Level: PhD

Course title: Modelling of physical processes

Status: elective

ECTS: 15

Requirements: Computational physics

Learning objectives

To familiarize students with the software for processing of the results of physical measurements and simulations.

Learning outcomes

Upon completion of this subject, students are supposed to have:

- General abilities: knowledge of software packages for processing the results of physical measurements and simulations;
- Subject specific abilities: knowledge of certain technologies applicable in practice.

Syllabus

Theoretical instruction

Computer physics in the knowledge system. Overview of programming languages and software packages. General principles of programming in computational physics. Review of numerical methods in computational physics: errors and uncertainties of numerical calculations, interpolation, differentiation, integration, ordinary and partial differential equations, matrices, eigenvalue problems, Fourier transform. Monte Carlo methods. Deterministic randomness. Graphic visualization of simulated processes.

Illustrative application: Movement of missiles. Oscillations and chaos. Celestial mechanics. Potentials and fields. Waves. Random systems. Examples from statistical mechanics. Molecular dynamics. Examples of quantum mechanics. Interdisciplinary examples. Fundamentals of computer simulations of high performance: RISC, Vector, Parallel computing.

Measurement uncertainties in physics. Combining the measurement uncertainties. Probabilistic theory of measurement uncertainties. Distributions. Discrete variables. Matrix of measurement uncertainty. Counting experiments.

Setting the parameters. Normalization. The meaning of the estimated values of uncertainty. Upper limits.

Estimates in areas outside of physics. The method of moments. The method of maximum probability. The method of least squares. Hypothesis testing. Minimization. The general method of least squares. Background withdrawal problems.

Quantitative analysis of the spectra. The detection limits.

Software packages for processing the results of physical measurements. Seminar with the simulation of processes in respective fields of physics, by choice.

Weekly teaching load				Other:
Lectures: 4	Exercises:	Other forms of teaching:	Student research: 6	