LITEBIRD-LNF

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1 Scientific Rationale

The LiteBIRD [1)] (Lite satellite for the studies of B-mode polarization and Inflation from cosmic background Radiation Detection) space mission, led by Japan[1] (JAXA, Japan Aerospace Exploration Agency) but with significant international participation, aims at measuring the primordial gravitational waves generated during inflation, through 'extremely' precise measurements of the B-mode polarization pattern of the CMB (Cosmic Microwave Background). LiteBIRD was selected by JAXA in 2019, and will be launched in 2032 (as of 31st December 2023) with an H3 launch vehicle for three years of observations at the Sun-Earth Lagrangian point L2. Cosmological inflation describes the first instants of the Universe, and claims that the Universe underwent a 'very' rapid expansion, moments after its formation, also providing 'robust' explanations for cosmological observations. According to the inflation theory, primordial gravitational waves were originated during the inflationary era, about $t \approx 10^{-38}$ s after the Universe began. One expects that the primordial gravitational waves are imprinted in the B-mode polarization pattern of the CMB; hence, measurements of polarization of the CMB are the 'best' probe to detect the primordial gravitational waves, paving the way to a new era of testing for theoretical cosmology.

2 Italian Contribution to LiteBIRD

The Italian contribution to LiteBIRD [2)] was outlined since almost 10 years ago, thanks to the activities of the Workshop 'ASI CMB Day' (30th March 2016) and the 'ASI/COSMOS Project'[2]: while the Planck Surveyor was the driving force for setting milestones in the history of CMB, frontiers of fundamental physics and cosmology are still far to be reached; it is crucial, for the Italian community, to maintain its leading role, without dispersing the heritage of Planck, concerning theoretical, experimental, and data analysis fields. Together with the theoretical, simulation related, and data analysis related activities, the Italian contribution to the instrument is focused on the design, manufacturing, and testing of the two MHFTs, the Mid Frequency Telescope (MFT) and the High Frequency Telescope (HFT) [1)].

3 INFN-LNF Contribution to LiteBIRD

The INFN-LNF LiteBIRD Group [3)], hereafter LiteBIRD-LNF, active since January 2023, will contribute to the design, manufacturing, and testing of the two MHFTs; namely, thanks to:

[1] `https://www.isas.jaxa.jp/en/missions/spacecraft/future/litebird.html` (as of 31st December 2023).

[2] `https://www.cosmosnet.it/` (as of 31st December 2023).

- Thermal balance test (and correlation to models) of the electronics of interest, thanks to the 'pocket' cryostat which is at our disposal, and that is being instrumented in a dedicated space.
- (Non)destructive irradiation testing of the electronics of interest in the XlabF, with extrapolation at other wavelengths, and X-ray circuitry diagnostics on specifically dedicated and instrumented optical bench.
- Joining the simulation related, and data analysis related activities, at both cosmological and instrumental levels.

Concerning the 'pocket' cryostat (Fig. 1):

- It is being instrumented in a dedicated space.
- It was specifically designed for thermo vacuum tests and thermal balance tests.
- Operational pressure, $p < 10^{-6}$ mbar, and operational temperature, $(80 < T < 380)$ K.
- It has got a new, stronger, custom-made stand with wheels, and it is getting control remotely-operated electronics (Figs. 2 and 3).

4 Workshop 'LiteBIRD-Italia 2023 @ INFN-LNF (LB-ITA23@INFN-LNF)'

The LiteBIRD-LNF Group hosted the Workshop during which the progress of the project, towards the approval of Phase B, was presented, concerning all of its components: instrumental development, simulations, analysis and modelling constraints. The Workshop was especially devoted to the Italian branch of the Collaboration, that consists of university nodes, ASI (Agenzia Spaziale Italiana, as the main national funding agency), INAF (Istituto Nazionale di Astrofisica) and INFN. On the 22nd and 23rd May, the ongoing national activities were reviewed; on the 24th May, the main INFN instrumental contribution, the SQUID (Superconducting Quantum Interference Device) Controller Unit, was subjected to an in-depth analysis. The website of the Workshop can be reached at: `https://agenda.infn.it/event/35371/`.

5 List of Conference Talks by LNF Authors in Year 2023

1. L. Porcelli, et al., "LNF Thermo-Vacuum Facility and Contribution to LiteBIRD", Workshop 'LiteBIRD-Italia 2023 @ INFN-LNF (LB-ITA23@INFN-LNF)', Frascati, Italy, May 22-24, 2023.

References

1. M. Hazumi, et al., "LiteBIRD: A Satellite for the Studies of B-Mode Polarization and Inflation from Cosmic Background Radiation Detection", Journal of Low Temperature Physics (2019) 194:443-452, `https://doi.org/10.1007/s10909-019-02150-5`.
2. N. Vittorio, "The Italian Contribution to LiteBIRD", Workshop 'LiteBIRD-Italia 2023 @ INFN-LNF (LB-ITA23@INFN-LNF)', Frascati, Italy, May 22-24, 2023, `https://agenda.infn.it/event/35371/`.
3. L. Porcelli, et al., "LNF Thermo-Vacuum Facility and Contribution to LiteBIRD", Workshop 'LiteBIRD-Italia 2023 @ INFN-LNF (LB-ITA23@INFN-LNF)', Frascati, Italy, May 22-24, 2023, `https://agenda.infn.it/event/35371/`.

Figure 1: *The LiteBIRD-LNF 'pocket' cryostat.*

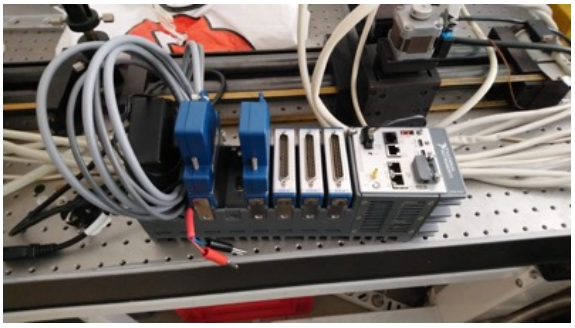

Figure 2: *The LiteBIRD-LNF 'pocket' cryostat's control electronics (partial).*

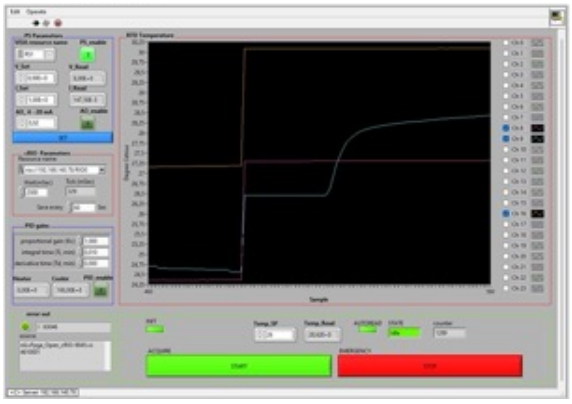

Figure 3: *The LiteBIRD-LNF 'pocket' cryostat control electronics' remote control (example).*