

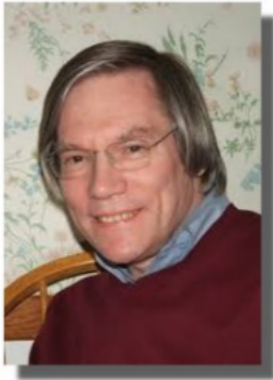
The Large Scale Polarization Explorer

Aniello Mennella

Università degli Studi di Milano
Dipartimento di Fisica

Inflation and the first 10^{-33} seconds

Guth



Steinhardt



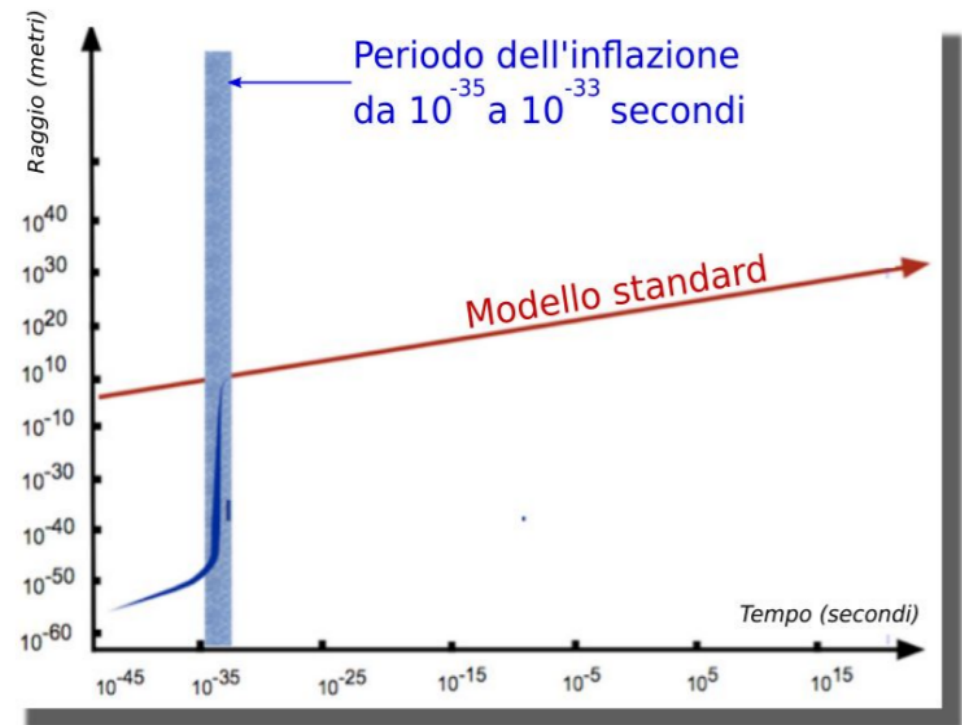
Linde



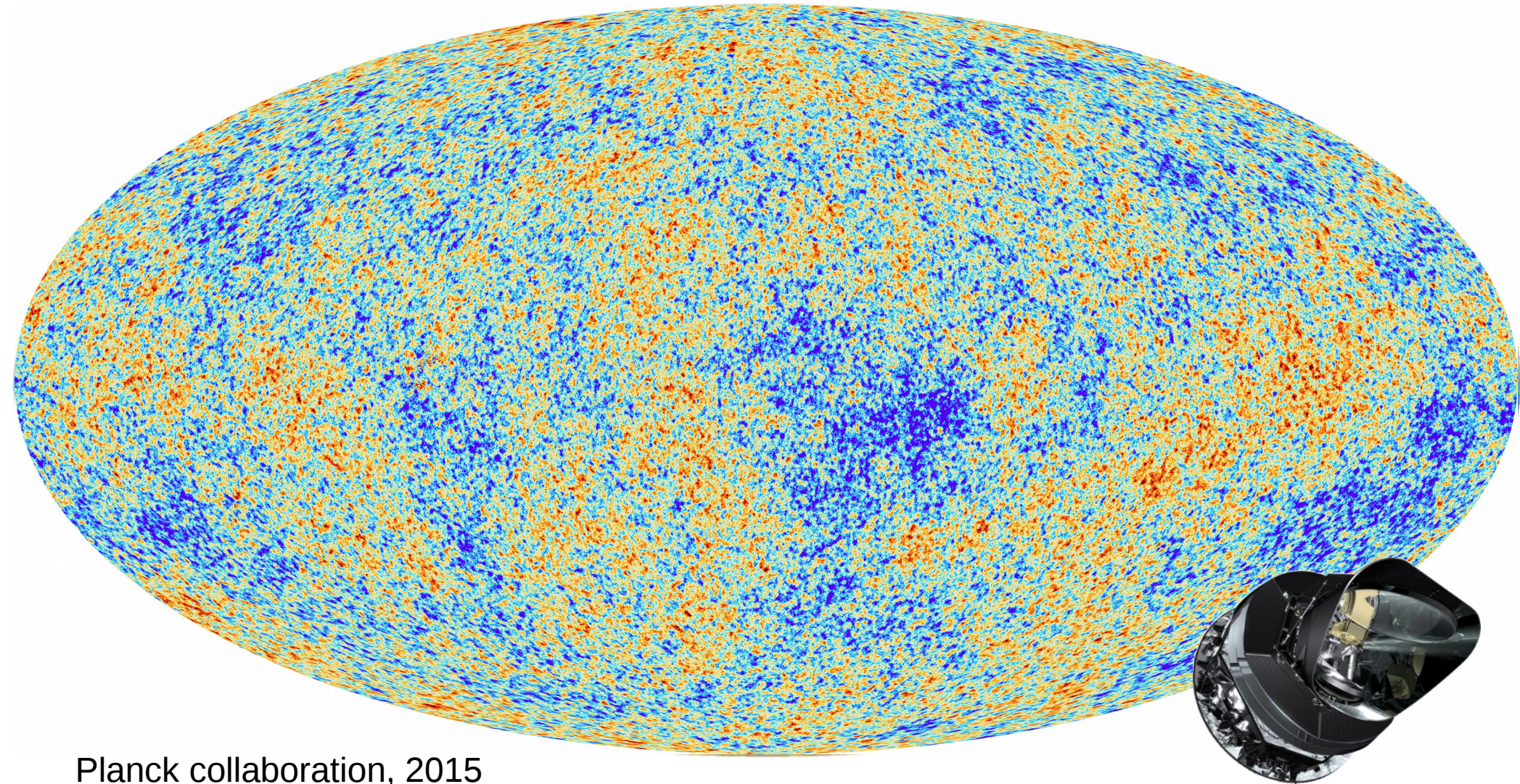
Albrecht



Espansione dell'universo osservabile



CMB polarization, a probe for inflation and primordial GWs



Planck collaboration, 2015

Competition from the ground

PolarBear (Atacama desert, Chile)



ACT-Pol (Atacama desert, Chile)



QUIET (Atacama desert, Chile)



SPT (South Pole)



BICEP2 / Keck array (South Pole)



Competition from the ground

QUIJOTE (Tenerife)

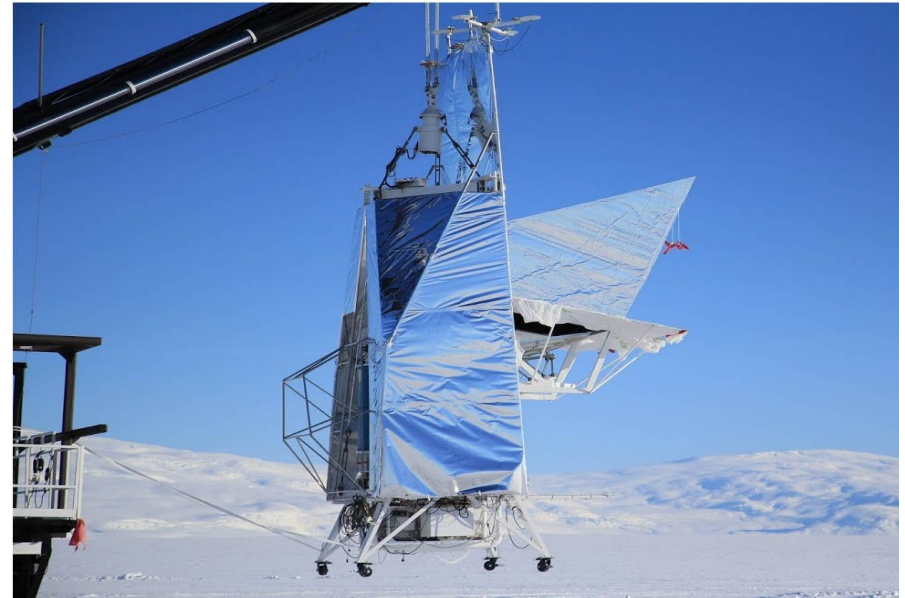


Competition from the stratosphere

EBEX (Antarctica)

