Study programmes: Bachelor studies – Mathematics - Astronomy

Course name: Introduction into Theory of relativity and cosmology

Lecturers: Darko Milinković, Jelena Katić, Bojan Novaković

Status: Optional

ECTS: 5

Attendance prerequisites: None

Course aims: Learning principles of Theory of relativity and cosmology

Course outcome: Upon completion of the course, the student has basic knowledge in the theory of relativity and cosmological models, as well as the understanding of the origin and evolution of the cosmos.

Course content:

Introduction: Basic concepts of classical mechanics, Newton axioms. Inertial systems. Galilean transformation. Rotational movement. Coriolis force. Foucault's pendulum. Speed of the light in the vacuum. Star aberration. Special Theory of Relativity (STR): Postulates of STR, ether, Michaelson-Morley experiment. Experimental tests of the special theory of relativity. Relativistic dilatation of time, relativistic contraction of length, relativistic speeds, simple Lorentz transformation (along x-axis). Minkowski space, proper time, time-space cone. 4-vectors of events, speeds and moments. Rest mass and relativistic mass and moment. Total energy and rest energy. Simple Lorenz group, the invariance of a scalar product in the Minkowski space relative to the Lorenz group. Doppler effect. Visual perception of relativistic motion. General theory of relativity: Gravitation. Space-time metric. Einstein's field equations. Cosmology: The cosmological principle of homogeneity and isotropy, comoving coordinates. Big Bang Theory. Friedman equations – derivation from the Newton's theorem. Possible geometry of the cosmos. Hubble's law. Cosmological parameters (density, deceleration, Hablov). Expansion the Universe and the red shift. Early Univesre. Black holes. Age of the universe.

Literature:

1. I. Supek, Teorijska fizika I, Školska knjiga, Zagreb, 1960.
2. I. Lukačević: Osnove Teorije relativnosti, Beograd, 1982.
3. A. Liddle, An Introduction to Modern Cosmology, WILEY, 2nd edition, 2003.
4. Ta-Pei Cheng, Relativity, Gravitation and Cosmology, Oxford, 2010.
5. Sachs, Wu: General Relativity for Mathematicians, Springer 1977
6. Hawking, Ellis: The Large Scale Structure of Space-Time, Cambridge University Press 1975.
7. A. Lightman, W. Press, R. Price, Problem book in relativity and gravitation, 1975,

Number of hours: 4+	**Lecures: 2**	**Tutorials: 2**	**Laboratory: -**	**Research: -**

Teaching and learning methods: Lectures / Exercises

Assessment (maximal 100 points)

Course assignments	**points**	**Final exam**	**points**
Lectures	-	Written exam	30
Exercises / Tutorials	-	Oral exam	40
Colloquia	30	Written-oral exam	-
Essay / Project	-		