

Título/Title:

Modeling galaxy cluster populations with Machine Learning methods

Área/Area:

Cosmologia

Orientador/Supervisor:

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Local do Estágio/Host Place:

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Descrição/Description:

Galaxy clusters are the largest gravitationally bound systems in the universe. They offer a unique way to study the formation and evolution of cosmological structures and to test alternative cosmological models such as those that include dynamical dark energy, modified gravity, dark matter and primordial non-Gaussian models. One of the main issues of using galaxy clusters as cosmological probes is the need for having accurate models of how their observational properties relate to the underlying cosmological model. Numerical N-body simulations are often used for this purpose, but the simulated cluster populations obtained from these simulations are usually modeled by fitting functions that are not able to fully capture the complex formation history of the whole cluster population.

The main objective of this project is to develop new approaches to the modeling of galaxy cluster populations using machine learning algorithms that are able to provide fast and accurate estimation of cluster properties without relying on analytical fitting function procedures used in the traditional modeling of clusters. The work involves the development of an algorithm that learns the details of the galaxy cluster populations in state-of-the-art N-body simulations of the standard Λ CDM cosmological model. The algorithm should then be able to provide fast, realistic estimates of cluster properties in a wide range of masses and redshift. The candidate will be challenged to test different machine learning algorithms and to address the issue of hyperparameter optimization of these algorithms. Further extensions of the work would include applying the method to simulations for alternative cosmological models and study ways to use these algorithms within data analysis pipelines being developed in the context of the ESA Euclid satellite mission.

Requisitos/Requirements:

Part of the work will require the use of a programming data languages, such as Python, R or IDL. Prior knowledge on some of these languages and on Linux OS basics would be advantageous but are not a requirement.