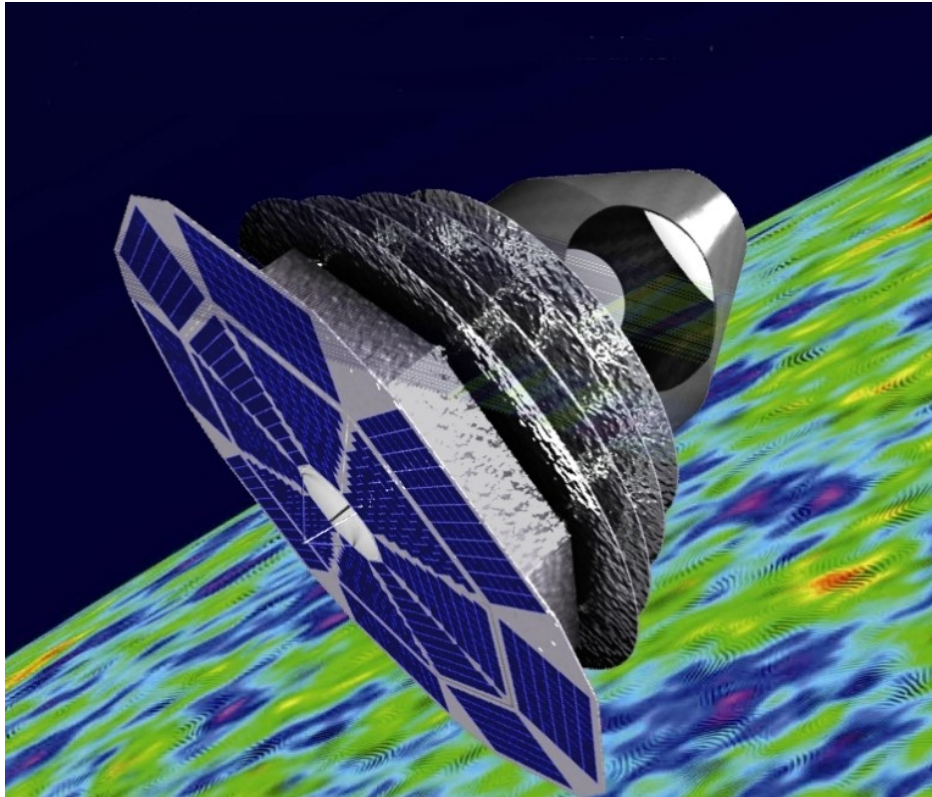


SPIDER (Antarctica)



Competition from space

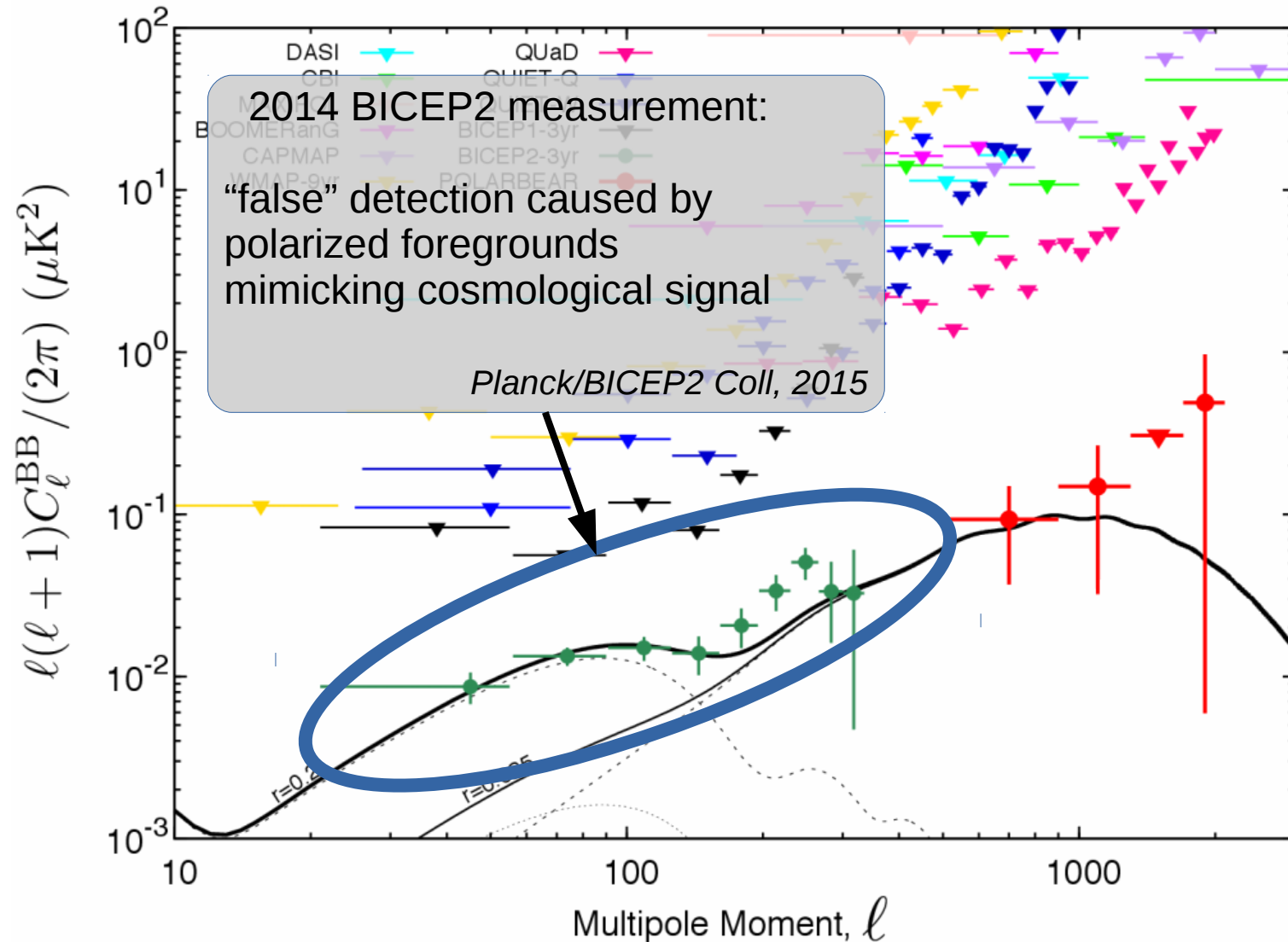
CoRE (Europe)



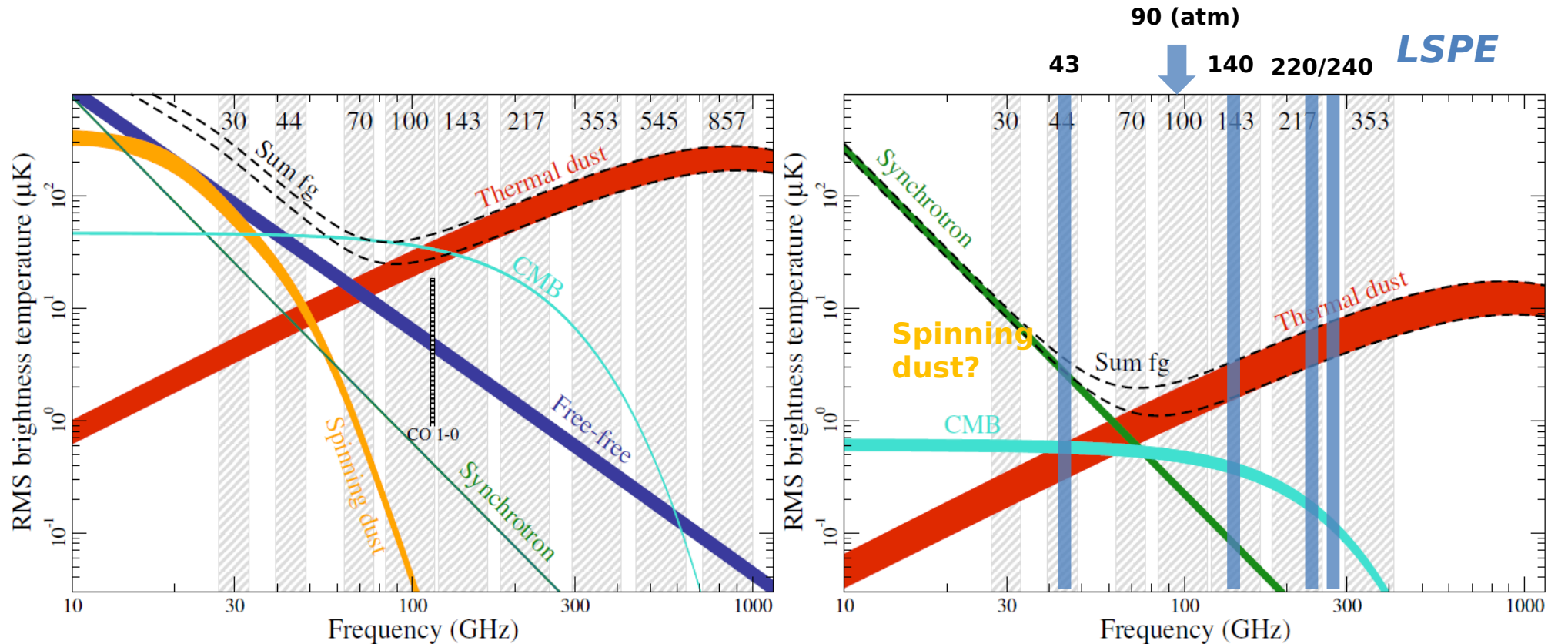
Lirebird (Japan, USA)



State-of-the-art



The foreground challenge



Planck 2015

Large scale foregrounds in polarization are a much harder challenge than for temperature. Their understanding is key to any CMB B-mode experiment

