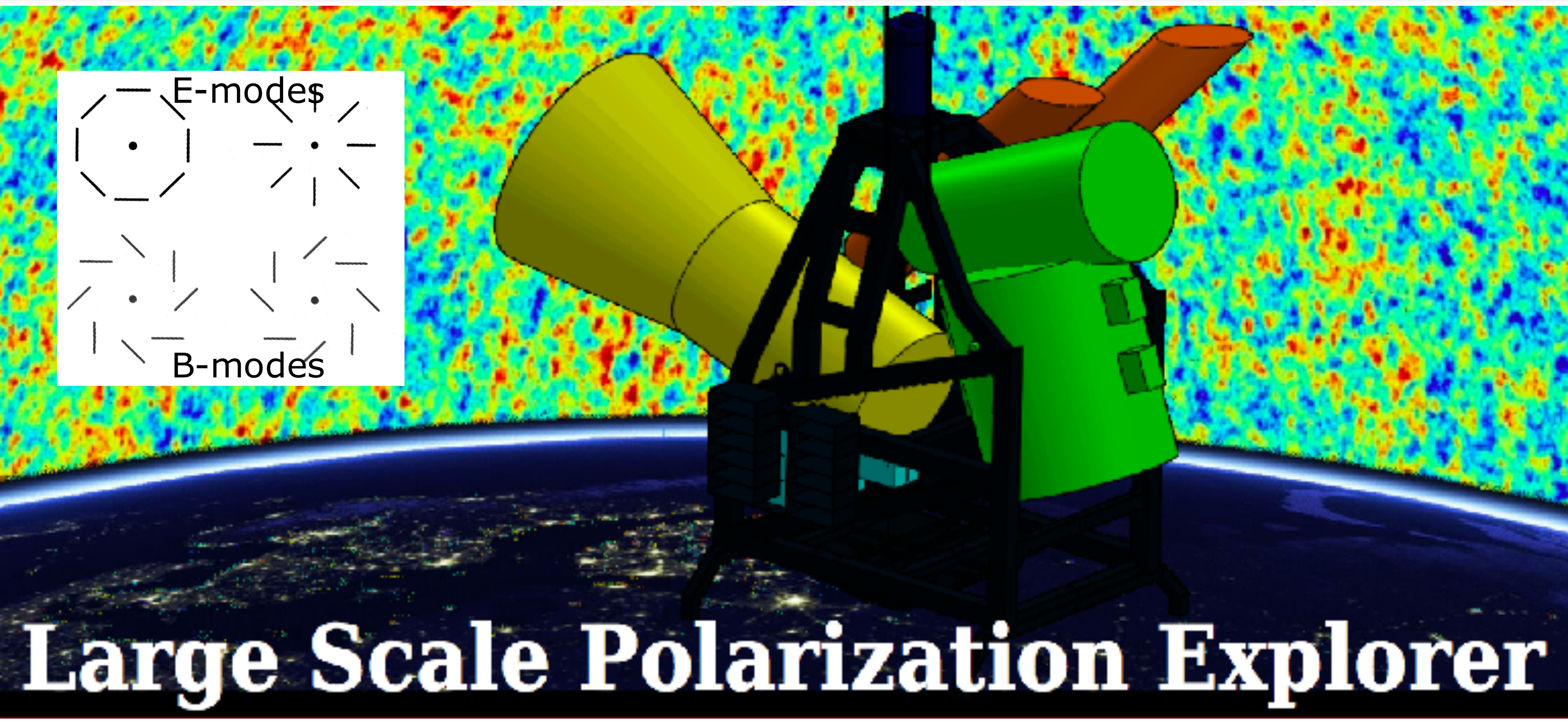
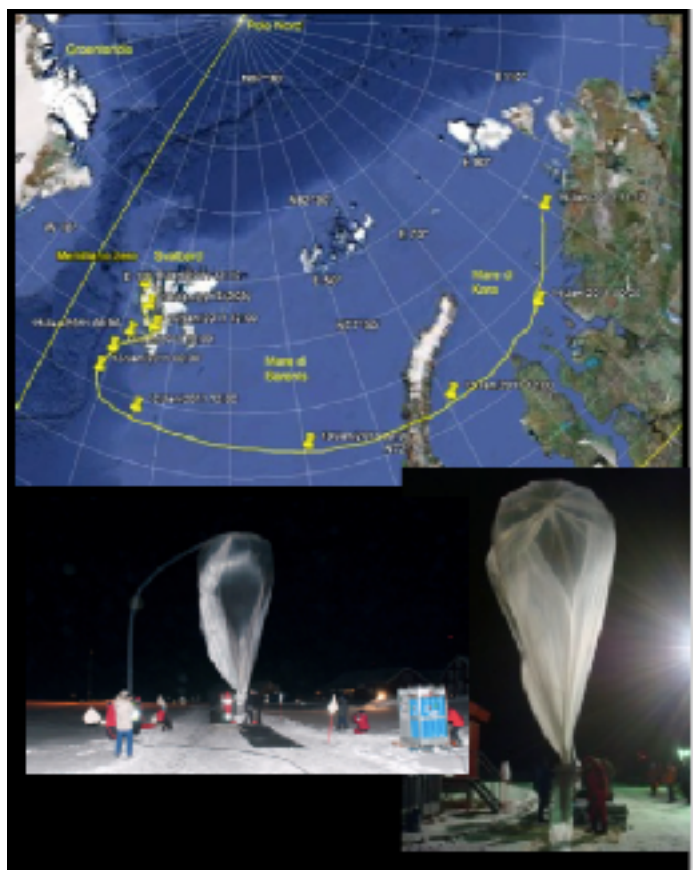
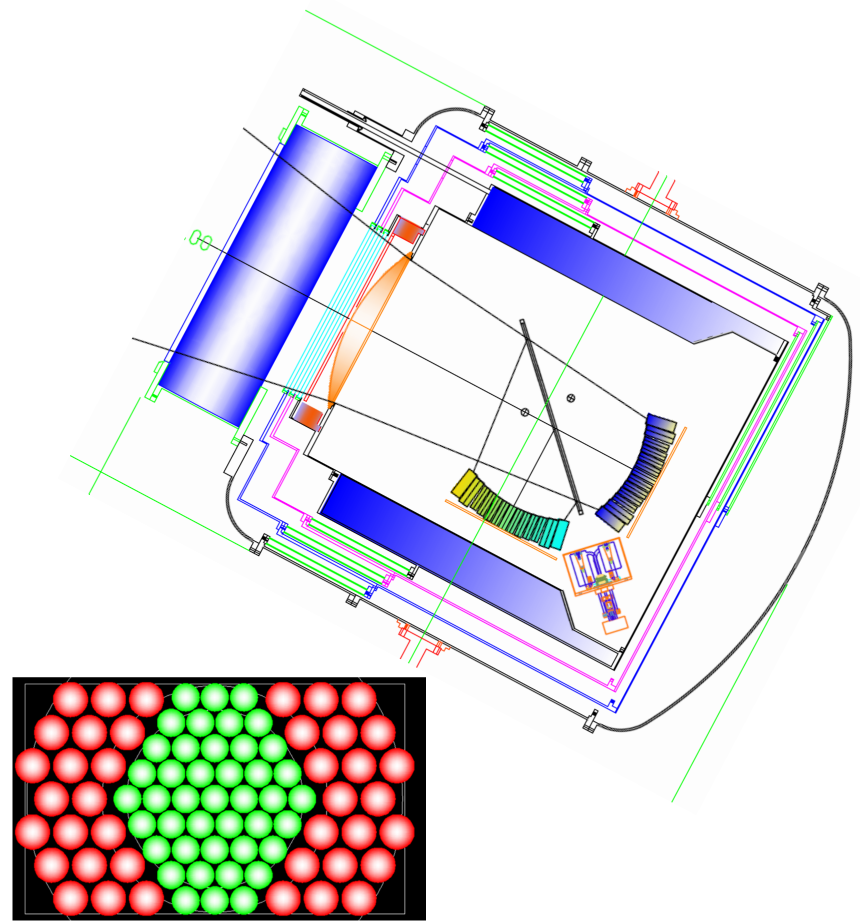
# LSPE

