Syllabus

OSE 6447, Attosecond Optics

Zenghu Chang

Semester: Fall 2017 (Aug. 21 to Dec. 9)
Lecture time: Tuesday & Thursday 3:00PM - 4:15PM
Classroom: CREOL A214

1. Prerequisites:

Graduate level wave optics or electrodynamics.
Graduate level quantum mechanics.

For examples:

OSE 6349 Applied Quantum Mechanics for Optics and Engineering or PHY5606 Quantum Mechanics I.
OSE 5041 Introduction to Wave Optics, or OSE 6111 Optical Wave Propagation, or PHY5346 Electrodynamics I,

2. Course assignments/exams:

- 11 homework assignments. 30 pts from the 10 best homework grades (lowest one is dropped). Late homework is NOT accepted.
- 3 tests. 30 pts from the 2 best exam grades (lowest one is dropped).
- Final project. 40 pts

3. Grading procedures:

A: 90-100 pts
B: 80-89 pts
C: 70-79 pts
D: 60-69 pts
F: <60pts (Fail)

4. Course description

This course introduces the forefront of attosecond optics research. Topics include the fundamental theories and latest journal publications. Lab tours will be offered when necessary for connecting the theories to the experiments. We will challenge students on the problems that yet to be solved by the scientists in this field.

5. Topics

Chapter 1 Introduction

1.1 Brief review of Lasers
1.2 Brief review of Quantum Mechanics
1.3 Description of coherent light pulses
1.4 Overview of attosecond pulse generation

Chapter 2 Driving lasers

2.1 Mode-locked oscillator
2.2 Chirped pulse amplifier
2.3 Hollow-core fiber compressor
2.4 Optical parametric chirped pulse amplifier
2.5 Comparison between femtosecond and attosecond pulses

Chapter 3 Strong Field Approximation

3.1 Schrödinger equation for laser atom interaction
3.2 Laser field ionization
3.3 High harmonic generation
3.4 Complete Reconstruction of Attosecond Burst
3.5 PROOF and other attosecond pulse characterization schemes

Chapter 4 Phase Matching

4.1 Wave propagation equation
4.2 Phase matching for plane waves

Final project

Calculate high harmonic spectrum of a hydrogen atom interacting with a 12 fs laser at 1.6 micrometer center wavelength. The peak intensity of the laser is $1x10^{14}$ W/cm^2. The carrier envelope phase is zero. You may use the strong field approximation.