Study programmes: Bachelor studies – Astronomy and Astrophysics

Course name: Stellar kinematics and dynamics of stellar systems

Lecturers: Bojan Arbutina

Status: Compulsory

ECTS: 5

Attendance prerequisites: enrolled in a fourth year of studies

Course aims: Acquiring general and specific knowledge of kinematics and dynamics of stellar systems

Course outcome: At the end of the course student has basic knowledge of kinematics and dynamics of stellar systems and is capable for future scientific work in this area.

Course content: Galactocentric velocity distribution. Relation between descriptional and observed kinematic characteristics. Transformation of coordinate systems. Local centroid and residual velocities. Local motion of Sun in Galaxy. Radial elements of motion. Apex coordinates from proper motion. Special centroids. Natural coordinate of proper motion. Statistical parallax. Distribution of residual velocities. Spherical distribution. Two-stream hypothesis. Ellipsoidal distribution. Schwarzschild's velocity ellipsoid from observations. Galaxy rotation. Stellar motion asymmetry. General equations of Galaxy rotation (Boetlinger's equations). Local field of barotropical centroid rotation (Oort's equations). Kinematical Galaxy constants. Analysis of Oort's constants. General plane-parallel motion of centroid. Plane-parallel parameters of motion from observations. Dynamical modelling of gravitational systems. Fundamental and perturbative force. Binary passage and stellar encounters. Cumulative effect of encounters. Relaxation and stationarity. Statistical stellar dynamics. Stellar phase density function. Fundamental equation of stellar dynamics. Jeans and Liouville theorem. General solution of fundamental equation. Direct Jeans problem. Quasi-ergodic stellar systems. Non-symmetrical potential of regulatory field. Spherical symmetry potential. Systems with rotational symmetry. Reversed Jeans problem. Gravitational potential function. Centroid kinematics and theoretical velocity ellipsoid. Comparison with observations. Quasi-integrals. Stellar hydrodynamics. Equations of stellar hydrodynamics. Application on Galaxy. Interpreting velocity asymmetry. Virial theorem. Derivation of theorem for continuum systems. Application to stellar systems. Global structure of Galaxy. Populations and subsystems. Spiral structure. Dark matter.

Literature:

Т. Ангелов, 2013, *Звездана астрономија*, Математички факултет, Београд
K.F. Ogorodnikov: 1958, *Dinamika zvezdnih sistem*, "Nauka", Moskva
L.S. Maročnik, A.A. Sučkov: 1984, *Galaktika*, "Nauka", Moskva
G. Gilmore, I.R. King, P.C. van der Kruit: 1989, *The Milky Way as a Galaxy* (eds. R. Buse, I.R. King)

Exercises: И. Атанасијевић, Ј. Милоградов-Турин, 1974, *Изабрана поглавља из звездане астрономије*, Београд

Number of hours: 4	Lectures: 2	Tutorials: 2

Teaching and learning methods: Group work

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures		Written exam	
Exercises / Tutorials	30	Oral exam	70
Colloquia			
Essay / Project			