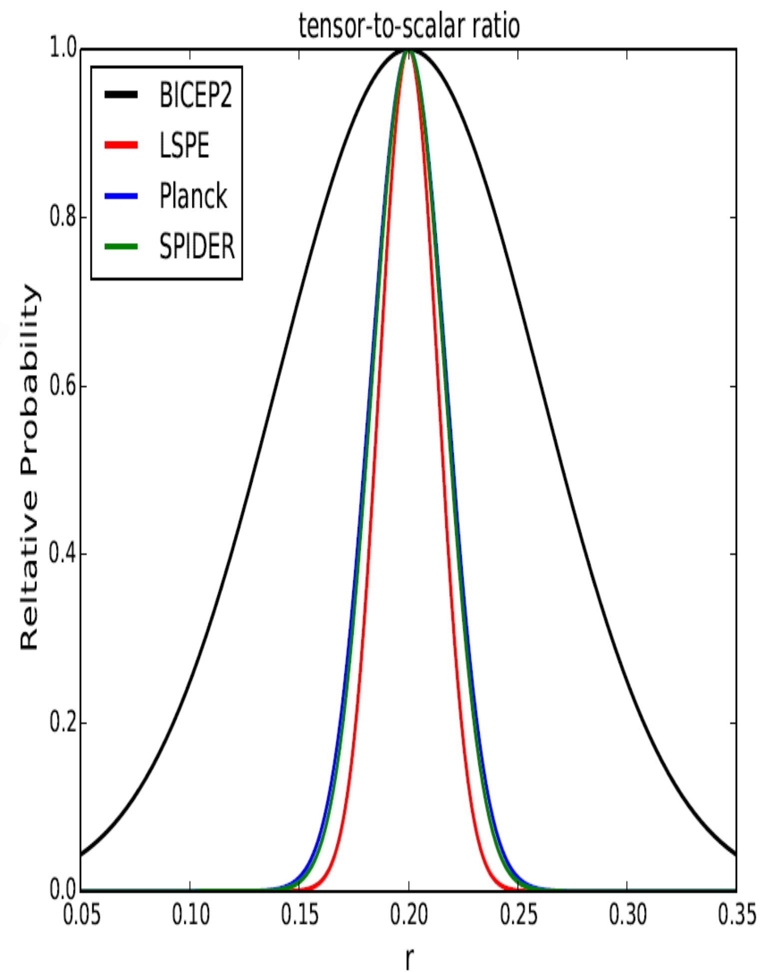
F.Gatti

CdS, 2 Jul 2018

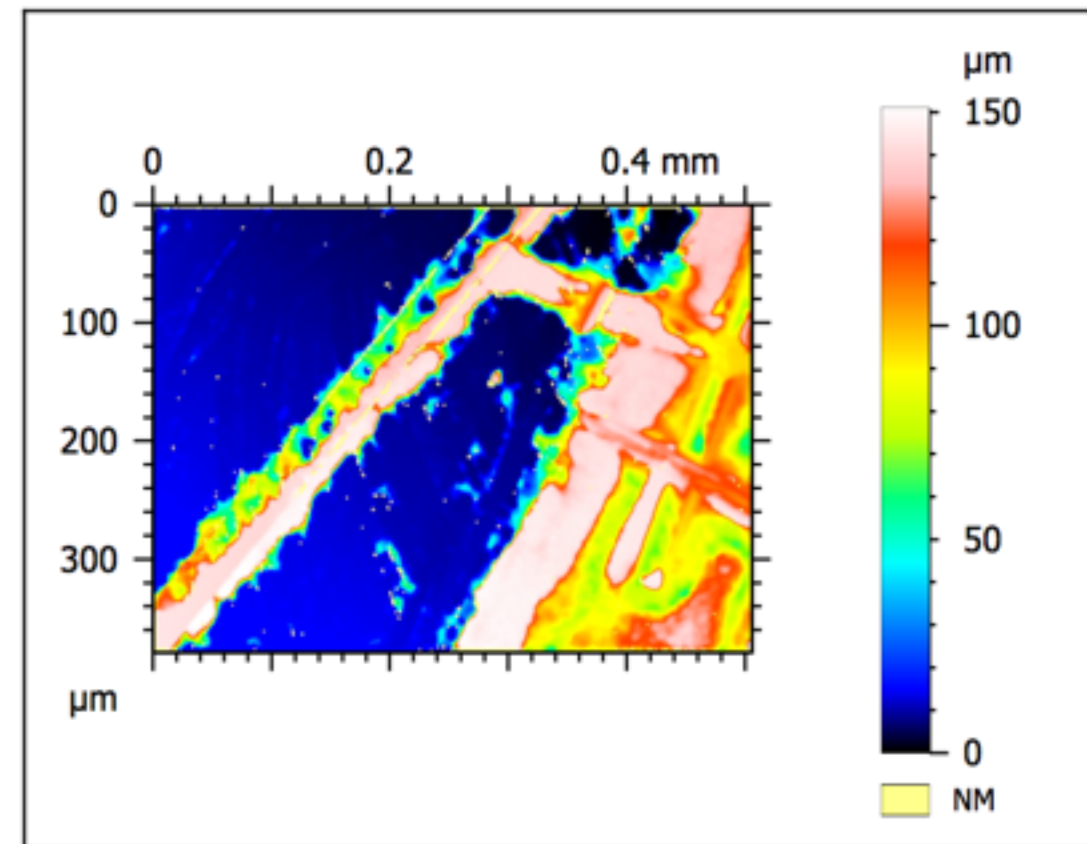

E-modes
B-modes
Large Scale Polarization Explorer

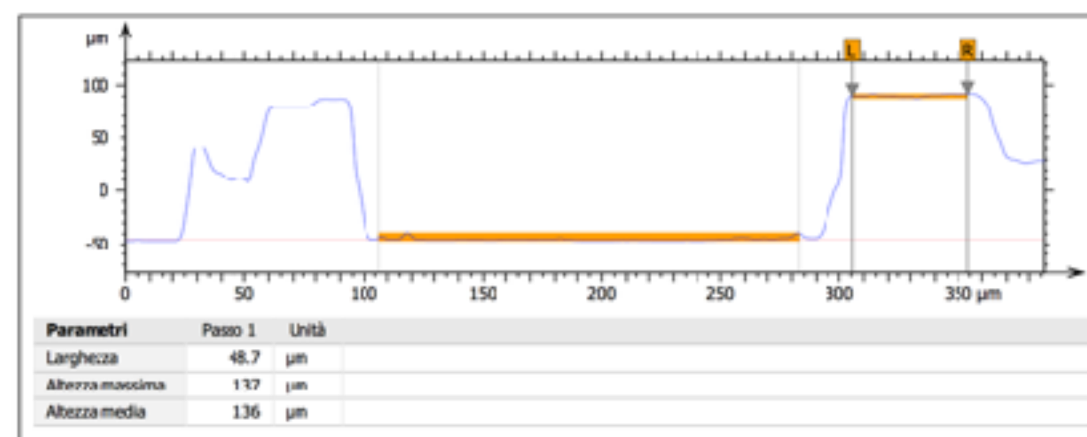





tensor-to-scalar ratio
BICEP2
LSPE
Planck
SPIDER
Reltative Probability
r
1.0
0.8
0.6
0.4
0.2
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.35

# 330 bolometri




| Parametri | Passo 1 | Unità |
| --- | --- | --- |
| Larghezza | 48.7 | µm |
| Altezza massima | 137 | µm |
| Altezza media | 136 | µm |

Quota al profilometro ottico del bolometro rispetto bordo della cavità EM.

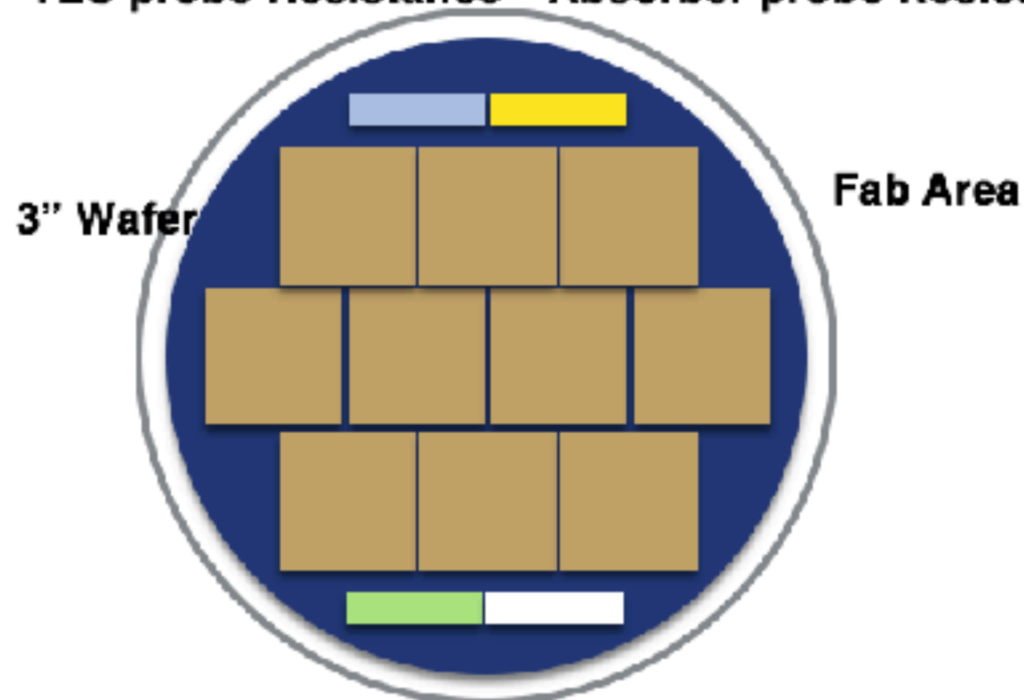
# Fabrication Plan

## TES Fab Process

3 teams:

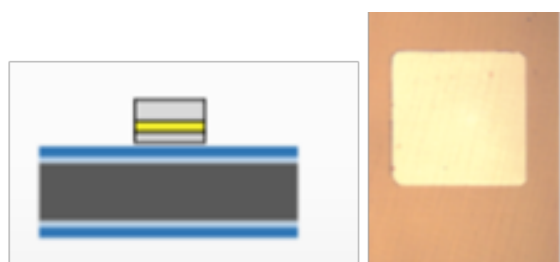
- 2 teams (2 techs) alternating at Fab
- 1 team (2 techs) Qualification

Fab Yield >70%




| | 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 | |

# Qualification of Bolometer Fab Process (1)



4 x chips — 2 x 3" wafers

Wafer cleaning 15'

TES Litho N 25'

TES deposition 30'

TES lift-off 15'

< 1 h 25 m

4 chips — 2 x 3" wafers

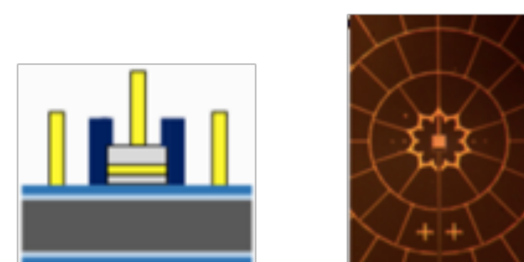
TopSide Clean. 5'

Wires Litho N 30'

Wires deposition 30'

TES lift-off 15'

< 1 h 20 m



4 chips — 2 x 3" wafers

TopSide Clean. 5'

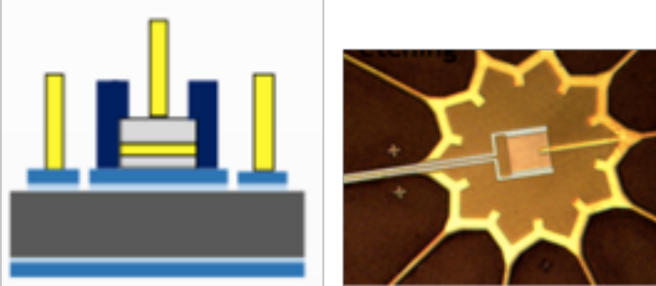
Abs. Litho N 20'

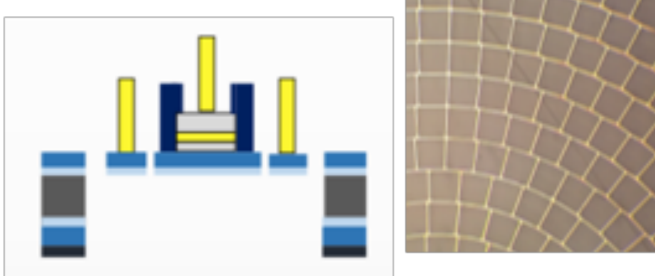
Abs. deposition 30'

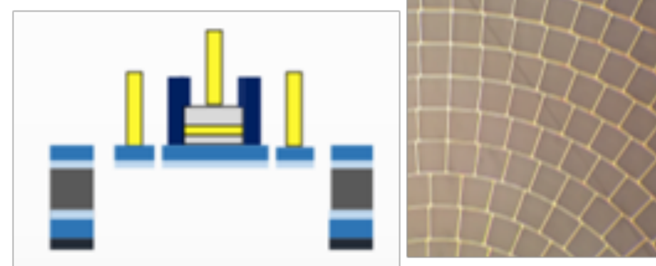
Abs. lift-off 15'

