PHY-565 SPRING 2013

In this spring 2013 semester, PHY-565 will be devoted to the burgeoning area of Atomic Physics. It will focus on modern topics suitable for the laser era and emphasize the ideas that capture the attention of the research groups in our department (it can also be a breadth course). It will not be mired in the details of atomic structure and other arcane topics.

The course will begin by addressing several very current topics in the simple language of two level atoms. These include, but are not limited to atom optics and interferometry, the Ramsey method, the Bell inequalities, entanglement and quantum information, the non-cloning theorem, etc. After that we can turn to the role of the multilevel structure of real atoms which will take us to laser cooling, optical pumping, non-linear optics, Bose-Einstein condensation, and other subjects. Once all these topics are in hand there will be an introduction to spontaneous emission based upon the ubiquitous density matrix description. Only in the latter part of the course will we discuss fine and hyperfine structure, external fields, multi-electron atoms, etc. The tentative syllabus will soon be accessible from the department website.

Atomic, Molecular, and Optical (AMO) physics is one of the largest and fastest growing research areas, and our department has recognized the importance and emergence of this field by adding two (yup, two) new faculty members starting this January. Tom Allison is already here and Eden Figueroa arrives in another week. The growth and importance of AMO has also been recognized by the Royal Swedish Academy: there have been four Nobel prizes in the field during the past 15 years, most recently in 2012.

AMO in our department is strong and growing. There are three established experimental groups headed by Dominik Schneble, Tom Weinacht, and Hal Metcalf, and the two new ones mentioned above. You may have heard some of us in the Friday afternoon seminars, and there will be more. All five groups offer fascinating research topics and financial support for interested students. In addition to the experimental groups, we offer opportunities in the Laser Teaching Center with Dr's. John Noé and Marty Cohen, support of our own theorist Tom Bergeman, quantum information studies with Tzu-Chieh Wei of the YITP, and weekly seminars by outside visitors. For now, you may want to pay more-than-casual attention to this blatant advertisement.

PHYSICS 565 – – SPRING 2013

MW 10:00 - 11:20
Room: P-122

QUANTUM ELECTRONICS
will be devoted to

Text: van der Straten and Metcalf, *Atomic Physics**

ATOMIC PHYSICS

TENTATIVE - as of January 17, 2013

week	Mon. date	Monday	Wednesday	reading
I	1/28	The Classical Radiator and the Bohr Model	Two Level Atoms in Light, Rabi Oscillations	Ch. 1 Sec's. 2.1 - 2.3
II	2/4	The Dressed Atom Picture and the Bloch Picture	Adiabatic Rapid Passage Superposition and Entanglement The Bell Inequalities	Sec's. 2.4 - 2.5 Sec. 23.3
III	2/11	The Schrödinger Equation and Approximations for its Solution in Light	Selection Rules, $\sigma = \lambda^2$ Hanle Effect Level Crossing Spectroscopy	Ch. 3
IV	2/18	Extending the Electric Dipole Approximation M1 and E2 Transitions	Lifting the Perturbation Approximation Non-linear Optics	Ch. 4
V	2/25	Spontaneous Emission Einstein A and B coeff's. Field Quantization	Laser Cooling Optical Molasses and The Limits of Laser Cooling	Ch. 5 Sec's. 18.1 - 18.4
VI	3/4	Breaking the Cooling Limit Sisyphus Cooling	The Density Matrix Pure Case and Mixed Case	Sec's 18.5 - 18.7 Ch. 6
VII	3/11	Structure of The Hydrogen Atom	Other One-electron Atoms Alkalis and Quantum Defects	Ch. 7 Ch. 10
	3/18	**SPRING VACATION**	**YIPPEE!!!**	
VIII	3/25	Fine Structure Spin Orbit Interaction Relativistic Effects	Effects of the Nucleus Hyperfine Structure	Ch. 8 Ch. 9
IX	4/1	Effects of the Nucleus Hyperfine Structure	Effect of Magnetic Fields Zeeman Effect	
X	4/8	Strong Magnetic Fields Example - Positronium	The Non-Crossing Theorem The Stark Effect	
XI	4/15	The Schrödinger Eq. in Parabolic Coordinates	Rydberg Atoms	
XII	4/22	Helium Atom Ground State	Helium Atom (2) Excited States	
XIII	4/29	Rest of the Perodic Table	Laser Cooling	
XIV	5/6	Neutral Atom Confinement (maybe ?)	BEC (maybe ?) Optical Lattices (maybe ?)	

* Manuscript of book will be distributed in class.

ACADEMIC INTEGRITY
Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Any suspected instance of academic dishonesty will be reported to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/uaa/academicjudiciary/

ELECTRONIC COMMUNICATION
Email to your University email account is an important way of communicating with you for this course. For most students the email address is 'firstname.lastname@stonybrook.edu', and the account can be accessed here: http://www.stonybrook.edu/mycloud. *It is your responsibility to read your email received at this account.*

For instructions about how to verify your University email address see this: http://it.stonybrook.edu/help/kb/checking-or-changing-your-mail-forwarding-address-in-the-epo . You can set up email forwarding using instructions here: http://it.stonybrook.edu/help/kb/setting-up-mail-forwarding-in-google-mail . If you choose to forward your University email to another account, we are not responsible for any undeliverable messages.

RELIGIOUS OBSERVANCES
See the policy statement regarding religious holidays at http://www.stonybrook.edu/registrar/forms/RelHolPol%20081612%20cr.pdfStudents are expected to notify the course professors by email of their intention to take time out for religious observance. This should be done as soon as possible but definitely before the end of the 'add/drop' period. At that time they can discuss with the instructor(s) how they will be able to make up the work covered.

DISABILITIES
If you have a physical, psychiatric/emotional, medical or learning disability that may impact on your ability to carry out assigned course work, you should contact the staff in the Disability Support Services office [DSS], 632-6748/9. DSS will review your concerns and determine, with you, what accommodations are necessary and appropriate. All information and documentation of disability is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and DisabilitySupport Services. For procedures and information go to the website http://www.sunysb.edu/ehs/fire/disabilities.shtml

CRITICAL INCIDENT MANAGEMENT
Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the University Police and the Office of University Community Standards any serious disruptive behavior that interrupts teaching, compromises the safety of the learning environment, and/or inhibits students' ability to learn. See more here: http://www.stonybrook.edu/sb/behavior.shtml