UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Applied Astrophysics

2021-1-F5801Q044

Aims

1.
2. will be able to interpret, at least at a basic level, observational data, and in particular gravitational waves;
3. will be able to read and understand scientific articles on the topics covered in the classroom;
4. will have a basic knowledge of the main open source numerical codes available in the field of numerical relativity.

Contents

Neutron stars, gamma-ray bursts, binary neutron star systems and their observations, basic concepts of numerical relativity.

Detailed program

1. Neutron Stars
    1. Pulsars
    2. Polytropic Equation of State

    3. TOV Equations and their numerical solution
    4. Neutron Star Collapse to Black Hole
2. Binary Neutron Stars
    1. Gamma-Ray Bursts
    2. Gravitational Waves from Binary Neutron Stars
    3. Electromagnetic Emission from Binary Neutron Stars
    4. Gravitational Wave Observations
3. Numerical Relativity
    1. 3+1 Formulation
    2. ADM Formulation
    3. BSSN Formulation
    4. General Relativistic Magnetohydrodynamic Equations
    5. Einstein Toolkit

Prerequisites

This course requires a basic knowledge of special and general relativity. The latter can be obtained by following the Relativistic Astrophysics or General Relativity Courses.

Teaching form

The course is divided into 42 hours of lectures conducted by the teacher in the classroom. During the lessons the theoretical bases will be exposed and the most recent observational data discussed. The lessons will take place partly on the blackboard and partly through the use of slides. In the latter case, the slides will then be uploaded to the course e-learning site.

Textbook and teaching resource

Main textbooks:

1. "High Energy Astrophysics" by M. S. Longair
2. "Introduction to High-Energy Astrophysics" by S. Rosswog and M. Brueggen
3. "Black Holes, White Dwarfs and Neutron Stars" by S. L. Shapiro and S. A. Teukolsky
4. "A First Course in General Relativity" by B. F. Schutz
5. "Numerical Relativity: Solving Einstein's Equations on the Computer" by Baumgarte and Shapiro
6. "Relativistic Hydrodynamics" by Rezzolla and Zanotti

Semester

I year, second semester

Assessment method

During the course homeworks will be assigned with the aim of increasing the understanding of the topics covered in class. The homeworks have to be delivered via e-learning at least two weeks before the date of the oral exam. Homeworks with obvious cases of plagiarism will be assigned a grade of zero.

Books and notes cannot be used during the oral exam. The use of slides for the seminar is permitted.

Office hours

by appointment