< 1 h 10 m

# Qualification of Bolometer Fab Process (1)







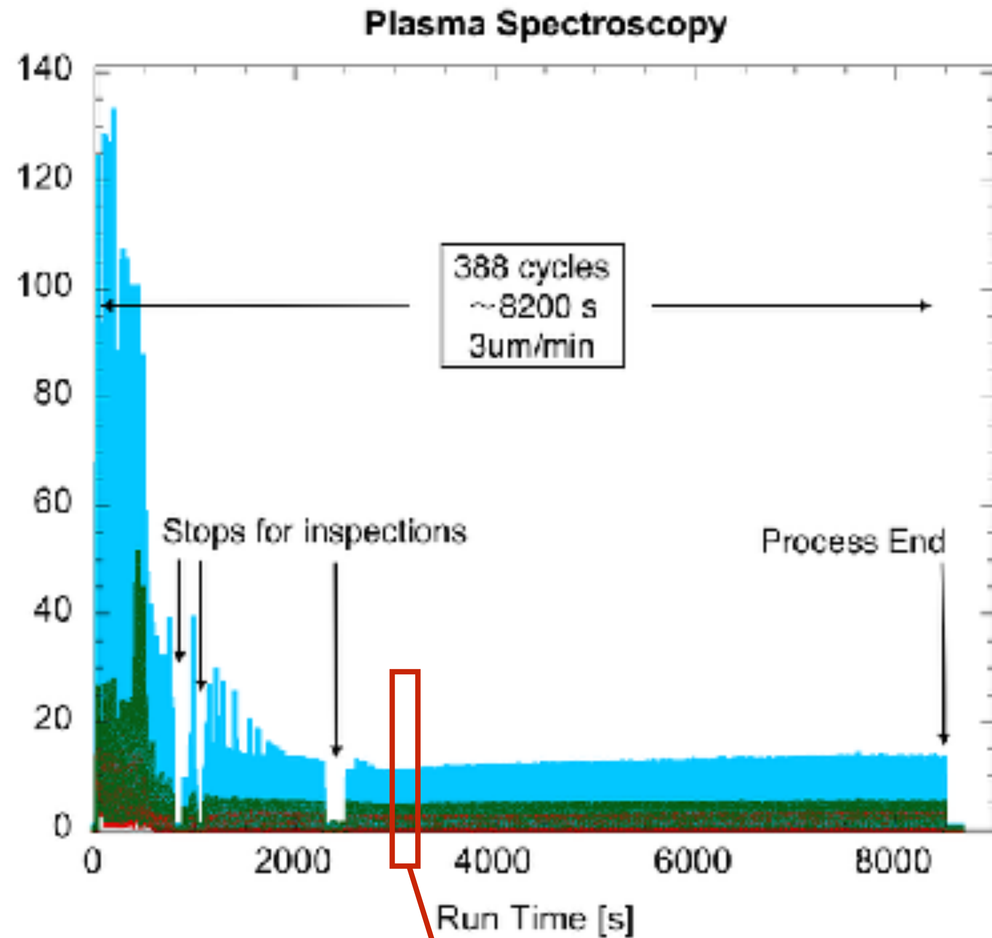
| 4 x chips / 2 x 3” wafers | 4 chips / 1 x 3” wafers | |
|---|---|---|
| Top Side Clean. 5’ | Top Side Clean. 5’ | Top Side Clean. 5’ |
| SW Litho P 20’ | Back Side Mask 20’ | Back Side Mask 20’ |
| 2x SiN/SiO Etch 30’ | Back Etch 60’ | Back Etch 60’ |
| Cleaning 15’ | Chip release 25’ | Chip release 25’ |

