Level: bachelor

Course title: Cosmic Microwave Background

Status: elective

ECTS: 6

Requirements: none

Learning objectives

The objective of this course is to introduce students to the subject of the origin and properties of the cosmic microwave background, which represents the echo of the Big Bang and is one of the three key pieces of observational evidence supporting the modern cosmology.

Learning outcomes

After completion of the course, students should be familiar with physics of the microwave background radiation and its observations, and trained to make conclusions about conditions and processes in the early universe, and the properties of the first galaxies and galactic clusters.

Syllabus

Theoretical instruction

Introduction; History, discovery and observations; Background radiation at 2,74K; Black body radiation in an expanding Universe; Properties of background radiation; Inflation; Relic neutrinos; Thermal ionization; Recombination rate; Coupling between matter and cosmic microwave background; Structure formation; Interaction with relativistic particles; Sunyaev-Zel'Dovich effect.

Practical instruction

With the goal of in-depth understanding of the content covered in classes, a great deal of attention will be given to practical work both during the lectures and in the form of homework. Students will be encouraged to use real astronomical data and draw conclusions based on the observed anisotropies in the cosmic microwave background, as well as to solve problems in class, which will help prepare them for homework problems and a written exam.

Term paper

The goal of assigning a term paper is to provide students with a deeper introduction to a specific topic chosen by them. Students will have to independently search the literature and afterwards write a short description of the topic with the task of presenting the key points and their understanding of the topic. An important part of the term paper assignment will be making and delivering an in-class presentation of the topic in order to help improve their presentation skills and share the knowledge about a certain topic with fellow students.

Weekly teaching load				Other:
Lectures: 3	Exercises: 1	Other forms of teaching: 1	Student research:	