

ERASMUS TEACHING STAFF MOBILITY. TEACHING PROGRAMME
Faculty of Physics. University of Barcelona

Introduction to plasma physics

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The course will give a brief introduction to plasma physics and its space applications. It will consist of two independent periods separated by a month; the first week (10, 11, 12 and 13 March) is introductory, the second week (14-17 April) will be devoted to applications and specialised topics on space science.

Open to Ph.D., master, graduate and last course undergraduate students

First week

From 13:40 to 15:30 (with a 5 minutes break)

Seminar of the Department d'Astronomia i Meteorologia (seven floor)

Facultat de Física. Universitat de Barcelona

Contacte: Blai Sanahuja (934021131; Blai.Sanahuja@ub.edu)

Basic plasma theory

March 10. Lecture 1

Electrodynamics (short review)

Maxwell's equations, electromagnetic fields and potentials. Electromagnetic waves, phase speed and group speed, polarization. Lorentz force.

Basic plasma concepts

Plasma state, plasma oscillations and plasma frequency, Debye shielding and Debye length. Gyro motion, gyrofrequency and gyroradius. Particle collisions. Examples of plasmas.

March 11. Lecture 2

Single-particle motion

Motion in homogeneous fields, $E \times B$ -drift; Adiabatic invariants, gradient and curvature drifts. Magnetic scattering. Example: charged-particle motion in the solar wind)

Basic kinetic formulation

Distribution function. Vlasov equation. Examples of Vlasov equilibria. Examples of kinetic instabilities.

March 12. Lecture 3

Fluid description

Scope of fluid approximation. Magnetohydrodynamic equations. Multi-fluid equations. MHD equilibria

Magnetohydrodynamic waves

Dispersion relation for linear waves, MHD wave modes. MHD shock waves. Example: Shock waves and Alfvén waves in the solar wind

March 13. Lecture 4

Cold-plasma waves

Cold-plasma equations. Dispersion relation of cold-plasma waves. Principal wave modes. Examples: whistler waves in the magnetosphere, ion-cyclotron heating.

Introduction of homework problems

(With tips on how to solve them)