LSPE collaboration



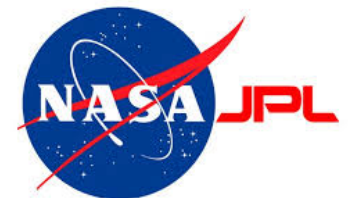
SAPIENZA
UNIVERSITÀ DI ROMA



**UNIVERSITY OF
CAMBRIDGE**



The University of Manchester



LSPE in a nutshell

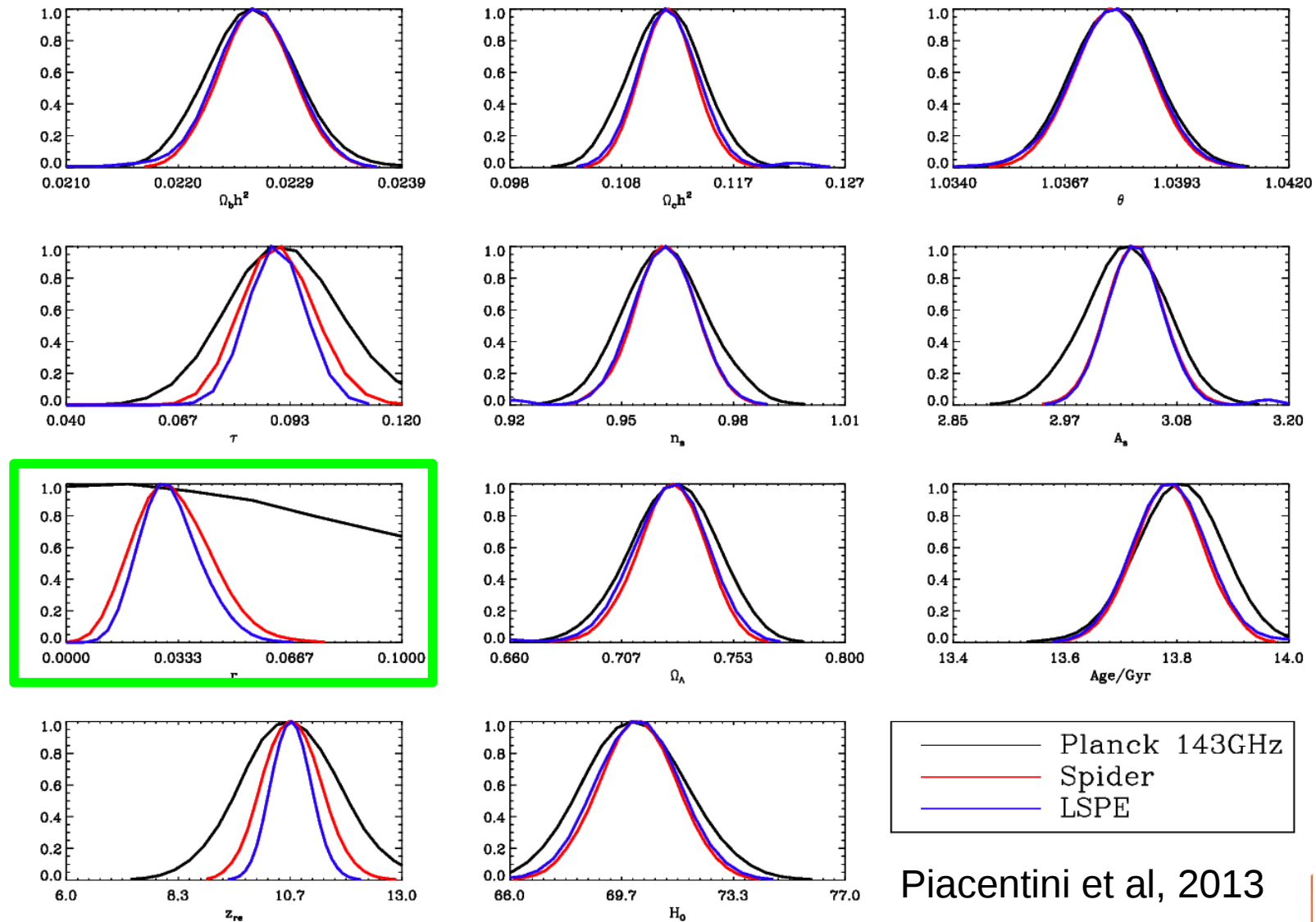
Objective

- Map $\frac{1}{4}$ of the sky with high sensitivity with large frequency coverage (40 – 240 GHz)
- Constrain $r < 0.03$ with 99.7 % confidence level (3σ)

Method

- Night polar Long Duration Balloon flight (around North Pole)
 - *Night flight allows spinning*
 - *Arctic flight easier for logistics*

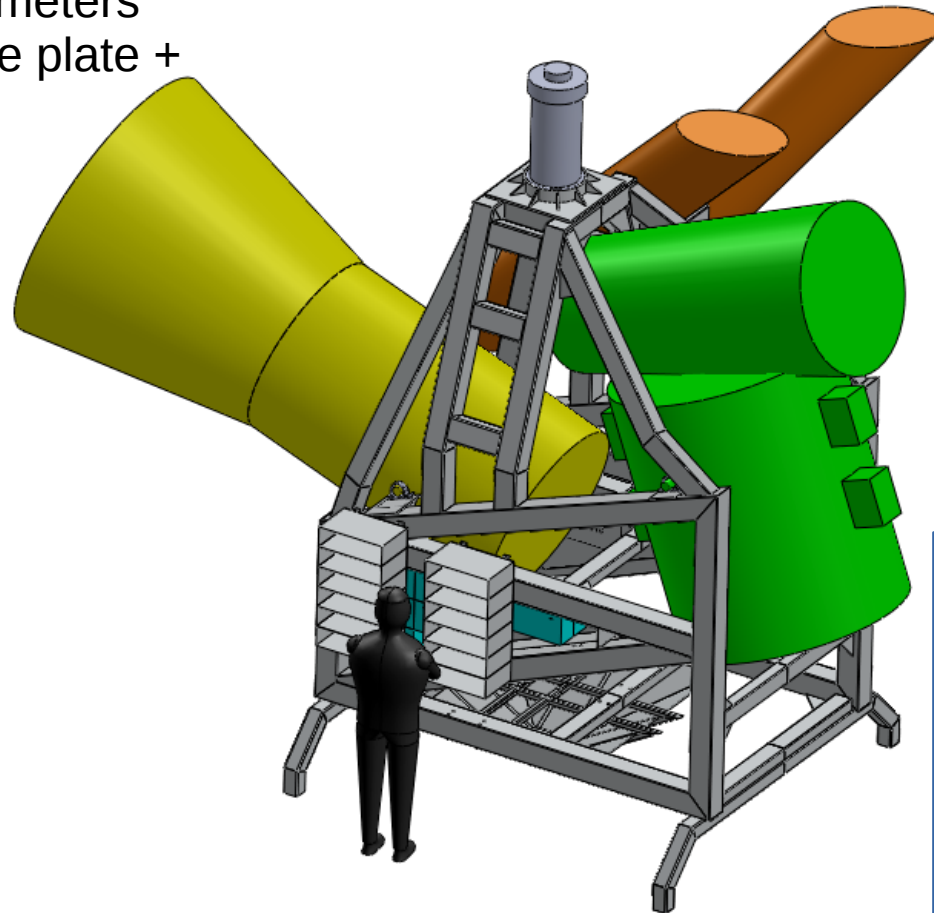
Main objective



LSPE in a nutshell

SWIPE

- 140, 220, 240 GHz
- Multi-moded bolometers
- Rotating half-wave plate + grid polarizer

