National Cheng Kung University
Modular Course 2024 Summer Program

領域：自然與工程科學

高密集能量電漿的模擬
Simulation of HED Plasmas

Instructor	Affiliation	Graduation (Ph.d.)
叢士宇 Frank S. Tsung	Department of Physics and Astronomy, UCLA	University of California, Los Angeles. (UCLA)

Course Type	Course Credit	Student Size (Maximum)
Lecture + Recitation	1	12

Student Background

College of Science, College of Engineering

Difficulty

☐ Challenging ■ Moderately Difficult ☐ Medium ☐ Entry Level (Basic)

Format of The Course

Lecture 30%, Hands-on Practice 50%, Discussion 15%, Presentation 5%

Grading Policy

- Presentation 70%:
  Presentation on the last day. The presentation makes up most of the grade. The projects can be done individually or as teams. The presentation grades will be based on the physics results (50%), the level of difficulty of the problem chosen (20%), and also the style of the presentation (30%).
- Hands-on Practice 20%:
  Propose and perform a project or pick a project that was designed by UCLA. Students are required to write a proposal for a project or pick a project from our previous summer school.
- Attendance 10%:
  Because it is very hands-on, attendance is required every day.

Code of Conduct for The Course

None

Course Description

I wish to spend one week teaching basic concepts in kinetic simulations and also show some interesting examples (Landau Damping, drag and diffusion in velocity space) which are both fundamentally important but are also relevant to current research. Some examples include plasma-based accelerators and ion acceleration.

These examples demonstrate the importance of understanding the evolution of the distribution in plasma physics. These examples will lead to a better understanding of high energy density systems that involve plasmas, such as plasma-based accelerators and radiation sources.

Keywords：Physics, HED Physics, Plasma Physics, High Performance Computing

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Timetable and Syllabus

Period	Timetable	Syllabus
8/19(MON)	14:00-17:40	Day 1: setup, introductions (14:00-15:00) and introduction to particle-in-cell and plasma physics (lecture) (15:00-17:00) and hands on lab (17:00-17:40)
8/20(TUE)	14:00-17:40	Day 2: Numerical integration, field solvers and particle pushers (14:00-16:00) and hands on lab (16:00-17:40)
8/21(WED)	14:00-17:40	Day 3: Noise Properties in PIC, Diffusion and Drift in Velocity space (14:00-16:00) and hands on lab (16:00-17:40)
8/22(THU)	14:00-17:40	Day 4: Introduction to data analysis, Fourier transforms, Wigner transforms, and wavelet transforms (14:00-16:00) and hands on lab (16:00-17:40)
8/23(FRI)	14:00-17:40	Day 5: Project Presentation by students (14:00-17:40, approximately 15 minutes per student)

Goal of the Course

1. Data analysis in python.
2. Hands on examples of concepts in kinetic plasma physics, e.g., Landau damping.
3. Perform particle-in-cell simulations.

The Importance, Cross-Over Disciplinary and Contemporary of The Curriculum

Kinetic simulations span over a large area of plasma physics. By providing a course on particle-in-cell simulations a wide range of students will benefit from this knowledge and it will provide growth in NCKU and also foster collaboration between NCKU and UCLA.

Remarks

References：

Birdsall & Langdon, "*Plasma Physics via Computer Simulation*"
Dawson, "*Particle simulation of plasmas,*" Review of Modern Physics, 55

本課程若因天災等不可抗力之因素或中央、地方政府公告停課，授課教師需依情況依建議補課方式調整課程進度與補課；若需使用假日、國定假日補課，則需與所有修課學生達成共識方能用例假日補課。

建議補課方式：

1. 線上授課方式補課；
2. 當預期可能會因天災(颱風、超大豪雨…等)宣佈停課時，建議老師先行調整加快課程進度或預先增加可能天氣預警之前幾次課程時數；
3. 停課後隔天起延後下課，補足停課延誤的進度；若停課超過 1 天，則在開始上課後延後下課補課，或當週星期六、日補課；

更改課程授課方式，例如：DEMO 改以考試、報告、作業取代。