BELGRADE

Semester3

1. Spectroscopy of Astrophysical Plasmas

Content:

Plasma in different celestial objects - physical background. Collective process in plasma. Different radiation mechanisms of astrophysical plasma. Stellar and interstellar plasma. Plasma in extragalactic objects. Spectroscopical methods and tools for investigation of astrophysical plasma.

Compulsory, 6 ECTS

2. Active Galactic Nuclei

Content:

Photoionization and thermal equilibrium in gaseous nebulae, calculation of emitted spectrum, comparison of theory with observations - plasma diagnostics, active galactic nuclei – classification, properties, physics of the continuum and line emission regions in all wavelength bands, structure and unification model.

Compulsory, 6 ECTS

3. Physics of Interstellar Matter

Content:

Physics of different phases and forms of interstellar matter and theory of shock waves.

Optional, 5 ECTS

4. Computational Astrobiology

Content:

Introduction to computational astrobiology. Overview of astrobiologial databases and tools. Formation of planetary systems. Simulation of vortices within accretion disk.Solar system and life origins. Exoplanets detection methods. A software tool for exoplanets characterization from radial velocity and transit data. Time Series Analysis for Exoplanets. Application of Gaussian process to transit light curves in order ot detect exoplanets. Inferring the properties of the underlying planet population from incomplete and biased samples from a range of surveys. Planetary signals in sparse datasets.Circumstellar habitable zone modeling. Relationship between genetic code and human designed codes. Simple rules and algorithms for reading DNA sequence. Maximum entropic principle and definition of intelligence. Maximum entropic principle and existence of observes within Universe.

Optional, 5 ECTS

5. Line Shapes in Astrophysics

Content:

Atomic spectra and their description – physical background. Broadening mechanism of spectral lines. Spectral line broadening and astrophysical plasmas. Influence of collisions with charged particles on spectral lines in stellar atmospheres. Broadening of Radio recombination lines. Calculation and estimation of the spectral line broadening parameters

Optional, 3 ECTS

6. Introduction to Nucleosynthesis and Particle Astrophysics

Content:

Review of thermonuclear reactions and rates. Measuring abundances. Big bang nucleosynthesis, cosmic origin of lightest elements. Cosmic abundances – observations and problems. Review of stellar evolution and stellar nucleosynthesis. Neutron capture processes. Cosmic ray nucleosynthesis. Introduction to galactic chemical evolution

Optional, 5 ECTS

7. Astroinformatics – Astrostatistics and Machine Learning in Astronomy

Content:

Introduction to statistical frameworks and esploratory data analysis (probability and statistical distributions, classial and bayesian statistical inference), Data nining and machine learning (searching for structure in point data, dimensionality and its reduction, regression and model fitting, classification and time series analysis)

Optional, 5 ECTS

8. Gravitational Lenses - theory and applications

Content:

Brief introduction to cosmology - standard model, basic parameters and cosmological distances. Gravitational lensing theory – lens equation, strong, weak and microlensing. Gravitational lenses and Active Galactic Nuclei - ray-tracing simulations of microlensing influence on radiation from relativistic accretion disks around supermassive black holes. Gravitational lenses and cosmological constraints - lensing time delays, optical depth and statistics

Optional, 5 ECTS

9. Supernovae and Their Remnants

Content:

Classification of supernovae and their rates. Physics of supernova explosions. Classification of supernova remnants (SNRs). Shock waves. Cosmic rays, magnetic fields and synchrotron radiation from SNRs. Hydrodynamic evolution of SNRs. Radio evolution of SNRs.

Optional, 5 ECTS

10. Astrophysical data reduction and analysis techniques

Content:

Types of astrophysical data. Catalogues and selection effects. Instruments for astrophysical observations. CCD detectors. Observation preparation and proposal writing. Tools for astrophysical data reduction and analysis. Data reduction in IRAF and Heasoft. An overview of astrostatistics. Testing for correlation. Data modeling and parameter estimation. Basics of time series analysis.

Optional, 3 ECTS

11. **Small Solar System objects**
Content:
Asteroid Composition and Physical Properties: The Compositional Structure of the Asteroid Belt; Mineralogy and Surface Composition of Asteroids; Sizes, Shapes and Spins. Populations: The Near-Earth Object Population; Trojan Asteroids; The Active Asteroids. Dynamical Evolution: The Dynamical Evolution of the Asteroid Belt; The Yarkovsky and YORP Effects. Other Evolutionary Process: The Collisional Evolution of the Main Asteroid Belt; Space Weathering Processes. Asteroid Families: Identification and Dynamical Properties of Asteroid Families; Physical Properties; Collisional Formation and Modeling of Asteroid Families. Multiple Systems: Asteroid Systems: Binaries, Triples, and Pairs; Formation and Evolution of Binary Asteroids. Trans-Neptunian objects: Orbital and Dynamical Properties; Composition and Physical Properties. Comets: Orbital and Physical Characteristics; Source Regions; Comet–asteroid continuum.
Optional, 5 ECTS

12. Serbian as a Foreign Language
Optional, 3 ECTS

Semester4

1. Master Thesis + Presentation
Compulsory, 30 ECTS