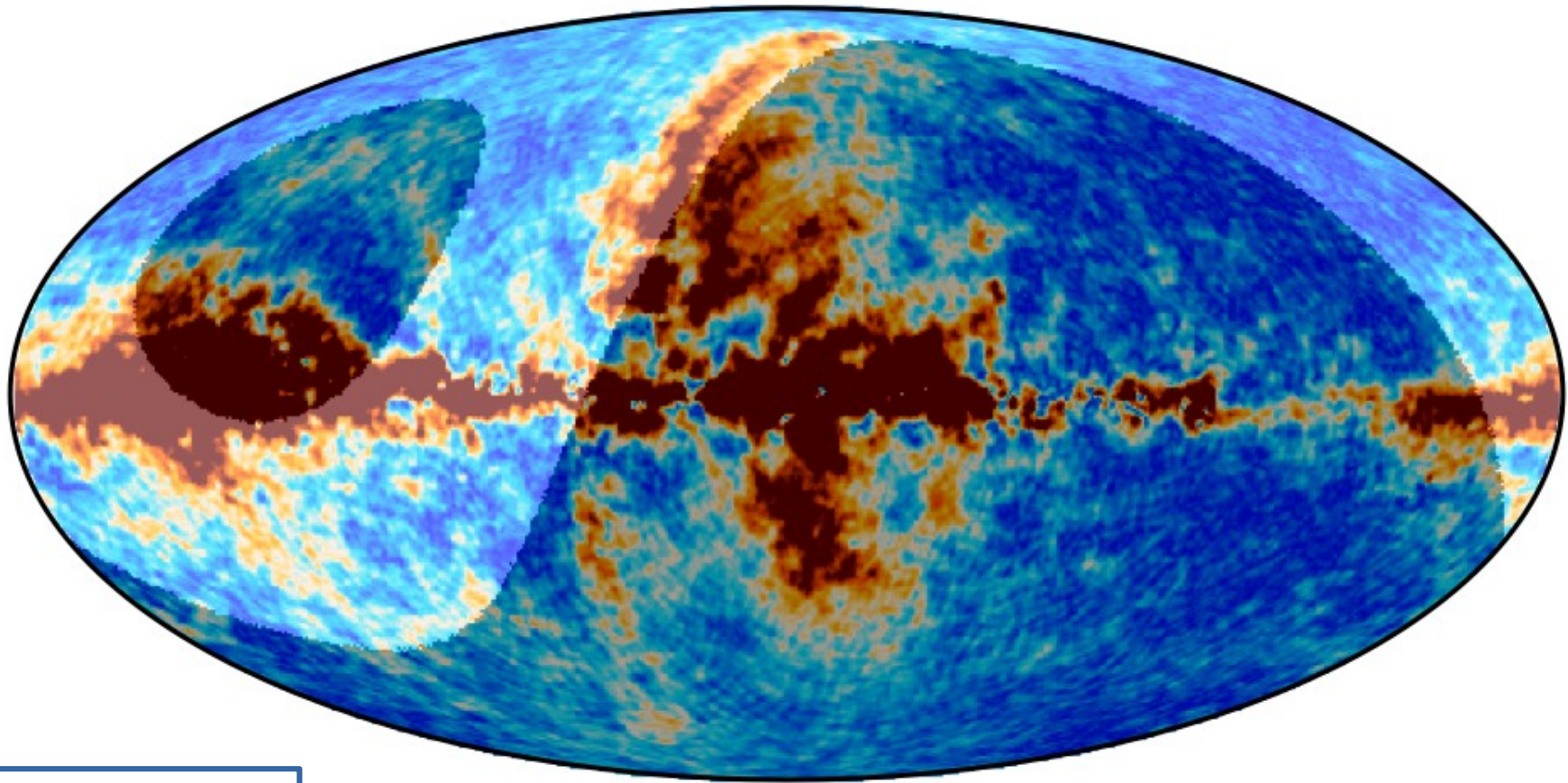


STRIP will observe from Tenerife Izana site (next to QUIJOTE)

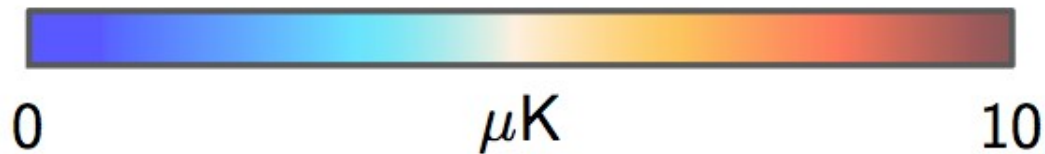
STRIP

- 43, (90) GHz
- QUIET coherent polarimeters
- Dragone side-fed telescope ($\sim 0.5^\circ$ - 1° angular res.)

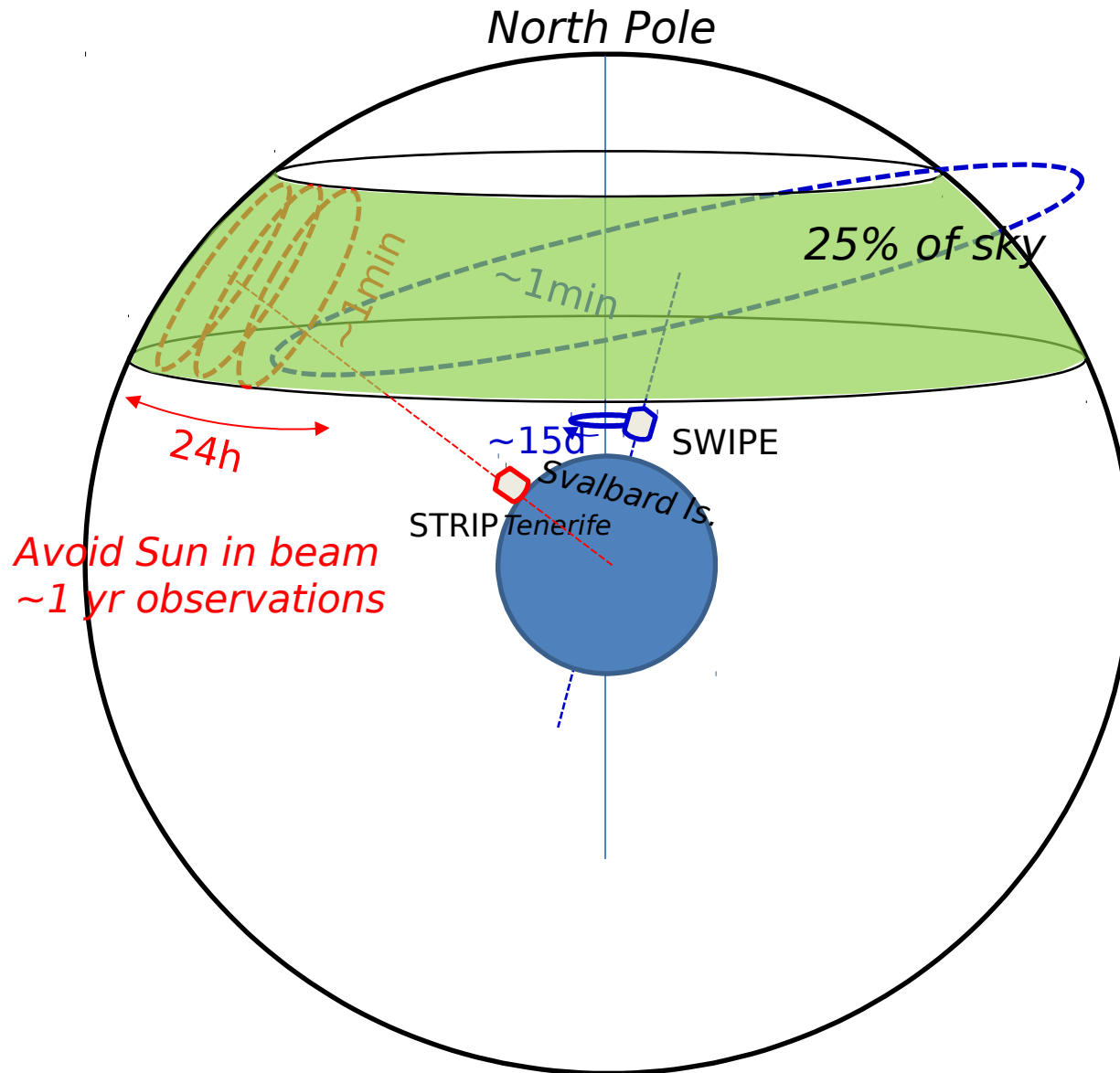
Sky coverage



~ 23% of the sky
available after
masking polarized
emission

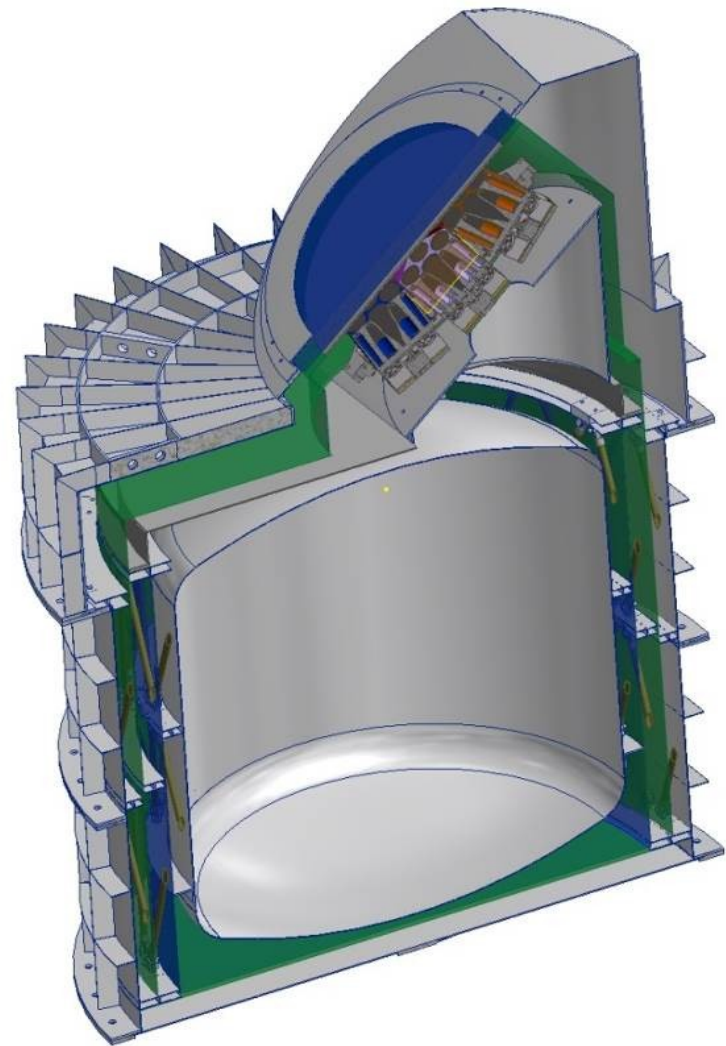
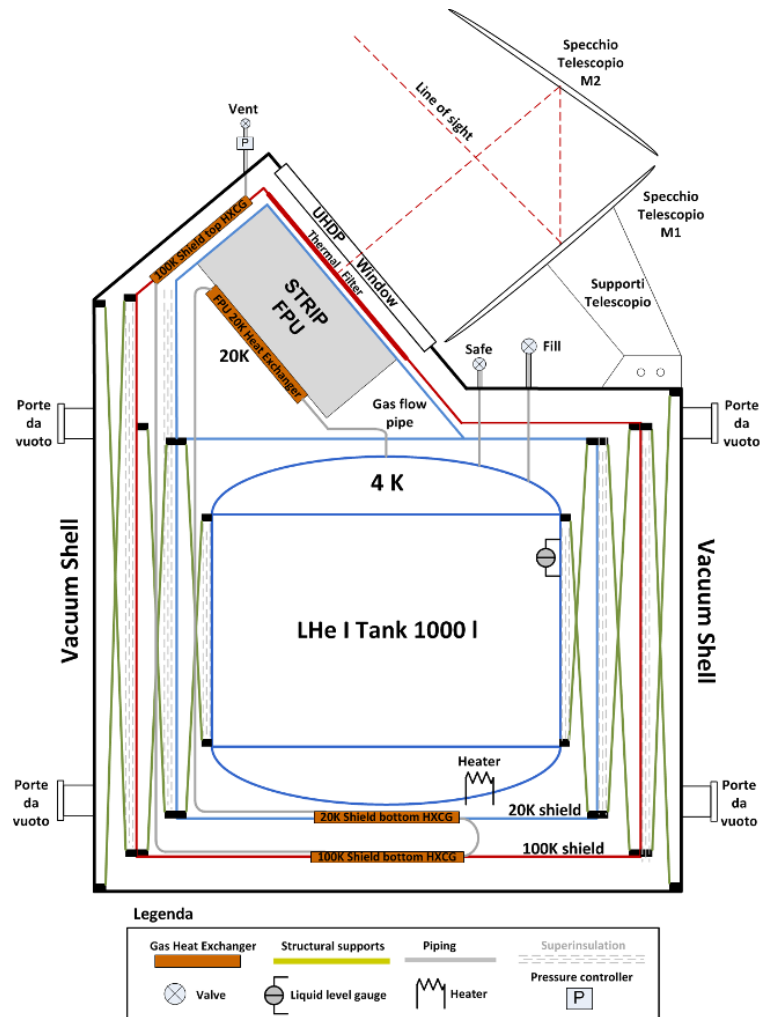


