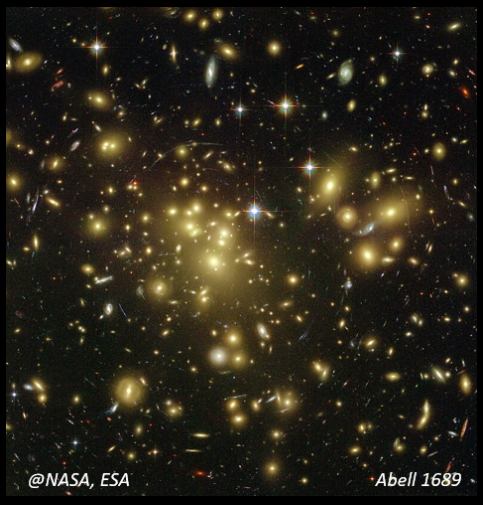
Cosmology / Extragalactic

Galaxy clusters : from astrophysics to cosmology



SUMMARY.
Galaxy clusters are the most massive bound structures in the universe, product of a long history of accretion or merging of smaller units. Their evolution in time is therefore a witness of large scale mass assembly processes, which make them good tracers of the expansion rate of the universe. Galaxy clusters are also unique laboratories to study the evolution of galaxies and high energy physics.
This METEOR proposes to study astrophysical processes occurring in galaxy clusters, theory of structure formation and how cosmological models can be constrained by large cluster samples.

OBJECTIVES

Based on a theoretical lectures, article reviews, and hands-on sessions, the students will acquire general knowledge on galaxy clusters seen as astrophysical objects as much as cosmological probes.

They will also understand how clusters can be detected and characterized to infer cosmological constraints from next generation surveys such as the Euclid ESA mission launched in July 2023.

From a more practical side they will learn how to query data from large astronomical databases, how to manipulate such data using various tools and perform data analysis on large data sets with Python.

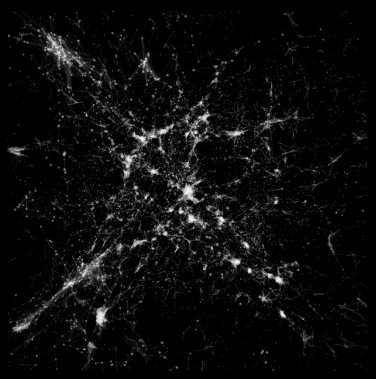
PREREQUISITES

Fundamental course linked/coming in support to this METEOR: General Relativity, Extragalactics and Cosmology.

THEORY

by Christophe Benoist

- Multi-wavelength analysis of galaxy clusters, impact of environment on galaxy evolution, cluster detection, proto-clusters.
- Theory of large scale structures formation, linear perturbation theory, the spherical collapse model, power spectrum, cluster counts and dark energy.
- Observational probes of cosmic structure growth: from CMB anisotropies to galaxy clusters.



APPLICATIONS

Possible projects based on real and/or simulated data:
– Estimate the mass of a galaxy cluster
– Characterization of proto-clusters
– Properties of brightest CL. galaxies
– CLs.: a factory to transform galaxies
– Measuring the optical richness of CLs.
– Modelling the mass-richness relation

MAIN PROGRESSION STEPS

– Once a week: theoretical courses
– Every week : preparation of one paper commentary
– Project starting the first week
– Last week: preparation of the final oral presentation.

EVALUATION

Written examination (25%), project (50%), and article review (25%).

BIBLIOGRAPHY & RESSOURCES

Kravtsov & Borgani 2012, Review Article, *Formation of galaxy clusters*

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