



Galaxy cluster detection with Weak Lensing for CFIS and Euclid

Summary

Euclid is an ESA mission important for cosmology and internationally renowned, planned to be launched in 2022. The laboratory AIM initiator of the mission, is strongly involved in Euclid. AIM is also strongly involved in the ongoing CFIS survey (PI: Jean-Charles Cuillandre) that has to provide some of the ground-based data necessary for the Euclid mission. In Euclid, AIM has the responsibility to provide the catalogue of galaxy clusters detected by weak lensing. In this context, one prototype dedicated to the detection of galaxy clusters using exclusively the weak lensing signal has been developed. The internship aims to evaluate the quality of the prototype on simulated data and to apply it on CFIS data.

Scientific context

Clusters of galaxies are the largest and most massive collapsed structures in the Universe. Their content reflects that of the Universe : 85% of dark matter and only 15% of ordinary matter in the galaxies and the inter-galactic gas. Clusters contain valuable information on cosmology, and are particularly important for dark matter studies. Weak Lensing is the process in which light from background galaxies is bent by foreground objects (i.e cluster of galaxies) as it travels toward us. The resulting distortions in the shape of background galaxies provides a direct way to probe the total mass distribution of galaxy clusters. Weak lensing surveys covering a large fraction of the sky such as CFIS and Euclid will offer for the first time the possibility to detect galaxy clusters based on their lensing signal i.e. directly on their total mass. This will allow us to build a galaxy cluster catalogue representative of the true cluster population, providing new constraints on galaxy cluster abundances in the Universe.

Subject

The objectives of the internship are the following:

1. The candidate will get familiar with the methods of weak lensing galaxy cluster detection.
2. Based on realistic mock observations derived from cosmological numerical simulations, the candidate will use the prototype of the detection method to build a sample of galaxy clusters detected exclusively from their lensing signal and assess its associated completeness and purity.
3. The candidate will apply the prototype on CFIS data in order to build a real sample of galaxy clusters detected using only their weak lensing signal.
4. The candidate can potentially suggest a new methods of detection.

The proposed work will allow the student to learn about inverse problems, sparse image processing and galaxy clusters. This internship project can potentially be continued as a PhD.

Candidate

The candidate should be a Master 2 (or equivalent) in either physics, astrophysics or signal/image processing. Experience with python coding would be advantageous.

Scientific environment

The internship will take place in the [Astrophysical Department](#) of CEA Saclay, at the interface of the Galaxy Clusters group and the [Cosmostat group](#). The CosmoStat group is recognised for its expertise in Signal processing, it hosts a multidisciplinary team whose research include statistical methods, signal processing, and cosmology. The Galaxy clusters group uses multi-wavelength (optical, X-ray, mm) data to probe the properties of galaxy clusters. They have extensive experience of X-ray observations, and were key members in the construction and exploitation of the cluster catalogue from the Planck SZ survey. Supervision will be jointly performed by [Sandrine Pires](#) (Astrostatistician and Weak Lensing expert) and [Gabriel Pratt](#) (Galaxy Cluster expert).

Internship

- Deadline for applications: 28 February 2020
- Sandrine Pires (sandrine.pires@cea.fr)
- Duration: 4-6 months
- Possibility to continue for a PhD: yes

For information and application, contact: sandrine.pires@cea.fr