Physics 7750: Atomic and Molecular Spectra
Spring 2007

Lecture: Tuesdays 1-2:15pm, JILA auditorium
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Office hours: Lewandowski: Monday 3-4 pm (or by appointment),
JILA tower A907, phone 2-1446
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JILA S-377, phone 2-5426
Web page: www.colorado.edu/physics/phys7550/phys7550_sp07/index.html

Textbook: Physics of Atoms and Molecules, Second Edition by Bransden and Joachain
Clicker: iClicker (not the old infrared HITT clickers)

Goals for the class

Atomic, Molecular, and Optical (AMO) physics is currently undergoing its second major growth period. The first, which began almost a century ago, served as the proving ground for the (then new) quantum theory and elucidated the basic structure of the matter around us. The "new" atomic physics, which has become prominent in the last 20 years, is largely driven by new developments in laser technology. Modern topics include the behavior of atoms in unusual environments such as super intense light fields and in ultracold gases; or in energy regimes where the classical analogue of the atom is chaotic; or the ability to control atoms and molecules to drive a desired transition or break a specific bond in a molecule; or to harness coherent states of atoms for unusual applications such as quantum computing. These developments point not only to interesting new physics unimaginable a decade ago, but also to real-world applications as our control over matter on the atomic scale becomes ever more precise.

The ability to understand these developments requires a background in how atoms are put together and how they interact with light. Our goal in this course is to hit the highlights of the past century's developments, to give students a working knowledge of ideas they will apply daily as the move on to research in AMO physics. For students who do not intend to continue in AMO research, this course is also useful as an "applied quantum mechanics" course that shows how our world works on a microscopic scale. It is therefore an alternative to the more esoteric advanced quantum courses whose focus is on more formal developments such as second quantization, field theories, etc.

Course Schedule

- Atomic structure (2 weeks)
- Molecular structure (3 weeks)
- Atoms and molecules in DC electric and magnetic fields (2 weeks)
- Classical atom picture and quantization of the electromagnetic field (2 weeks)
- Perturbative light-matter interactions: Spontaneous emission, photo-absorption, etc. (2 weeks)

- Non-perturbative light-matter interactions: Rabi flopping, dressed states, etc. (3 weeks)
- Special topics (1 week)

Grading

Weekly homework sets will be assigned and will determine 95% of the grade. Clicker questions and instructor discretion will constitute the remaining 5%. You are encouraged to discuss the homework with fellow classmates. However you must work out and turn in your own solutions for each set.

In advance of each lecture, we will post required reading assignments on the course website. To ensure the reading assignments are completed, we will ask one quick clicker question at the beginning of class based on the reading. Additional clicker questions will be asked during the lecture to stimulate discussion and give feedback to the instructors.

Late homework will be accepted but with a stiff penalty of 20% per day up to a maximum of 50%. Please make sure your solutions can be read and understood easily. *(A happy grader is a generous grader.)* Solutions without mathematical support will not be given credit.

Additional Information

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and http://www.Colorado.EDU/disabilityservices

Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please contact me as soon as a conflict is known. See full details at http://www.colorado.edu/policies/fac_relig.html

Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions. Professional courtesy and sensitivity are
especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See polices at
http://www.colorado.edu/policies/classbehavior.html and at

http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

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