Thesis subject

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Subject's title: **Unveiling the high-z galaxy properties through deep JWST surveys**

Subject description:

The James Webb Space Telescope (JWST) **has been successfully launched into orbit Dec. 25, 2021**. This infrared observatory will revolutionize our knowledge of the unobserved first galaxies in the cosmic era when the Universe was in the process of being reionised by these primordial sources. This critical epoch remains largely unexplored, and its study will lead to new constraints on galaxy formation and on the properties of these distant sources.

The thesis project will be centered on discovering, analyzing and interpreting the galaxies of the young Universe through unprecedented observations of deep field imaging during JWST Cycle 1 observations. Those will be obtained through two Treasury Programs on the well-known extragalactic deep fields (COSMOS and UDS) with pre-existing information acquired through various facilities (HST, VLT, ALMA, Spitzer, …). The PRIMER (Public Release IMaging for Extragalactic Research) Treasury Program with 187 hours awarded on NIRCam+MIRI (l = 0.9 – 18mm) JWST instruments. The PRIMER pointing on the sky are the COSMOS and UDS CANDELS extragalactic fields, with 8-band NIRCam imaging over 400 arcmin^2 of which 2-band MIRI imaging over 230 arcmin^2 will be acquired. These data will unveil the Universe in its time of reionisation thanks to the discovery of a large, homogenous samples of galaxies paving this cosmic epoch, that cannot yet be access with our current facilities. We expect ~13000 galaxies at z=7, ~500 at z=8, ~150 at z=9, and ~50-100 at 10<z<12. The COSMOS-Webb (The Webb Cosmic Origins Survey) Treasury Program will map a larger area over the COSMOS field of 0.6 deg^2 in 4-band NIRCam imaging, and 0.2 deg^2 with MIRI. These shallower data will enable to eliminate cosmic variance from smaller field of views, to identify rarer sources, and to relate the sources to their large-scale environment.

The objective is the PhD project is to exploit these new and original JWST imaging. The first step will be to extract large samples of galaxies at z » 4 – 12 in using various statistical and/or deep learning technics to secure their photometric distances. The second step will be dedicated to measure several fundamental physical properties (stellar masses, star formation rates, dust attenuation, star formation histories, etc.). The third step is to estimate their luminosity/mass function evolution with respect to those estimated at the end of the reionization of the Universe from z=6 down to the Cosmic Noon at z=2. In this step, the representativity and the completeness of the datasets is fundamental to establish meaningful statistical estimations, thus a study using both PRIMER and COSMOS-Webb sources at the end of reionization (z » 6 - 10) will be critical. Finally, the results will be confronted to the predictions from theory and simulations of the early Universe.

The PhD student will work within a fruitful environment expert team in deep fields, ranging from observations, analyses, interpretations and simulations, and involved in several JWST programs related to deep fields (e.g., GTO-MIRI, COSMOS-Webb Cycle 1, PRIMER Cycle 1).

Bibliography:
PRIMER : https://ui.adsabs.harvard.edu/abs/2021jwst.prop.1837D/abstract
COSMOS-Web : https://ui.adsabs.harvard.edu/abs/2021jwst.prop.1727K/abstract