COURSE DETAIL

GRAVITATIONAL WAVES
Country Netherlands
Host Institution Utrecht University
Program(s) Utrecht University
UCEAP Course Level Upper Division
UCEAP Subject Area(s) Physics
UCEAP Course Number 137
UCEAP Course Suffix
UCEAP Official Title GRAVITATIONAL WAVES
UCEAP Transcript Title GRAVITATIONAL WAVES
UCEAP Quarter Units 6.00
UCEAP Semester Units 4.00

Course Description

The course starts with an introduction to the basic mathematical tools needed: tensors (in particular the metric tensor), index notation, and coordinate transformations. Special relativity is introduced, and a basic overview of general relativity is given. The linearized Einstein equations are discussed, and their physical degrees of freedom are identified; it is shown how this leads to a wave equation and hence gravitational waves. The basic properties of gravitational waves are studied: what polarizations they have, how they interact with matter, and the energy they carry. Next quadrupole formula, which describes how gravitational waves are generated by the motion of masses, is reviewed. An important example is the gravitational radiation emitted by two compact objects (neutron stars and/or black holes) that orbit each other, and spiral towards each other until they merge together. The course discusses how these, and other gravitational wave signals are detected with interferometers such as LIGO and Virgo, including the basics of gravitational wave data analysis: how to identify and study weak signals in noisy detector data. Finally, lectures make a connection with discoveries made by LIGO and Virgo in the past few years, and their impact on fundamental physics, astrophysics, and cosmology. The course ends with a discussion of future gravitational wave observatories such as the underground Einstein Telescope and the space-based LISA, together with the scientific output that can be expected from these.

Language(s) of Instruction
English

Host Institution Course Number
NS-377B

Host Institution Course Title
GRAVITATIONAL WAVES

Host Institution Course Details
https://osiris-student.uu.nl/#/onderwijscatalogus/extern/cursus

Host Institution Campus

Utrecht University

Host Institution Faculty
Sciences

Host Institution Degree

Host Institution Department

Course Last Reviewed
2023-2024

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