

Topic: Cosmology

Lecturer: David Mota

Description:

We will start with an overview of the main observational features of the Universe: matter content, geometry, expansion rate, dark energy, and dark matter. We will then introduce General Relativity and the standard model to describe the Universe geometry. An overview of inflation and how it can explain some of the main cosmological puzzles. As a concrete example, we will study the physics of the CMBR and how one can extract information that can be used to understand the very early Universe as well as the late epochs. The course finishes with an overview of how nonlinear structure formation, in particular galaxy clusters, can be used to unveil the nature of dark energy and gravity.

Syllabus:

Lecture 1: Observational Cosmology

The main observational features of the Universe: matter content, geometry, expansion rate, dark energy, and dark matter.

Lecture 2: General Relativity and Inflation

General Relativity and the FRW model of the Universe. An introduction to Inflation, the main cosmological puzzles, and how Inflation could explain them.

Lecture 3: Cosmic Microwave Background Radiation

Formation of the CMB photons, its main properties, and how one can use the CMB features to probe the main large-scale properties of the Universe.

Lecture 4: Galaxy Clusters as a probe of Gravity beyond General Relativity

Main features of Modified Gravity models, and how one can use galaxy cluster properties to test and search for signatures of those models.