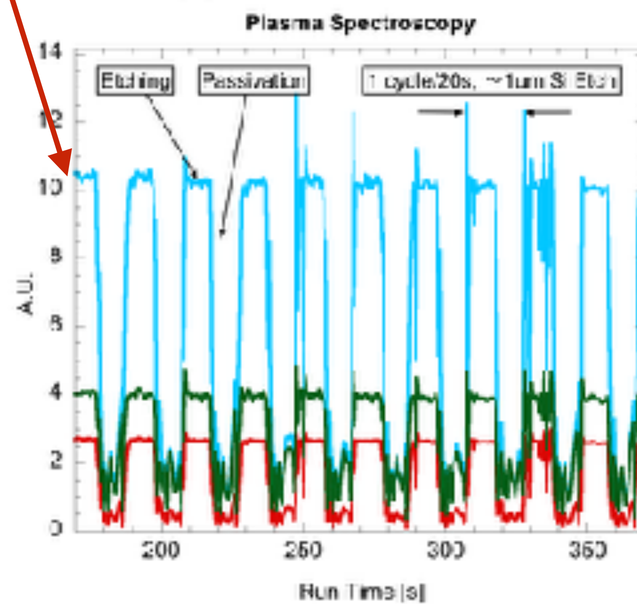
< 1 h 30 m

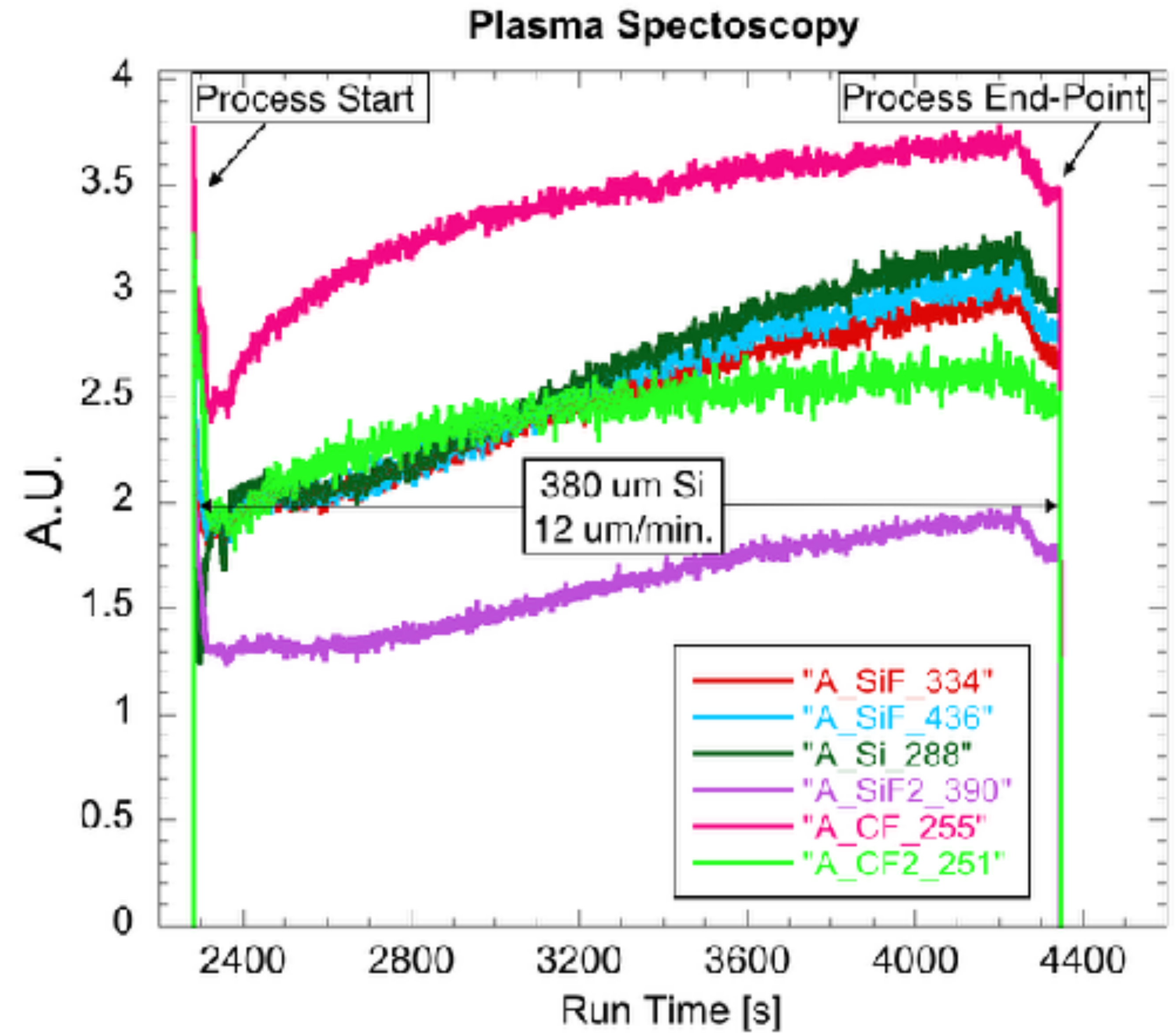
< 1 h 50 m

< 1 h 50 m

# FINAL STEPS: Deep RIE/ICP

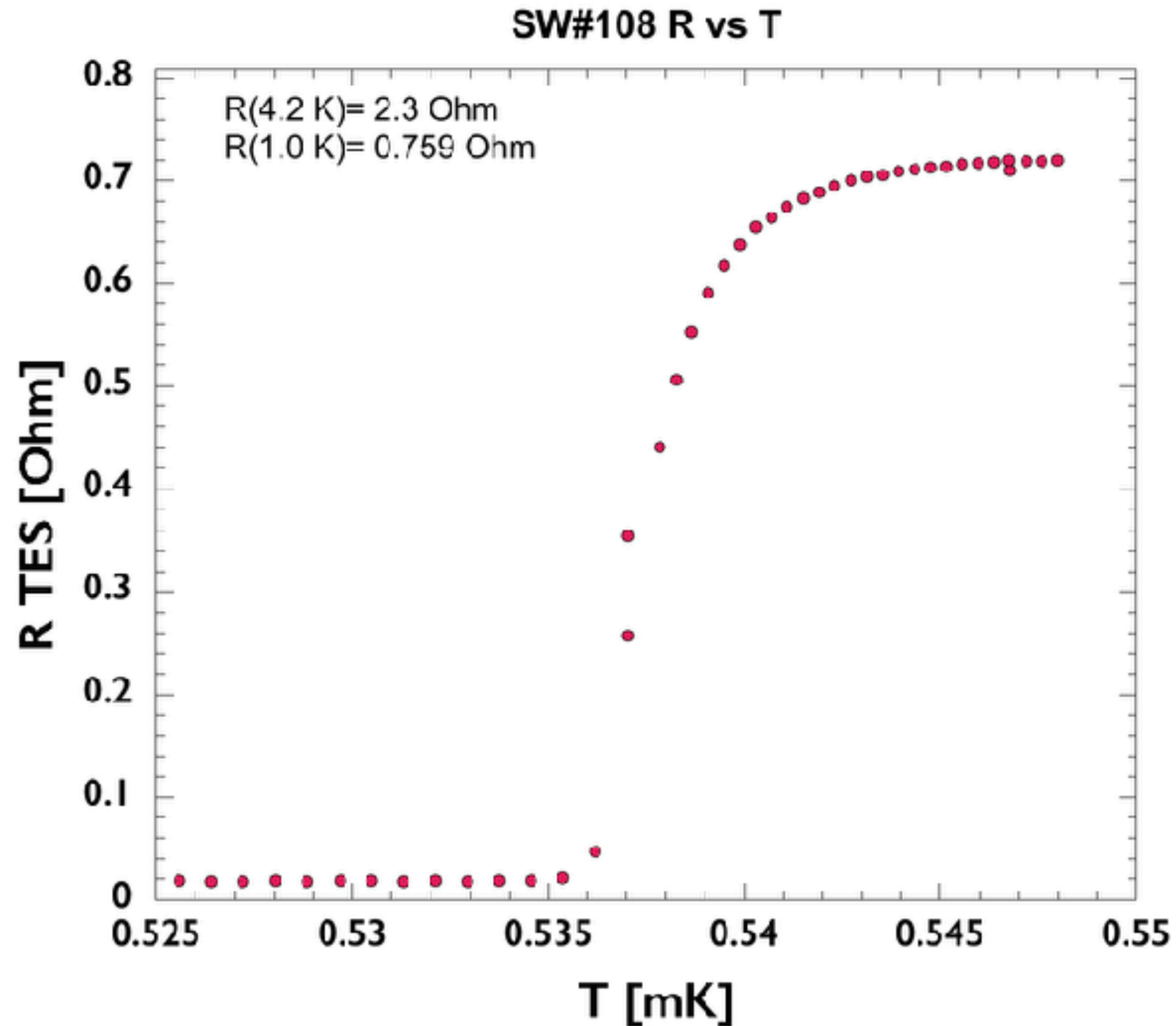


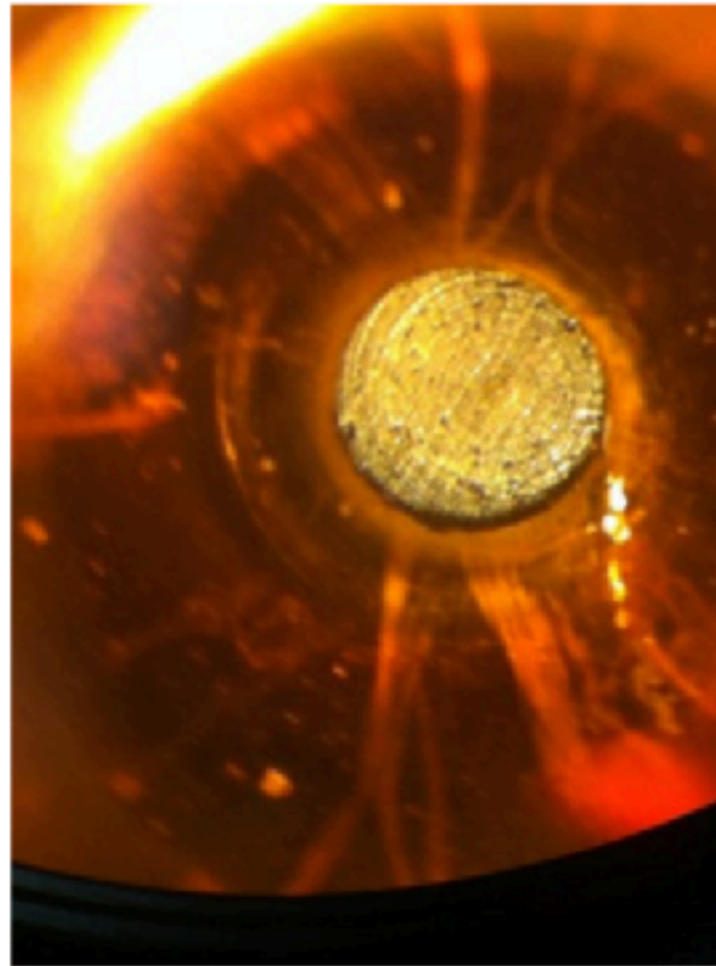
# Last Fab-Run Low T test SW Bolometer

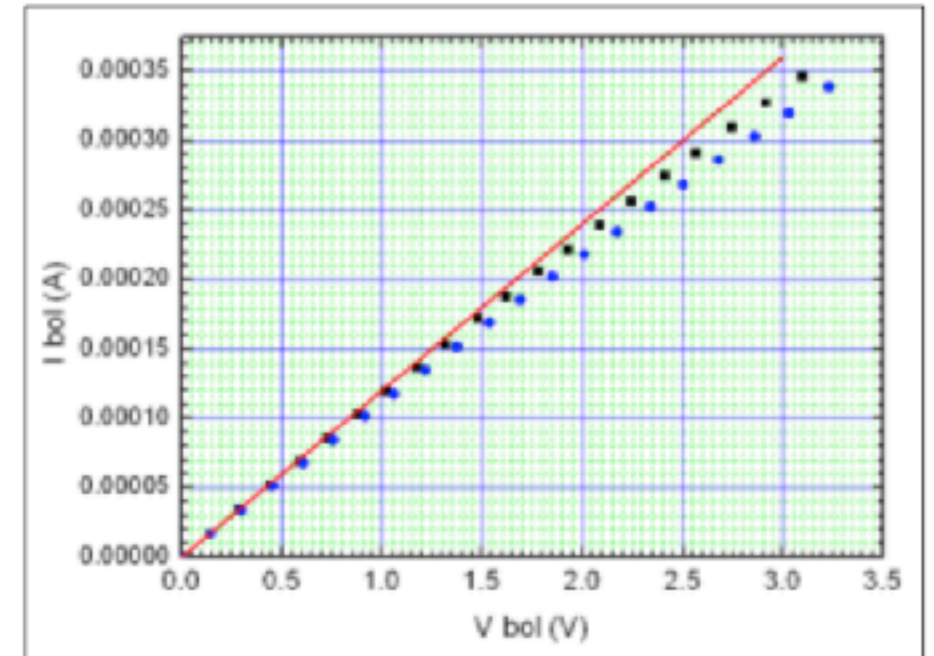
- Last Test Fab-Run (SW#108-111) low temperature characterisation of one of four bolometers.

