PHYS 850: AMO 1
Lecture: TU 2:30, Zoom (https://ksu.zoom.us/j/3276450118)
Spring 2021

Instructor:
Brett Esry
CW 325
esry@phys.ksu.edu

Textbooks:

- Primary: Bransden and Joachain, Physics of Atoms and Molecules
- Supplemental: H. Friedrich, Theoretical Atomic Physics

Grading:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm</td>
<td>20%</td>
<td>A: 85–100</td>
</tr>
<tr>
<td>Final</td>
<td>30%</td>
<td>B: 75–84</td>
</tr>
<tr>
<td>Homework</td>
<td>50%</td>
<td>C: 65–74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D: 55–64</td>
</tr>
</tbody>
</table>

Course philosophy:

My primary goal for this course is to educate you about atomic and molecular structure that you need to know for your research. Given the diversity within our AMO group and within this class, however, not everything we cover will relate directly to each and every person’s research. Moreover, we will not be able to cover everything any of you will need to know about atomic and molecular structure. A secondary goal of this course is thus to give you enough knowledge to be able to learn the rest on your own.

Another secondary goal of this course is to give you a broader education in atomic and molecular physics. In the course of your career, you will talk to many people outside of your immediate area of expertise and you will listen to many talks similarly outside your expertise. A broader education will let you participate more intelligently in these exchanges. In addition, few of us continue doing just one type of AMO physics throughout our career. A broader education provides opportunities and helps you to recognize them. It also makes it easier to switch directions ... maybe for a postdoc position.

To achieve any of these goals, though, requires active participation from you, and that means homework. I will assign regular homework, but will strive to keep their time demands in check as I know most of you have research to do. You will be most time efficient if you discuss the problems with your classmates. You should, however, write up the assignment on your own. Some assignments will require computer work.

Guidelines for homework:

- Discuss your homework with classmates as much as you like, but write your homework solutions on your own! Do not copy a classmate’s work and do not ask for, accept, or use copies of my solutions from previous semesters. This is the best way for you to learn the material as well as an issue of academic honesty.
- As a scientist in training, you need to learn to communicate scientific information in an effective, efficient manner. You should consider homework assignments as practice in this art. It is your responsibility to present your homework solutions in a readable, logical manner — not mine to decipher and interpret them.
- Also as a scientist in training, you need to clearly acknowledge the contributions of others to your work. For example, if you benefitted from discussing the homework with someone, you should acknowledge them. Or, if you found the solution on the web (in a book or elsewhere) and copied it — even if not verbatim — then you should cite the source. If you use computer code that you did not write, you should cite the source of that code. These are issues of professional ethics and academic honesty.
- You will often be required to plot your results. You should do this on your own to develop your own sense of how to best present scientific results. Similarly, if you are required to carry out a numerical solution, do so on your own. You may use a code that you did not write, but you should run it to produce the needed results on your own.

Tentative Course Outline:

We will tentatively cover the following topics (in no particular order):

- many-electron atomic and molecular structure
- polyatomic vibrational states
- x-ray transitions
- scattering: phase shifts, $S$ matrices, $T$ matrices, resonances
- Auger, autoionization, and autodetachment
- Born-Oppenheimer approximation
- non-adiabatic transitions
- adiabatic vs diabatic representations
- curve crossing dynamics; Landau-Zener
- dipole transitions in atoms and molecules
- line shapes and spontaneous decay

The exact topics covered will evolve somewhat during the semester.
Statement Regarding Academic Honesty:

Kansas State University has an Honor and Integrity System based on personal integrity, which is presumed to be sufficient assurance that, in academic matters, one’s work is performed honestly and without unauthorized assistance. Undergraduate and graduate students, by registration, acknowledge the jurisdiction of the Honor and Integrity System. The policies and procedures of the Honor and Integrity System apply to all full and part-time students enrolled in undergraduate and graduate courses on-campus, off-campus, and via distance learning. A component vital to the Honor and Integrity System is the inclusion of the Honor Pledge which applies to all assignments, examinations, or other course work undertaken by students. The Honor Pledge is implied, whether or not it is stated: "On my honor, as a student, I have neither given nor received unauthorized aid on this academic work." A grade of XF can result from a breach of academic honesty. The F indicates failure in the course; the X indicates the reason is an Honor Pledge violation.

Statement Regarding Students with Disabilities:

Students with disabilities who need classroom accommodations, access to technology, or information about emergency building/campus evacuation processes should contact the Student Access Center and/or their instructor. Services are available to students with a wide range of disabilities including, but not limited to, physical disabilities, medical conditions, learning disabilities, attention deficit disorder, depression, and anxiety. If you are a student enrolled in campus/online courses through the Manhattan or Olathe campuses, contact the Student Access Center at accesscenter@k-state.edu, 785-532-6441; for K-State Polytechnic campus, contact Julie Rowe, Diversity, Inclusion and Access Coordinator, at jarowe@ksu.edu or call 785-826-2971.

Statement for Copyright Notification:

Copyright 2019 (Brett Esry) as to this syllabus and all lectures. During this course students are prohibited from selling notes to or being paid for taking notes by any person or commercial firm without the express written permission of the professor teaching this course. In addition, students in this class are not authorized to provide class notes or other class-related materials to any other person or entity, other than sharing them directly with another student taking the class for purposes of studying, without prior written permission from the professor teaching this course.

At no point should the professor or other students put themselves into an unsafe situation while attempting to enforce the face-covering policy.

The K-State Student Conduct Code prohibits any illegal or unauthorized taking, selling, or distribution of class notes. Students violating this provision will be subject to discipline under the conduct code, including but not limited to possible expulsion from K-State.

Statement Regarding Wearing of Face Coverings:

To protect the health and safety of the K-State community, students, faculty, staff and visitors must wear face coverings over their mouths and noses in all indoor and outdoor spaces while you are on university property unless you are alone in a private office or workspace or alone outdoors. In addition, all new students are required to complete face covering training that also covers COVID-19 transmission, risk mitigation and the Every Wildcat a Wellcat pledge. Students needing accommodations may contact the Student Access Center at accesscenter@k-state.edu.

In classrooms, faculty have the right to deny a student entry into the room if the student is not wearing a face covering. Students not wearing a face covering will be reminded to do so and offered a clean face covering, if one is available. If the student does not comply, the faculty member will ask the student to leave the space, and if available, join the class remotely. As a last resort, campus police will be called. The faculty member will complete the Code of Conduct form and the Office of Student Life will look further into the issue and take the non-compliance with the request to leave into consideration of further accountability measures.

At no point should the professor or other students put themselves into an unsafe situation while attempting to enforce the face-covering policy.

Statement Defining Expectations for Classroom Conduct:

All student activities in the University, including this course, are governed by the Student Judicial Conduct Code as outlined in the Student Governing Association By Laws, Article V, Section 3, number 2. Students who engage in behavior that disrupts the learning environment may be asked to leave the class.