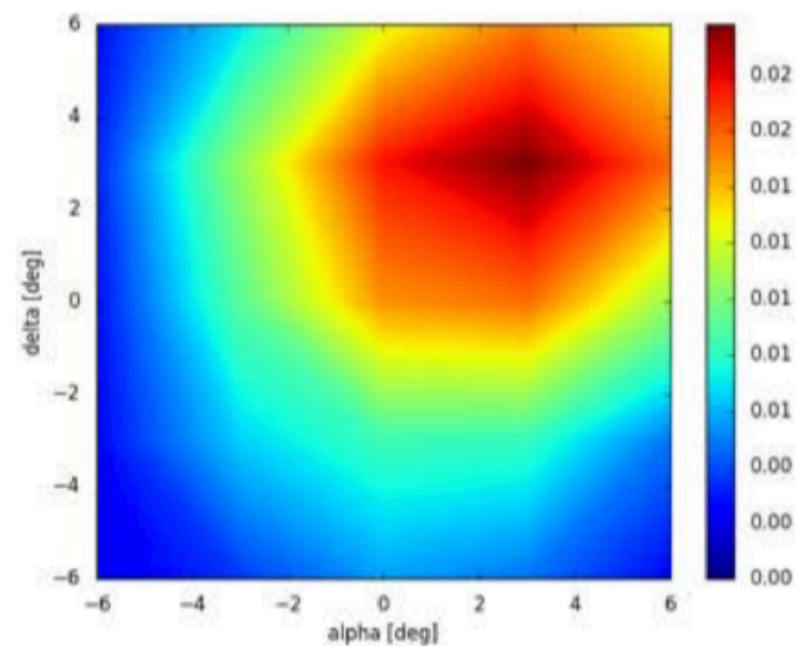


PC (rotary stage control and data acquisition)

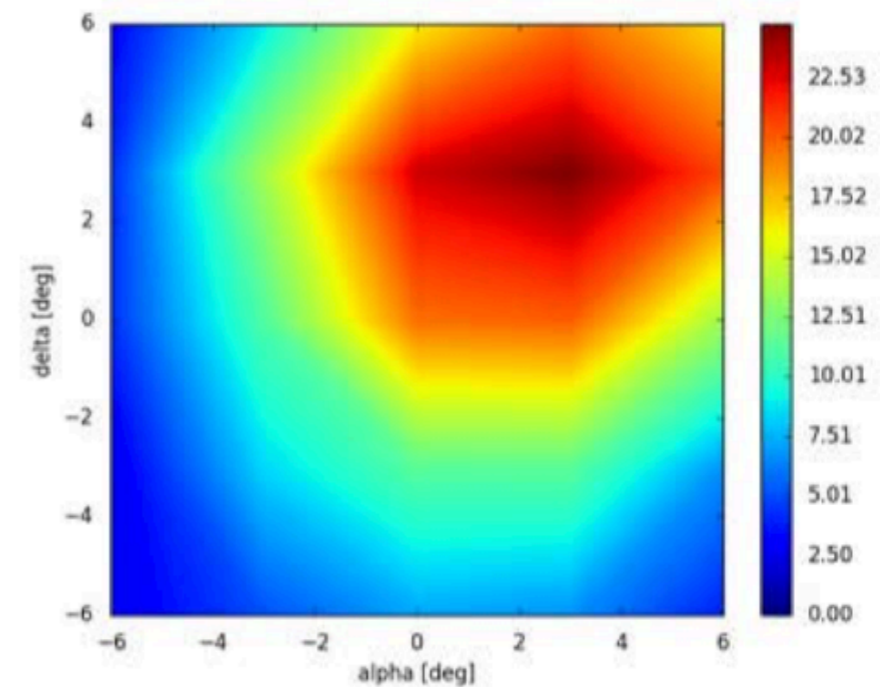
Over 300 hours of tests run so far

Beam measurement repeated without the beam splitter along the radiation path from the Gunn Oscillator to the pixel.

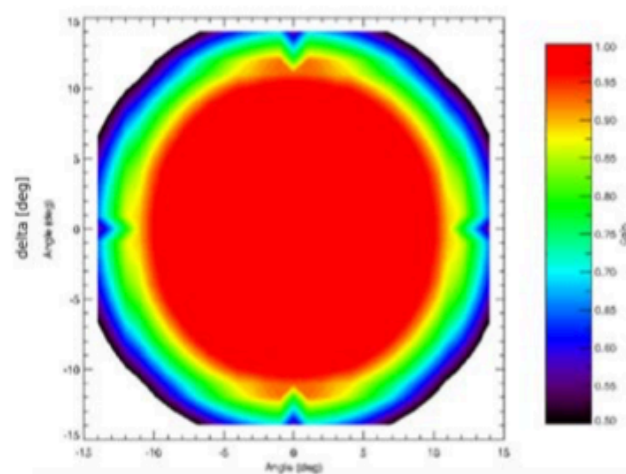
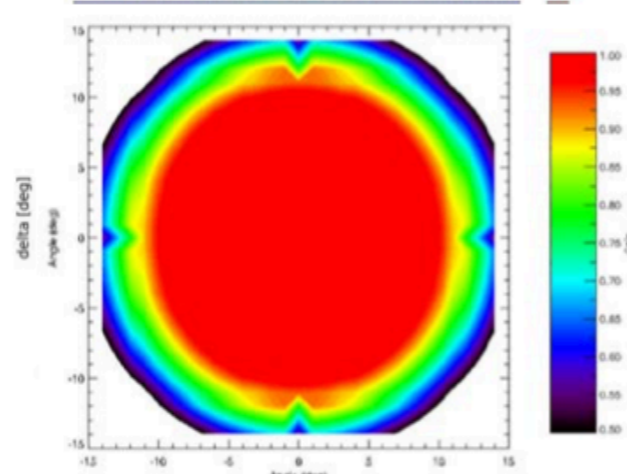
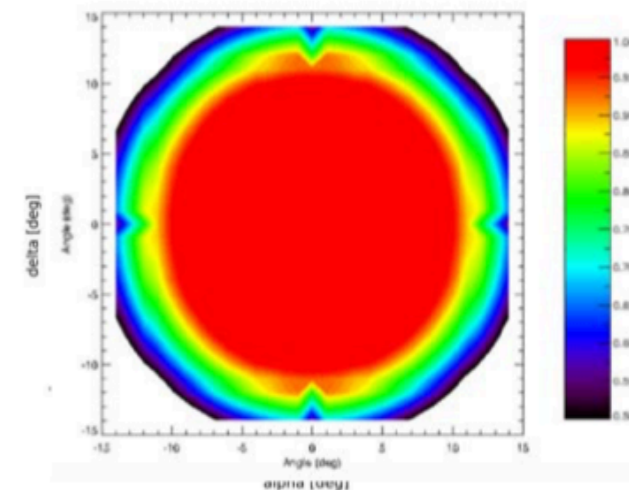
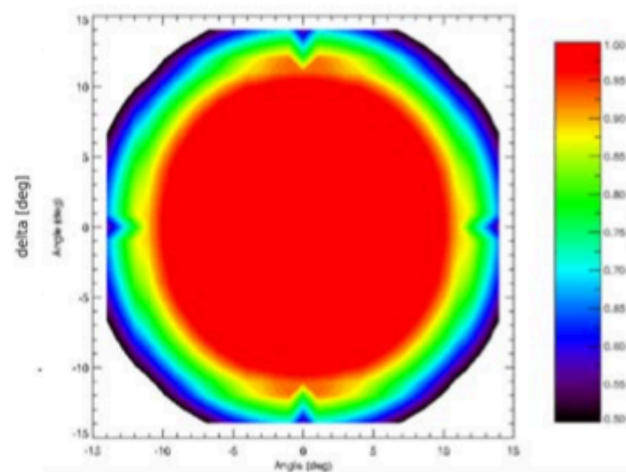
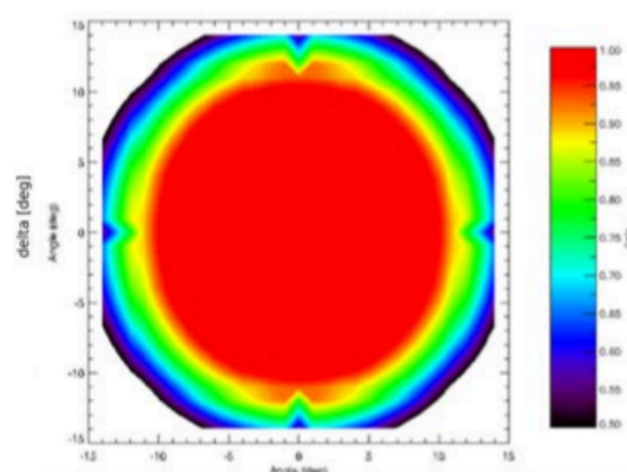
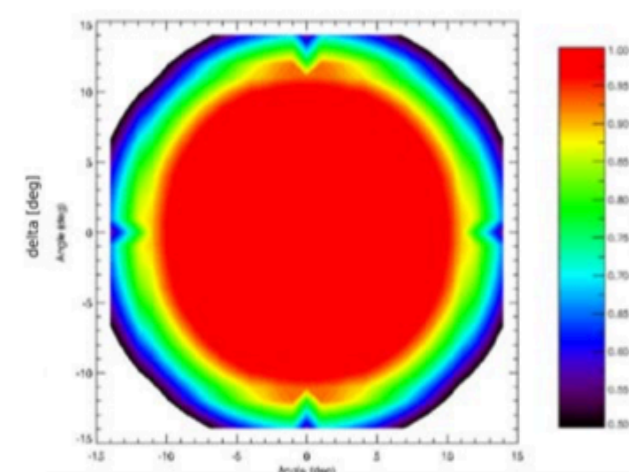
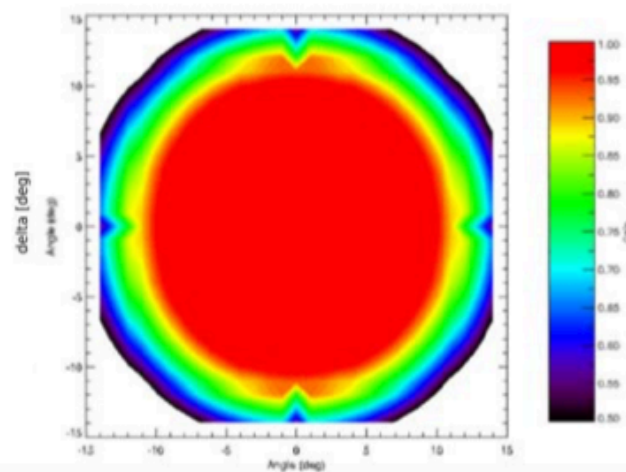
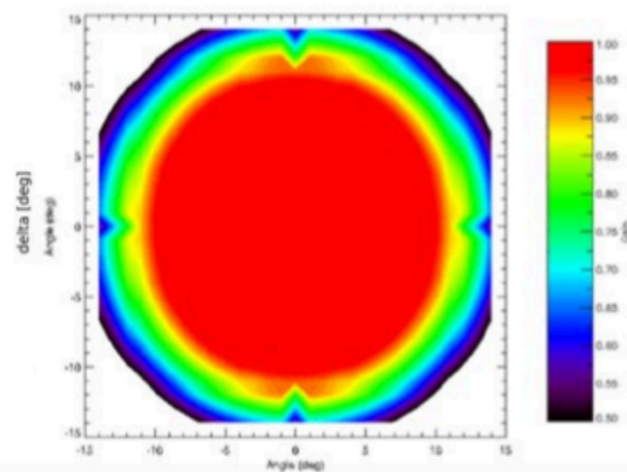
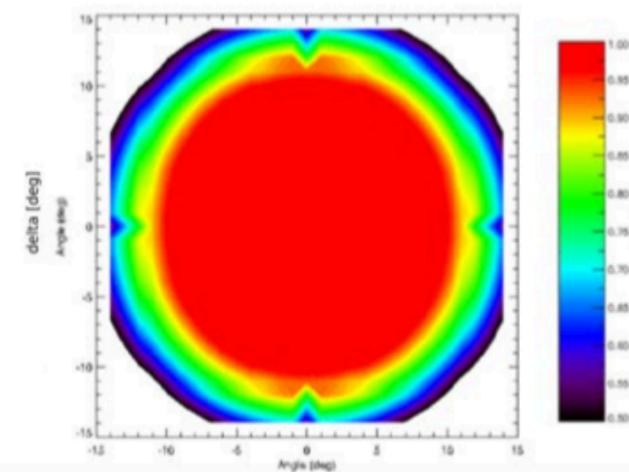
No Beam Splitter