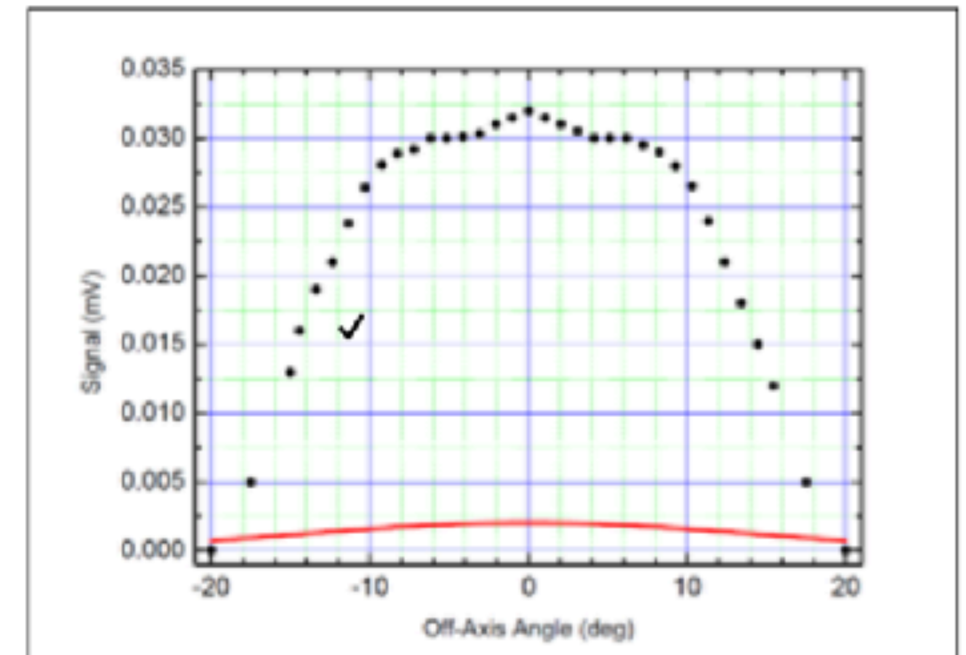


# Room Temperature Beam Characterisation in multi-mode regime

## First promising measurements

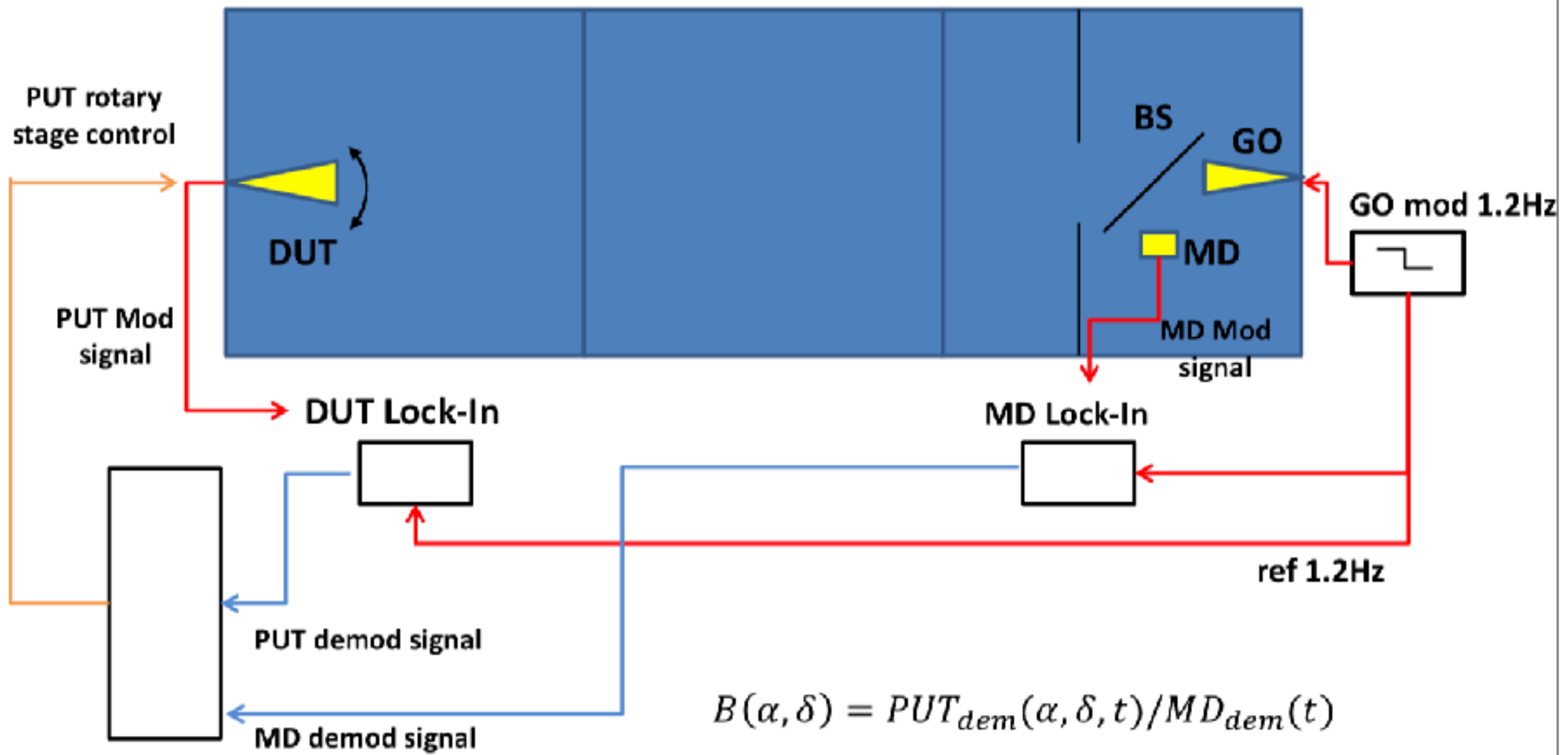





Slide CSN2 Set.14

# Tests of the pixel assembly

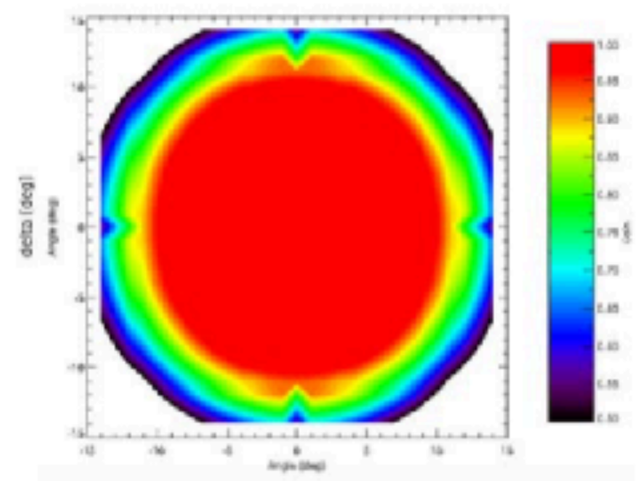



$$B(\alpha,\delta) = PUT_{dem}(\alpha,\delta,t)/MD_{dem}(t)$$

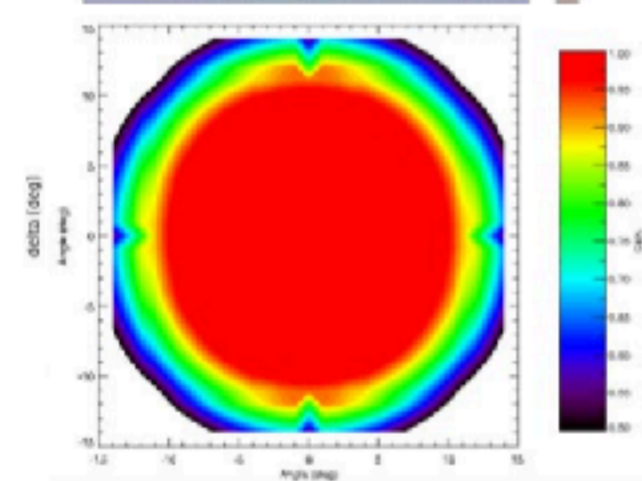
Over 300 hours of tests run so far

# Frequency sweep (self-normalized)

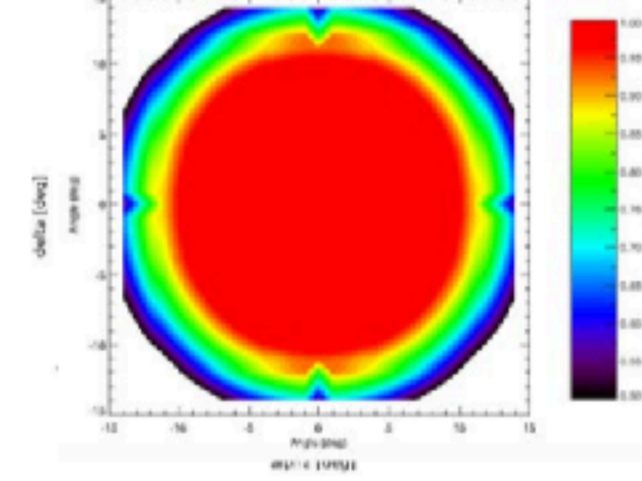
115 GHz



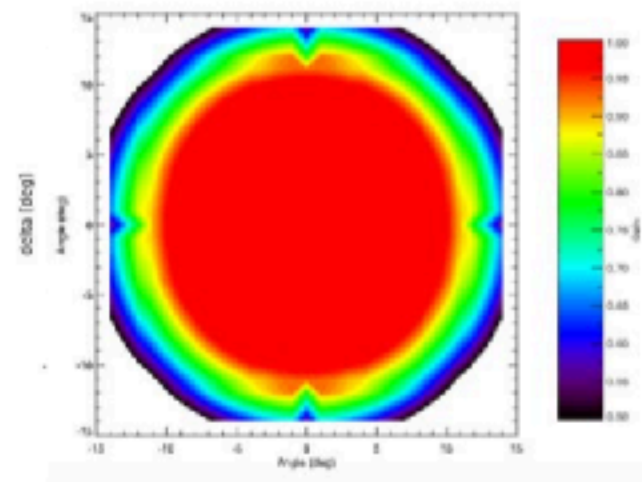
120 GHz



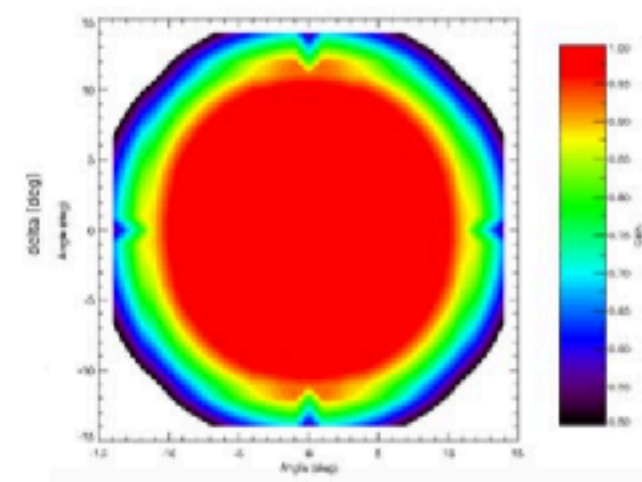
124 GHz



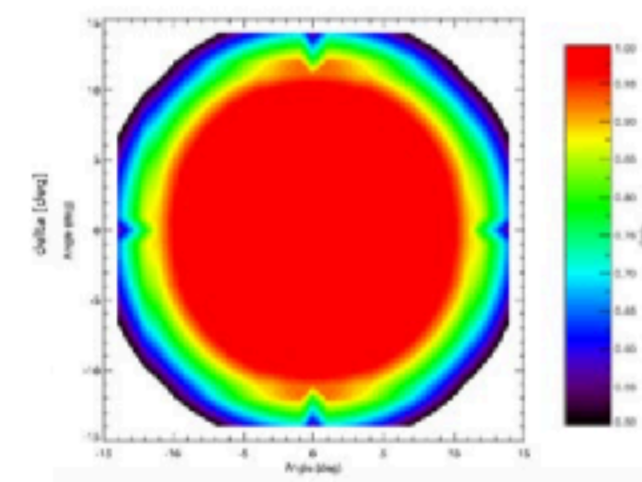
128 GHz



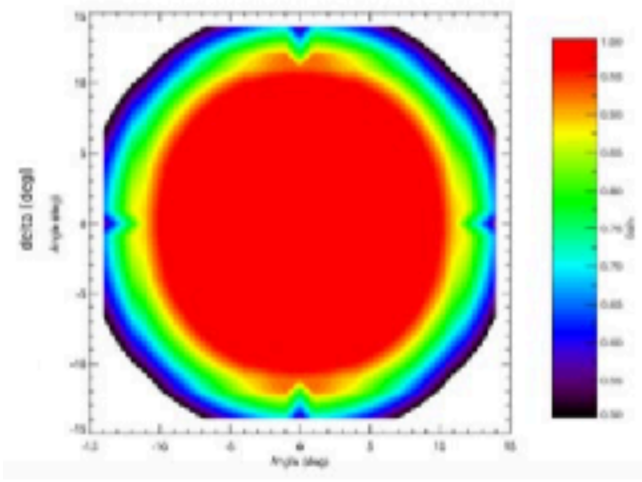
131 GHz



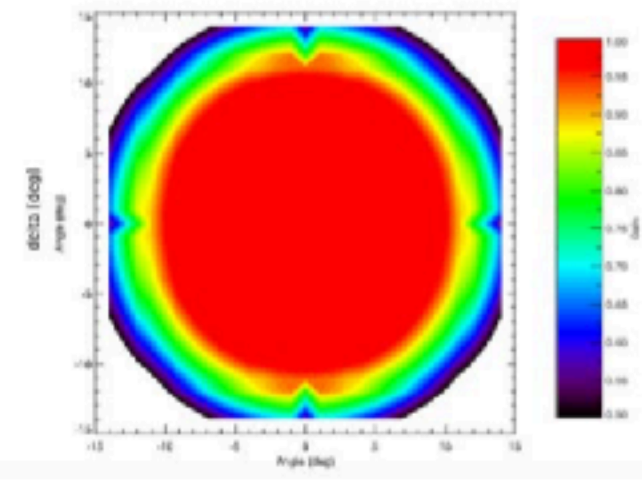
135 GHz



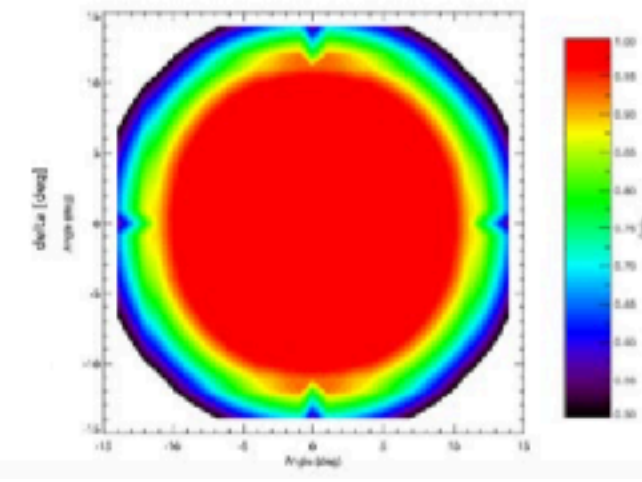
139 GHz



142 GHz

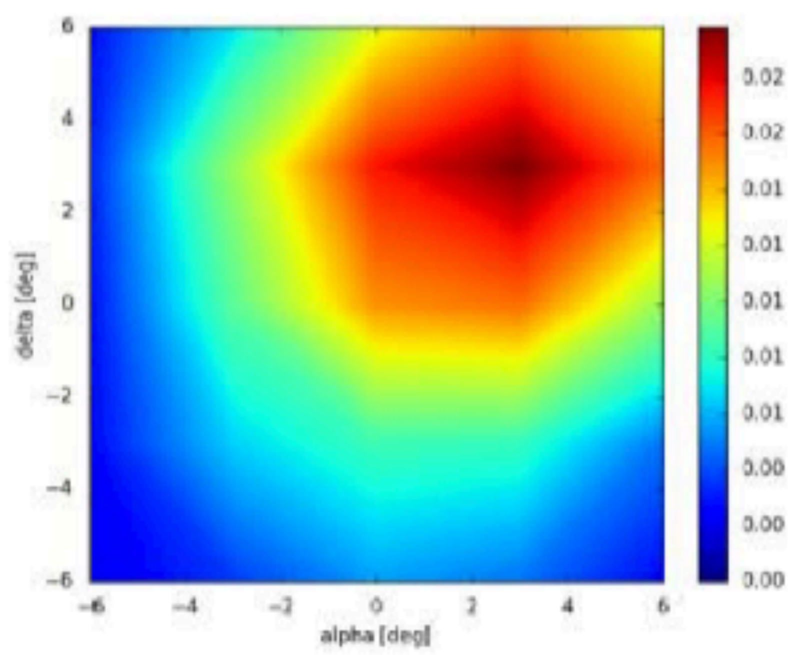


145 GHz

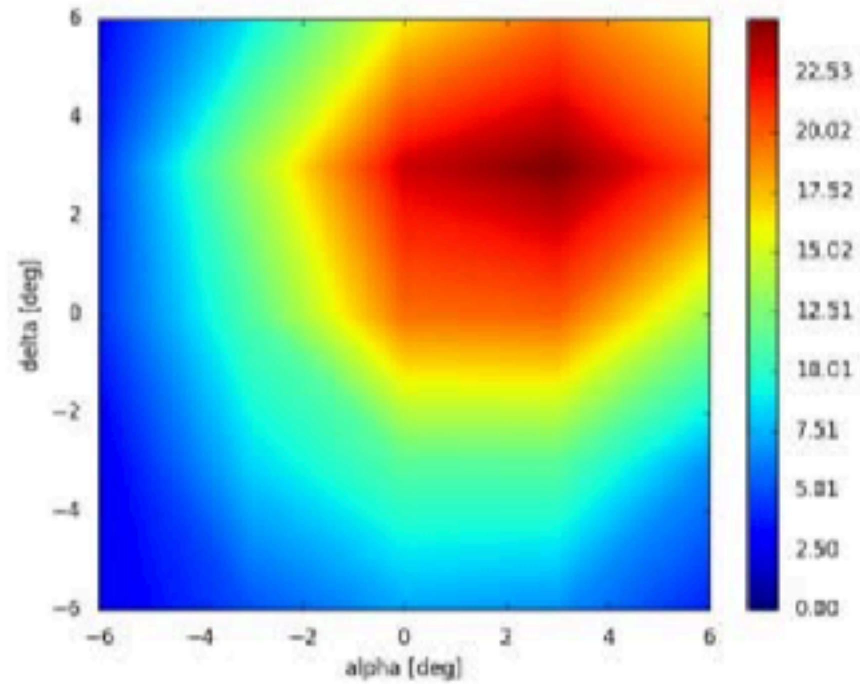


Beam measurement repeated without the beam splitter along the radiation path from the Gunn Oscillator to the pixel.

