

## PhD position

**Title:** Cosmology with SZ observations of clusters of galaxies with the NIKA2 Camera at the IRAM 30 m telescope.

**PhD Advisor:** Frédéric MAYET

**Phone:** +33 4 76 28 40 15

**Email :** [mayet@lpsc.in2p3.fr](mailto:mayet@lpsc.in2p3.fr)

**Address:** Laboratoire de Physique Subatomique et de Cosmologie (LPSC), 53 avenue des Martyrs, 38026 Grenoble

**Application deadline: June 8th**

**Starting date:** 1/10/2018

**PhD Funding:** fully-funded

**More information:** <http://lpsc.in2p3.fr/NIKA2SZ/>

### Scientific context

Galaxy clusters are powerful tools for studying cosmology as they are the largest gravitationally bound objects in the Universe. Their abundance in mass and redshift is sensitive both to the history of expansion and to the content of the Universe. The large surveys, from e.g. the Planck satellite, have been used to build catalogues of galaxy clusters whose cosmological exploitation is however limited by the low angular resolution and by the astrophysical uncertainties. High resolution observations (10 to 20 arcsec) are required to go further.

The Sunyaev-Zel'dovich (SZ) effect is an inverse Compton scattering of CMB photons by hot electrons of the intracluster medium. It allows us to have an observable proportional to the electronic pressure integrated along the line of sight, which is complementary to the observations in X-ray. The advent of the NIKA2 camera at IRAM 30 metre telescope (Granada, Spain) provides a unique opportunity for SZ observation of clusters, thanks to its two frequency bands (150 and 260 GHz), high sensitivity, excellent resolution (11 and 18 arcsec) and large field of view (6.5 arcmin).

This PhD thesis subject is part of the NIKA2 SZ Large Program, of which the LPSC is responsible and which has just started. We have 300 hours of guaranteed time to observe 50 clusters with NIKA2 until 2023. The objective is to study the thermodynamic properties of a representative sample of high redshift ( $0.5 < z < 0.9$ ) galaxy clusters, by combining SZ data with X-ray data from the XMM-Newton satellite. The combined analysis will allow us to establish a universal pressure profile and an unbiased scaling law between the SZ observable and the cluster mass. These two ingredients will be used to re-analyze the data from large cluster surveys in order to assess results from cluster cosmology.

### PhD thesis subject

The PhD student will be a member of the NIKA2 collaboration and of the SZ Large Program. He/she will be heavily involved in all aspects of cosmology with galaxy clusters (observation, data analysis and phenomenology).

1) He/She will be an active member of the team in charge of the observations at the IRAM 30 metre telescope (Granada, Spain).

2) He/She will be responsible for the development of the raw data analysis. The SZ emission of the clusters is both very faint and extended with respect to the NIKA2 beam. Dedicated decorrelation strategies are therefore required to improve mapmaking and to account for the atmospheric contamination.

3) He/She will develop the SZ analysis of the cluster sample within the framework of a multi-probe study. This activity will benefit from the SZ analysis tools developed at LPSC, while requiring specific developments related to the morphology of clusters at high  $z$  (departure from sphericity, mergers, etc.).

4) He/She will develop the cosmology part of the SZ Large Program. This project covers the study of the universal pressure profile and of the scaling law as a function of the redshift and of the cluster morphology but also the consequences on the cosmological parameters obtained with the large catalogues. This study will be conducted both with simulated clusters (N-body simulation MUSIC) and clusters observed with NIKA2.

The PhD student will benefit from the scientific collaboration with NIKA2 experts. The current phase of the SZ Large Program is ideally suited to an ambitious PhD thesis subject, providing solid knowledge in cluster cosmology that will constitute a complete background for starting a career in this field.

Candidates are requested to send a file containing: a CV, a letter of motivation, transcripts covering their undergraduate studies and possibly a letter of recommendation to the following address: [mayet@lpsc.in2p3.fr](mailto:mayet@lpsc.in2p3.fr)