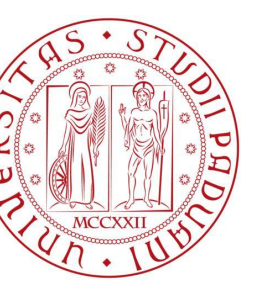


ITALY

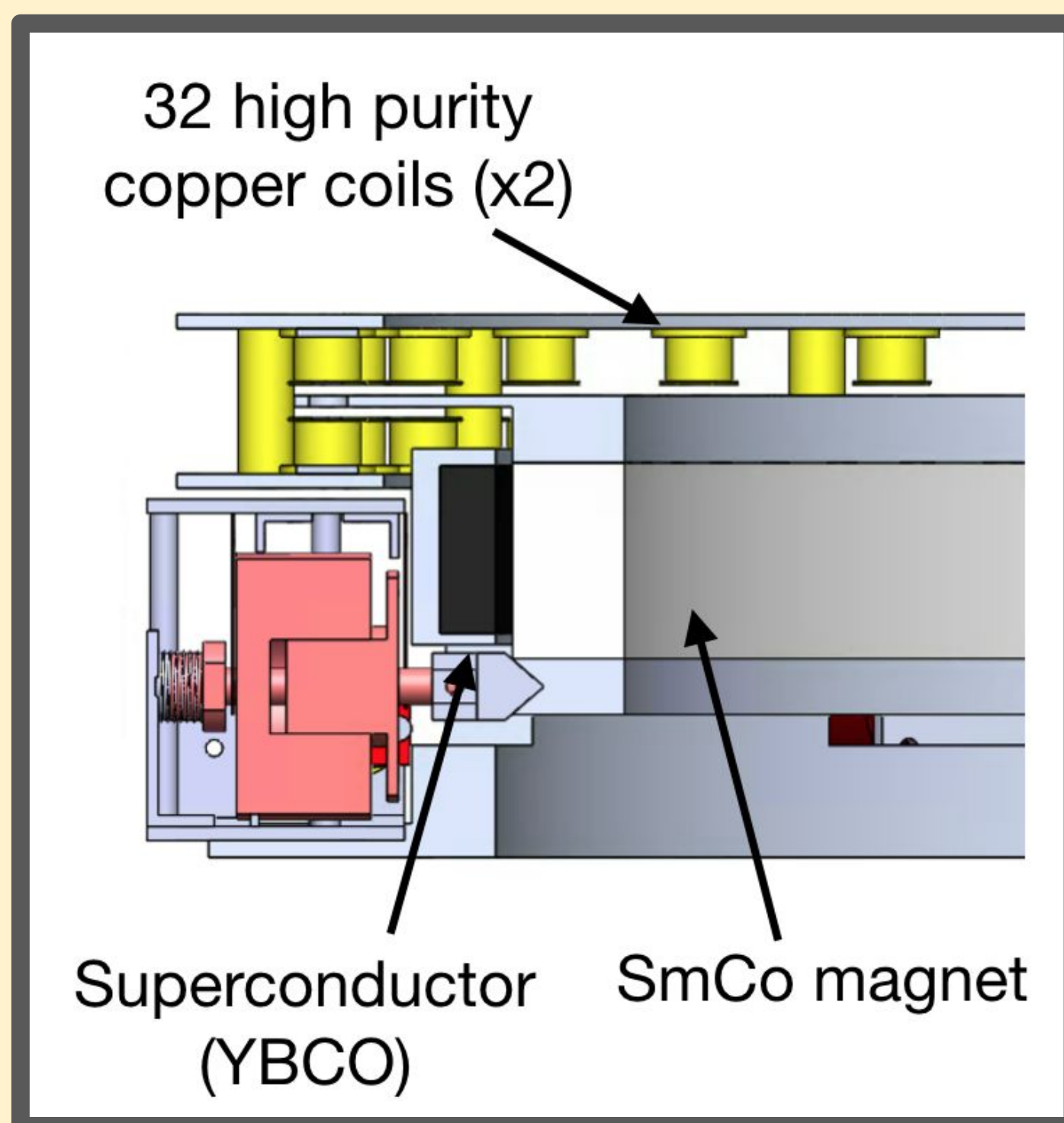
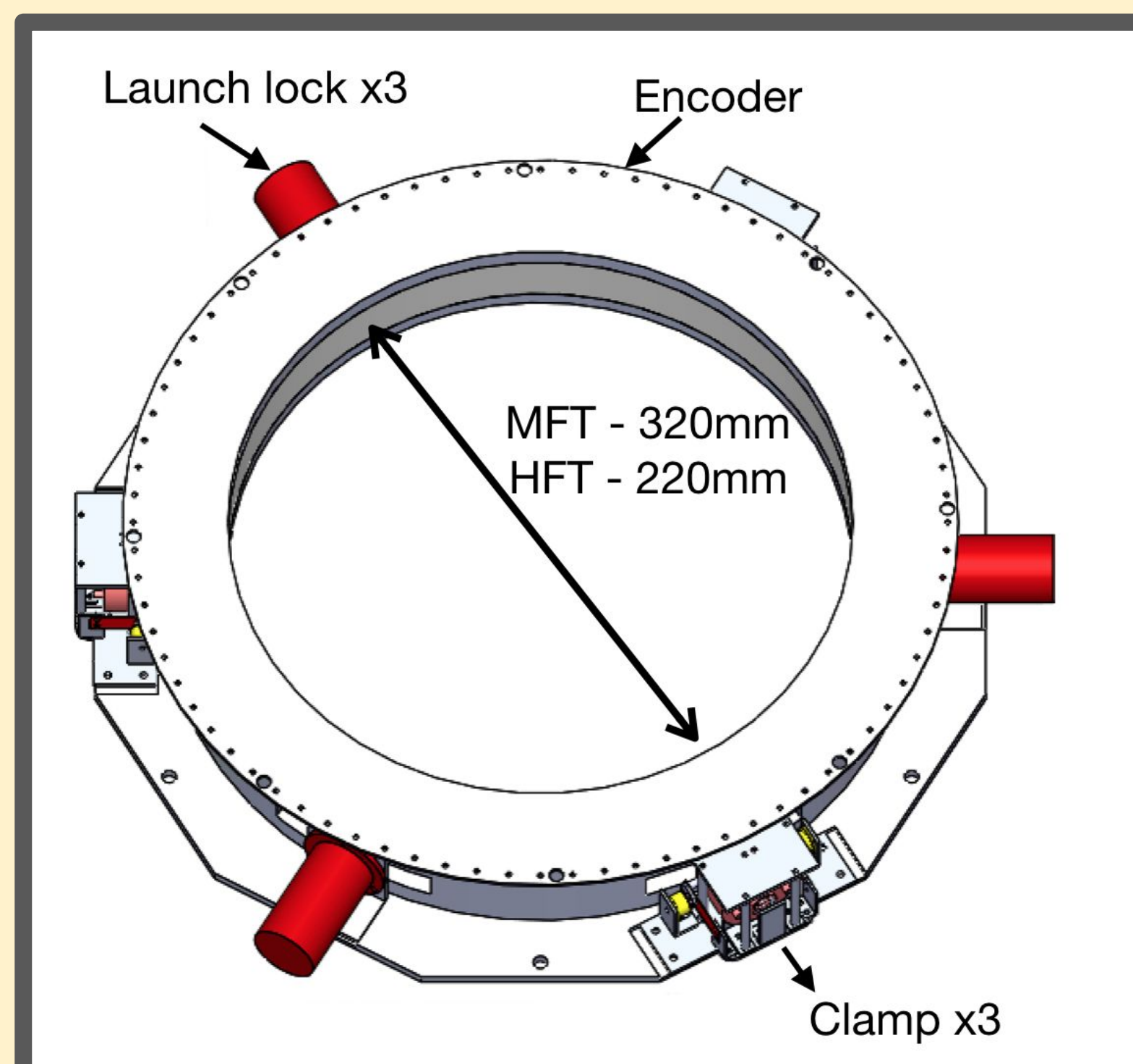