No Beam Splitter

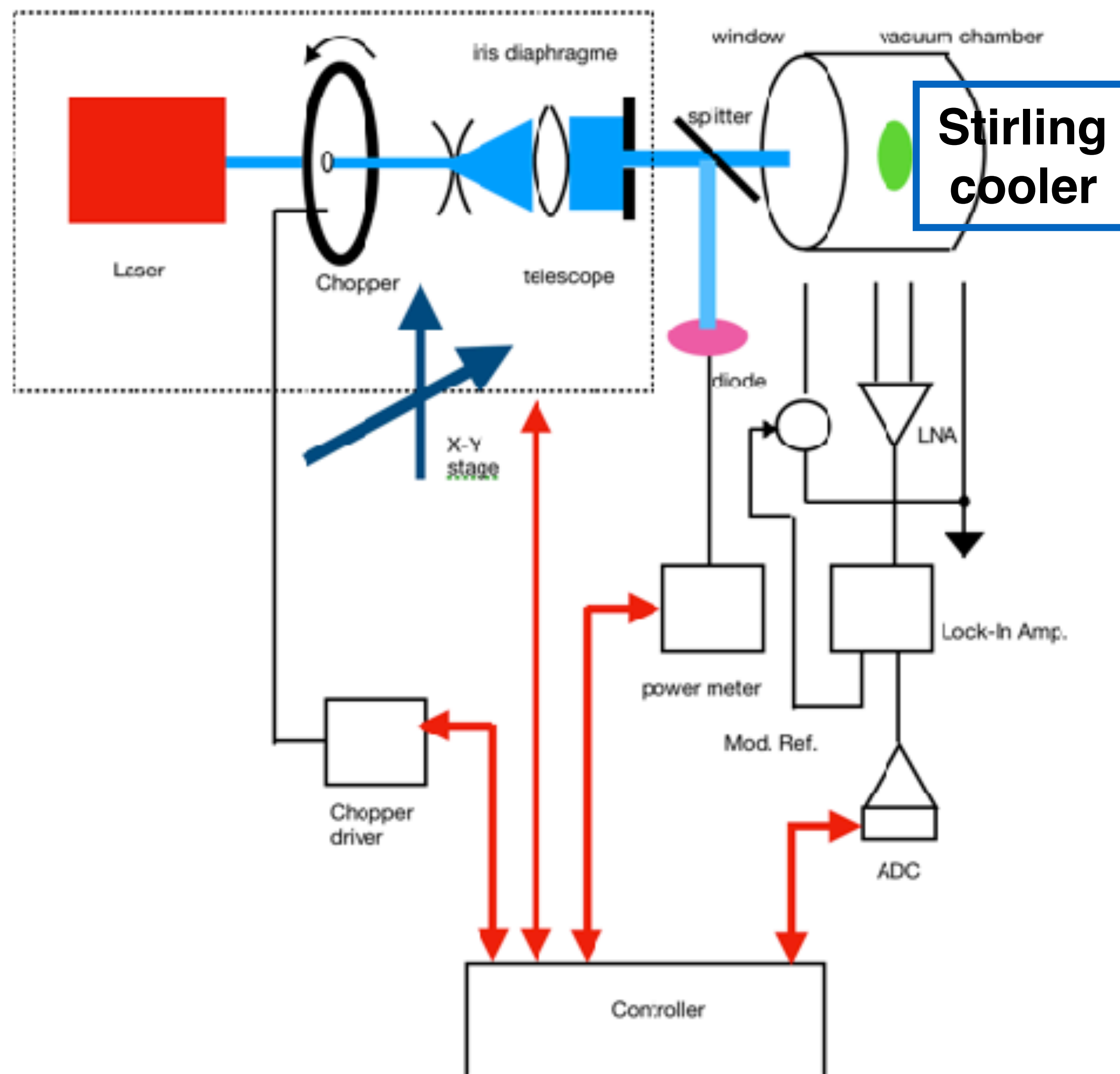



With Beam Splitter



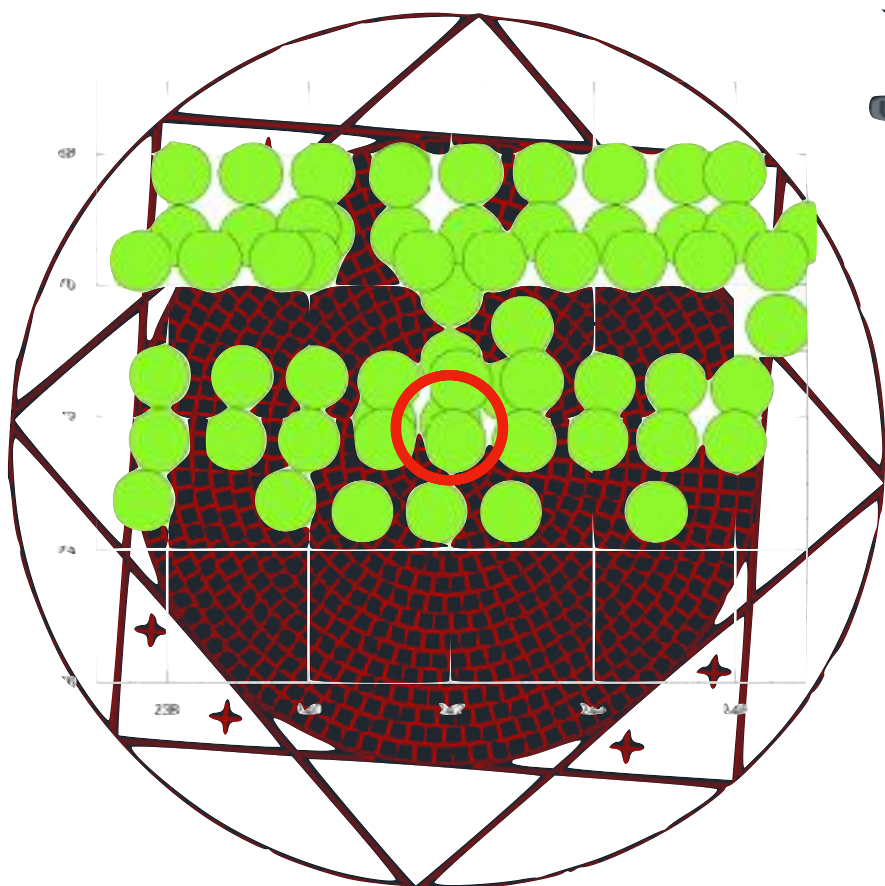
# Detector Uniformity Test

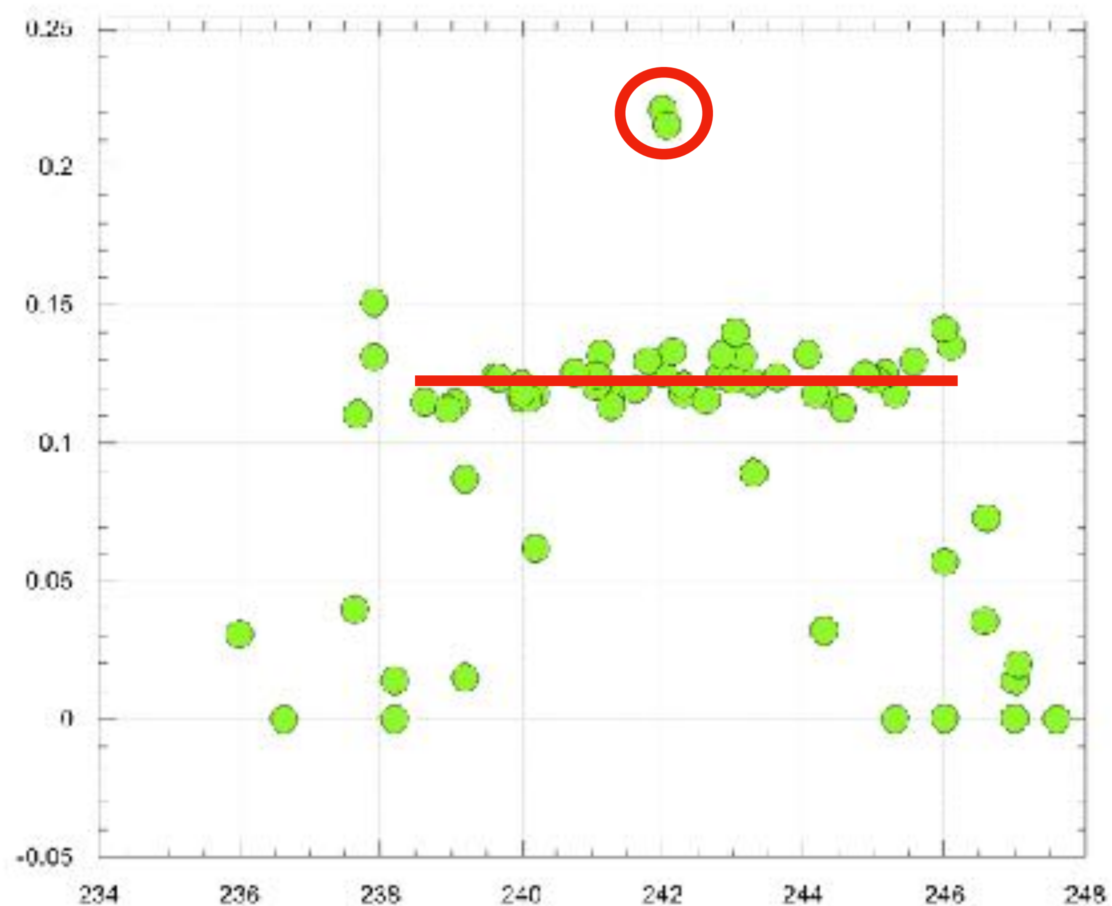
- In modi ad alta molteplicità il campo E ha configurazioni che cambiano sulla scala del mm, equivalente alla dimensione di 4-5 elementi della griglia.
- Il bolometro risponde uniformemente anche con dissipazioni di potenza cosi localizzate?
- Necessario un test indipendente.
- Scanning dello SW con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