Scanning strategies

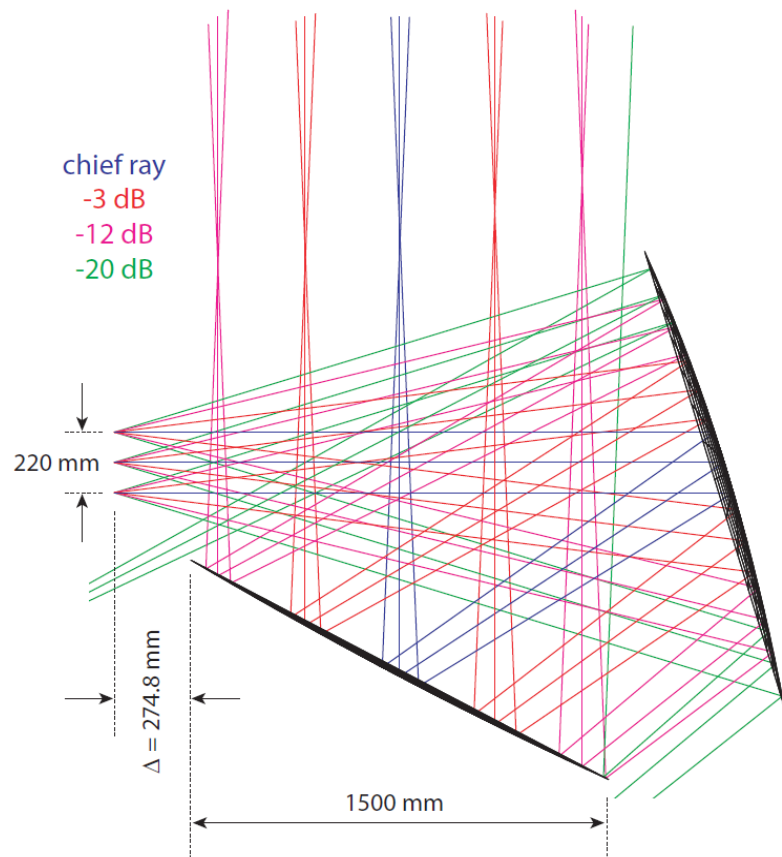


STRIP

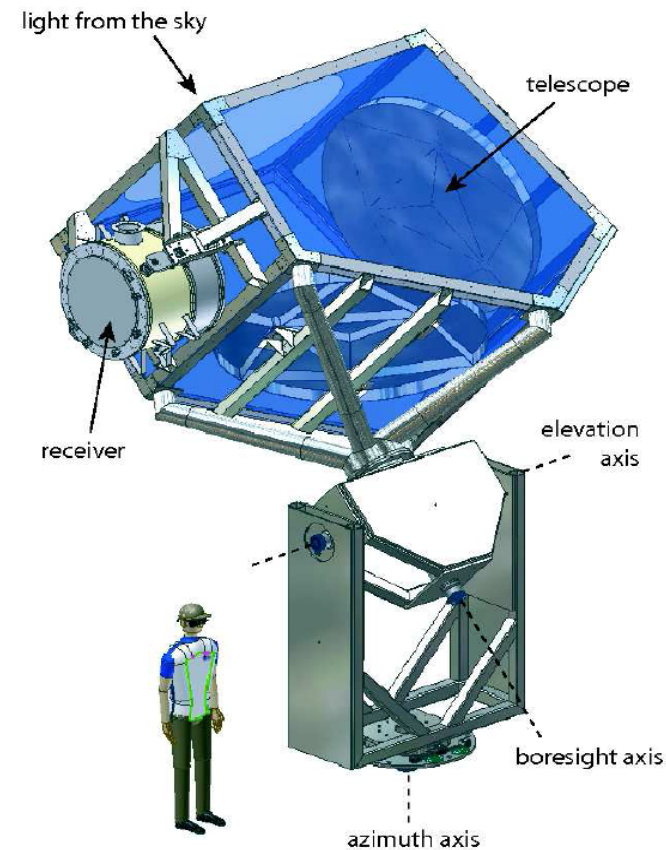
(STRatospheric Italian Polarimeter)



Telescope



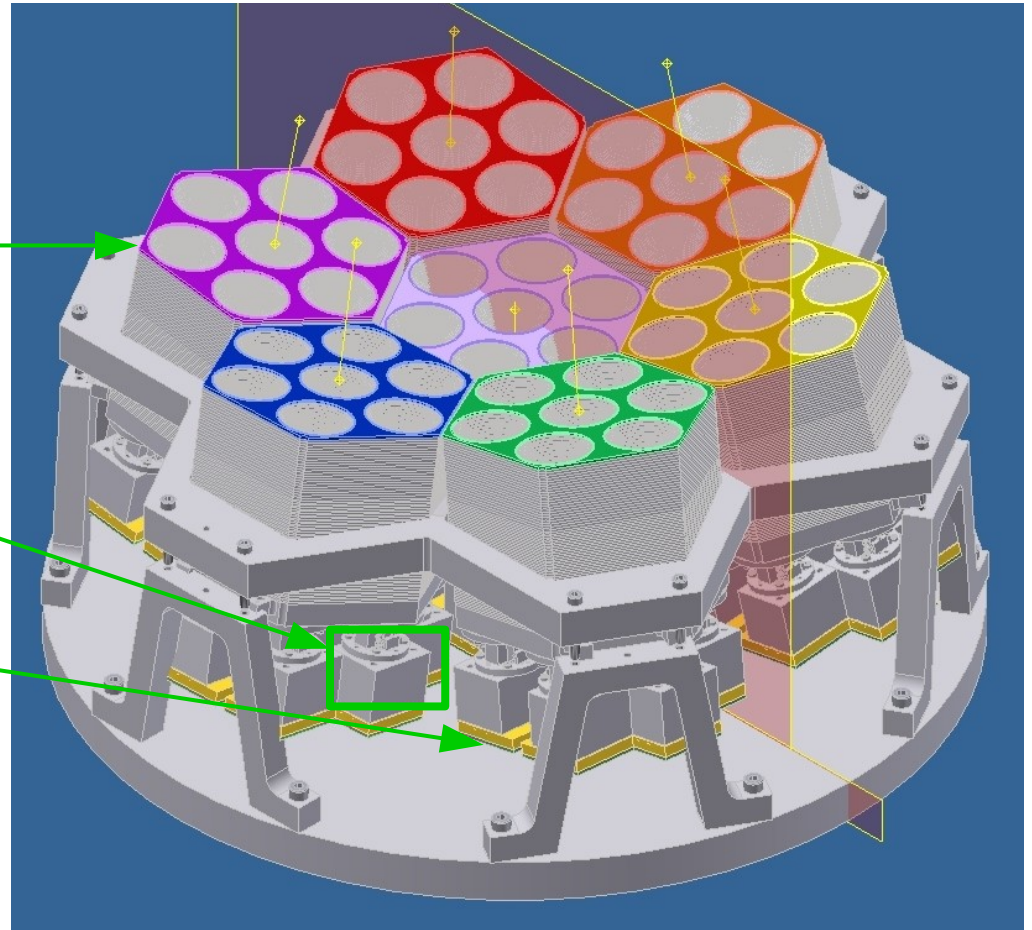
Baseline:
Clover telescope offered by M. Jones, Oxford
1.5m aperture (*20 arcmin resolution*)



