Syllabus

OSE 6447, Attosecond Optics

Zenghu Chang

Semester: Fall 2021
Lecture time: Tuesday & Thursday 4:30PM - 5:45PM
Classroom: CREOL 102
Office hour: By email appointments

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, which are collected every Tuesday. 30 pts from the 10 best homework grades (lowest one is dropped). Late homework turn in without getting approval in advance from Zenghu Chang 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.

Textbook: *Fundamentals of Attosecond Optics*, Zenghu Chang, CRC Press. ISBN-13: 978-1420089370, ISBN-10: 1420089374.

The digital version of the course textbook is available for free through the UCF Libraries. You can view it online or download PDF chapters to read offline. Accessing the text requires that you authenticate (log in) as a UCF student. Contact your librarian, Sandy Avila, if you have any problems.

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
1.5 Measurement of the time profile of laser 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

Chapter 2 Driving lasers

2.1 Laser beam propagation
2.2 Laser pulse propagation in nonlinear media
2.3 Laser pulse propagation in linear dispersive media
2.4 Kerr-lens mode-locking

Final project

Calculate high harmonic spectrum of a hydrogen atom interacting with a 12 fs laser at 2.5 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.

Statements

https://fctl.ucf.edu/teaching-resources/course-design/syllabus-statements/#covid

S1 Video or audio recording

Students may, without prior notice, record video or audio of a class lecture for a class in which the student is enrolled for their own personal educational use. A class lecture is defined as a formal or methodical oral presentation as part of a university course intended to present information or teach enrolled students about a particular subject. Recording class activities other than class lectures, including but not limited to lab sessions, student presentations (whether individually or part of a group), class discussion (except when incidental to and incorporated within a class lecture), clinical presentations such as patient history, academic exercises involving student participation, test or examination administrations, field trips, private conversations between students in the class or between a student and the faculty member, and invited guest speakers is prohibited. Recordings may not be used as a substitute for class participation and class attendance, and may not be published or shared without the written consent of the faculty member. Failure to adhere to these requirements may constitute a violation of the University's Student Code of Conduct as described in the Golden Rule.

S2 Academic Integrity

Students should familiarize themselves with UCF's Rules of Conduct at <https://scai.sdes.ucf.edu/student-rules-of-conduct/>. According to Section 1, "Academic Misconduct," students are prohibited from engaging in

1. Unauthorized assistance: Using or attempting to use unauthorized materials, information or study aids in any academic exercise unless specifically authorized by the instructor of record. The unauthorized possession of examination or course-related material also constitutes cheating.
2. Communication to another through written, visual, electronic, or oral means: The presentation of material which has not been studied or learned, but rather was obtained through someone else's efforts and used as part of an examination, course assignment, or project.
3. Commercial Use of Academic Material: Selling of course material to another person, student, and/or uploading course material to a third-party vendor without authorization or without the express written permission of the university and the instructor. Course materials include but are not limited to class notes, Instructor's PowerPoints, course syllabi, tests, quizzes, labs, instruction sheets, homework, study guides, handouts, etc.
4. Falsifying or misrepresenting the student's own academic work.
5. Plagiarism: Using or appropriating another's work without any indication of the source, thereby attempting to convey the impression that such work is the student's own.
6. Multiple Submissions: Submitting the same academic work for credit more than once without the express written permission of the instructor.
7. Helping another violate academic behavior standards.

8. Soliciting assistance with academic coursework and/or degree requirements.

Responses to Academic Dishonesty, Plagiarism, or Cheating
Students should also familiarize themselves with the procedures for academic misconduct in UCF's student handbook, *The Golden Rule* <https://goldenrule.sdes.ucf.edu/>. UCF faculty members have a responsibility for students' education and the value of a UCF degree, and so seek to prevent unethical behavior and respond to academic misconduct when necessary. Penalties for violating rules, policies, and instructions within this course can range from a zero on the exercise to an "F" letter grade in the course. In addition, an Academic Misconduct report could be filed with the Office of Student Conduct, which could lead to disciplinary warning, disciplinary probation, or deferred suspension or separation from the University through suspension, dismissal, or expulsion with the addition of a "Z" designation on one's transcript.

Being found in violation of academic conduct standards could result in a student having to disclose such behavior on a graduate school application, being removed from a leadership position within a student organization, the recipient of scholarships, participation in University activities such as study abroad, internships, etc.

Let's avoid all of this by demonstrating values of honesty, trust, and integrity. No grade is worth compromising your integrity and moving your moral compass. Stay true to doing the right thing: take the zero, not a shortcut.

