Cosmology

Programme course

6 credits

Kosmologi

TFYA71

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2017-01-25

Main field of study
Mathematics, Applied Mathematics, Applied Physics, Physics

Course level
Second cycle

Advancement level
A1X

Course offered for
- Physics and Nanoscience, Master's programme
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- Applied Physics and Electrical Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering

Specific information
The course is offered every second year. It will be available during 2017.

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Calculus in several variables, Linear Algebra, Vector Analysis, and basic knowledge of physics including Wave motion, Mechanics, Thermodynamics and familiarity with the special theory of relativity (corresponding e.g. to a course in Modern Physics). The course is suitable for physics, mathematics and engineering students without previous knowledge of the subject, but a basic course in Astronomy can be studied as a background.

Intended learning outcomes

This course outlines the development of cosmological models from earliest times to today, with the main emphasis on the 'Big Bang ' model, although other models will also be considered. A discussion of the inadequacies of Newtonian Mechanics and Special Relativity Theory motivates the need for General Relativity Theory and the associated mathematical tools for calculations in curved spacetimes, which enable physical phenomena such as Mercury's orbit, the deflection of light, the expansion of the universe, black holes, the initial Big Bang singularity, and the final fate of the universe to be investigated. To pass this course students will need to:

- have an overview of the main historical cosmological models and be able to repeat simple historical geometric calculations.
- have an overview of today's cosmological models and make simple calculations on the cosmic distance hierarchy.
- be able to make simple calculations in Newtonian Mechanics and Special Relativity, and understand their inadequacies in cosmology.
- understand the physical basis of general relativity, and carry out calculations in curved spacetime involving metrics and geodesics.
- be able to carry out calculations in curved spacetime near massive objects using the Schwarzschild metric.
- be able to carry out calculations to make comparisons between different cosmological models using the Robertson-Walker metric.
- be able to derive the Friedmann equations and use them to study the history of the universe according to the different models of the universe.
- understand the relevance of the cosmic black-body radiation in the 'Big Bang' theory
- have an overview of some alternative cosmological theories.
- have an overview of the most recent developments and theories.

Course content

An overview of cosmological theories from earliest times to the present day. Cosmography. The difference between Newton's mechanics and the relativity theories. A simple presentation of curved space. Geodesics. Relativistic phenomena close to massive objects. Relativistic cosmology and the Big Bang. Description of the standard model of cosmology, including concepts as accelerating universe, inflation, dark matter, dark energy.

Teaching and working methods

Lectures.

Examination

UPG1	Hand-in assignments and presentation	6 credits	U, 3, 4, 5

Hand-in assignments may give grades (U,3,4); a written mini-project may increase the grade with at most one step.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Theory of Relativity, for a more thorough treatment of general relativity.

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent

Magnus Johansson

Examiner

Magnus Johansson

Course website and other links

Education components

Preliminary scheduled hours: 38 h
Recommended self-study hours: 122 h

Course literature

Berry, M. V: Principles of Cosmology and Gravitation. Institute of Physics Publishing 1989, samt kompletterande utdelat material. Alternativ: A. Liddle: An Introduction to Modern Cosmology, 2nd Edition (Wiley, 2003) B. Ryden: Introduction to Cosmology (Addison Wesley, 2003)

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.