With Beam Splitter

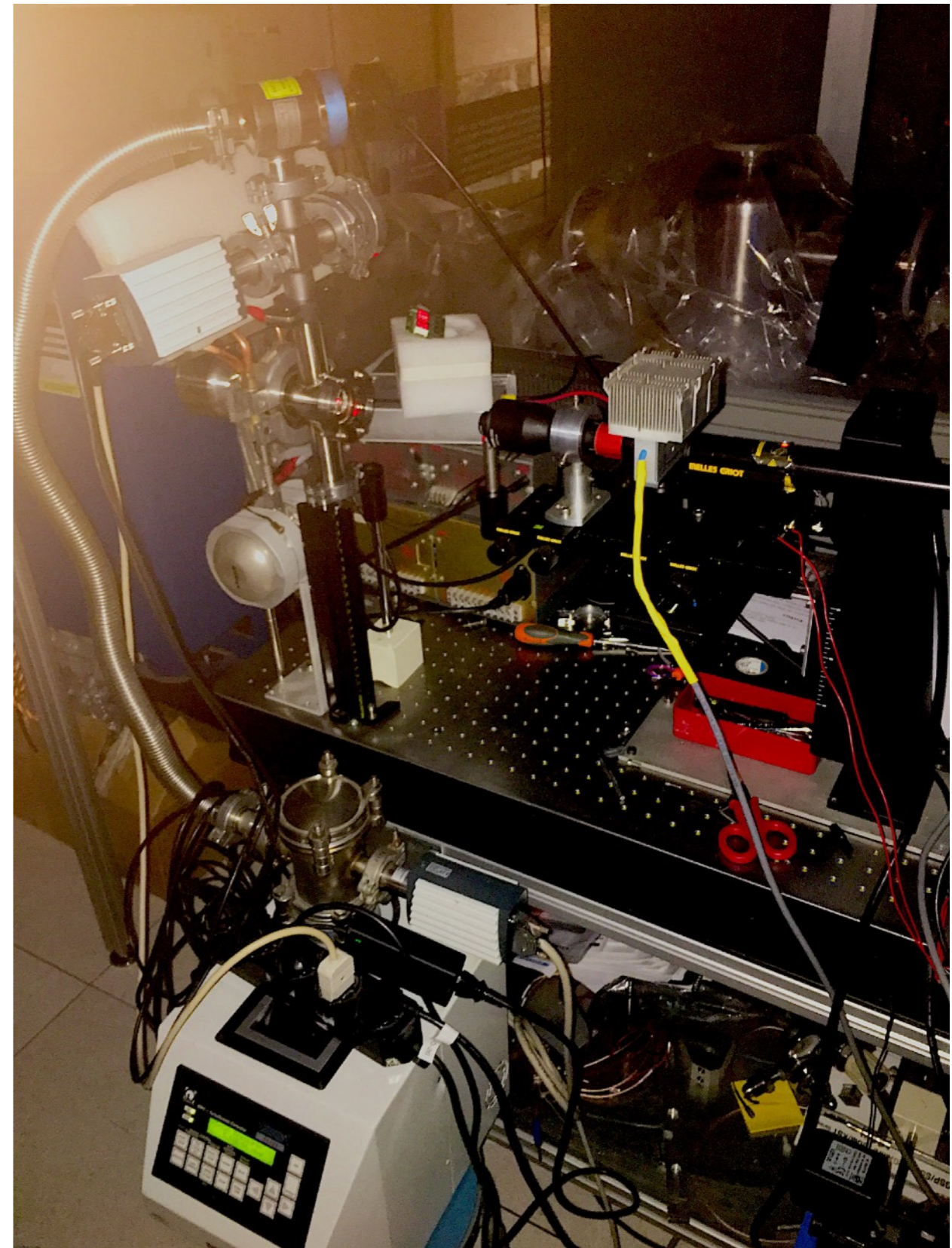
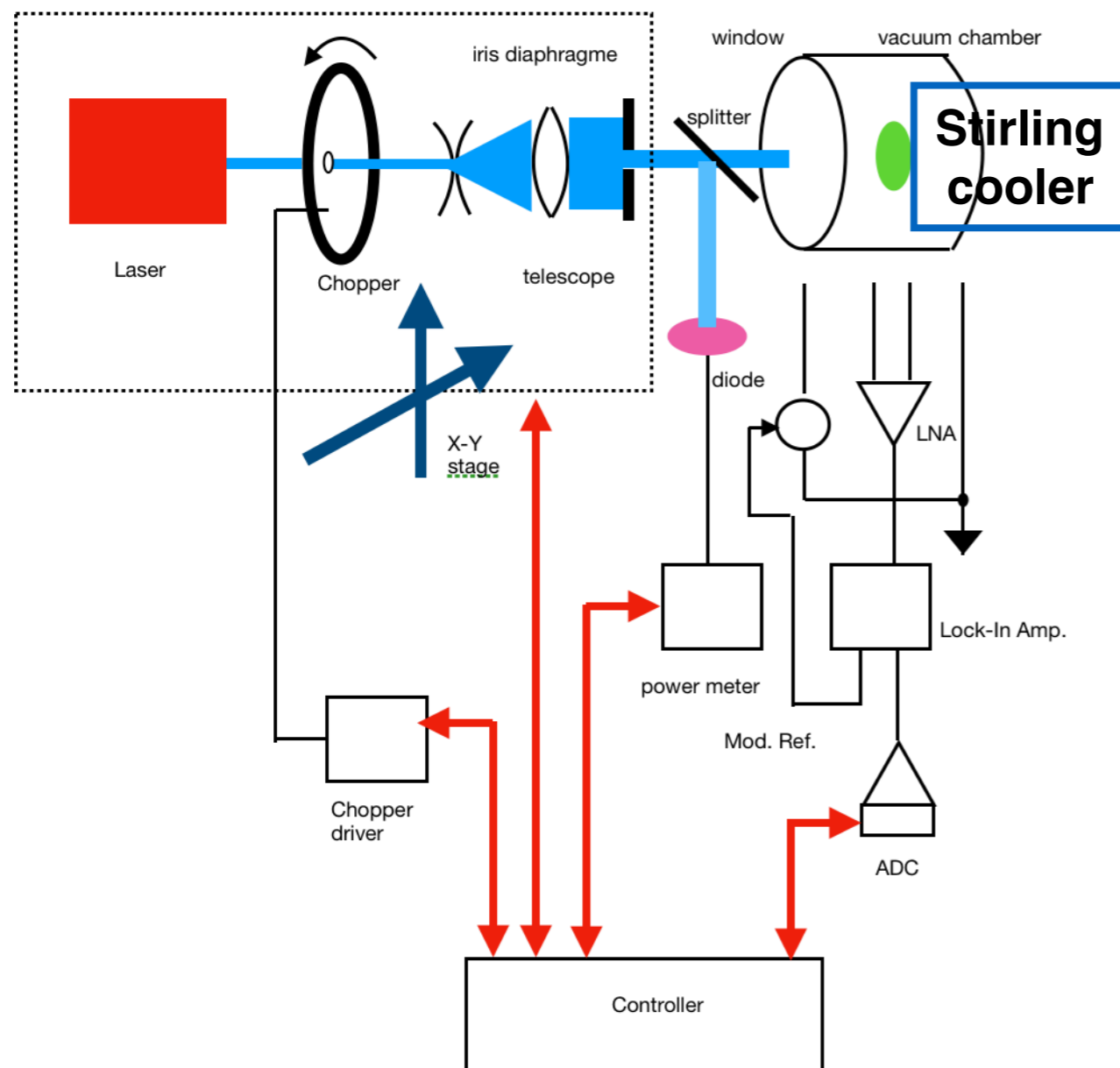