The Italian COSMOS network has been funded by ASI for the LiteBIRD Phase A activities



Agenzia Spaziale Italiana

HWP rotator

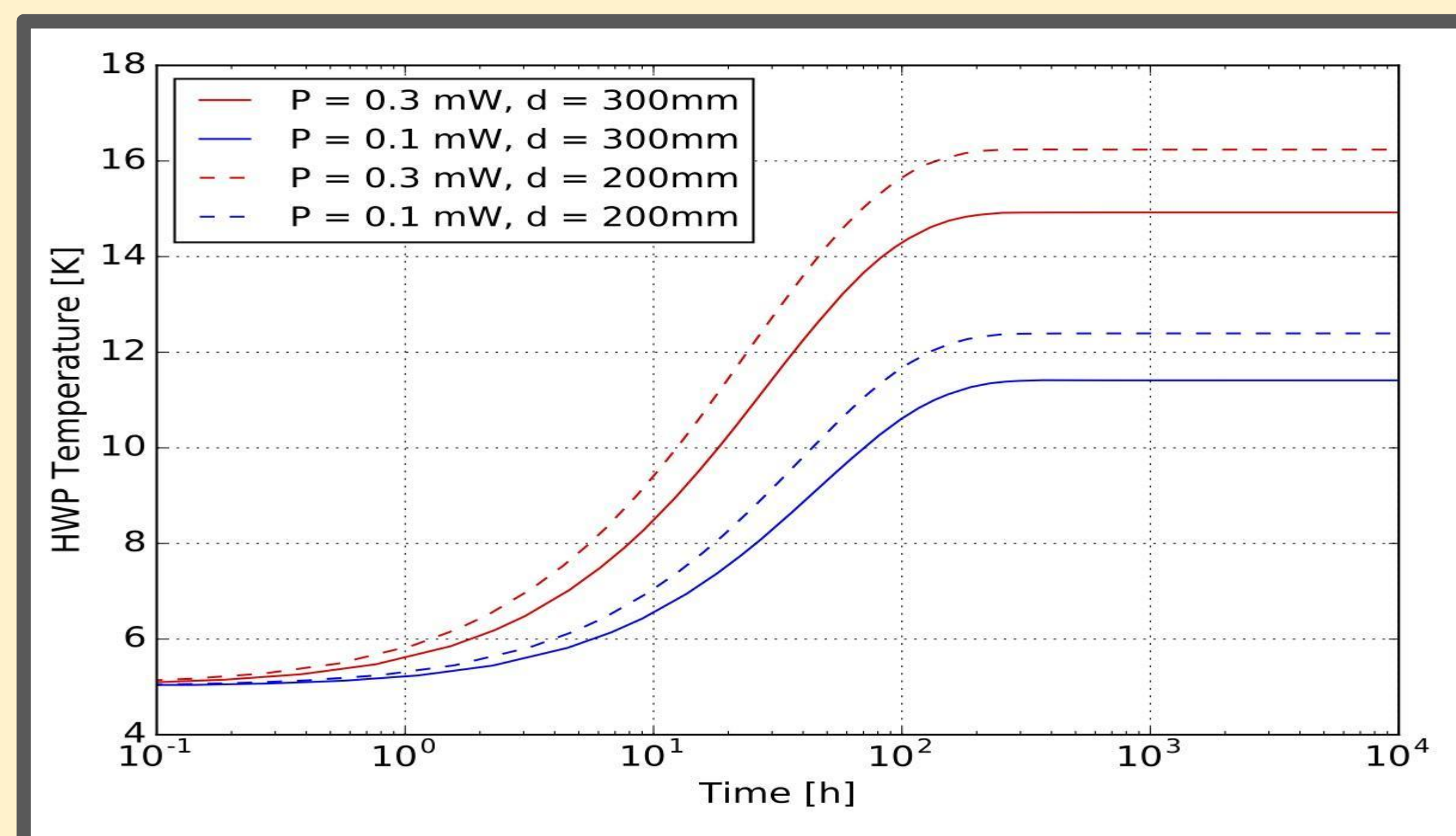


The HWP diameters of MFT and HFT are 320mm and 220mm, respectively. The *Sapienza* proposal is to have two scaled polarization modulators with the HWP mounted on a nearly frictionless bearing. This is obtained via the magnetic levitation of a permanent magnet rotor ring (cream grey) above a stator ring hosting an array of super-conducting bulks (black). The magnet ring is sandwiched between an Aluminum grooved ring, coupled with 3 actuators (and 3 launch locks), and an encoder ring.

