



ED2235 Atomfysik för fusion 6,0 hp

Atomic Physics for Fusion

När kurs inte längre ges har student möjlighet att examineras under ytterligare två läsår.

Fastställande

Kursplan för ED2235 gäller från och med HT09

Betygsskala

A, B, C, D, E, FX, F

Utbildningsnivå

Avancerad nivå

Huvudområden

Elektroteknik, Fysik, Teknisk fysik

Särskild behörighet

Required background: Basic mechanics and electromagnetic theory, introductory modern physics (SH2008 or equivalent).

Undervisningsspråk

Undervisningsspråk anges i kurstillfällesinformationen i kurs- och programkatalogen.

Lärandemål

The research and development of controlled fusion involves knowledge and methods from many different branches of physics, such as electromagnetism, plasma physics, nuclear physics, atomic physics, surface physics and materials physics.

The purpose of this course is to make the student familiar with those aspects of atomic physics that are most important in fusion research. The focus of the course is on basic understanding of atomic collisions and applications in plasma modeling, plasma diagnostics and plasma surface interactions. Much of the course content is applicable also in other contexts in plasma processing and technology, ion implantation and radiation effects.

Kursinnehåll

Short review of quantum mechanics and atomic structure. Collision kinematics, cross sections, rate coefficients. Elastic collisions, classically and in wave mechanics, the Born approximation. Interatomic potentials. Thomas-Fermi model. A universal interatomic potential. Plasma resistivity, stopping power, sputtering and backscattering at surfaces. Inelastic collisions classical- and Born approximations. Electron impact ionization and excitation, recombination, electron transfer, bremsstrahlung. Semi-empirical fits and Effective Z, power balance, thermal equilibria, interplay of ion transport and atomic processes. Numerical exercises with MATLAB, involving rate coefficients, penetration of impurities in plasmas, emissivity profiles and neutral particle transport, etcetera.

Kursupplägg

Individual and group assignments and one written exam.

Kurslitteratur

R.E. Johnson, Introduction to Atomic and Molecular Collisions

Excerpts of D. Park, Introduction to the Quantum Theory, 3rd ed. 1991, R.D. Cowan, The Theory of Atomic Structure and Spectra, J.F. Ziegler, J.P. Biersack and U. Littmark, The Stopping and Ranges of Ions in Matter Vol. 1 or similar literature.

Selected journal papers. Lecture notes.

Examination

- ANN1 - Inlämningsuppgift- individuellt, 1,5 hp, betygsskala: A, B, C, D, E, FX, F
- ANN2 - Inlämningsuppgift-grupp, 1,5 hp, betygsskala: A, B, C, D, E, FX, F
- TEN1 - Skriftlig tentamen, 3,0 hp, betygsskala: A, B, C, D, E, FX, F

Examinator beslutar, baserat på rekommendation från KTH:s handläggare av stöd till studenter med funktionsnedsättning, om eventuell anpassad examination för studenter med dokumenterad, varaktig funktionsnedsättning.

Examinator får medge annan examinationsform vid omexamination av enstaka studenter.

Övriga krav för slutbetyg

Having followed this course the student should:

- Understand basic atomic collision physics in terms of the dominating mechanisms in physical processes like elastic collisions, electron impact ionization and excitation, and charge transfer.
- Be able to exercise intuitive judgment of the relevant orders of magnitude, time scales, energy dependencies and similar in atomic collisions with fusion relevance.
- Be able to account for the role of atomic collisions in fusion plasma physics and plasma surface interactions.
- Be familiar with the use of fitting formulae and databases for cross sections, rate coefficients and derived quantities like stopping power or sputtering yield.
- Be able to use atomic data in numerical modeling.

Etiskt förhållningssätt

- Vid grupparbete har alla i gruppen ansvar för gruppens arbete.
- Vid examination ska varje student ärligt redovisa hjälp som erhållits och källor som använts.
- Vid muntlig examination ska varje student kunna redogöra för hela uppgiften och hela lösningen.