Frequency sweep (self-normalized)

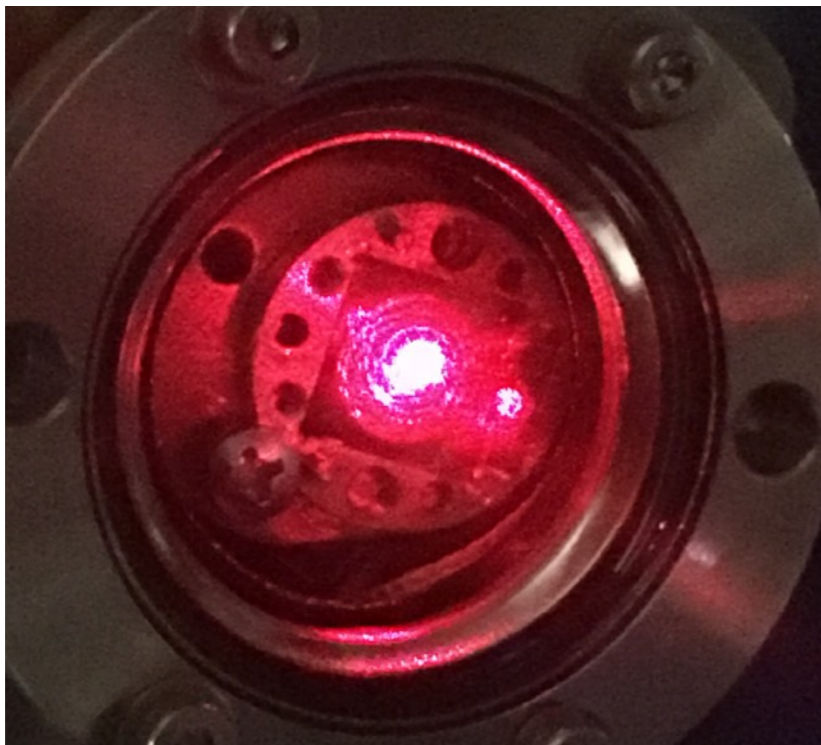
115 GHz**120 GHz****124 GHz****128 GHz****131 GHz****135 GHz****139 GHz****142 GHz****145 GHz**

Detector Uniformity Test

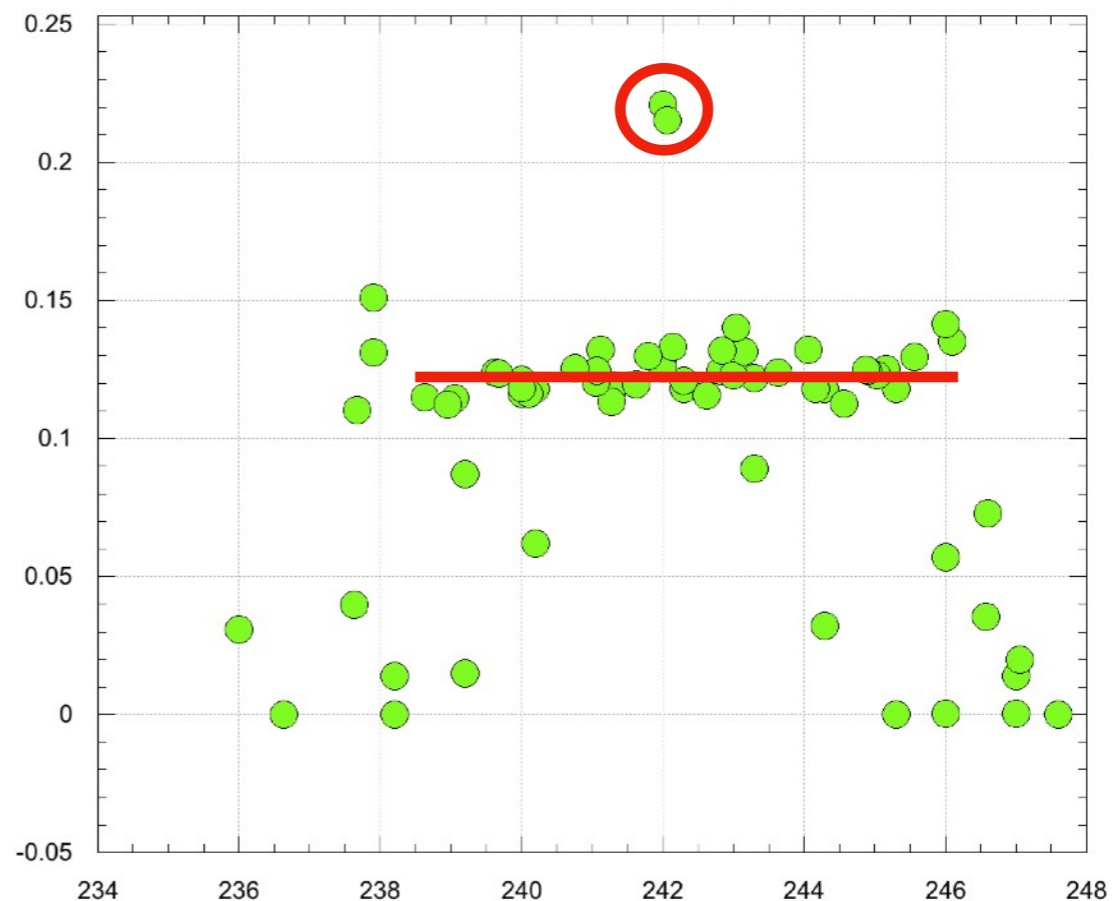
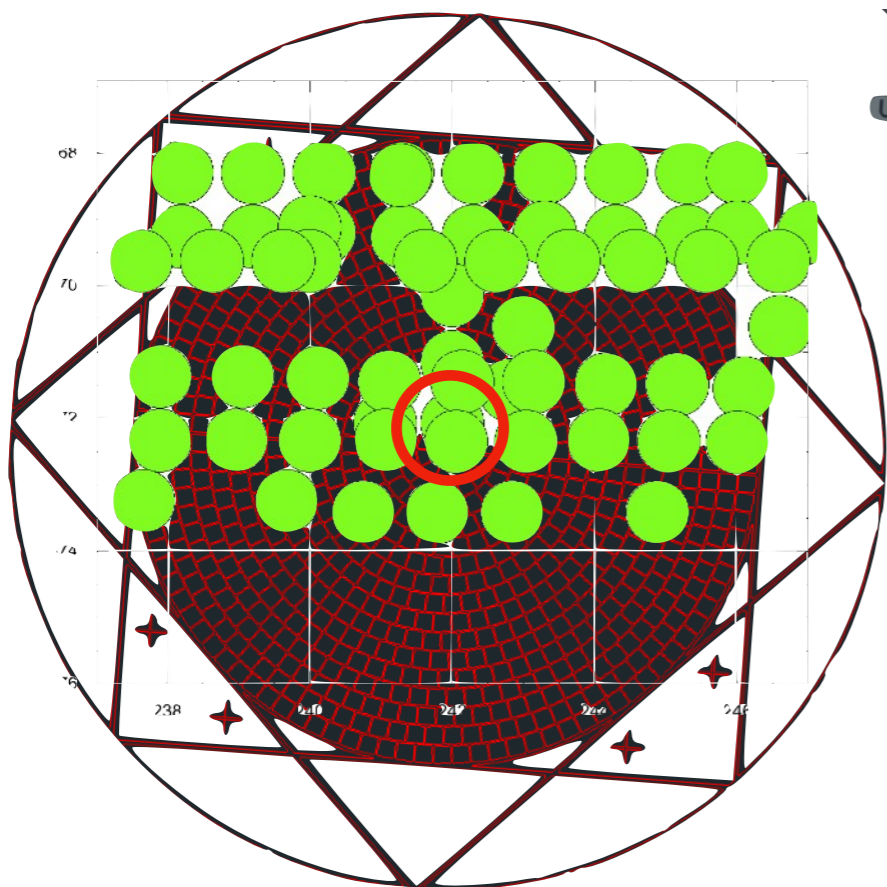
- In modi ad alta molteplicità il campo E ha configurazioni che cambiano sulla scala del mm, equivalente alla dimensione di 4-5 elementi della griglia.
- Il bolometro risponde uniformemente anche con dissipazioni di potenza così localizzate?
- Necessario un test indipendente.
- Scanning dello SW con fascio laser di dimensioni di pochi mm di diametro.

