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Unsupervised photometric detection of cluster candidates in large surveys

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Galaxy Clusters are essential to study galaxy evolution and sensitive probes of cosmology and the dynamics of the Universe Dark sector. Large galaxy surveys, such as Euclid, DES, LSST/Rubin will provide a wealth of information that can be used to detect many new clusters. For example, the Euclid mission survey may reveal more than 60000 clusters with S/N>3 up to redshift 2, representing a whole new era for cluster cosmology. A large fraction of these clusters will be unknown high-redshift cluster candidates, lacking spectroscopic information. Thus, a major challenge for cluster detection is the identification of member galaxies from photometry alone, and ideally without strong assumptions of what clusters are.

In this talk, we present the results of a modified version of the UPMASK (Unsupervised Photometric Membership Assignment) method for the detection of galaxy clusters. The method, originally created to study star clusters, uses heuristics and statistical analysis to separate cluster candidate galaxies from other field galaxies without assuming cluster profiles or any strong theoretical priors about what a cluster is. We show that the method operates in a fully unsupervised way and it can even work with minimal amounts of astrometry and photometry information, using Euclid and DES galaxy survey simulations. We then use Pan-STARRS data to assess the performance of the method to identify Planck clusters and present
possible detections of optical counterparts for cluster candidates in the second PlanckSZ data release catalog. Finally, we compare our findings with other Planck cluster candidate follow-up efforts and comment on possible extensions for automated cluster detections with the Euclid survey.

Primary author: CARVALHO, Ana (IA/FCUL)

Presenter: CARVALHO, Ana (IA/FCUL)

Session Classification: Machine Learning in Astronomy: AGN, Transient Events, Cosmology and Others

Track Classification: Active Galactic Nuclei: Machine learning in astronomy: AGN, transient events, cosmology and others