The rotation is performed thanks to 32 coupled coils on the stator, paired with 8 small SmCo magnets on the rotor. Eddy currents produced on the rotor will heat up the HWP. For its thermal model we assumed:

- motor composed by 32 coupled copper coils (RRR > 100)
- ~10 mA current needed in the motor
- ~0.1 mW dissipated during operation on the rotor
- Emissivities: HWP = 0.03 and Al = 0.4.

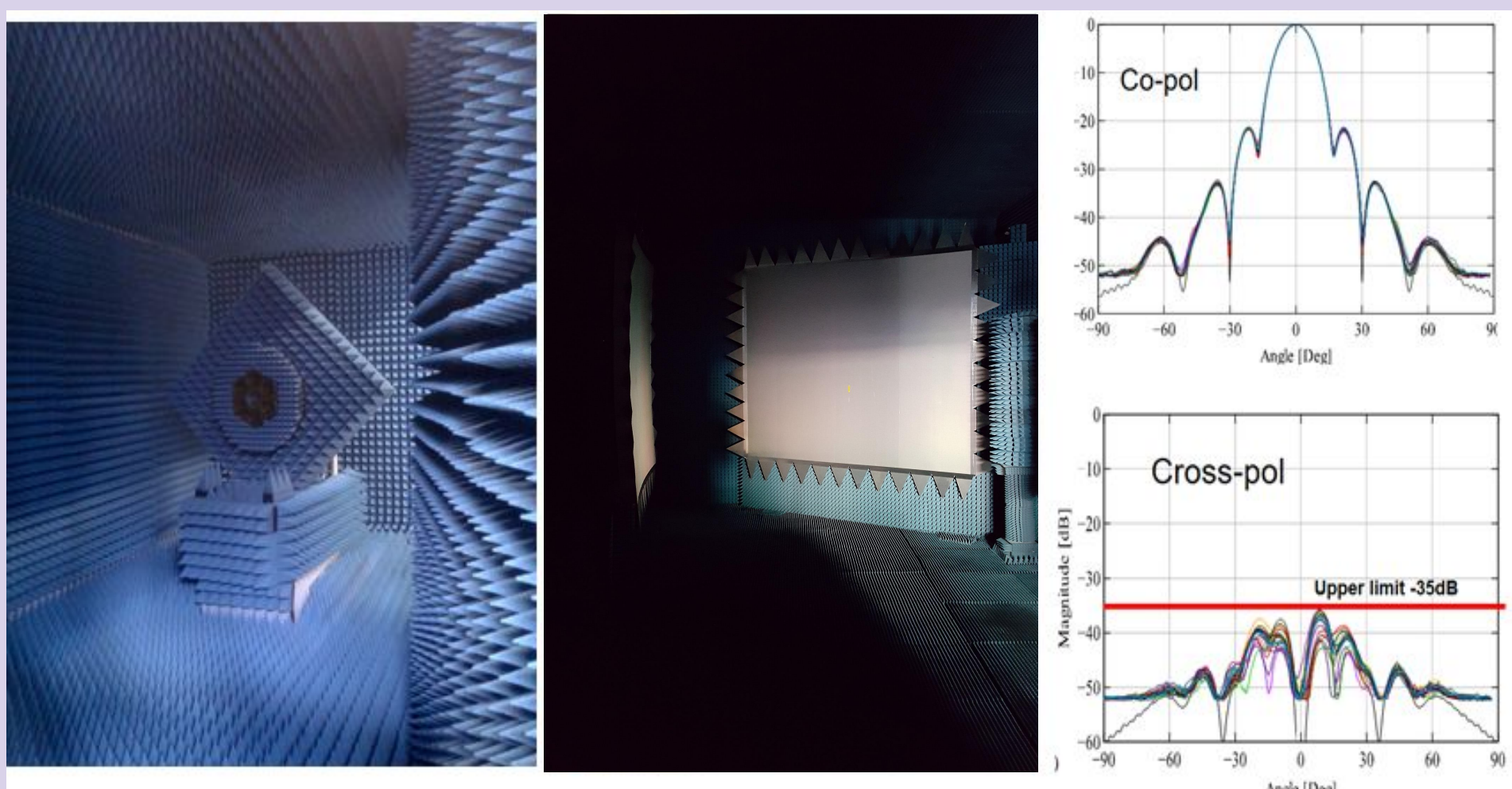
After a drift of a few hours, the expected temperatures are both below 20K (figure below)



We are in the process of selecting an industrial partner for the feasibility study of the subsystem. A similar concept is being used for the LSPE-SWIPE mission.