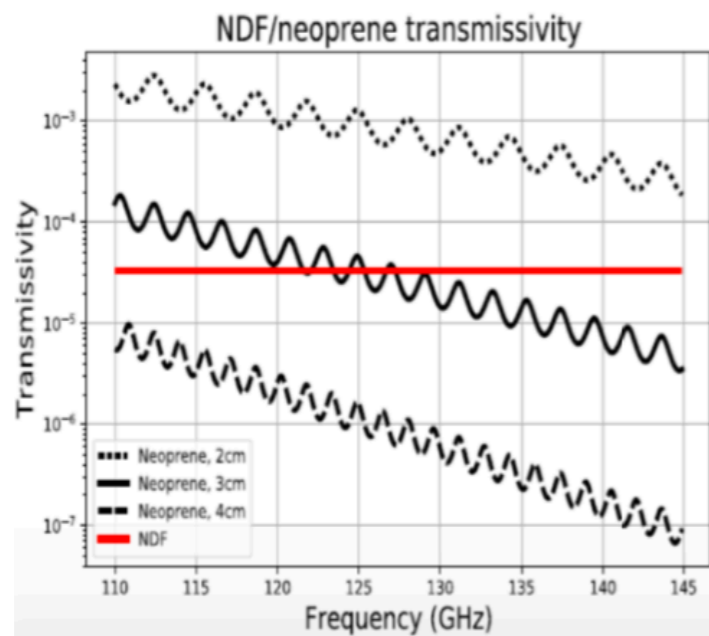
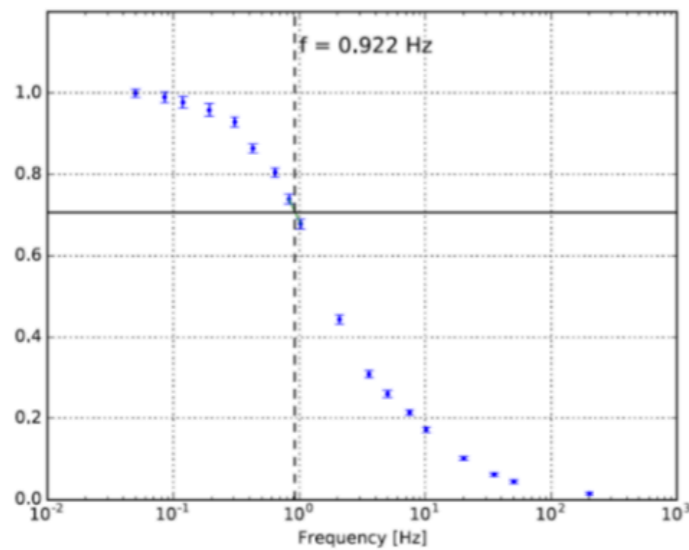
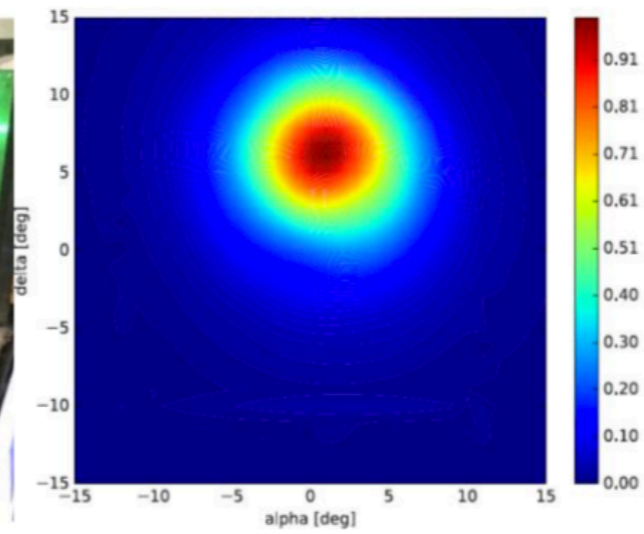
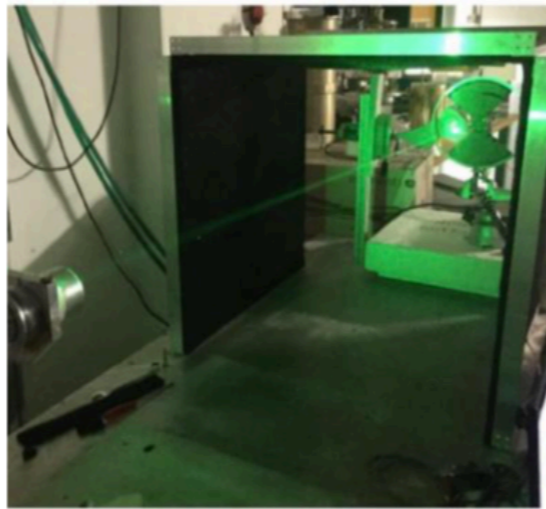
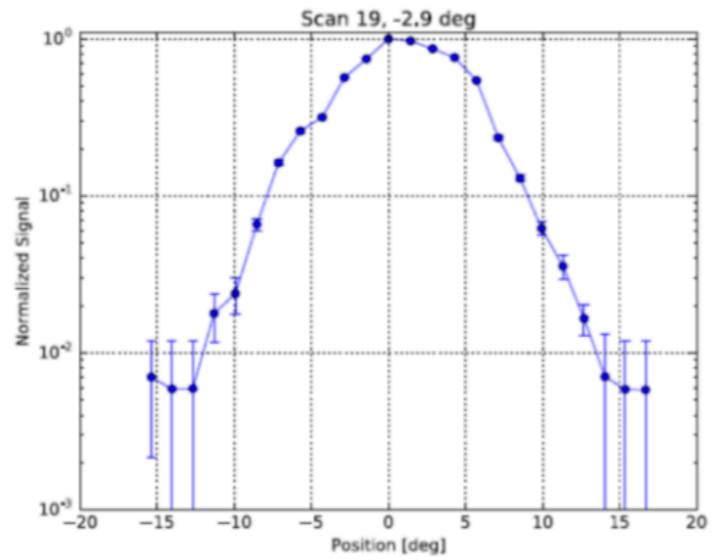