Mount:
H/W parts mostly built
Develop I/F S/W, Rotary joint

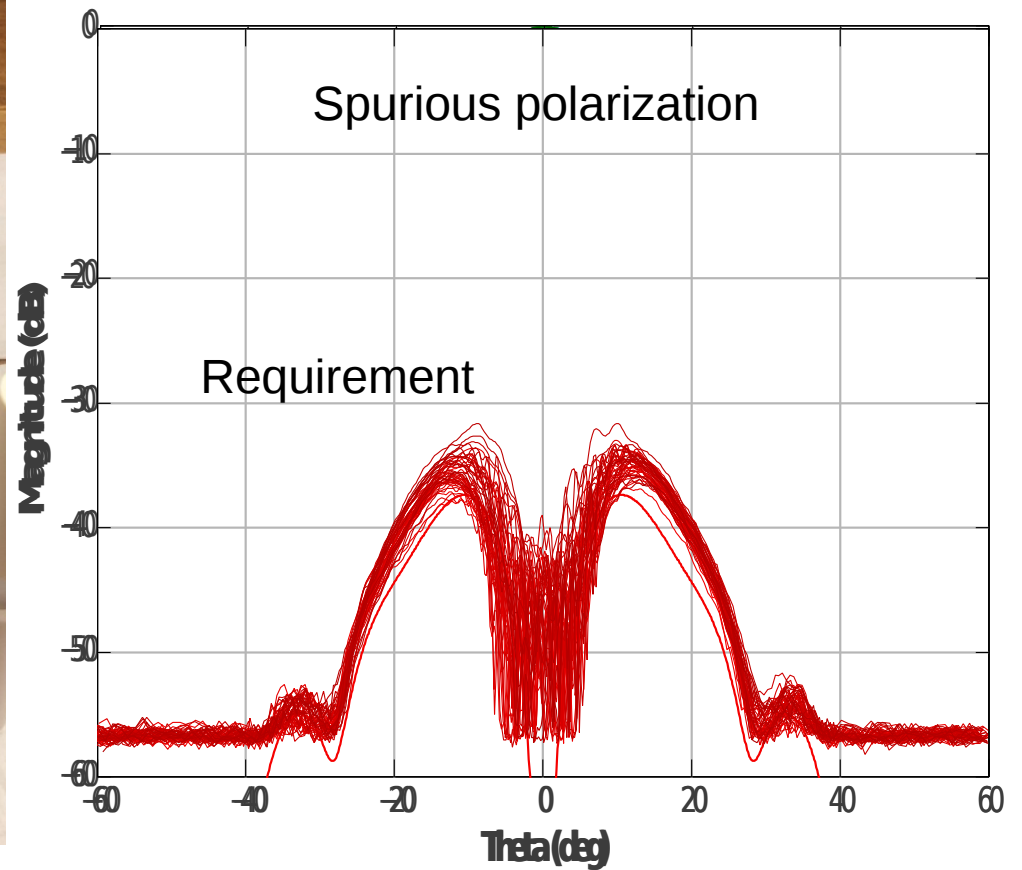
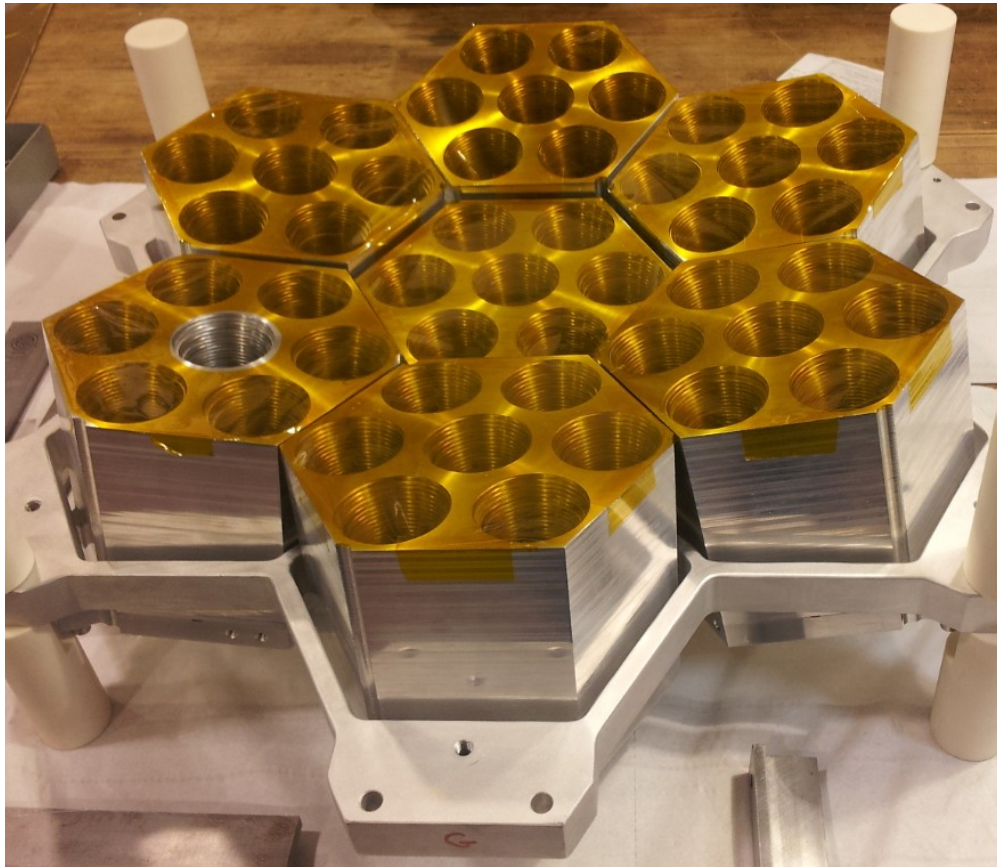
STRIP 43 GHz focal plane

- Corrugated feed horns (7 modules with 7 horns each)
- Polarizers + Orthomode Transducers (OMT)
- Polarimeters
- Mechanical support



Feed horns

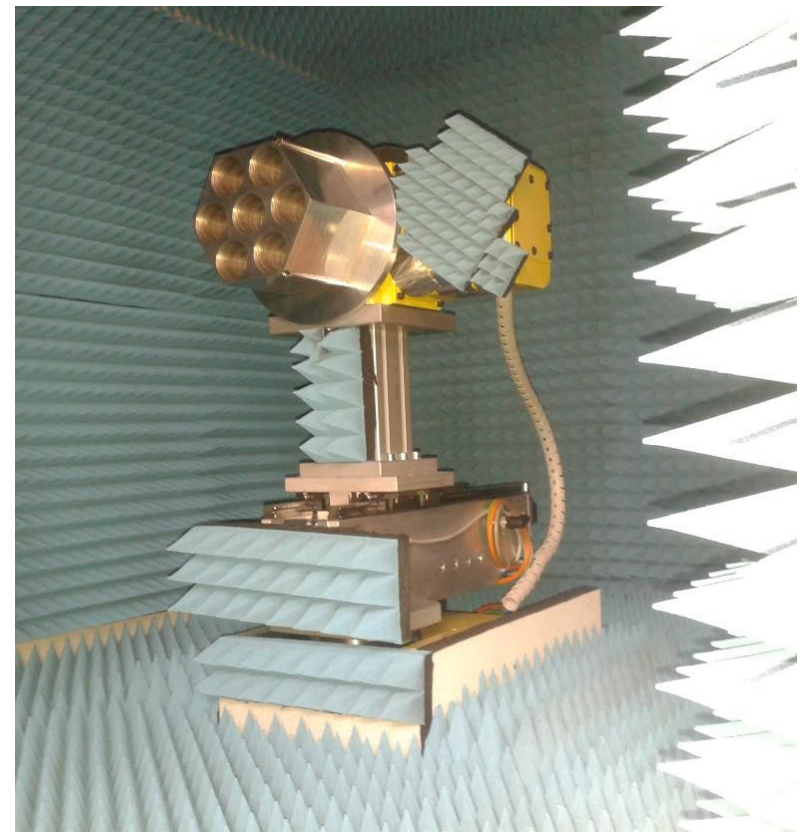
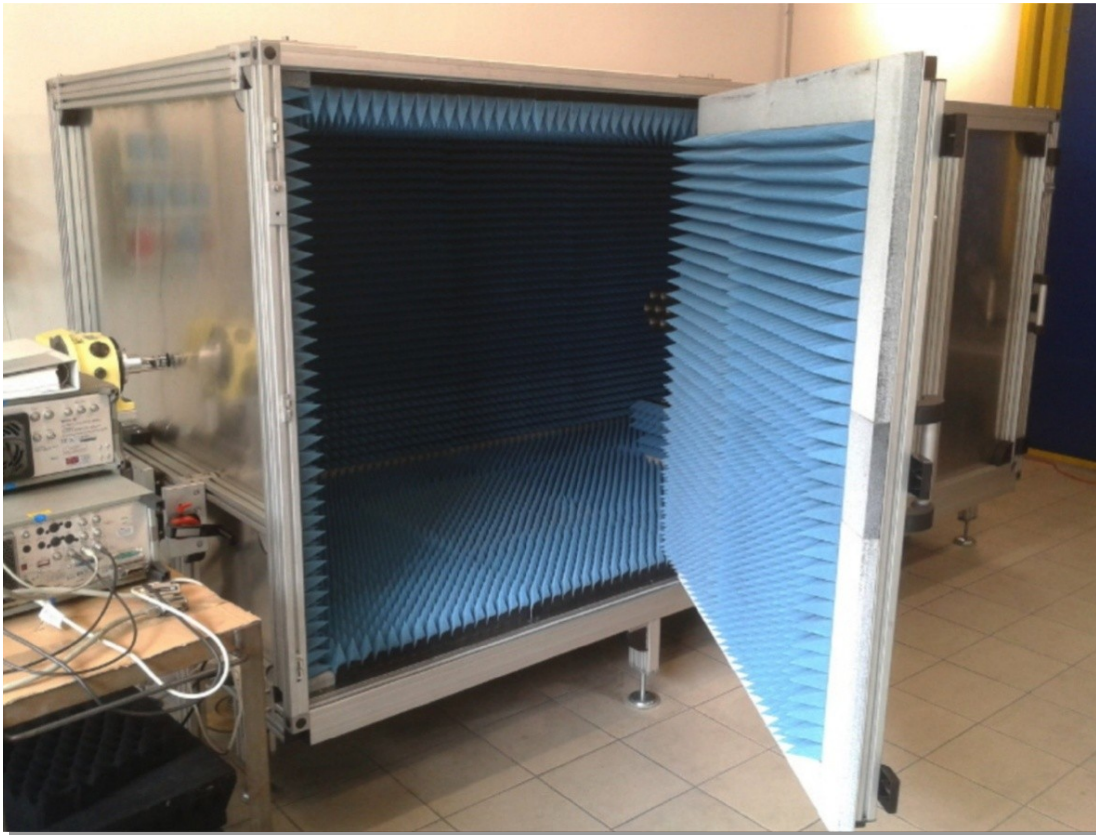
49 beam patterns at 47.3 GHz