Calibration

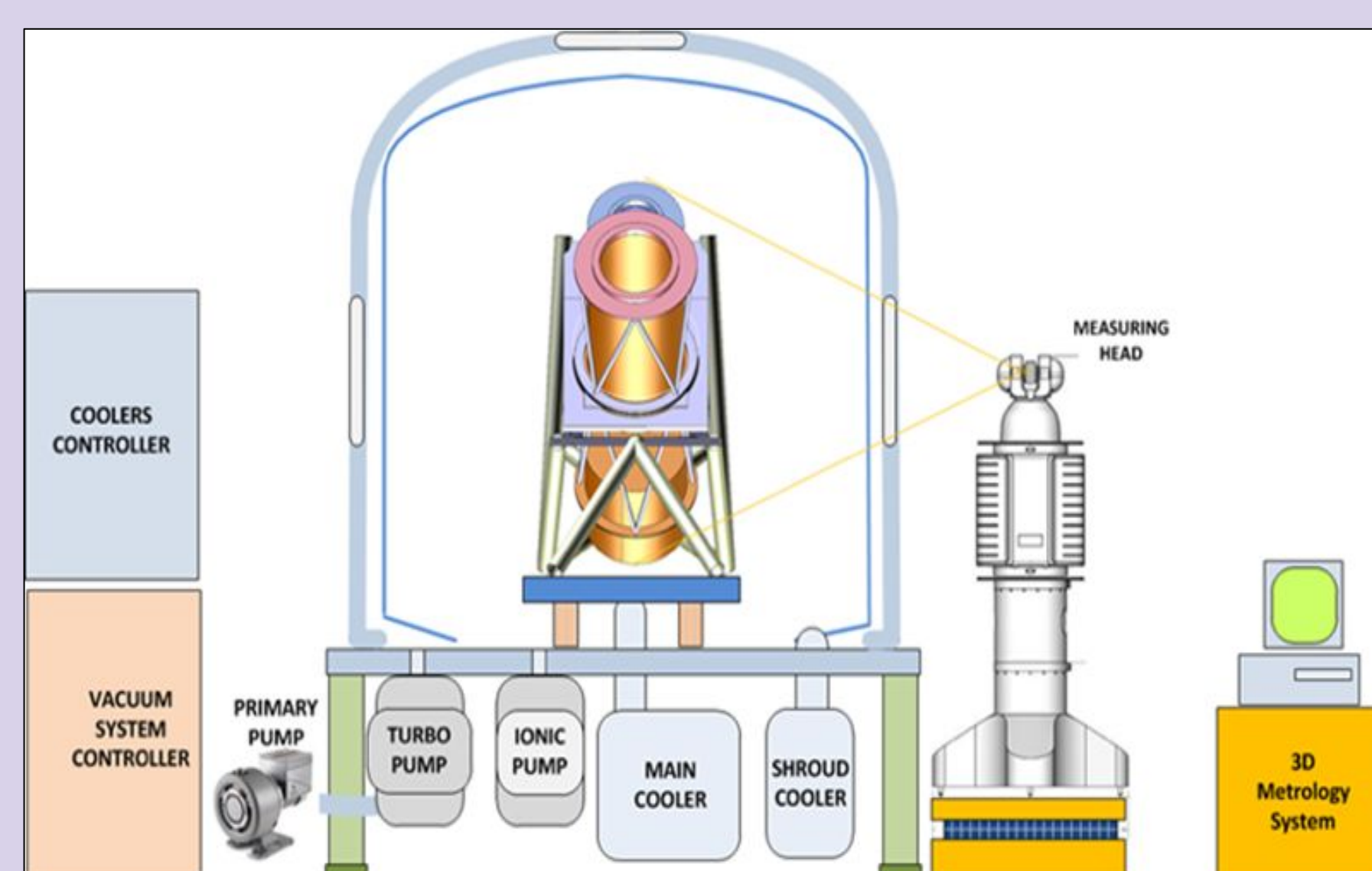
Building on the experience developed for the Planck mission, Italy will contribute to the test and calibration of LiteBIRD.



