FED3210 Laddade partiklars rörelse, kollisionsprocesser och grundläggande transportteori I 6,0 hp

Motion of Charged Particles, Collision Processes and Basis of Transport Theory I

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

Fastställande

Kursplan för FED3210 gäller från och med VT19

Betygsskala

P, F

Utbildningsnivå

Forskarnivå

Särskild behörighet

Undervisningsspråk

Undervisningsspråk anges i kurstillfällesinformationen i kurs- och programkatalogen.

Lärandemål

When completing the course, the student should be able to:

Describe particle motion in terms of drift motion of guiding centre,

Understand the concept of adiabatic invariants. Stochastisation of orbits by asymmetries.

Know how to use Poincaré plots and standard mapping for analysing regular and stochastic orbits, Chirikov criterion for determining stochastisation, and KAM surfaces. Understand how Coulomb collisions affect the motion of single particles and how relaxation towards isotropic thermal plasmas takes place.

Be familiar with the concept of stochastic differential equations and how to use it for solving diffusion equations. The most important collision processes in plasma including nuclear reactions.

Understand the basis of curvilinear coordinate system: covariant and contra variant representation, differentiation in curvilinear coordinate system, flux coordinate system, Clebsch representation of magnetic field and coordinate system suitable for analysing guiding centre motion.

Understand the basis of classical mechanics: Lagrange equation, Hamilton equation, canonical transformation, cyclical coordinates, action-angle variables, Lagrange and Hamiltonian equations of motion of charged particles.

Kursinnehåll

Perturbation theory of charged particle motion and adiabatic invariants. Drift motion of guiding centre. Stochastisation of the orbits by asymmetries, Poincaré plots, Chirikov criterion. Collision processes. Relaxation processes by Coulomb collisions with a background plasma. Interactions by time dependent fields (including wave-particle interactions; resonance interactions) superadiabatic oscillations, collisionless absorption and stimulated emission processes. Brownian motions – Monte Carlo methods for describing particle motion. Curvilinear coordinate system with application to charged particle motion. Basis of analytic mechanics with application to charged particle motion in curvilinear coordinate system.

Kursupplägg

Seminars or discussion meetings.

Kurslitteratur

Lecture notes. Research articles refered to in the lecture notes for understanding the notes.

Parts of the following, or similar, litterature:

P. Helander and D.J. Sigmar Collisional Transport in magnetized Plasma Introduction 1-13, Collision operator 22-58, 99-136, adiabatic invariants 99-117 with Lagrange and Hamiltonians.

D.J. Rose and McClark, Plasma and Controlled Fusion, M.I.T. and Wiley, New York-London 1961, p. 13-53, 228-256.

L. Spitzer, Physics of Fully Ionized Gases, second rev. Ed., New York, 1962, 120-154.

P. Rutherford and Goldstone Poincaré plot and Chirikov criterion. The subject is also included in Chap. 11 in Classical mechanics, Goldstein (Third Edition 2001).

Curvilinear coordinate system. R. B White, Ch. 1.,

E. Madelung Die Mathematischen Hilfsmittel des Physikers, p 212-220 or corresponding content in any other classic text book,

Classical mechanics, Goldstein Chapters corresponding to the lecture notes. Ch 8-10 in Third Edition, Addison Wesley, San Fransico 2002.

Stochastic differential equations Numerical Solutions of Stochastic Differential Equations, P. E. Klueden and E. Platen, Springer-Verlag, Berlin 1992, Introductory chapter XX-XXXV

Examination

• EXA1 - Examination, 6,0 hp, betygsskala: P, 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

Pass on final written and oral exam.

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.