C. Franceschet, 2016

Feed testing

Two anechoic chambers for far field vector measurements up to 70 GHz



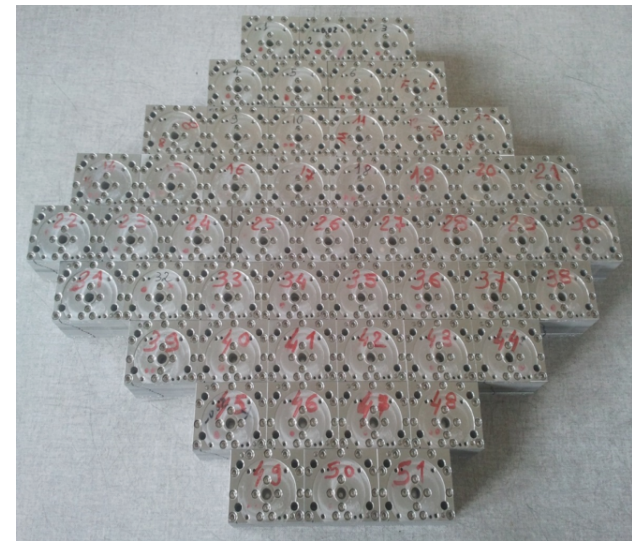
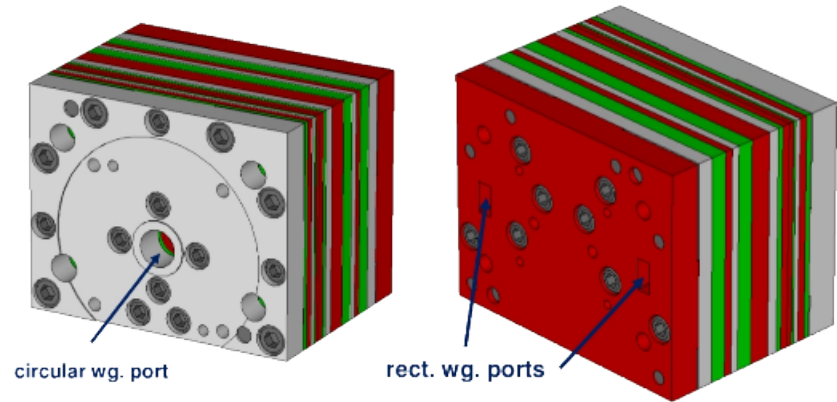
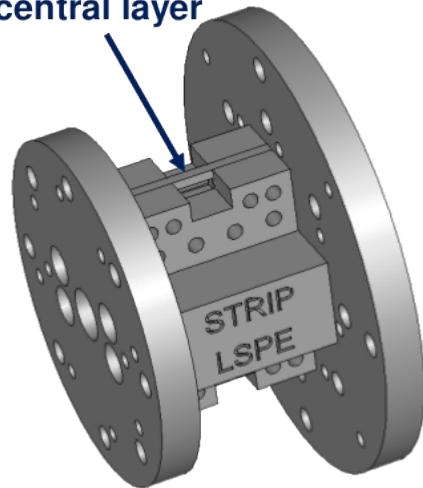
Feed testing

Metrological measurements with Werth scopecheck 200 machine



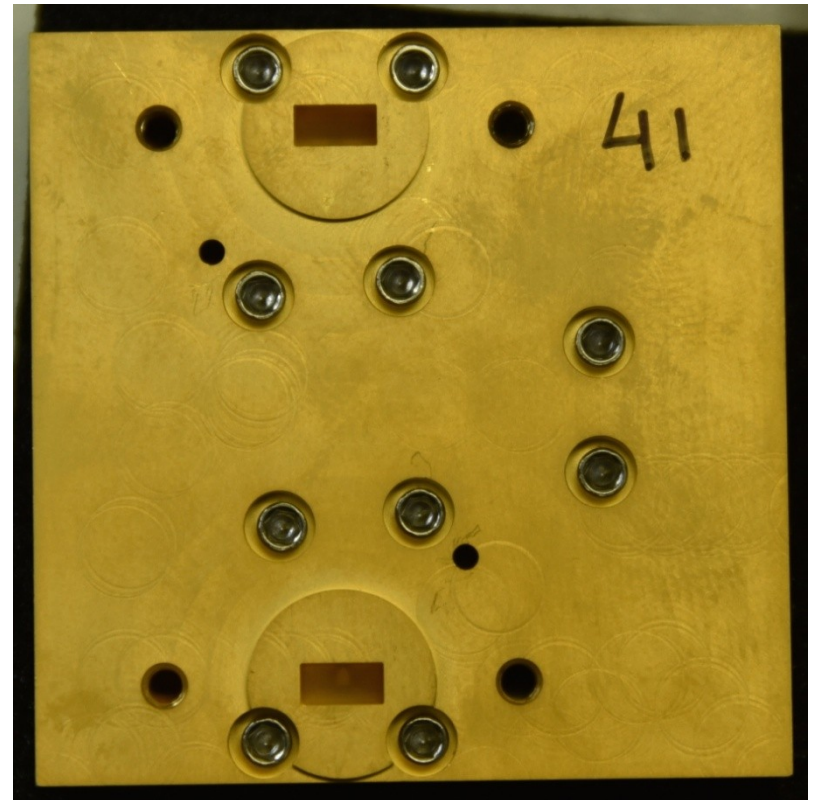
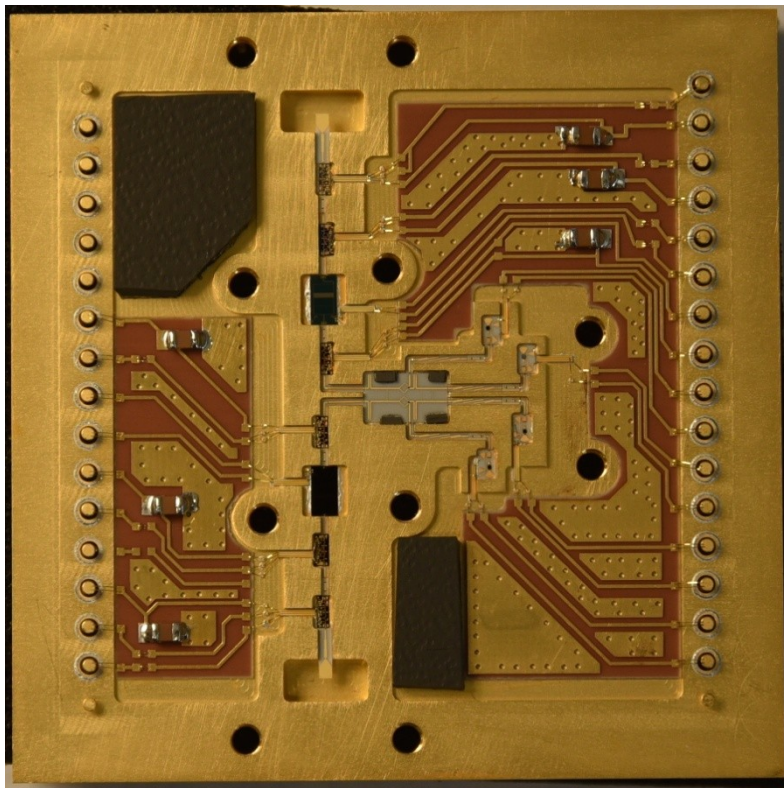
Polarizers – OMTs (IEIIT - Torino)

