UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Dynamics of Stellar Systems (blended)

2324-1-F5802Q021

Aims

The acquisition of basic knowledge of the structure of galaxies and the comprehension of the fundaments of the dynamics of complex stellar systems.

By the end of the class the students:

1. will be able to derive either analytically or numerically the gravitational potential generated by a given mass distribution;
2. will be able to derive and use the distribution function (the probability density of having a star at a given position with a given velocity) for highly-symmetric systems;
3. will understand the dynamical secular processes driving the evolution of galaxies and other stellar structures;
4. will acquire an operative knowledge of numerical simulation techniques.

Contents

Galactic dynamics. Introduction to N-body numerical simulations. Introduction to the physics of galaxy clusters.

Detailed program

Introduction to galactic dynamics. The two body problem. Introduction to direct N-body codes. Potential theory. Simulation of the collapse of a homogeneous sphere. Introduction to galaxies: morphology and dynamics. Introduction to tree-codes, Orbits in spherical and axisymmetric potentials. Introduction to the Toomre parameter and simulation of a stellar disc fragmentation. Introduction to the distribution function. Collisionless Boltzmann

equation. Jeans and virial equations. Jeans theorem. Derivation of the distribution functions for spherically symmetric systems. Simulation of a Plummer sphere in equilibrium. Relaxation processes. Two-body relaxation time. Dynamical friction. Introduction to the physics of galaxy clusters.

Prerequisites

Undergraduate degree in physics

Teaching form

Blended learning

In addition to the more traditional lectures and to the blended numerical experiments, the course will feature lectures based on the story-telling technique and the possibility for the students to design their own numerical experiment on the topics discussed.

The course will be divided into 28 hours (4 cfu) of traditional lectures and 40 hours (4 cfu) of practical classes. The online part of the course will include 7 hours (1 cfu) of traditional lectures and 30 hours (3 cfu) of practical classes.

Textbook and teaching resource

Galactic Dynamics - Binney & Tremaine – Princeton series in Astrophysics. Videos and articles on the e-learning page of the course

Semester

Second semester

Assessment method

The final exam is a viva and is based on the topics discussed during the class. Each exam will include the discussion of a specific topic of galactic dynamics previously agreed between the student and the professor, including the design of a numerical test of the topic.

The basic knowledge of the arguments of the class, the ability of the students use them to derive quantitative predictions and to test such predictions with numerical tests will be evaluated during the exam.

There are no evaluated intermediate tests. Intermediate team-works will be available to consent the self-evaluation of the students learning curve.

Office hours

Monday from 16 to 18

Sustainable Development Goals

QUALITY EDUCATION