Title: predicting the clustering of dark matter halos with modified gravity theories

A large number of galaxy surveys are being planned to carry out accurate measurements of the evolution of large-scale structure of the Universe, with the aim of constraining the equation of state of dark energy, revealing possible deviation from a simple cosmological constant, and testing general relativity as a theory of gravity on the largest scales. However, while accurate analytical and numerical techniques to predict the clustering of matter are available, their extension to modified gravity theories is still incomplete.
The PhD project will focus on developing and exploiting a method, based on Lagrangian Perturbation Theory (LPT), to predict the clustering of dark matter halos, that host visible galaxies and clusters of galaxies.
The work will use a mixed analytic and numeric approach to extend LPT up to third order (the second order has already been fully worked out), to compute the evolution of a homogeneous ellipsoid in modified gravity, and to implement these extension in an existing code. Also, work will be needed to include the free-streaming effect of massive neutrinos, that is degenerate with a possible modification of gravity.
The developed tool will be used to produce simulated catalogs of dark matter halos, to be inserted into existing pipelines of analysis to understand the accuracy with which modifications of gravity can be measured with forthcoming surveys.
This study will be applied to the planned Euclid mission, and will be developed within the Euclid Consortium, that is preparing the collection and scientific exploitation of the data. The results of this PhD project are expected to be of great utility both for the Euclid Consortium and for the wider cosmology community working in the many planned surveys for precision measurement of large-scale structure clustering.

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