# Detector Uniformity Test

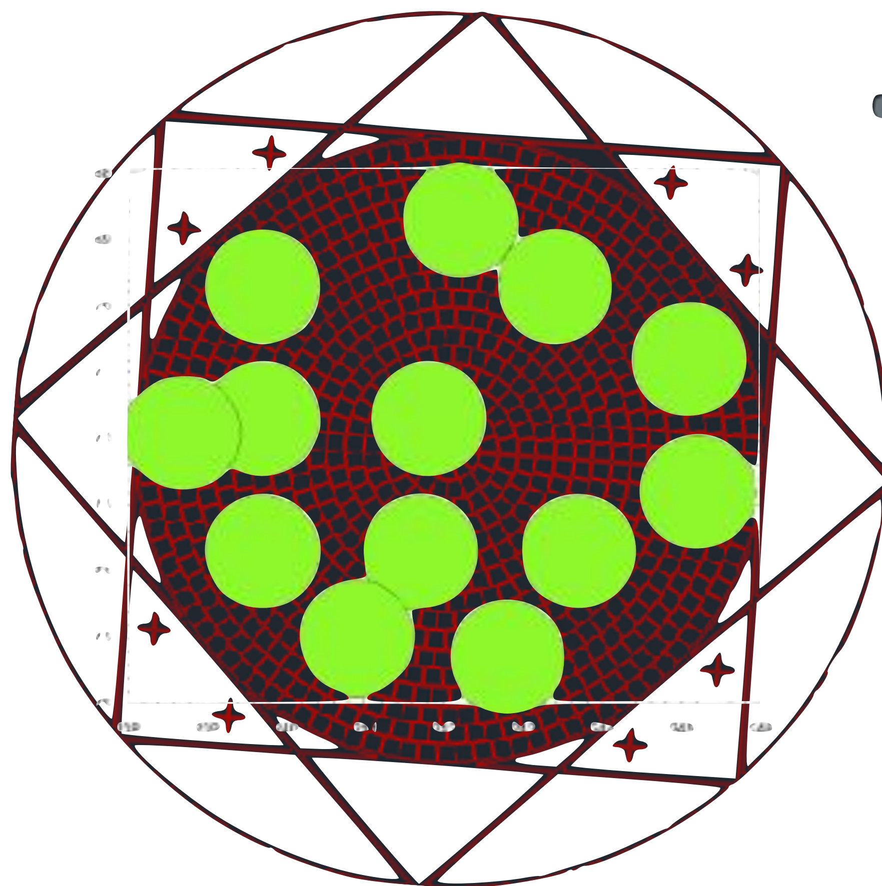
- Test with 1 mm diameter spot
- Power 3-5 uW in the spot
- Temperature: 300 K and later 140 K
- Pressure $5x10^{-6}$ mbar
- Alignement approximate

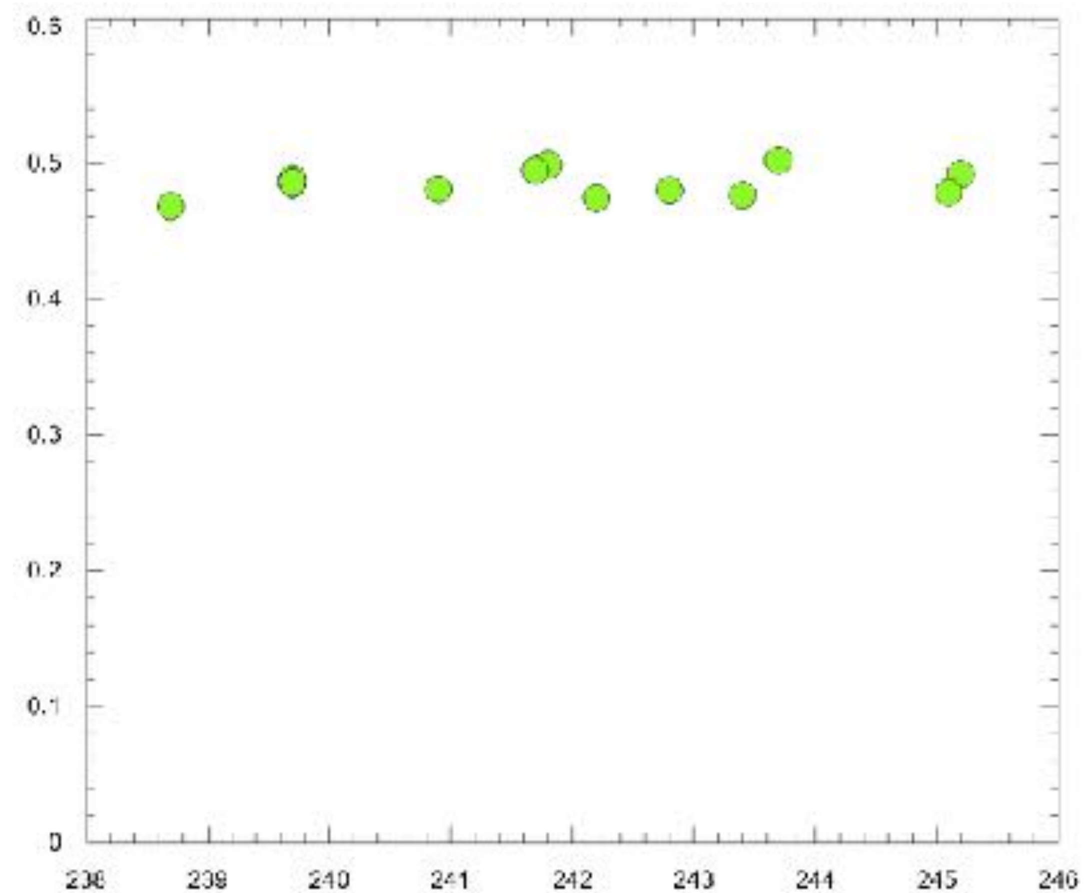




# Detector Uniformity Test

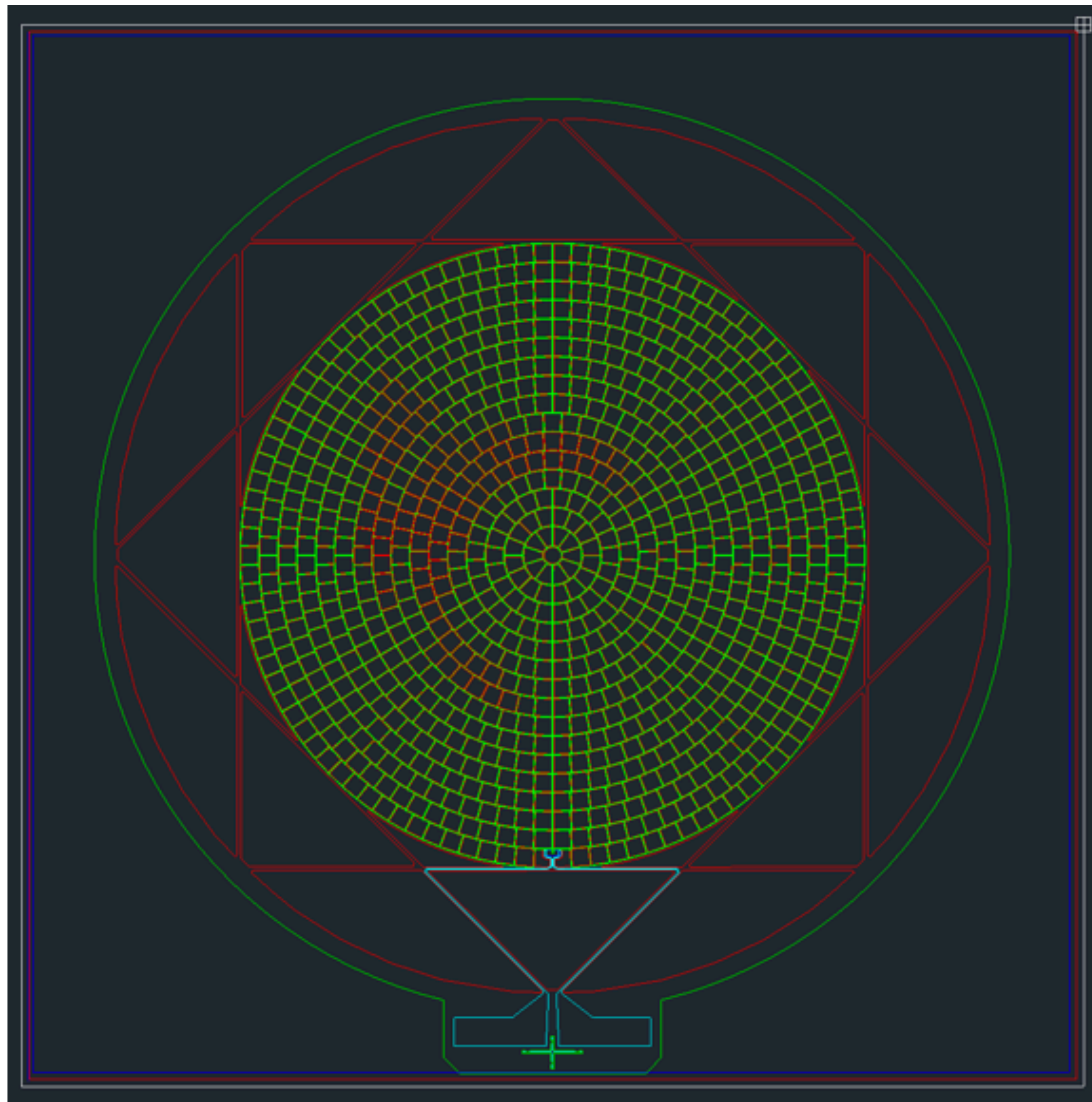
- Test with 2 mm diameter spot
- Power 3-5 uW in the spot
- Temperature: 300 K and later 140 K
- Pressure $5x10^{-6}$ mbar
- Alignement approximate