S3 Course Accessibility

The University of Central Florida is committed to providing access and inclusion for all persons with disabilities. Students with disabilities who need access to course content due to course design limitations should contact the professor as soon as possible. Students should also connect with Student Accessibility Services (SAS) <http://sas.sdes.ucf.edu/> (Ferrell Commons 185, sas@ucf.edu, phone 407-823-2371). For students connected with SAS, a Course Accessibility Letter may be created and sent to professors, which informs faculty of potential course access and accommodations that might be necessary and reasonable. Determining reasonable access and accommodations requires consideration of the course design, course learning objectives and the individual academic and course barriers experienced by the student. Further conversation with SAS, faculty and the student may be warranted to ensure an accessible course experience.

S4 Campus Safety

Emergencies on campus are rare, but if one should arise during class, everyone needs to work together. Students should be aware of their surroundings and familiar with some basic safety and security concepts.

- In case of an emergency, dial 911 for assistance.
- Every UCF classroom contains an emergency procedure guide posted on a wall near the door. Students should make a note of the guide's physical location and review the online version at <http://emergency.ucf.edu/emergency_guide.html>.
- Students should know the evacuation routes from each of their classrooms and have a plan for finding safety in case of an emergency.

- If there is a medical emergency during class, students may need to access a first-aid kit or AED (Automated External Defibrillator). To learn where those are located, see <https://ehs.ucf.edu/automated-external-defibrillator-aed-locations>.
- To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to <https://my.ucf.edu> and logging in. Click on "Student Self Service" located on the left side of the screen in the toolbar, scroll down to the blue "Personal Information" heading on the Student Center screen, click on "UCF Alert", fill out the information, including e-mail address, cell phone number, and cell phone provider, click "Apply" to save the changes, and then click "OK."
- Students with special needs related to emergency situations should speak with their instructors outside of class.
- To learn about how to manage an active-shooter situation on campus or elsewhere, consider viewing this video (<https://youtu.be/NIKYajEx4pk>).

Though most emergency situations are primarily relevant to courses that meet in person, such incidents can also impact online students, either when they are on or near campus to participate in other courses or activities or when their course work is affected by off-campus emergencies. The following policies apply to courses in online modalities.

To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to https://my.ucf.edu and logging in. Click on "Student Self Service" located on the left side of the screen in the toolbar, scroll down to the blue "Personal Information" heading on the Student Center screen, click on "UCF Alert", fill out the information, including e-mail address, cell phone number, and cell phone provider, click "Apply" to save the changes, and then click "OK."

Students with special needs related to emergency situations should speak with their instructors outside of class.

S5 Deployed Active Duty Military Students

Students who are deployed active duty military and/or National Guard personnel and require accommodation should contact their instructors as soon as possible after the semester begins and/or after they receive notification of deployment to make related arrangements.

S6 Make-Up Assignments for Authorized University Events or Co-curricular Activities

Students who represent the university in an authorized event or activity (for example, student-athletes) and who are unable to meet a course deadline due to a conflict with that event must provide the instructor with documentation in advance to arrange a make-up. No penalty will be applied. For more information, see the UCF policy at https://policies.ucf.edu/documents/4-401.pdf

S7 Religious Observances

Students must notify their instructor in advance if they intend to miss class for a religious observance. For more information, see the UCF policy at http://regulations.ucf.edu/chapter5/documents/5.020ReligiousObservancesFINALJan19.pdf

S8 Masks in Classroom

UCF expects that all members of our campus community who are able to do so get vaccinated, and we expect all members of our campus community to wear masks indoors, in line with the latest CDC guidelines. Masks are required in approved clinical or health care settings.

S9 Notifications in Case of Changes to Course Modality

If the instructor falls ill during the semester, there may be temporary changes to this course, including having a backup instructor take over the course or going remote for a short time. Please look for announcements or mail in Webcourses@UCF or Knights email for any temporary alterations to this course.

S10 COVID-19 and Illness Notification

Students who believe they may have been exposed to COVID-19 or who test positive must contact UCF Student Health Services (407-823-2509) so proper contact tracing procedures can take place. Students should not come to campus if they are ill, are experiencing any symptoms of COVID-19 or have tested positive for COVID-19.

Students should contact Zenghu Chang as soon as possible if they miss class for any illness to discuss reasonable adjustments that might need to be made. When possible, students should contact Zenghu Chang before missing class.