Detector Uniformity Test



- Test with 1 mm diameter spot
- Power 3-5 uW in the spot
- Temperature: 300 K and later 140 K
- Pressure 5×10^{-6} mbar
- Aligment approximate



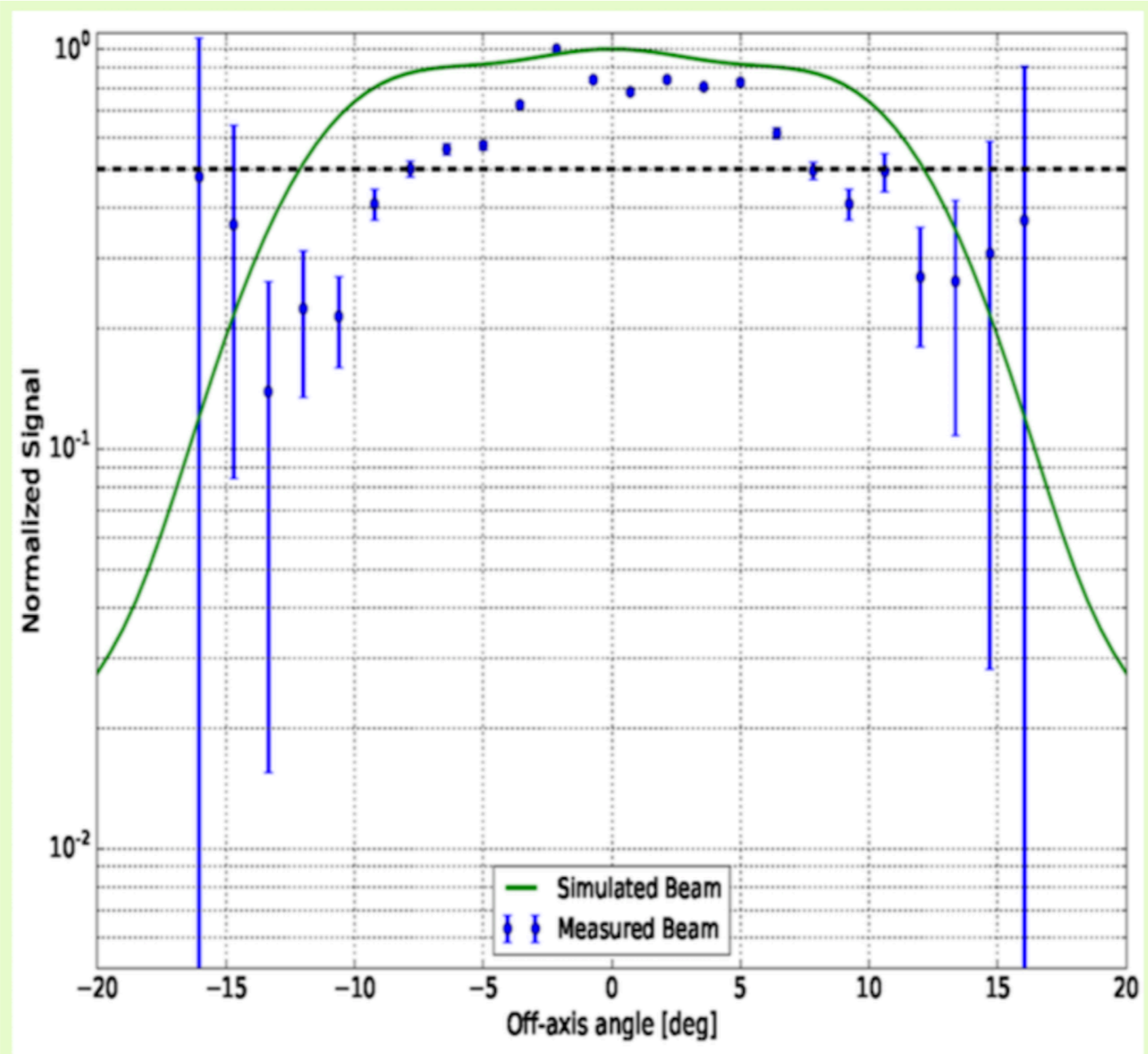


Detailed view of the experimental setup with labels:

