



UNIVERSITÀ DI PISA

KINETIC THEORY OF PLASMAS / PLASMI TEORIA CINETICA

FRANCESCO PEGORARO

Academic year 2022/23

Course FISICA

Code 355BB

Credits 6

Modules	Area	Type	Hours	Teacher(s)
PLASMI TEORIA CINETICA FIS/03		LEZIONI	36	FRANCESCO PEGORARO

Obiettivi di apprendimento

Conoscenze

After completing the course the student will have a solid knowledge of the physics of high temperature dilute plasmas of interest for astrophysics, space physics, thermonuclear fusion studies and high-energy laser plasma interactions. The course is mostly theoretical. The course has an interdisciplinary perspective and is a needed prerequisite for all research activities in physical settings where plasmas are present from space to the laboratory.

Modalità di verifica delle conoscenze

The assessment aims to ascertain the basic knowledge of kinetic plasma physics and, most importantly, the understanding of, and the ability to use the methods that have been developed for the study of a complex system like a plasma.

Capacità

Being able at the end of the course to read and understand a research article in plasma physics

Modalità di verifica delle capacità

Seminar on a specific research article

Comportamenti

Modalità di verifica dei comportamenti

Prerequisiti (conoscenze iniziali)

Mechanics

Statistical mechanics

Electromagnetism in vacuum and in media

Relativistic kinematics

Indicazioni metodologiche

Learning activities:

- attending lectures
- participation in seminar

Attendance: Advised



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Programma (contenuti dell'insegnamento)

Definition of high temperature dilute plasmas, derivation of Vlasov equation. Relationship with fluid plasma descriptions. Linear versus nonlinear plasma dynamics. Vlasov equilibria and plasma waves in a kinetic description; Landau damping. Waves in a magnetized plasma, the method of the characteristics. Low frequency, large scale limit of the kinetic plasma description. Plasma instabilities and anomalous transport properties of a plasma in regimes where thermodynamic equilibrium is absent even at a local level. Quasilinear theory and anomalous diffusion.

Bibliografia e materiale didattico

Krall and Trivelpiece Principles of Plasma Physics or any standard textbook on kinetic plasma theory

Notes on specific subjects distributed by e-mail or on

<https://drive.google.com/drive/folders/1EZbGv5OpY6UnEpzzgv30nlpUn5mOZ1v2>

Indicazioni per non frequentanti

Modalità d'esame

- Final oral exam

The oral exam consists in a seminar on an agreed subject (the seminar is based on reading and understanding a research article) with free questions related to the seminar subject and covering the material of the course.

Altri riferimenti web

<https://drive.google.com/drive/folders/1EZbGv5OpY6UnEpzzgv30nlpUn5mOZ1v2>

Note

Lecture schedule and examination dates decided together with participating students

Teacher freely available for clarifications and suggestions in his office

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