



SH2200 Astroparticle Physics

6.0 credits

Astropartikelfysik

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for SH2200 valid from Autumn 2008

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Specific prerequisites

Recommended prerequisites: Previous knowledge corresponding to SH1009 Modern Physics, or equivalent.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

Astroparticle physics is a relatively new field of science. The fields of particle physics, astronomy and cosmology are combined to allow an understanding of the physical processes at work in the Universe at a fundamental level. During the course, particular emphasis will be laid on the experimental aspects of astroparticle physics, namely a survey of current results and the experiments used to produce them. Astroparticle physics is an extremely dynamic field with annual new and fundamental discoveries - this will also be reflected in the topics covered during the course. After completing this course, you should be able to:

- Classify the fundamental subatomic particles by their possible interactions.
- Explain how ‘particle probes’ can open a new window on the universe compared to historical observations using electromagnetic radiation.
- Explain how particles can be detected and their properties determined, and appreciate the limitations of different detection techniques.
- Identify the astrophysical observations which motivate the key features of the current ‘Standard Cosmological Model’.
- Use a Newtonian-inspired model to describe the expansion of the universe. Account for the dynamics of the expansion of the universe during the radiation- and, subsequently, matter-dominated epochs. Defend the basic properties of your model with observational data.
- Defend the hypothesis that the vast majority of the universe consists of forms of (‘dark’) matter and energy which are completely unknown today. Explain the independent observations which lead to this startling fact. Hypothesize over the possible particle candidates for the ‘dark matter’ of the universe.
- Perform dimensional analysis to define relationships between physical variables in astrophysical systems.
- Interpret data from figures published in the scientific literature and use this to perform calculations and develop conclusions.
- Reflect on the current ‘open questions’ in astroparticle physics and the experiments planned to address these issues.

Course contents

Review of particle physics phenomena. Review of cosmological models. Big Bang nucleosynthesis and thermal relics. The cosmic microwave background and the measurement of fundamental cosmological parameters. Candidates for the dark matter of the universe and techniques to detect dark matter. Neutrinos from the sun, supernovae, the atmosphere and exotic sources. Galactic cosmic rays. Cosmic rays at the earth. Satellite and balloon cosmic ray experiments. Ultra-high energy cosmic rays. Cosmic gamma rays. Neutrino detectors and evidence for oscillations.

Course literature

D. Perkins, Particle Astrophysics, Oxford University Press, ISBN 0-19-850952 (2003).

Examination

- INL1 - Hand in Assignments, 6.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Home assignments. Oral presentation. Oral examination (for grade A).

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.