Course information

Course Name: High-Field Laser Technology
Course No.: NCU - PH6086
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: fundamental optics

Course Objective:

(1) Use learning the construction of a high-peak-power ultrashort-pulse laser system as a platform to let the students grasp the essence of the four pillars of optics (EM wave propagation, Fourier optics, nonlinear optics, and laser) and learn how to apply them in real works.

(2) Teach the students the step-by-step procedure for building a high-peak-power ultrashort-pulse laser system.

Content:

1. Fundamental Optics
   1.1. Laser propagation in a medium
   1.2. Fourier optics
   1.3. Nonlinear optics
   1.4. Laser oscillator

2. High-field laser technology
   2.1. Architecture of a high-peak-power laser system
   2.2. Ultrashort-pulse mode-locked laser oscillator
   2.3. Carrier-envelope phase control
   2.4. First-stage amplifier (eight-pass amplifier) and pulse selector/cleaner
   2.5. First-stage amplifier (regenerative amplifier)
   2.6. Late-stage amplifier (power amplifier) and spatial filter
   2.7. Pulse stretcher and compressor, global dispersion compensation
   2.8. Ultrafast pulse cleaner, frequency converter, and control of nonlinear effects
   2.9. Electronic control system and online monitoring system
   2.10. Control and measurement of temporal waveform
   2.11. Control and measurement of spatial waveform

2.12. Nd:YAG laser technology

Teaching materials:

Use class handouts which can be downloaded from BB station https://bb.ncu.edu.tw/ (for anyone with an NCU account) or http://ltl.iams.sinica.edu.tw/laser-technology/high-field_laser_technology.html (for anyone).

References:

(1) Ultrashort Laser Pulse Phenomena by Diels; Waves and fields in optoelectronics by Haus; Optical waves in crystals by Yariv

(2) The Fourier Transform and Its Applications by Bracewell

(3) Nonlinear Optics by Boyd

(4) Lasers by Siegman

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.