1.5-mm central layer



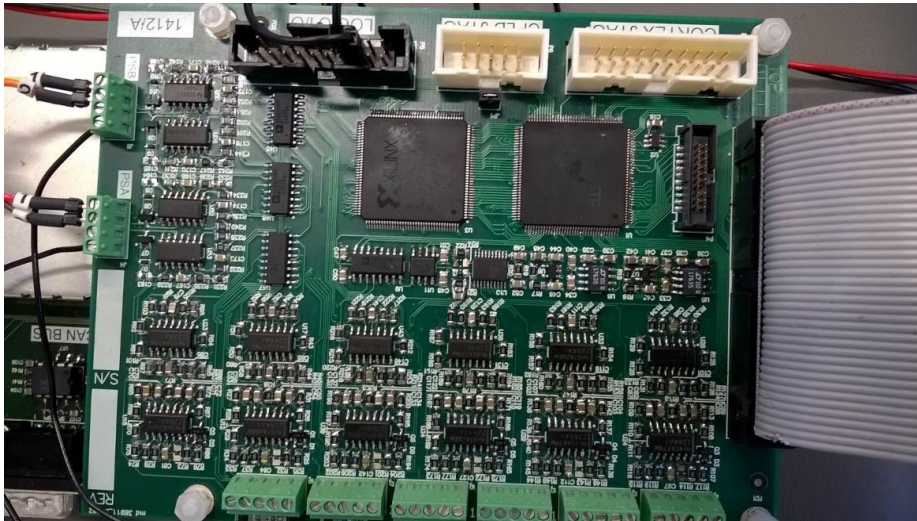
Polarimeters

50 units built with JPL LNAs and PSWs, currently under testing at JPL for functionality and UniMib (Milano Bicocca) for performance

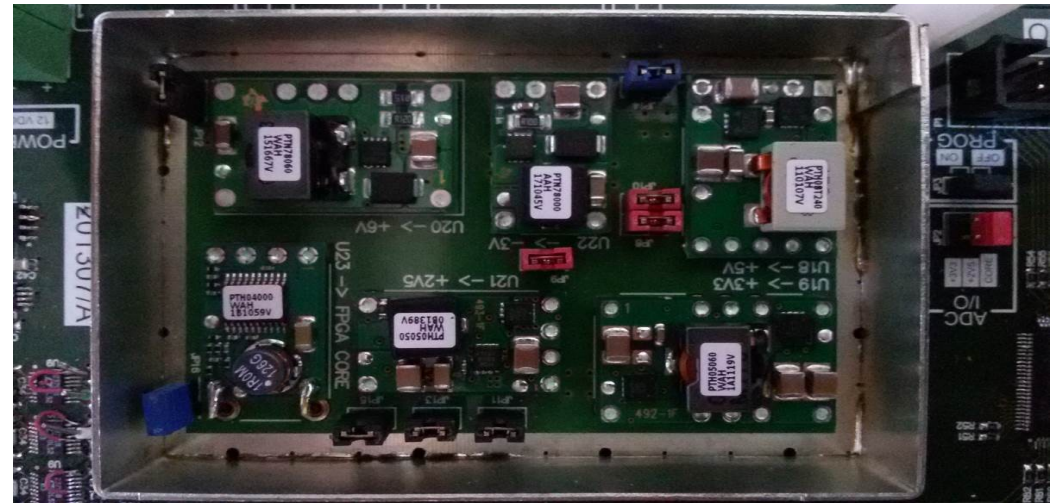


Electronics (Uni-Bicocca)

Discrete components bias board



Power supply



Sensitivity estimate (1° pixel)

	STRIP (original design)		STRIP (ground)	
	43GHz	90GHz	43GHz	90GHz
T_{noise} (receiver + window + mirror)	26.5	48.5	26.5	48.5
T_{atm}	0.002K	0.002K	9K	11K
Observing time	14 days	14 days	12 months	12 months
Duty cycle [%]	100	100	35	35
dT (Q/U)	2.55 μK	8.16 μK	1.12 μK	3.32 μK

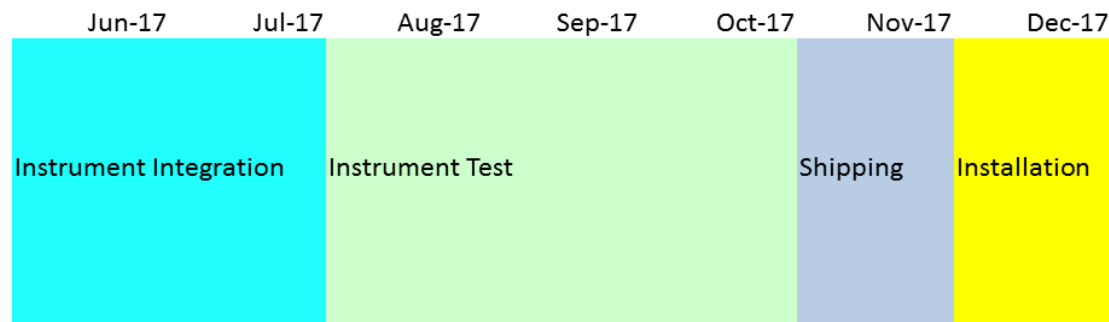
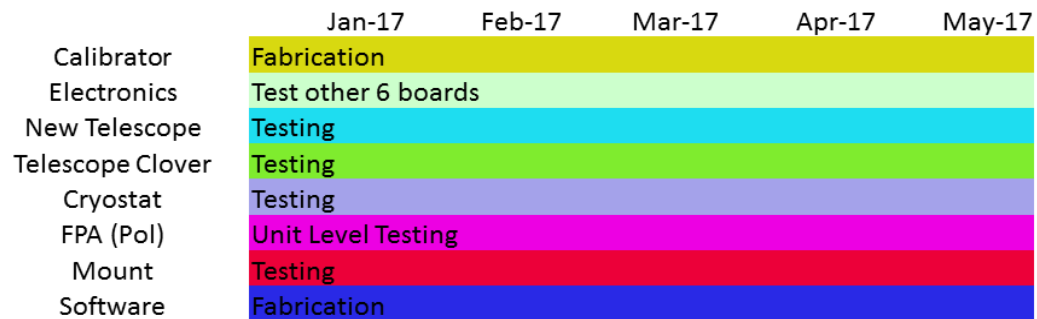
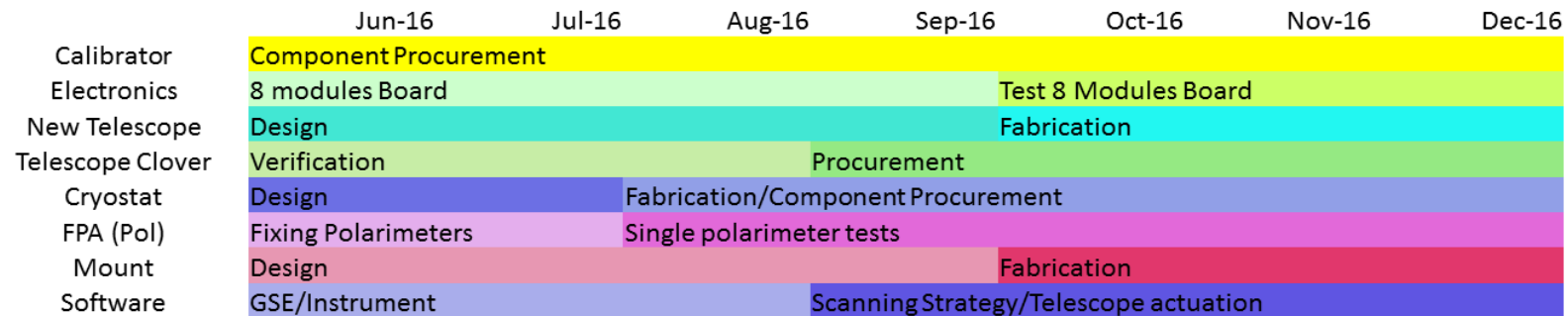
Main objective of STRIP: synchrotron (& spinning dust?) channel of LSPE

Independent measure of CMB B-mode: 1 year: $r = 0.05$

(campaign can be extended to 4 yrs)

Clear potential of combination with QUIJOTE dataset

Schedule



Richiesta INFN

Tipologia	Richiesta [k€]	Descrizione	Note
Missioni	5.1	Missioni per meeting (2 persone, 6 volte all'anno per due giorni, a 150€ al giorno + 250€ a viaggio A/R)	
Consumo	3	Materiali grezzi, utensili officina	
Altri consumi	4.5	Vestitario di sicurezza per operazioni in quota di inverno (n. 3 kit completi a 1.5 k€ l'uno)	
Trasporti	30	Trasporto montatura + telescopio CLOVER da UK a IT per integrazione con strumento di piano focale	Da verificare con team Oxford
Inventario	0		
Apparati	100	Modifiche montatura CLOVER per adattarla a STRIP: 50 K€ Acquisto e installazione rotary joint per consentire rotazione completa e continua in azimut: 50 k€	
Licenze software	0		
Servizi esterni	0		
Totale	142.6		