Thesis subject

Name of the laboratory: Laboratoire d'Astrophysique de Marseille

Thesis advisor: Guilaine Lagache
Email and address: guilaine.lagache@lam.fr
Phone number: +33 (0) 495 04 41 77

Co-advisor: Matthieu Béthermin

Subject's title: **Mapping the dusty star formation at high redshift**

Subject description:

Among the potentially most important results of cosmology in the last decades is the realization that the star formation rate at redshifts 1<z<3.5 were much higher than at present, and that much of the light produced by stars at those redshifts reaches us in the far-IR and sub-millimeter spectral range (~70-1000 microns), after having been reprocessed by dust. At higher redshift (z>4), quantifying the star formation rate density is a challenging endeavour. Currently, most of the measurements rely on the UV light emerging from the high-redshift galaxies themselves. But sensitive UV rest-frame data trace relatively unobscured star formation, and do no provide direct measurement of dusty star formation from normal galaxies at high redshift. Therefore, one of the key questions, is to quantify the primordial role of dusty galaxies to star formation at z>3.5. To reach that goal, new very deep unbiased millimetre surveys are mandatory. Those surveys have to combine high sensitivity and large field of view (i.e. high-mapping speed), with high-angular resolution to reduce confusion noise. Today, only a sensitive millimeter camera on a large telescope can fulfill all the requirements to fully map the dusty high-z star formation. That's the goal of the New IRAM KIDs Arrays NIKA2 camera.

NIKA2 is a Kinetic Inductance Detectors camera that has just been installed at the IRAM 30m telescope. NIKA2 is observing simultaneously at 1.2 and 2 mm. Our group is leading the Guaranteed Time observations of deep cosmological surveys (about 300 hours of observations on the GOODS-North and COSMOS fields) that just started this winter. These new observations will be the deepest ever achieved on these fields at these wavelengths, opening a grand legacy value, allowing to probe the dust content, hence the star formation rate and star formation efficiency, of hundreds of low-luminosity galaxies out to z~4-5. The surveys will also open a new window on previously undiscovered dusty star formation out to z~6-8, an era previously studied only with UV emission and untested extinction corrections.

The successful PhD candidate will participate to the observational campaigns at Pico Veleta (Spain), and will contribute to the data reduction of NIKA2 deep field observations. She/he will extract the sources using multi-wavelength source extraction codes, and search for counterparts of detected millimeter sources using ancillary data. When ancillary UV-to-mm data are available, she/he will analyse the spectral energy distribution to measure stellar masses and star formation rate. Once the observations are translated in terms of source counts, she/he will directly use them to constrain the history of dusty star formation by fitting for example our evolutionary model of galaxy evolution.

She/he will also help us to define the best strategy for follow up observations to measure the gas mass of the most representative galaxies. Such measurement will be used to relate the star formation efficiency to other galaxy properties (mass, merger state, kinematics) to learn what regulates their star formation. Finally, she/he could be involved in the study of the clustering of these objects, that will put particularly strong constraints on models for the evolution of large-scale structure, giving the link between star formation and dark-mater halos mass.

The NIKA2 camera is working perfectly. The thesis offers the unique opportunity to participate to a pioneering observational project, with a dedicated team at LAM. Members of the NIKA2 deep field surveys include M. Béthermin, V. Buat and D. Burgarella, in addition to the PIs G. Lagache & A. Beelen.

Bibliography:

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