Anechoic chambers at Milano University and example of co- and cross-polar measurements of 49 horns in Q band. The chamber will be equipped with ASI-funded Near Field System in preparation for LiteBIRD testing.

1. Telescope subsystem calibration (TSC)

We plan to take responsibility of the RF/optical testing of the MHFT (telescope subsystem calibration, TSC).



Design concept of the facility for the TSC calibration developed during Phase A1, with the support of ASI and Thales-Alenia

2. Telescope subsystem level test

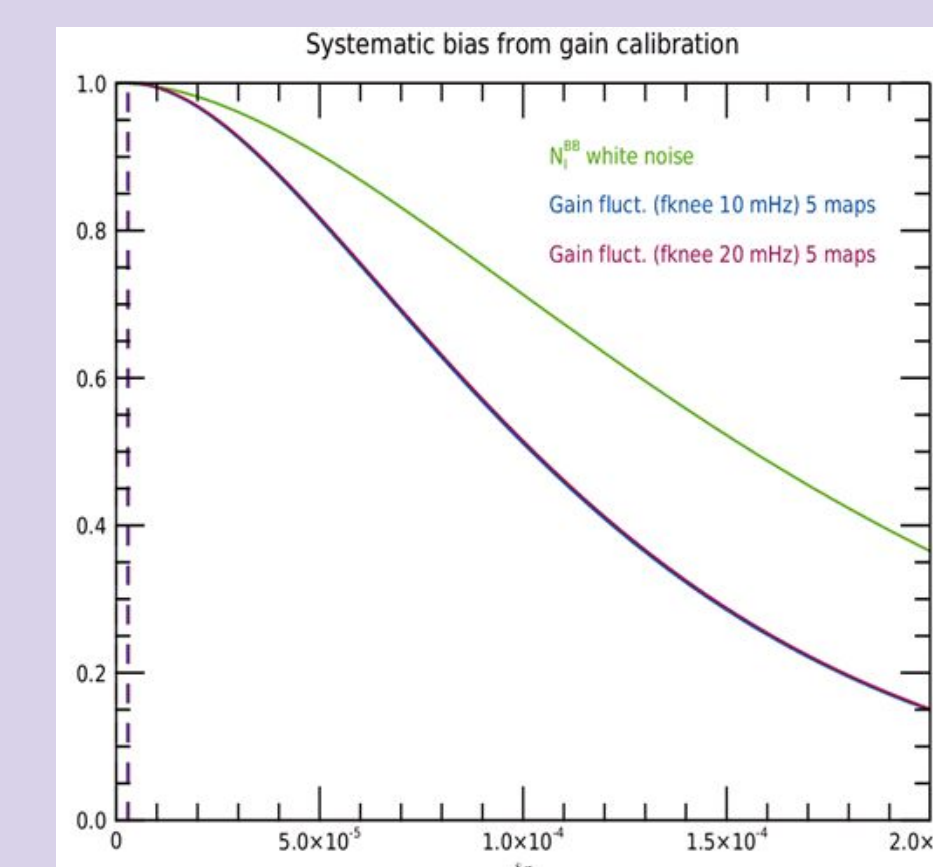
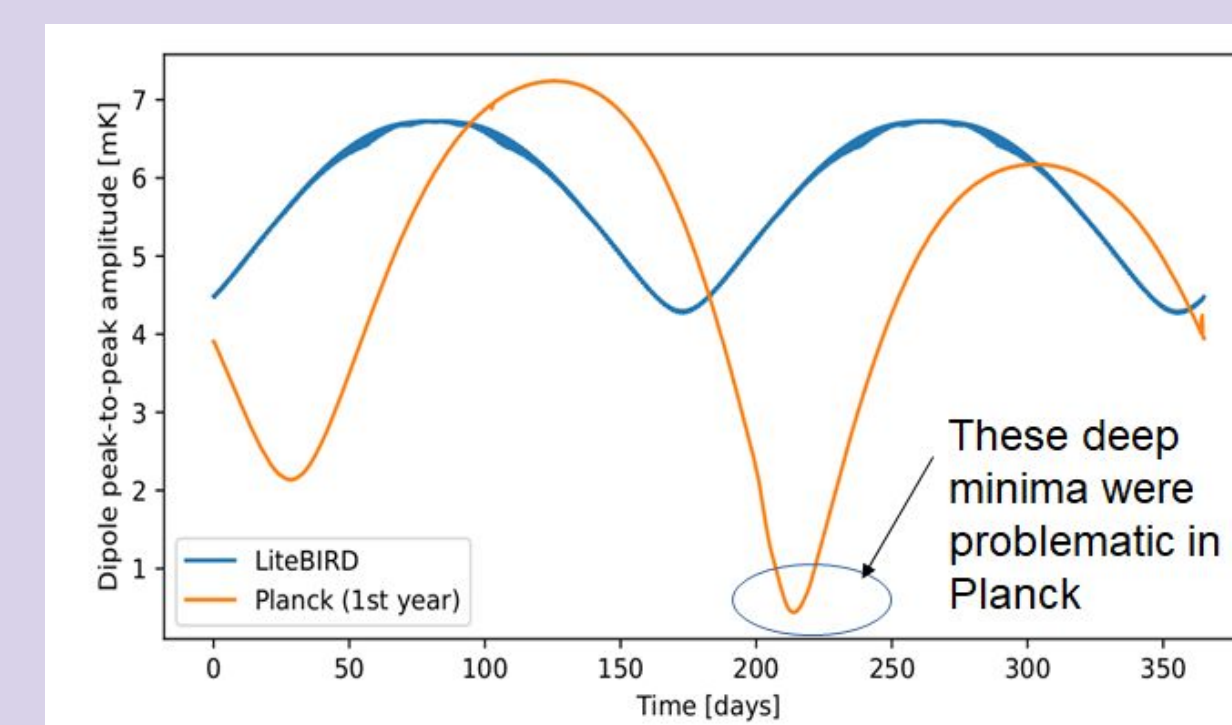
We will participate in the Instrument Level testing (ILT) of the MHFT. In particular, we will contribute to RF testing by following the consistency between TSC and ILT.

