3RD year Ph.D. report - Beatrice Siri

Ph.D. supervisor: prof. Flavio Gatti.

Detecting B-mode polarization of the Cosmic Microwave Background is one of the main challenges of modern observational Cosmology. It can be proved that polarization B-modes can only be generated when there is a tensor perturbation component present. Inflationary models, proposed along the standard cosmological model, imply the existence of a background of primordial gravitational waves which would generate a curl component (B-modes) in the Cosmic Microwave Background at large angular scales. The amplitude of this signal is expected to be linked to the energy scale of inflation. Thus, a direct measure of large scale B-modes polarization would strongly confirm inflationary theories.
LSPE (Large Scale Polarization Explorer) is an experiment aimed at measuring the polarization of the Cosmic Microwave Background at large angular scales. Its primary target is to improve the limit on the tensor to scalar perturbations amplitude ratio down to r=0.03, at 99.7% confidence. A second target is to produce wide maps of the foreground polarization. The mission is optimised for large angular scales, with coarse angular resolution (around 1.5 degrees FWHM) and wide sky coverage (25% of the sky). The mission is composed of two instruments: SWIPE and STRIP. STRIP is a ground-based telescope that will be installed at El Teide Observatory (Tenerife, Canary Islands). It will use an array of coherent polarimeters with cryogenic HEMT amplifiers to survey the sky at 45 and 90 GHz. SWIPE is a balloon-borne experiment that will fly in a circumpolar long duration balloon mission during the polar night. It will use an array of 326 bolometric polarimeters, with large throughput multi-mode bolometers and rotating Half Wave Plates (HWP), to survey the sky in three bands at 140, 220 and 240 GHz.
My work revolved around fabrication and test of bolometer for the SWIPE instrument. The detectors are TES (Transition Edge Sensor) spider-web bolometers with a micromesh absorber. The bolometer is fabricated using thin film techniques on a silicon nitride membrane over a silicon substrate. The detector is then suspended by removing the silicon layer.
The focus of my third year activity was the finalisation of detector parameters with fine tuning of fabrication process and design. This process was based on both electrical and beam measurements done in Rome and a complete electrical characterisation of a finished device that I completed here in Genoa. We also had to solve some issues linked to device integration, mainly related to the design of a new holder and mounting procedure to avoid device breakage. At the moment I am working on comparing detector performances with simulation results from a simple model.

Conferences:

I attended the following conference:

- Applied Superconductivity Conference ASC20 (https://ascinc.org/)

and I presented the following contribution:

- B. Siri et al. “Impact of Annealing on Titanium Thin Films T_C and Crystalline Structure”- talk at ASC 2020.

Papers:

- B. Siri et al., Impact of Annealing on Tc and Structure of Titanium Thin Films, DOI: https://doi.org/10.1109/TASC.2021.3071997
- M. Fedkevych et al., Direct Search for Low Energy Nuclear Isomeric Transition of Th-229m With TES Detector, DOI: http://doi.org/10.1109/TASC.2021.3063328
- The LSPE collaboration et al., The large scale polarization explorer (LSPE) for CMB measurements: performance, DOI: https://doi.org/10.1088/1475-7516/2021/08/008