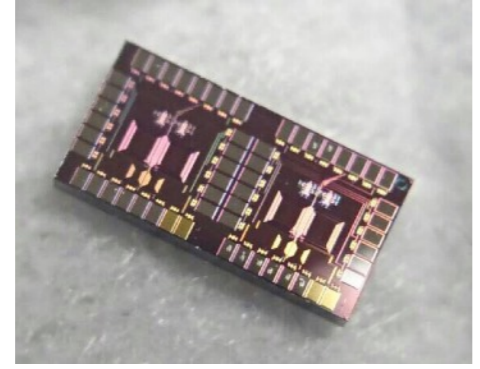
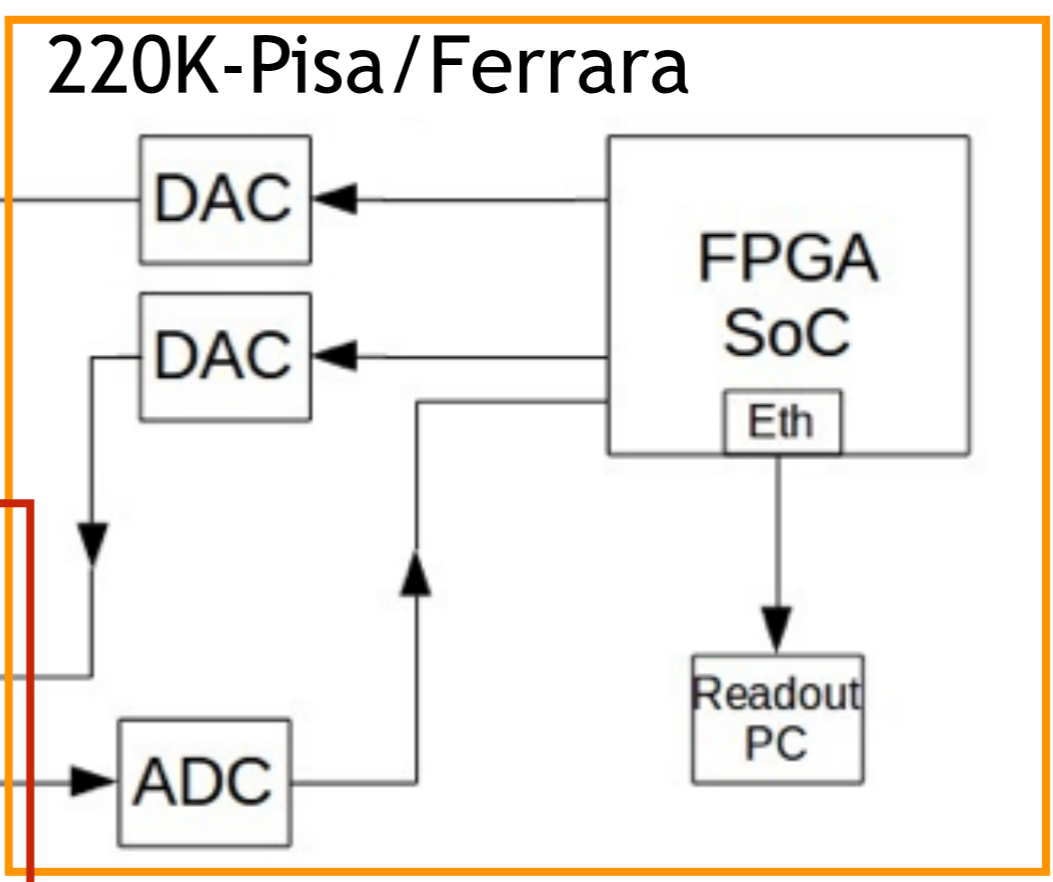
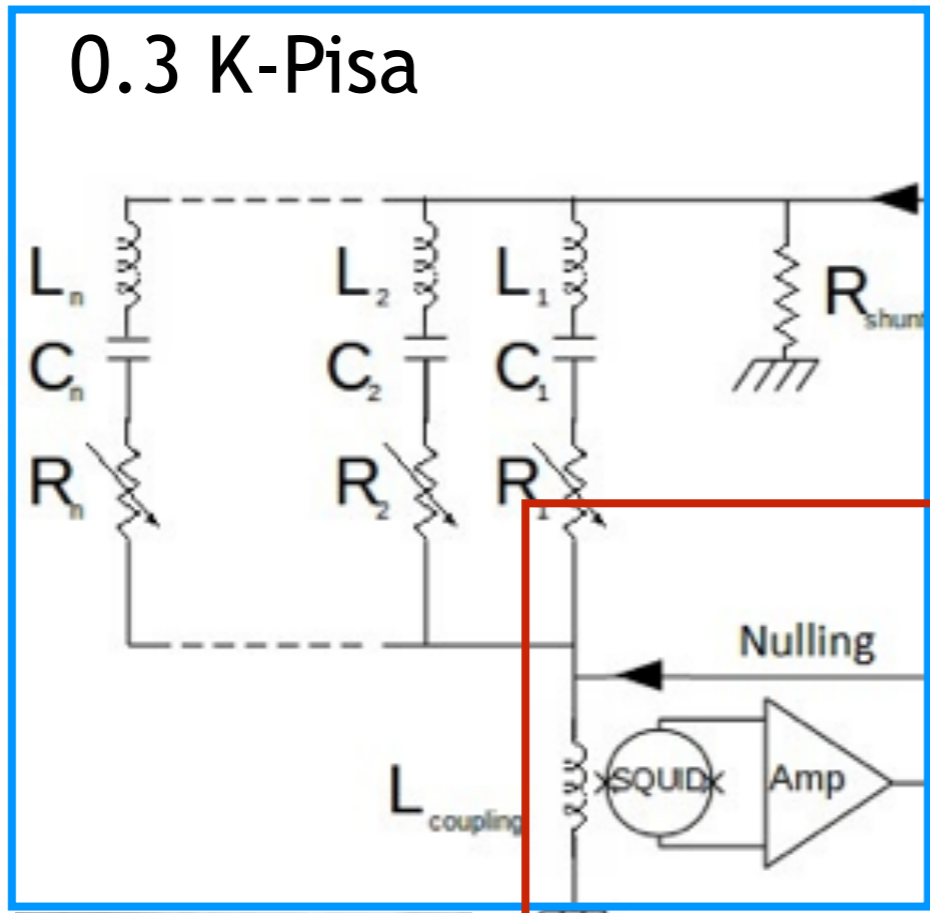
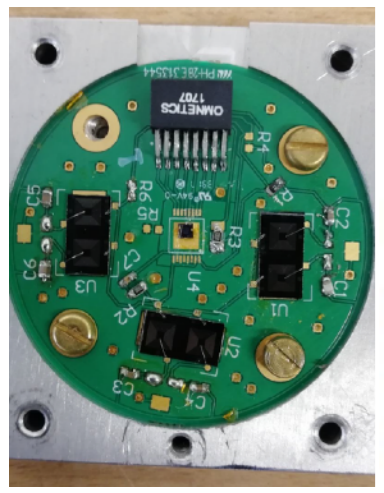
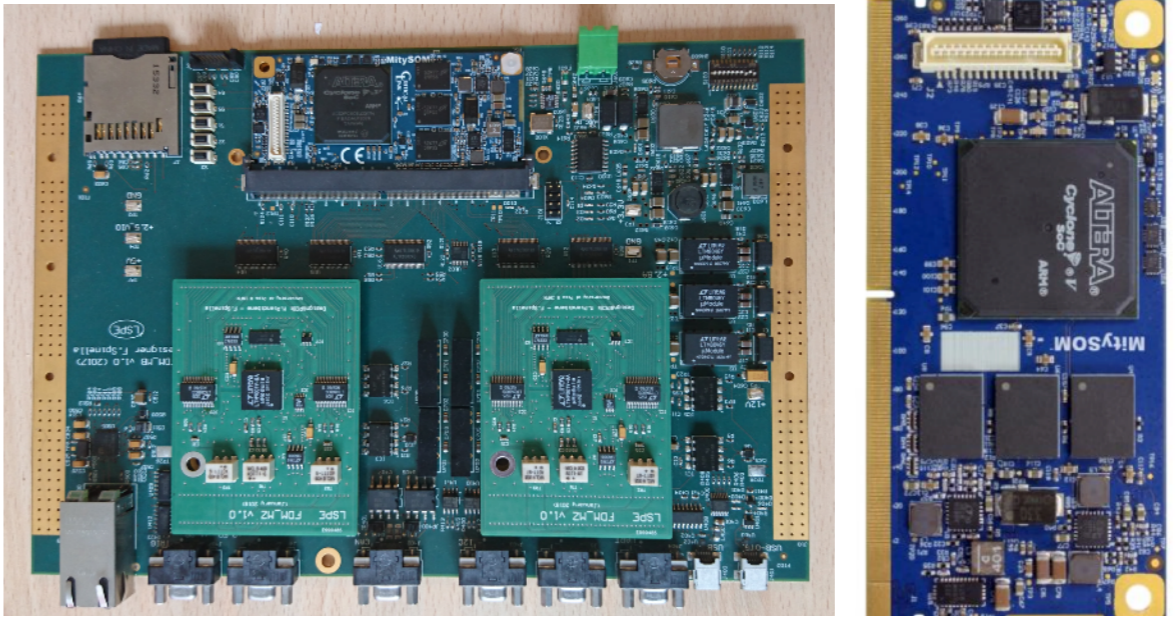
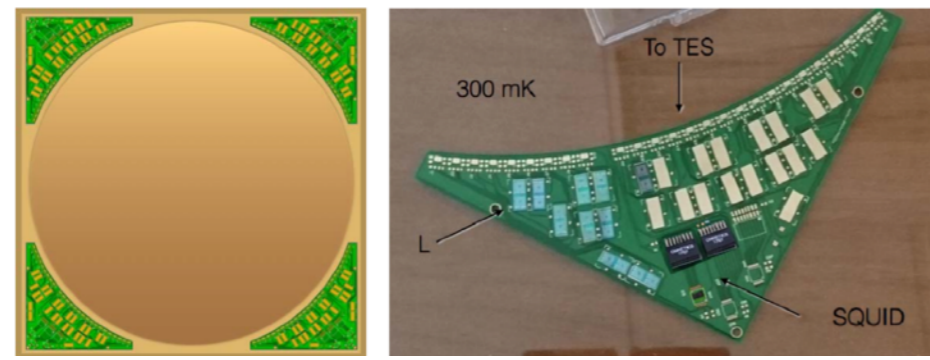
- pulse-tube 2nd stage (3K)
- SQUID array
- ³He (0.3K) refrigerator
- bolometer
- Feed structure & filter under test
- Pyramidal horn 25 dB WR08
- Variable attenuator WR08
- Gunn oscillator 110-145 GHz
- Linear stage
- bolometer & feedhorn (0.3K)
- Eccosorb box
- Gunn source (D-band)
- Synchronous demodulation electronics

