Project title: Cosmology with Clusters of Galaxies in the Euclid Era

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The Euclid ESA mission will deliver in few years a large photometric survey of galaxy clusters, which will include $\sim 10^6$ clusters out to redshift $z\sim 2$. As such, this will provide a unique map of the large-scale structure of the universe and of the rate of cosmic evolution. In particular this will be carried out through the study of the evolution of the cluster number counts and the correlation statistics of the large-scale distribution of clusters. These information has a huge potential to shed light on the nature of Dark Matter and Dark Energy, and the behaviour of gravity on cosmological scales.

The focus of this PhD project will concern the preparatory study to control the systematics that are expected to affect the cosmological constraints to be derived from the study of the halo mass function (HMF) and 2-point correlation function (2PCF). In particular, the PhD student should address the following issues:

- which is the definition of the likelihood function that maximizes the information obtainable from the HMF and the 2PCF?

- how these two probes can be suitably combined in the derivation of cosmological constraints?

- which precision can be reached in the calibration of HMF and halo bias using
  - large-scale simulations of both standard and non-standard cosmological models?

- how to optimally calibrate cosmic variance and co-variance in the measurement of HMF and 2PCF from large-scale cosmological simulations?