SEARCHING FOR PRIMORDIAL GRAVITATIONAL WAVES WITH QUBIC: ASTROPHYSICAL FOREGROUNDS WITH SPECTRO-IMAGING

The quest for B-mode polarization of the Cosmic Microwave Background is among the main challenges in Observational Cosmology. Measurement of B-mode polarization in the CMB will be clear evidence of the presence of primordial gravitational waves which are theoretically expected to be produced during inflation about 10^{-35} seconds after the Planck epoch. The B-mode measurement is perhaps the most difficult cosmological challenge because the expected signal is very small. It requires high sensitivity and negligible instrument systematic effects with wide frequency coverage in order to separate the primordial signal from foreground emissions.

QUBIC (QU Bolometric Interferometer for Cosmology: http://qubic.in2p3.fr) is a novel instrument concept dedicated to the search for B-modes by measuring the Q and U polarization modes. It brings together the advantages of bolometers with high sensitivity and those of interferometers that have exquisite control of instrument systematic effects. The interferometric nature of QUBIC also allows spectro-imaging and improved spectral resolution with respect to imagers, providing a significant advantage concerning foreground removal. The Technological Demonstrator is under test at APC since 2019 and will be installed at the QUBIC site at 5000m a.s.l. in the province of Salta in Argentina in mid-2021.

Besides participating in data taking and exploitation of QUBIC (including travel to Argentina), the post-doctoral fellow will work specifically on various aspects of the QUBIC data analysis pipeline including various topics among:

- Developing the data analysis pipeline: time-domain raw data processing, filtering, map reconstruction, angular power spectrum measurement, and cosmological constraints.
- Implementing and exploiting self-calibration and accounting for instrumental systematic effects in the data analysis pipeline
- developing astrophysical component separation for QUBIC using spectro-imaging, an innovative technique unique to bolometric interferometry.
  - classical component separation techniques (e.g. Internal Linear Combination) and adapting them to take advantage of QUBIC capabilities, such as narrow bandwidth spectral imaging.
  - Specific component separation algorithm directly going from time-domain data to component maps fully using QUBIC spectro-imaging.
- Machine-Learning learning techniques applied to CMB Data Analysis
- integration and characterization phase on-site where all the performances of the instrument will be checked and modeled with simulations

The student will work within the QUBIC team at APC, collaborating with the rest of the collaboration in France, Italy, Ireland, and Argentina.

Interested candidates are welcome to contact Jean-Christophe Hamilton, head of the QUBIC group at APC as well as Principal Investigator of QUBIC. Funding would be achieved by applying to the China Scholarship Council and the University of Paris

Head of group: J.-Ch. Hamilton (hamilton@apc.in2p3.fr) - QUBIC Principal Investigator