The Medium and High Frequency Telescopes of LiteBIRD

**Team**

LiteBIRD Join Study Group:
=> 211 researchers

**MHFT Instruments**

The European collaboration is responsible of the sub-K stage of the cryo-chain, and of the Mid- and High-Frequency Telescopes (MHFT), covering a large frequency range from 89 to 224 Hz and 166 to 448GHz, respectively. Both refractive telescopes are cooled down at 4.8K, with two half-wave plates rotating continuously. The two focal planes, cooled down at 100mK, consist, respectively, in 2074 and 1324 detectors delivered by the US.

**Mechanical Structure**

Cooled down to 5 K a thermoelastic study is performed to estimate the thermal contractions and reach the constraints on the optical alignments. Made of Aluminum, the mechanical structure of the telescopes ensure the thermal link between the MHFT’s subsystems and the cryo-chain.

**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 superconducting bulks (black). The magnet ring is sandwiched between an Aluminum grooved ring, coupled with 3 actuators (and 3 launch locks), and an encoder ring.

**Focal Plane Units**

More than 4600 detectors cooled down to 100mK (more than 3400 for both MHFT & HFT). Focal planes are made of TES bolometers coupled with a silicon lenslet & a sinuous antenna for MFT and coupled with silicon platelet for HFT. Each focal plane is composed of Monochromatic, Dichroic and Trichoic pixels sensitive to the polarisation.

**Quasi-optical components**

- **Filters**
  - Polypropylene embedded mesh-filter technology.
  - Thermal shielding and spectral bands definition.
  - Filter diameters up to 500mm
- **Lenses**
  - Millimetre-wave Anti-Reflection Coated dielectric lenses
  - Coating made with 5/8 wave PTFE
  - Process developed and refined under ESA contract
  - Deployed on several ground & balloon-based experiments
  - MFT and HFT telescopes based on two A/R coated polypropylene lenses
- **Mesh-HWPs**
  - Solution based on polypropylene embedded mesh-filter technology
  - Anisotropic grids providing phase-shifts in opposite directions
  - Employed in ground-based and balloon-borne instruments
  - Further performance developments funded by ESA contract