Universitat Autònoma de Barcelona

2019/2020

Neutron Stars, Black Holes and Gravitational Waves

Code: 44084
ECTS Credits: 6

Degree	Type	Year	Semester
4313861 High Energy Physics, Astrophysics and Cosmology	OT	0	2

Contact

Name: Carlos Fernández Sopuerta

Email: Desconegut

Use of Languages

Principal working language: english (eng)

Teachers

Miquel Nofrarias Serra

Cristina Manuel Hidalgo

Carlos Fernández Sopuerta

Pau Amaro Seoane

Laura Tolos

Francesco Coti Zelati

Prerequisites

No specific prerequisites are set for this course, but it is advisable to possess some basic knowledge of Astronomy and Physics.

Objectives and Contextualisation

Neutron Stars and Black Holes are the leftovers of the explosion of very massive stars. Furthermore, these extreme objects are also the main emitters of Gravitational Waves.

The curse is intended to provide a basic observational and theoretical introduction of Neutron Stars and Black Holes, their Gravitational Wave emission, and general multi-messenger physics of compact objects.

Part of the course will also be dedicated to the detection techniques used to discover such extreme stars via their electromagnetic and gravitational wave emission.

Competences

- Understand the bases of advanced topics selected at the frontier of high energy physics, astrophysics and cosmology and apply them consistently.

Learning Outcomes

1. Understand the physical processes responsible for the multi-band emission of neutron stars of different classes, and black holes of various masses.

Content

Neutron stars theory and observations.

Pulsar basic physics and applications.

Black hole theory and observations.

Multi-band observations: telescopes, satellites and data analysis basics.

Neutron star Equation of State.

Gravitational Waves theory and observations.

Gravitational Wave astronomy.

Methodology

Theory lectures.

Classwork and homework.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Course Lectures	45	1.8	1
Type: Supervised			
Classwork	45	1.8	1
Type: Autonomous			
Homework	45	1.8	1

Assessment

The evaluation will be composed of an oral presentation plus questions on a scientific article on any of the course subjects with 40% weight, plus three written exams, with three questions each, on each of the three main course subjects (with 20% weight each).

There will be a resit exam in case you fail the course.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam on Gravitational Wave Astronomy	20%	3	0.12	1
Exam on black hole physics	20%	3	0.12	1

Exam on neutron star physics	20%	3	0.12	1
Oral presentation and discussion of a scientific article relevant to the course.	40%	3	0.12	1
Resit exam	60%	3	0.12	1

Bibliography

The Physics and Astrophysics of Neutron Stars, Astrophysics and Space Sciences Library, Springer (Eds: Rezzolla, Pizzocchero, Jones, Rea, Vidana), 2018

High-Energy Emission from Pulsars and their Systems, Astrophysics and Space Sciences Library, Springer (Eds:Rea, Torres), 2011

Astrophysical Black Holes, Astrophysics and Space Sciences Library, Springer (Eds: Haardt, Gorini, Moschella, Treves, Colpi), 2016

Gravitational Wave Astrophysics, Astrophysics and Space Sciences Library, Springer (eds: Sopuerta), 2016