ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

DEPARTMENT
OF PHYSICS AND ASTRONOMY
"AUGUSTO RIGHI"

Title of the Project:

Cluster number counts and clustering in Euclid DR1

Supervisors and contacts:
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Scientific Case:
The European Space Agency's Euclid satellite was successfully launched in July 2023 and is currently observing about one-third of the extragalactic sky, conducting a wide galaxy survey. The first data release (DR1) is planned for June 2026, when the initial data will become publicly available. In addition to the galaxy spectroscopic and photometric samples, a vast catalogue of galaxy clusters will be detected and analyzed to provide additional cosmological constraints, which will be combined with galaxy clustering, cosmic shear, and other cosmological probes. This research project aims to leverage the Euclid DR1 cluster catalogue for cosmological purposes. Specifically, the project will focus on measuring and analyzing cluster number counts and clustering to constrain the parameters of the Λ cold dark matter model and explore alternative scenarios. The candidate will collaborate with the Euclid Clusters of Galaxies Scientific Working Group, having the privilege of exploiting the exceptional data sets provided by Euclid. The candidate will use state-of-the-art statistical analysis algorithms developed within the Euclid consortium to analyze these data sets. The primary goal is to contribute to Euclid's analyses by combining cluster number counts, weak-lensing mass profiles, and 2-point and 3-point statistics in both comoving and angular coordinates. An extensive analysis using simulations will be conducted in parallel to validate the cosmological pipelines and estimate uncertainties and covariances among different probes.

Outline of the Project:
The candidate is expected to contribute to the following tasks:

- Run the Euclid pipeline codes to build the DR1 cluster catalogue, measure the main summary statistics, and perform the cosmological analyses.
- Validate the results against simulations and previous cluster samples.
- Investigate optimal selection strategies to maximize cosmological results.
- Examine systematic uncertainties as a function of observational selections and model assumptions.
- Estimate the covariances among cluster statistics and other cosmological Euclid probes.
- Contribute to the publication of DR1 cosmological analyses.