Field theory in cosmology (L24)

Professor E. Pajer

This course discusses applications of classical, statistical and quantum field theory to cosmology. The course comprises three interconnected topics:

- Cosmological inflation and primordial quantum perturbations (QFT in curved spacetime)
- The matter and galaxy distribution in the Large Scale Structure of the Universe (statistical field theory)
- The physics of the Cosmic Microwave Background (classical and statistical field theory)

More specifically, the following topics will be discussed:

- Inflation: A brief review of background cosmology and inflation
- Inflation: Free fields on de Sitter spacetime
- Inflation: Interacting fields, the in-in formalism and correlators in $P(X, \phi)$ theories
- Inflation: Quantizing pure gravity, gravity plus matter, symmetries and phenomenology
- Large Scale Structures: Newtonian dynamics
- Large Scale Structures: Standard perturbation theory
- Large Scale Structures: the effective field theory approach
- Cosmic Microwave background: the Boltzmann equation
- Cosmic Microwave background: anisotropies and the angular power spectrum

Prerequisites

Some familiarity with introductory quantum field theory and general relativity, as for example provided by the respective michaelmas courses, is highly recommended. Basic knowledge of introductory cosmology is very helpful. Students who did not attend the Michaelmas course on cosmology may still follow this course, and may want to read Section 1.1 and 1.2 of the notes before the course starts.

Literature

The lecture notes for this course can be found on E. Pajer's website at this link.

Additional support

Four examples sheets will be provided and four associated examples classes will be given. There will be a one-hour revision class in the Easter Term.