

Background

Local Group and its dwarf galaxy members have proven to be important testbeds for theories of galaxies formation and key predictions of the Cold Dark Matter (CDM) on small scales. A number of tensions between CDM predictions and observations of dwarf galaxies have been raised over the past decade or two, with some of them having been fully or partially resolved by including galaxy formation processes in cosmological simulations. This project uses cosmological simulations of the Local Group (from the APOSTLE project) with and without baryons to explore how the population of low mass dark matter subhalos change between the two models.

Project Goal

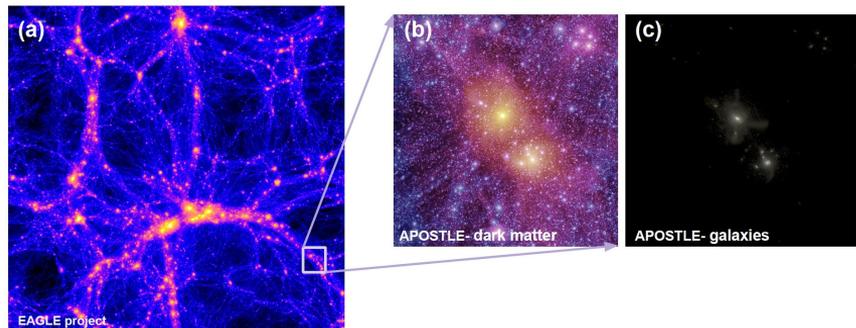
In this project participants will gain hands-on experience of working with cosmological simulations (dark matter only and hydrodynamical runs), and compute properties of low mass dark matter subhalos such as their mass function and radial distribution, and contrast their properties in the two models. If there is interest, we can include running a dark matter only cosmological simulation from the APOSTLE project, using either the Arepo or SWIFT codes.

Necessary Concepts

- familiarity with basic cosmology and predictions of CDM on small scale would be beneficial
- Proficiency in python (matplotlib, numpy)

Computing Need

Analysis of lower resolution simulations can be done on a laptop. Higher resolution simulations and running cosmological runs will require cluster access



Dark matter and stellar distribution in the Local Group (panels b & c) – from the APOSTLE project, which is a set of zoom-in simulations from the EAGLE project (panel a).

Background Resources

- Review on small scale problems of CDM: [1707.04256](https://arxiv.org/abs/1707.04256)
- The problems in the light of galaxy formation simulations [2206.05295](https://arxiv.org/abs/2206.05295)
- APOSTLE simulations introductions: [1511.01098](https://arxiv.org/abs/1511.01098) [1507.03643](https://arxiv.org/abs/1507.03643)
- AREPO code: <https://arepo-code.org/>
- SWIFT code: <https://swift.strw.leidenuniv.nl/>
- Python (plenty of resources)



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