UCLouvain

lphys2336

2026

Astroparticle and gravitational wave physics

10.00 credits	52.5 h + 7.5 h	Q1

Teacher(s)	Bruno Giacomo ;de Wasseige Gwenhaël ;Janquart Justin ;Lemaitre Vincent ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	LPHYS2131
Main themes	Depending on the partim chosen, 2 of the following themes will be covered: · Neutrino physics (physics of neutrino interactions and oscillations); · Astroparticle physics, where the origin of galactic and extragalactic sources is studied by observing different messengers (such as neutrinos, photons and gravitational waves); · Gravitational wave physics, whose objective is to better understand certain aspects of general relativity through an experimental approach (the origin of dark matter and the understanding of binary black holes in particular). · Data analysis methods in astrophysics (astroparticles and gravitational waves) are also covered in more detail.
Learning outcomes	**At the end of this learning unit, the student is able to :** **a. Contribution of the teaching unit to the learning outcomes of the programme (PHYS2M)** 1.2,1.3,1.4, 1.6, 2.1,3.1, 3.3, 3.4, 4.1, 4.2, 5.1, 5.2, 5.3, 5.4, 7.1, 7.2, 7.3, 7.5, 8.1. **b. Specific learning outcomes of the teaching unit** 1 Upon completion of this course, students will be able to: 1. Explain and discuss in detail advanced experiments implemented within the course themes. 2. Write reports documenting experiments in neutrino, astroparticle, and gravitational wave physics. 3. Relate theoretical concepts to their application in real-world environments. 4. Analyze the sources of uncertainty in an experimental measurement and assess their impact on the scientific conclusions of an experiment.
Evaluation methods	Evaluation of personal projects reports. Oral exam, partly based on the projects reports.
Teaching methods	Lectures in class. Personal projects. Students can choose the subject among a list proposed by the teachers. Reading portfolio for personal study.
Content	This course consists of 4 partims, each worth 2.5 credits: "Neutrino Physics", "Astroparticle Physics", "Gravitational-wave Physics", and "Data Analysis methods in Astrophysics". Students can either choose to take the entire course, totalling 10 credits, or any pair of partims to total 5 credits. The description of the content of each partim is below: PARTIM "Neutrino Physics" (2.5 credits): physics of neutrino interaction with matters with emphasis on neutrino oscillations, neutrinos produced at accelerators and nuclear plants, and cosmic neutrinos. PARTIM "Astroparticle Physics" (2.5 credits): theory and detection methods in astroparticle physics. PARTIM "Gravitational-wave Physics" (2.5 credits): theory and detection methods in gravitational-wave physics. PARTIM "Data analysis methods in Astrophysics" (2.5 credits): data analysis techniques used in observational astrophysics. They include both classical statistical data analysis and machine learning- based techniques.
Bibliography	Des diapositives de cours et des documents supplémentaires sur les sujets traités sont disponibles sur le site MoodleUCL de l'unité d'enseignement. Course slides and additional documents on the subjects addressed are available on the MoodleUCL website of the teaching unit.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [60] in Physics	PHYS2M1	10		🔍
Master [120] in Physics	PHYS2M	10		🔍