

Plasma Waves and Instabilities

Course Description

Plasmas support a wide variety of waves. These waves significantly determine plasma dynamics and can be used for plasma manipulation and diagnostics.

Studying plasma waves is an essential part of studying plasma physics and its applications. It is also useful for understanding waves in general, because the complexity of waves in plasmas demands a particularly systematic approach to wave theory.

This course is intended as an introduction to physics of (mostly linear) plasma waves and briefly covers the following general topics:

- concept of linear dispersion;
- dispersion operators and their symbols;
- geometrical-optics approximation;
- envelope equation, ray tracing, mode conversion;
- transport of the wave action, energy, and momentum;
- dispersion properties of nonmagnetized and magnetized plasma within fluid and kinetic models;
- basic types of plasma waves and their applications to plasma manipulation and diagnostics;
- basic instabilities and mechanisms of collisionless dissipation;
- nonlinear saturation of kinetic instabilities, quasilinear theory.