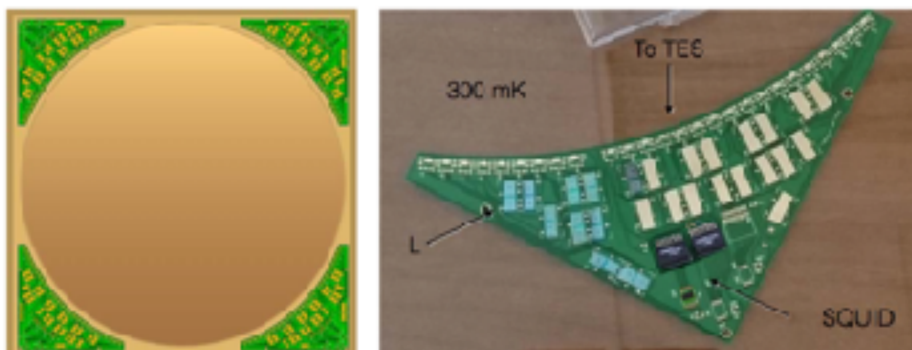


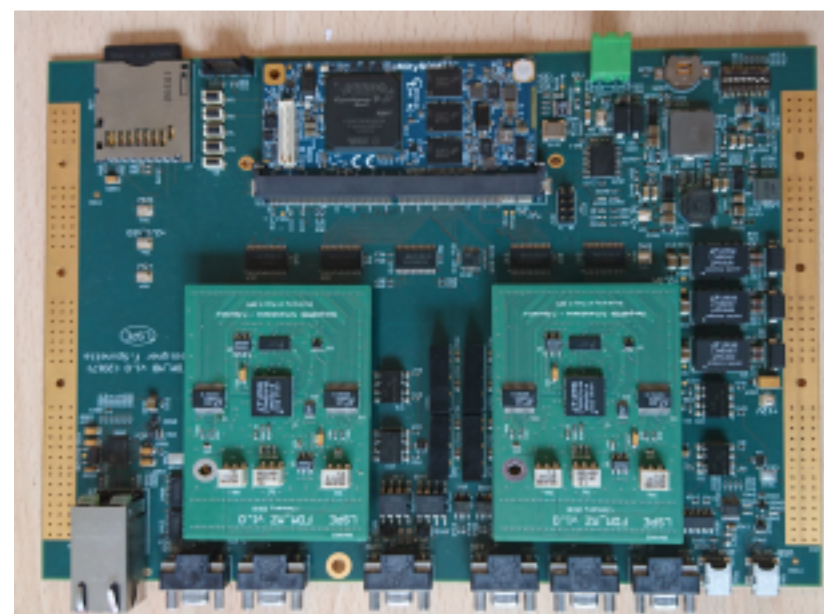
# 2nd bolometer upgrade

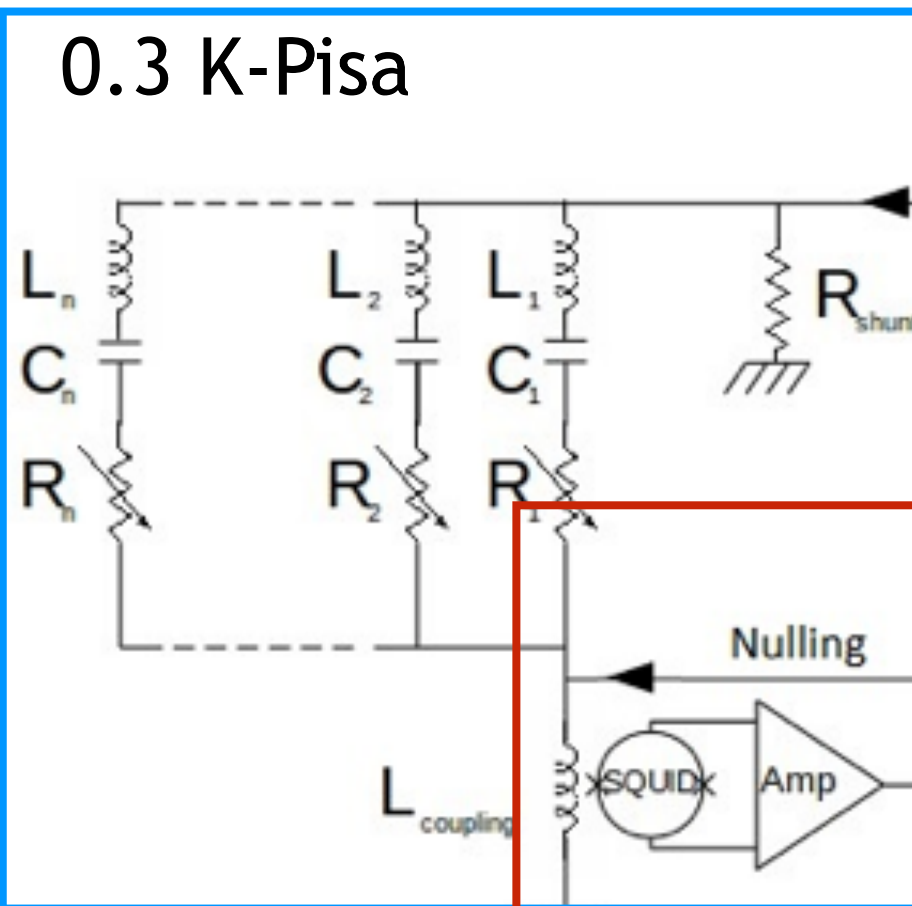
- Same configuration except: TES at the SW edge and uniforme grid at center

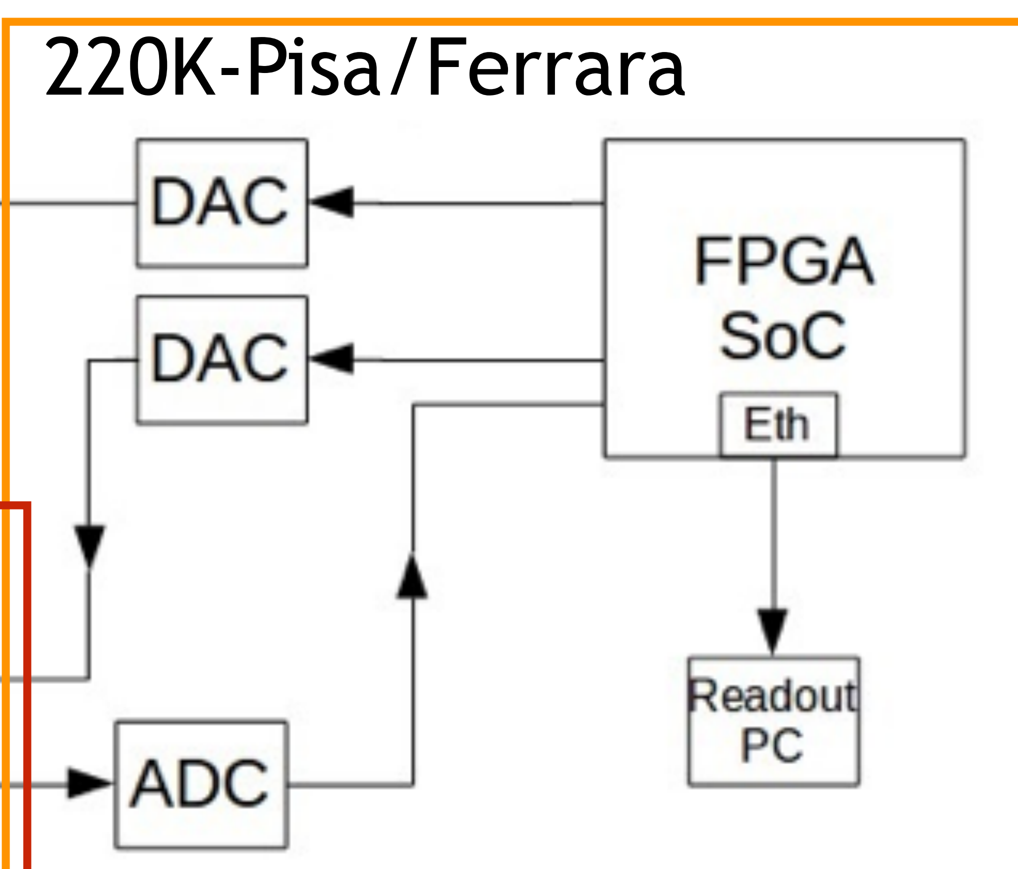


# Full readout

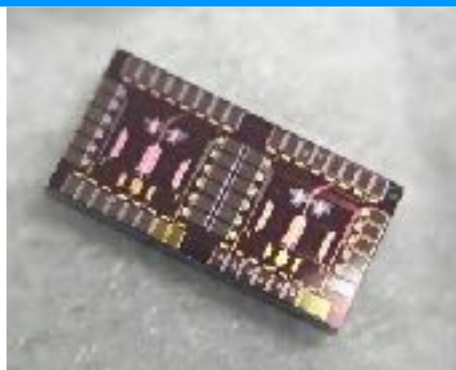





0.3/220K Genova/Pisa



# Anagrafica e Richieste alla Sezione

| Ric. | % |
|---|---|
| Gatti F. | 60 |
| Fontanelli F. | 30 |
| Biasotti M. | 60 |
| Boragno C. | 60 |
| Giovannini M. | 30 |
| Grosso D. | 20 |
| Totale | 260 |

| Servizio | MU |
|---|---|
| Progettazione | 4 |
| Meccanica | 3 |
| Elettronica | 1 |