UNIVERSITY OF GOTHENBURG

PHYSICS

ASF912 Black holes and relativity theory - a visual journey, 7.5 higher education credits

Svarta hål och relativitetsteori - en visuell resa, 7,5 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2015-10-09 to be valid from 2015-10-09, autumn semester of 2015.

Field of education: Science 100%
Department: Physics

Position in the educational system

Main field of studies	*Specialization*
Physics	G1N, First Cycle, has only upper-secondary level entry requirements

Entry requirements

General entrance requirements

Learning outcomes

On successful completion of the course the student will be able to:

Verbally and in writing account for the contents of the course in a popular scientific manner.

Knowledge and understanding

The student should have knowledge about:

- The core principles of special relativity
- The core principles of general relativity

- Black holes and cosmology
- How various relativistic scenarios are experienced visually

Skills and abilities
The student should verbally and in writing be able to account for the contents of the course, for example by interpreting images and diagrams.

Course content
The course consists of lectures about:

- Fundamental concepts in special relativity such as time dilation, length contraction and the relativity of simultaneity.
- The twin paradox and the pole vaulter paradox
- Red shift and aberration, light changes direction and color due to motion
- The effect of the velocity of light on the apparent shape of moving objects
- Gravity as a consequence of curved spacetime
- The concept of straight lines in a curved spacetime
- Accelerated reference frames, the similarity between gravity and acceleration
- Gravitational time dilation, time slows down near massive objects
- The event horizon concept
- Static black holes
- Rotating and charged black holes
- Gravitational waves
- Curved spaces
- Cosmological models
- Exotic theories such as warp drive and time travel

Form of teaching
The course is given as a series of lectures. In several cases the lecture will consist of two parts, where the latter part is given in a lecture hall specifically designed to show content in 3D. The first part of the lecture is then addressing the theory that underlies the visualizations of the second part.

Language of instruction: Swedish

Assessment
The student should be able to assess the scientific validity of popular literature concerning relativity theory, black holes and the other topics of the course.

If a student, who has failed the same examined component twice, wishes to change examiner before the next examination, a written application shall be sent to the

department responsible for the course and shall be granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

In cases where a course has been discontinued or has undergone major changes, the student shall normally be guaranteed at least three examination occasions (including the ordinary examination) during a period of at least one year from the last time the course was given.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Course evaluation

The results of and possible changes to the course will be shared with students who participated in the evaluation and students who are starting the course.