Logo: agenzia spaziale italiana

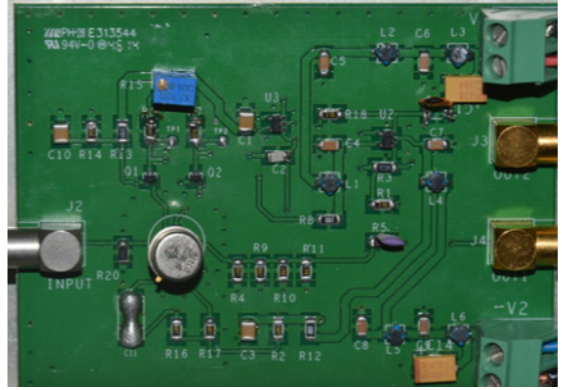
Beam v



Full readout



0.3/220K
Genova/Pisa



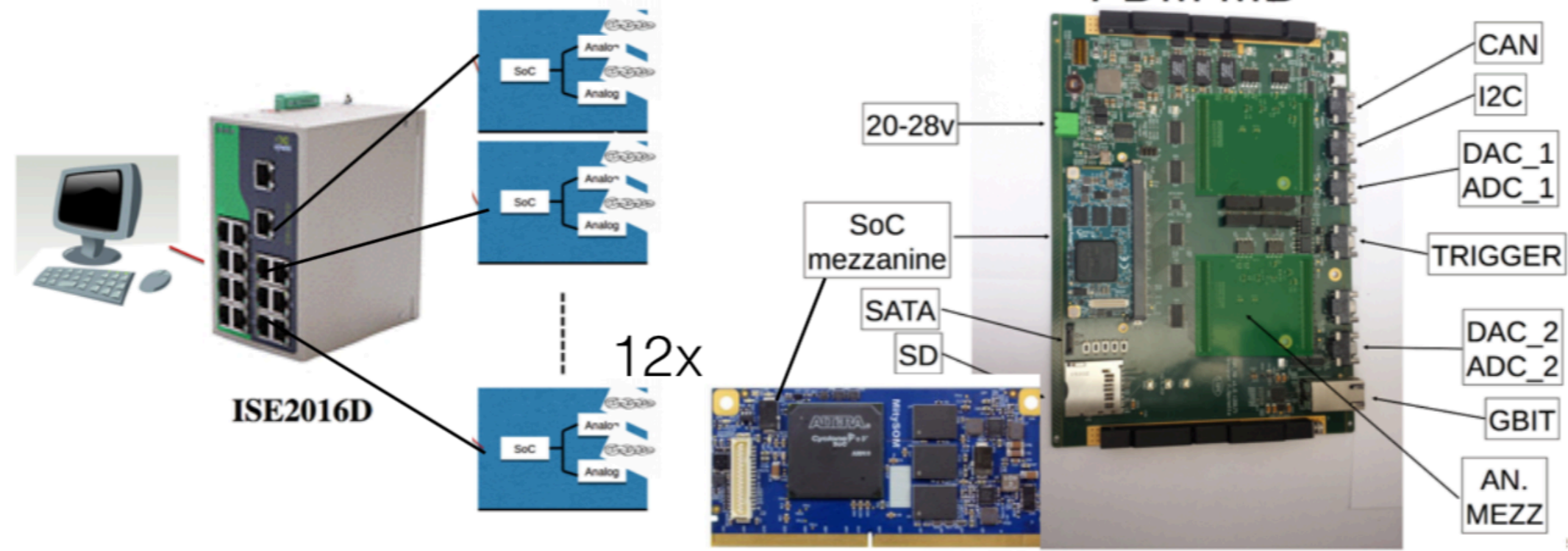
Conclusioni LSPE Genova

- Bolometri rispondono ai requirement di $NEP < \text{photon noise} \rightarrow$ ($NEP \text{ q.che } 10^{-7}$)
- Risolto il “mistero” del beam: limiti del test set-up di Roma1 (effetti delle finestre e diametro delle stesse).
- Auspicabile un aggiustamento della costante tempo (in corso).
- Processo di produzione già verificato con prove su batch di 16
- SQUID chip: wafer da VTT con chip non testati in corso di qualifica (20 x esperimento + altri per test)
- Elettronica per SQUID in fase finale di test
- Obiettivo: finire fabbricazione, integrare e completare l'apparato.

LSPE-SWIPE/STRIP: PISA



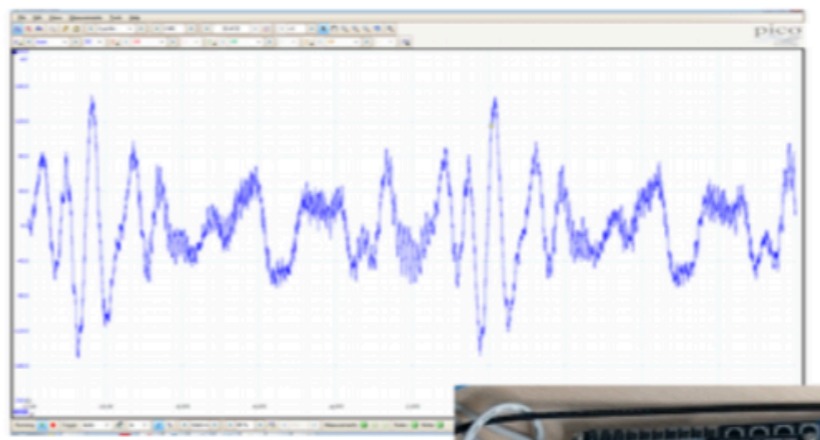
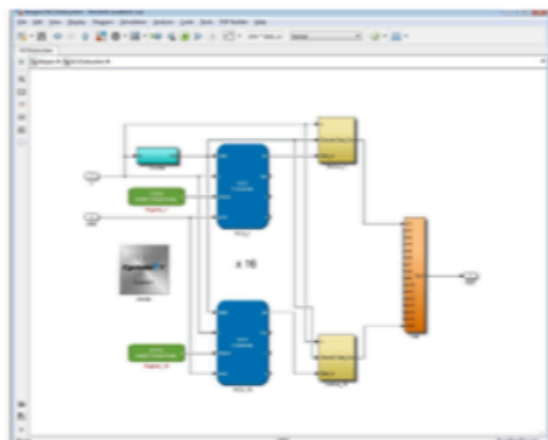
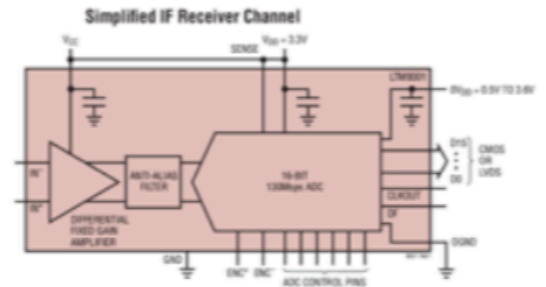
Warm readout



- Board V0 - containing all possible interfaces - designed, produced and under test
- Preliminary firmware for the tone generation tested
- Backbone of complete firmware presently being written

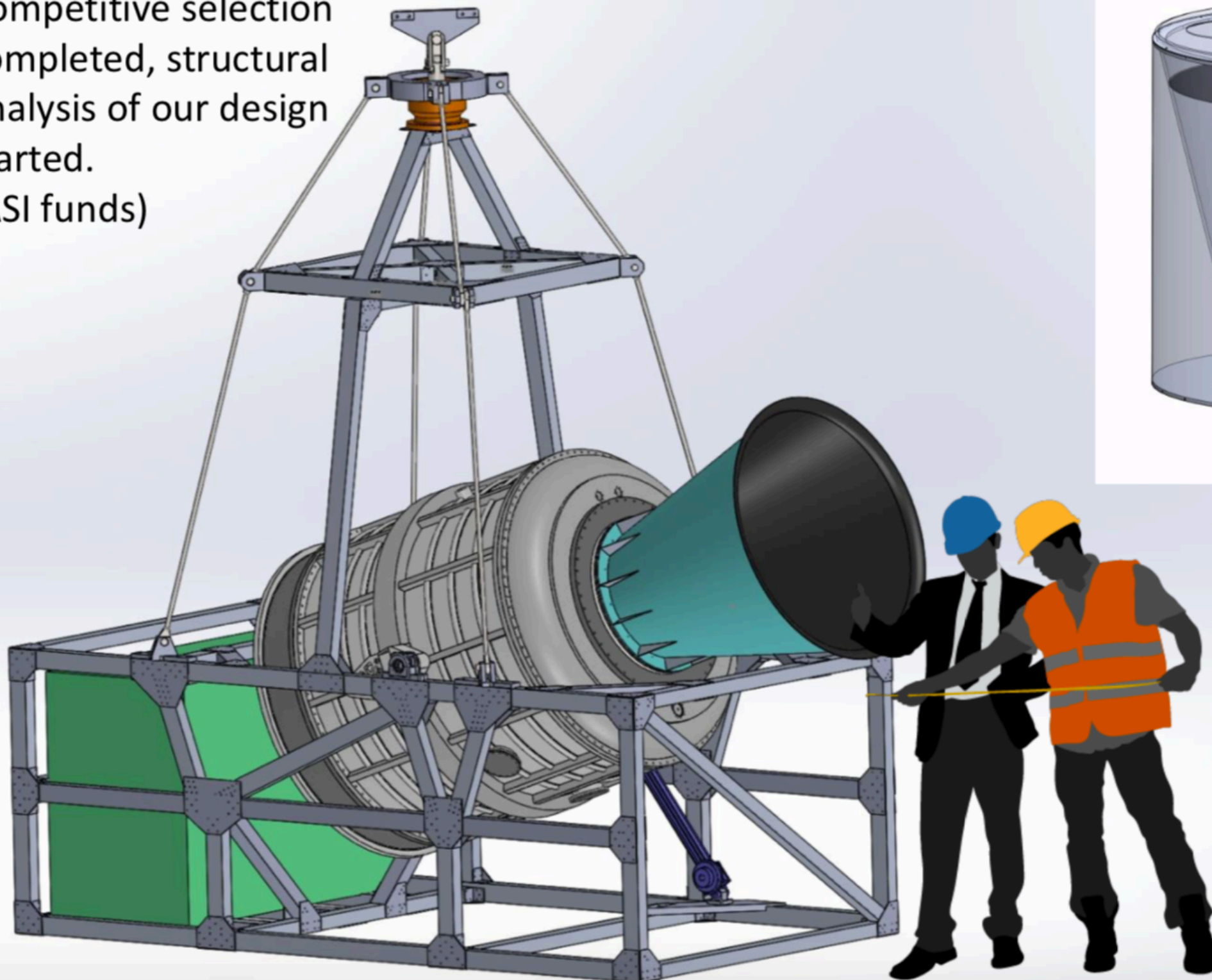
NEW

- (ADC LTM9001GA, DAC LTC1668)

