UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# SYLLABUS DEL CORSO

# Computational Physics with Applications to Astrophysics

**86R-XXXVI-CPAA**

## Aims

The main aim of this short course is to introduce some basic concepts for the numerical solution of equations describing the dynamics of fluids, with a focus mainly on astrophysical scenarios.

## Contents

This course will present some of the modern numerical algorithms and codes used to solve hyperbolic systems of partial differential equations, with a particular focus on fluid dynamics. This course will in particular introduce the students to open-source codes used to solve astrophysics problems, such as accretion disks, stellar collapse, and compact object binary mergers. It will also briefly present an open-source code to study the dynamics of fluids in industrial applications.

## Detailed program

1. Introduction to hyperbolic PDEs and basic numerical methods to solve them
2. A brief overview of some Open Source Software:
    1. GRHydro (numerical code for relativistic fluid dynamics)
    2. OpenFOAM (Computational Fluid Dynamic Solver for industrial applications)

## Prerequisites

A degree in Physics or Astrophysics.

## Teaching form

1 CFU, 10 hours, language: English.

## Textbook and teaching resource

- "Introduction to Computational Astrophysical Hydrodynamics" http://bender.astro.sunysb.edu/hydro_by_example/CompHydroTutorial.pdf
- https://python-hydro.github.io/pyro2/
- http://einsteintoolkit.org/
- https://openfoam.org/

## Semester

March-April 2021 (2 hours per week for a total of 5 weeks)

## Assessment method

Written exam. The exam will consist on using one of the codes discussed during the lectures to solve some simple problems. Students will have to write a short report presenting their results.

## Office hours

It is possible to contact the teacher to schedule an appointment.