Mapping large-scale structure with Euclid

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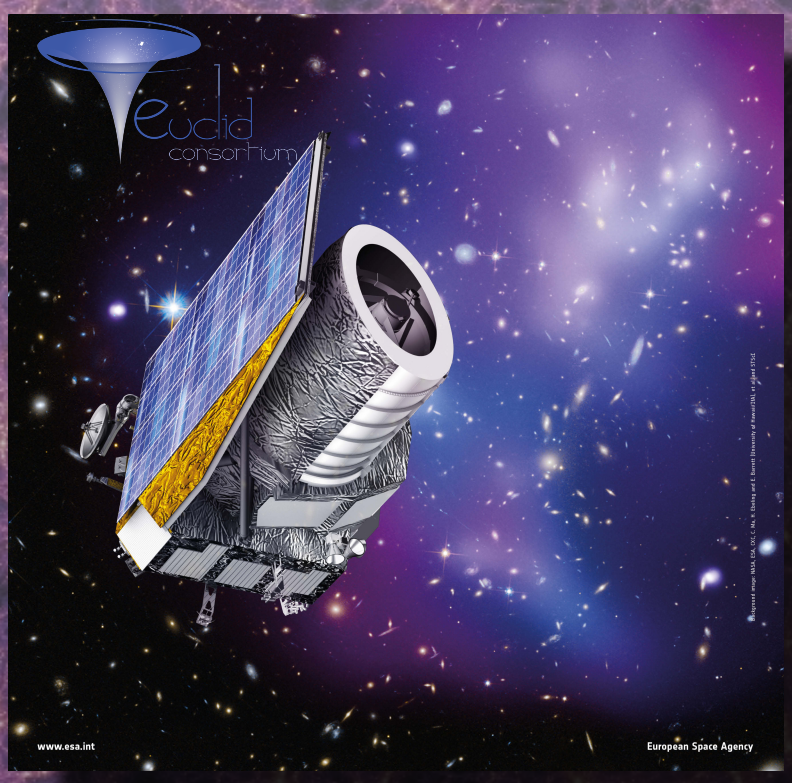
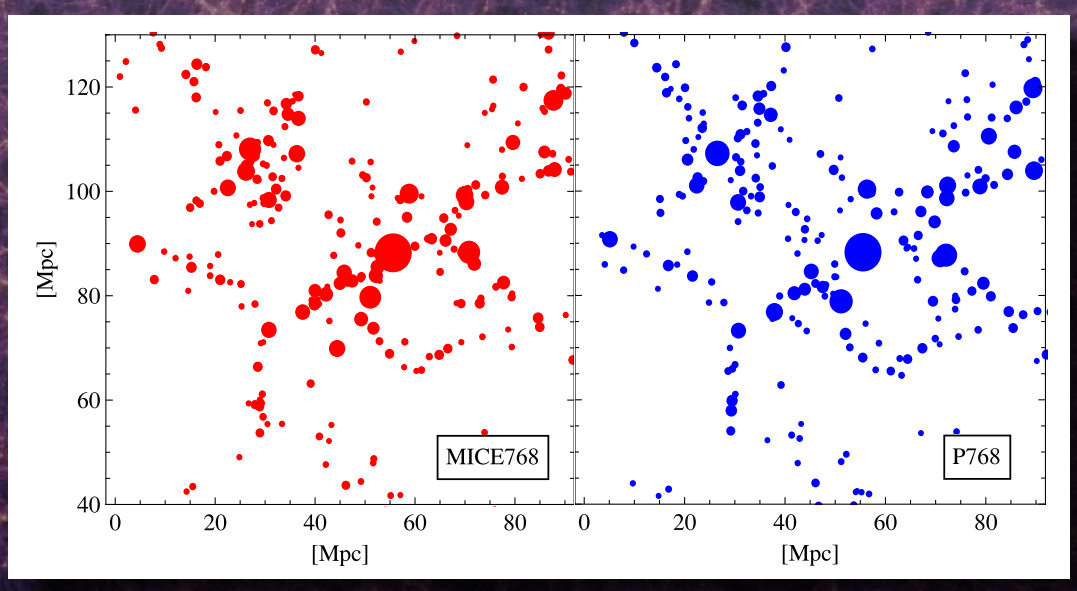
OPEN PROBLEMS IN COSMOLOGY:
What set the initial conditions of the Universe?
What is driving now its accelerated expansion?
What can we learn on dark matter and dark energy?
Is Einstein's gravity valid on cosmological scales?
Can we measure neutrino masses from cosmology?



Several up-coming redshift surveys will provide unprecedented maps of the galaxy distribution at large scales, aiming at a detailed description of cosmic evolution that will shed light on the open problems in cosmology.

The Trieste astronomical community (UniTS, OATs, SISSA, INFN) is actively involved in one of the largest galaxy survey, the Euclid optical space telescope of the European Space Agency. Euclid will take images of 1.5 billion galaxies on 1/3 of the sky, and distances (redshift) of tens of millions galaxies.



Cosmology is a peculiar science, forced to work with a single experiment: our Universe.

We need a large number of *cosmological simulations* to interpret observational data: this represent a severe computational challenge.

We develop codes for fast numerical simulations and adapt them to include the most interesting ideas challenging the Standard Cosmological Model.

The statistical properties of the matter and galaxy distribution at large scale can be predicted *analytically* in cosmological perturbation theory.

Theoretical models for crucial observables as the galaxy two-point correlation function are essential to fully exploit future observations.

A full model, including, among others, effects of neutrino masses is one of the goals of our research.