An opto-thermo-mechanical model will be developed during TSC and validated to high precision as a benchmark for higher level testing.

3. In-flight calibration

We carried out an extensive study of LiteBIRD in-flight calibration using the dipolar signal produced by the motion of the spacecraft with respect to the rest frame of the CMB.

A comparison of the peak-to-peak amplitude of the calibration signal, shows a much better situation for LiteBIRD than for Planck:

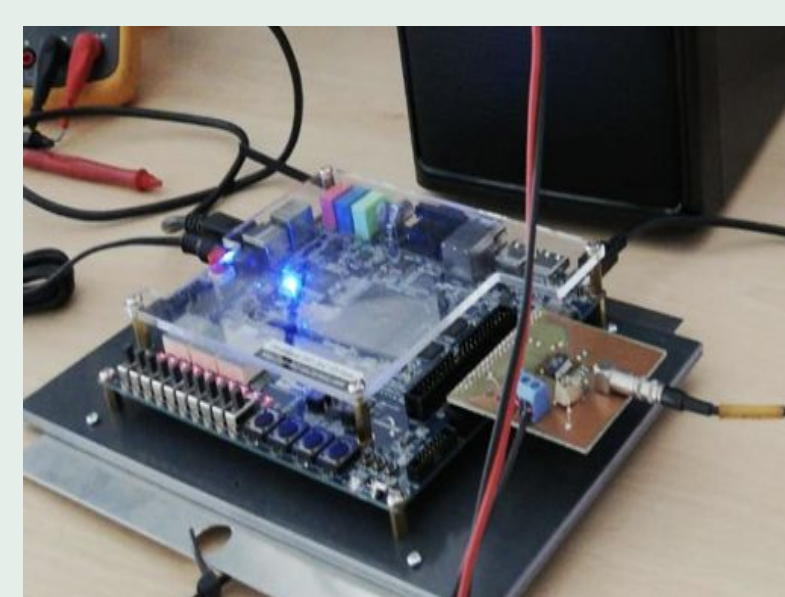


Considering an instrument model with white+1/f noise, we evaluated the quality of the calibration in terms of recovery of the parameter r .

Electronics Contribution to warm readout

In coordination with the Canadian colleagues Italy will help in the realization of the warm readout of LFT and MHFT with particular emphasis on:

- Study of space qualification of specific electronic components in order to reduce the power consumption of the overall readout;
- Realization of the SQUID control units assemblies.



