



# UNIVERSITÀ DI PISA

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## KINETIC THEORY OF PLASMAS / PLASMI TEORIA CINETICA

**FRANCESCO PEGORARO**

Anno accademico	2023/24
CdS	FISICA
Codice	355BB
CFU	6

Moduli	Settore/i	Tipo	Ore	Docente/i
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*

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#### *Modalità di verifica dei comportamenti*

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### 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

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### 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

*Ultimo aggiornamento 31/08/2023 19:06*