

# Course information

**Course Name:** Laser-Plasma Physics

**Course No.:** PH6075

**Class time:** 10 am~ 1 pm, Tuesday

**Location:** S4-209 (at NCU) and IAMS-404 (or another room, if there are more than 3 persons)

**Class Language:** English

**Prerequisite:** classical electrodynamics (or electromagnetism) and fundamental optics

## Content:

### Part I: Laser-Plasma Interaction

1. Propagation of electromagnetic wave in a plasma and response of electrons in an electromagnetic wave
2. Laser-plasma dynamics
3. Plasma nonlinear optics
4. Plasma instability mechanisms and excitation of plasma waves
5. Decay of plasma waves
6. High-harmonic generation

### Part II: Laser-Plasma Particle and Photon Sources

1. Laser wakefield electron accelerator
2. Table-top hard x-ray free electron laser
3. Mid-infrared and terahertz pulse sources
4. X-ray laser
5. High-harmonic generation
6. White-light generation and DUV pulse source
7. Proton accelerator

## Teaching materials:

No specific textbook. Use class handouts, which can be downloaded from:  
[bb.ncu.edu.tw](http://bb.ncu.edu.tw)

### References:

Basics for plasma physics and laser-plasma interactions

--The Physics of Laser Plasma Interactions, by W. L. Kruer.

--Reference for the pure basic plasma physics part: Introduction to Plasma Physics and Controlled Fusion, by F. F. Chen.

Basics for X-ray source, technique, and diagnostics

- X-Ray Lasers by R. C. Elton.
- Techniques of Vacuum Ultraviolet Spectroscopy, by J. A. R. Samson.
- Soft X-ray and Extreme Ultraviolet Radiation: Principles and Applications, by D. Attwood.
- X-Ray Spectroscopy, by B. K. Agarwal.
- Atomic and Molecular Spectroscopy, by Sune Svanberg.

Basics for particle diagnostics

- Techniques for Nuclear and Particle Physics Experiments, by W. R. Leo.
- Detectors for Particle Radiation, by K. Kleinknecht.

Basics for electron optics

- The Optics of Charged Particle Beams, by D. Carey.
- Charged Particle Beams, by S. Humphries.

Basics for plasma diagnostics

- Plasma Diagnostic Techniques, by R. H. Huddlestone and S. L. Leonard.
- Principles of Plasma Diagnostics, by I. H. Hutchinson.

### **Form of evaluation**

The mid-term exam accounts for 50% and the final exam accounts for 50%. The content of the exams are focused on the underlying fundamental physical concepts of various processes or techniques.