Study for a DPU

A proposal for a Data Processing Unit / Instrument Control Unit has been studied under ASI/COSMOS contract for LiteBIRD, in collaboration with ThalesAlenia Space Italy.

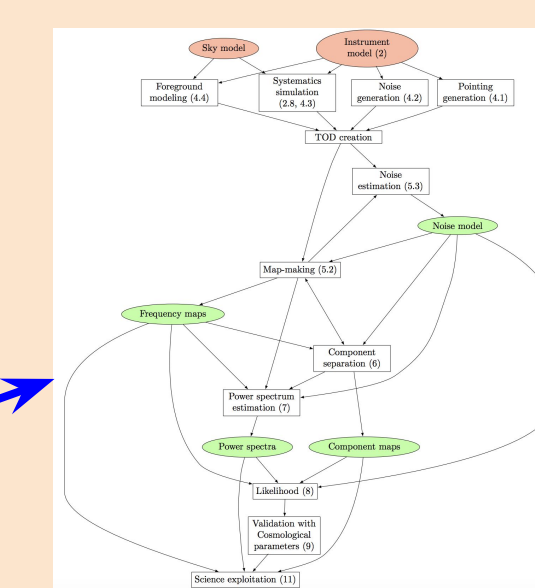
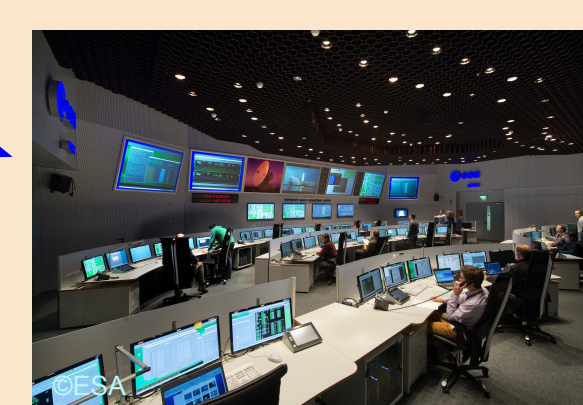
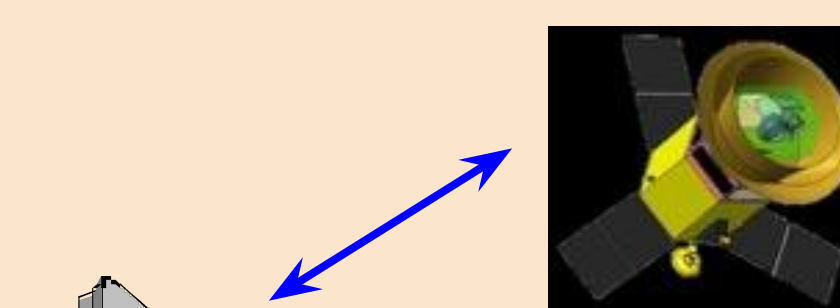
The proposed DPU is an electronic equipment embedding a microprocessor devoted to the control of the HFT instrument for data exchange (science + TC/TM), power regulation and distribution, clocks/syncs/resets distribution and management, and the warm electronics interface board.

Provide early test of LFT and MHFT separately and full redundancy once the entire instrument is assembled.

Application software to be developed by the consortium.



Interest in Science Ground Segment



Science Operation Centre

SW Developers / DA Experts

Survey Planning
Instrument Operations
PA/QA

Science Data Centre

Instrument Operation Team

Data processing
Simulations
Data Archiving & Science Support

Strong expertise in Italy (INAF-OATs, ASI-SSDC) on all SGS activities with leading roles:

- Covering the whole life cycle, from early design to operations and post-operations.
- Planck LFI DPC, Euclid SGS and extensive multi-frequency / multi-messenger experience.

Data Analysis and Science Exploitation

The Italian community has a 40+ year experience in CMB experiments and their science analysis and exploitation, culminated with its leadership role in Planck/LFI. The network of Italian LiteBIRD nodes can express full analysis pipeline capabilities, from raw data handling to science validation.

SC National members: Paolo Natoli & Francesco Piacentini
paolo.natoli@unife.it francesco.piacentini@roma1.infn.it