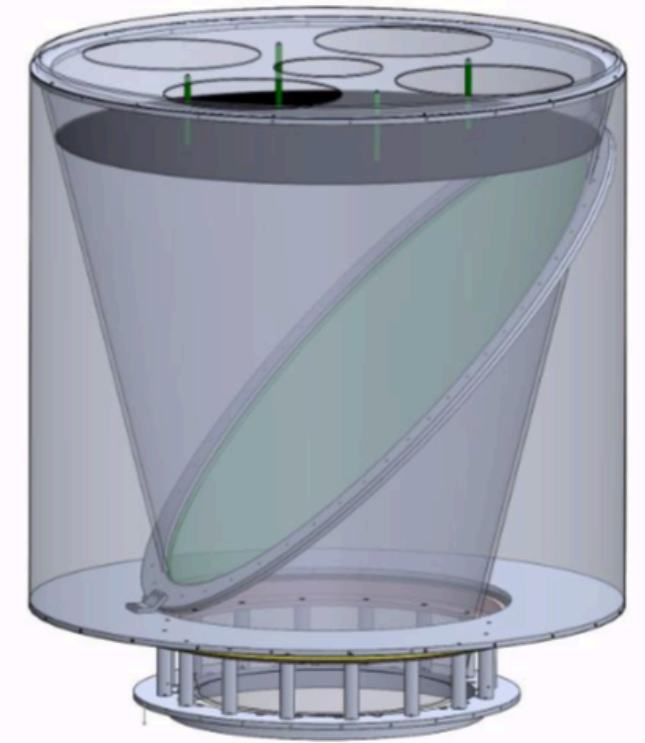


LSPE-SWIPE/STRIP: ROMA1

Payload gondola
Competitive selection
completed, structural
analysis of our design
started.
(ASI funds)



Full-beam polarized
calibrator (ASI funds)



LSPE-SWIPE/STRIP: ROMA1



Main Cryogenic System



LSPE-SWIPE/STRIP: MILANO

LSPE/STRIP status

Selected site: Teide Observatory, Tenerife

- Low atmospheric contamination
- Ensure nearly same sky coverage as for SWIPE (85% overlap)
- Site preparation: agreement with IAC ongoing
- Excellent science synergy opportunity with QUIJOTE and GroundBIRD

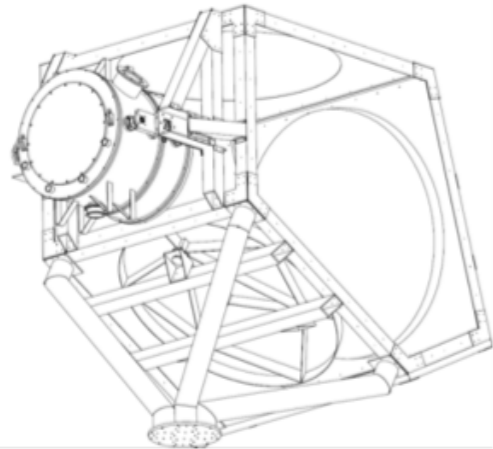


LSPE-SWIPE/STRIP: MILANO

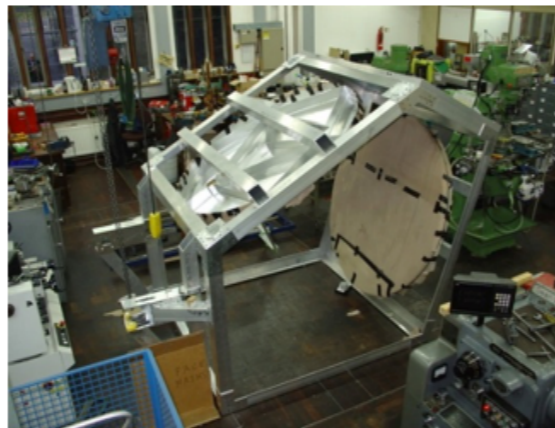
STRIP telescope and mount

Oxford-provided H/W requires significant modifications

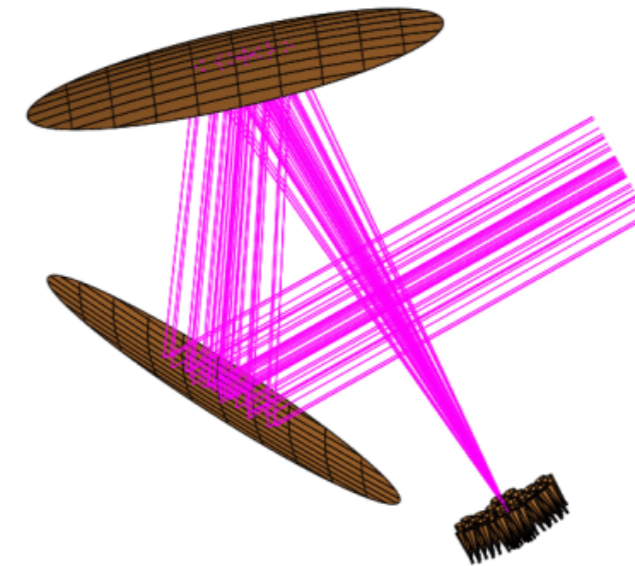
1) *Instrument interfaces to optical enclosure to be adapted to STRIP instrument*



Full CAD model of STRIP mount and interfaces (INFN Rome)



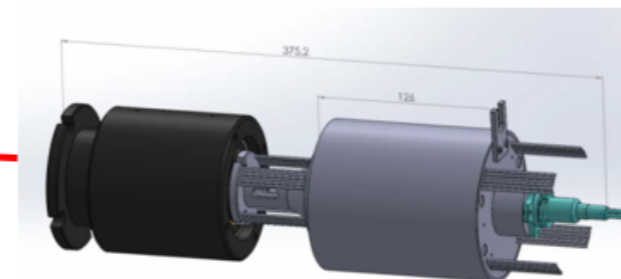
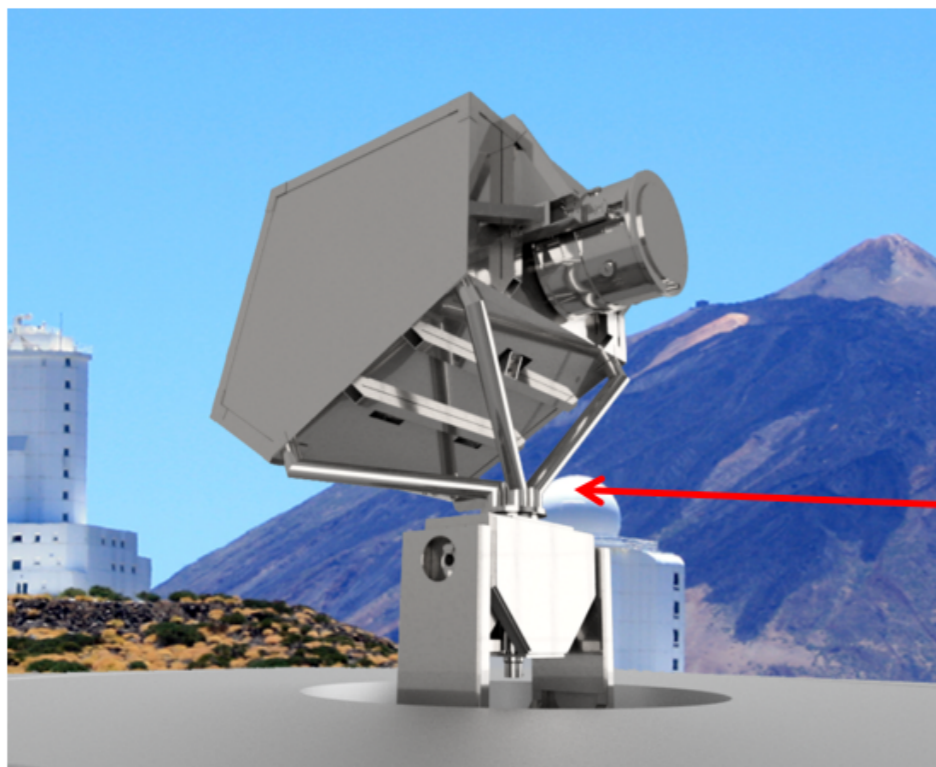
Telescope at Oxford



1.5m Cross-Dragone optics

2) *New motors need to be acquired*

3) *Enable continuous rotation in scanning strategy (needed for large scale observations)*



STRIP rotary joint system

4) *Star tracker to develop mount/pointing model*

Anagrafica e Richieste alla Sezione

Ric.	%
Gatti F.	60
Biasotti M.	60
Boragno C.	60
Buatier F.	50
Fontanelli F.	30
Giovannini M.	30
Grosso D.	20
Siri B.	100
Ferrari B. L.	80
Totale	490

Servizio	MU
Progettazione	4
Meccanica	3
Elettronica	1

Coll. Tecnici	MU	
Luigi Parodi	8	Criogenia-vuoto
Fabio Siccardi	5	Elettronica
Adriano Bevilacqua	5	Litografia/CR/ apparati film