

PHYSICS 452/562 – – FALL 2020

ATOMIC PHYSICS AND LASERS

Lecture: T θ – 11:30 - 12:50 as of July 22, 2020 Harold Metcalf - S225 - 632-8185 or 8036
 Room: Physics PP - 118 subject to change harold.metcalf@stonybrook.edu
 Text: van der Straten & Metcalf (Cambridge) find it at <https://doi.org/10.1017/CBO9781316106242>
 Text: Milonni & Eberly, 2nd Edition (Wiley)

Week # Monday date	Tuesday	Thursday	Reading & Homework
Background in Atomic Physics and Quantum Mechanics.			
I 8/24	Historical Background Classical models	Schrödinger Equation(s) Multiple solutions	vdS & M: Ch. 1, 2.1, 2.2 Problem set #1
II 8/31	Rabi and Bloch view for two-level atom	More on Bloch sphere Dressed atom picture	vdS & M: Ch. 2.; M&E: 9.1-9.3 Prob. set #2
III 9/7	Atomic Clocks Ramsey method	Separate S.E. for H atom Fine structure (intro)	vdS & M: Ch. 7 Problem set # 3
IV 9/14	Quantum defects (Eric Jones)	Fine structure Relativity and spin-orbit	vdS & M: Ch. 8.1 - 8.5, 8.A, 8.B vdS & M: 10.1 - 10.3 Problem set # 4
V 9/21	Hyperfine structure Zeeman, Stark & dipole Selection Rules	Quantum Transitions, Ω_R Other Atoms Again	vdS & M: Ch. 3.2.1, 3.3, 3.5, 9.1 - 9.3 vdS & M: Ch. 11; Problem set #5
VI 9/28	A and B Coefficients Stimulated Emission (Tom Weinacht)	Non-Linear Optics Harmonic Generation	vdS & M: Ch. 5 <i>and</i> M & E: Sec. 3.7 M & E - Ch. 10, prob 10.10
Laser Operation and Types of Lasers.			
VII 10/5	First Mid-Term Exam In Class	Introduction to Lasers Three and Four levels Gain - Rate Eq's	
VIII 10/12	Fabry Perot Longitudinal Modes, Single Mode - Lamb dip	Gaussian Beams and Fabry-Perot Resonators Saturated Absorption Spect.	M & E, Ch. 1 M & E, Ch. 4, Sec's. 1-12 M & E, prob's. 3.10, 3.14, 4.1, 4.4, 4.7
IX 10/19	Gas Lasers: HeNe, CO ₂ , Ar ⁺ Begin Tunable & Dye Lasers	More About Tunable Lasers Ring Laser Cavities	M&E, Sec's. 5.8 - 5.11; 11.3 - 11.11 M & E, prob's. 5.6, 5.8, 11.4, 11.7, 11.9
X 10/26	Solid State Lasers Ti:Sapphire, DPSS, and Semiconductor Lasers	Dye Laser Resolution Acousto-Optic Modulation	M & E, 11.12 - 11.15 no prob's - catch up
XI 11/2	I & T dependence for diodes Pound-Drever-Hall	Resolution Limits Mode Locked Lasers	M&E, 7.1-7.9, espec. 7.5 & Table 7.1 prob's 7.1, 7.3a, 7.4; prove Eq. 7.5.6
XII 11/9	Fiber Optics & Lasers - Limits to Telecom – Nanofibers Pulsed & Freq. Comb	Second Hour Exam In Class	M&E 8.6, 8.7, 14.7 prepare for exam
Applications of Lasers - Nobel Prizes.			
XIII 11/16	Laser Cooling & Temp. Limit Breaking the Limit	Magnetic Traps & Optical Lattices For Neutral Atoms	M&E 14.4 - 14.6
XIV 11/23	NO CLASS HOLIDAY	NO CLASS THANKSGIVING	M&E All of ch. 14; prob's 14.6, 14.8a, 14.6, 14.8a, 14.9a,b, 14.11, 14.14, 14.21
XV 11/30	Trapping and Confinement Optical Tweezers	Adaptive Optics Coherence - Ducks video	

(Required Statement)

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/>

Learning Objectives: Students are expected to be knowledgeable about the fundamentals of light-matter interactions as well as atomic structure and how it affects the interactions. Also, students are expected to know about the workings of different kinds of lasers, and how to measure and control their properties. The class topics on the first page are a good guide.

Face Masks/Coverings

For face to face classes, every syllabus should include a statement regarding face masks/coverings. Everyone participating in this class, must wear a mask/face covering at all times. Any student not in compliance with this will be asked to leave the class.

If a student refuses to wear a mask or leave the classroom, the faculty member is asked to report the student's name and the details of the situation to Community Standards.

Family Education and Privacy Act (FERPA): Stony Brook University maintains various student records to document academic progress as well as to record interactions with University staff and officials. To protect the student's rights to privacy, and to conform to federal and State laws the University has an established policy for handling students' records. Notice of this policy and of students' rights under federal law is given annually to the campus community.

With very few exceptions, student information must not be transmitted by any University employee or to anyone outside the University without the express written release by the student or pursuant to a lawfully executed subpoena/order, coordinated by the Office of University Counsel.

Please refer to the following campus website for guidance with laws regulating confidentiality of student records and dissemination of other student personal and academic information: <http://www.stonybrook.edu/commcms/registrar/policies/ferpa.php>

Please note without a signed FERPA release faculty cannot discuss a student with their parents under any circumstances. Faculty may not release student directory information (including email addresses) to any 3rd party vendors, including book publishers.

Student Accessibility Support Center

Student Accessibility Support Services (SASC): provides services and accommodations that advocate for the needs of students with permanent/temporary disabilities. Students work with SASC through the interactive process and provide documentation from a treating provider that addresses their functional limitations and how it relates to their academic experience. Individuals with visual, mobility and hearing impairments as well as those with hidden /invisible disabilities such as chronic medical conditions, psychological, and learning disabilities are invited to make an appointment to meet with an Accessibility Support Counselor. Once documentation is received SASC will work with the student and the faculty on implementing the appropriate accommodations.

At the end of this communication are two important SASC policies that I encourage you to familiarize yourself with.

Accessibility of Course Content: It is important that all students have equal access to course materials at all times. For this reason, when your pedagogy includes videos or audio, captions or a transcript must be available at the same time the media is posted. The appropriate format should be determined through discussion with the student and SASC. To insure access for students with print disabilities, electronic doc-

uments should be created following accessibility best practices. At a minimum, PDF and PowerPoint materials should also be posted as a Word Document. The National Center on Disability and Access to Education (NCDAE), has posted 'Cheatsheets' detailing common accessibility best practices to enable the creation of accessible PDF, word, PowerPoint and web materials (including how to caption YouTube videos) at: <http://ncdae.org/resources/cheatsheets>

If you have questions regarding how to make your course content accessible please contact CELT at 631-632-CELT (2358) celt@stonybrook.edu and the Student Accessibility Support Services (SASC) for assistance (2-6748 or sasc@stonybrook.edu).

It's important to note that exam monitoring software can not specifically control or prevent the provision of accommodations to students during exams; it simply monitors for violations of the standard rules. Many student accommodations contradict the standard exam rules using these software's, and students with a variety of disabilities and accommodations are likely to perform actions that trigger automatic flagging system. It is important to consult with SASC regarding any concerns of students not being able to use exam monitoring software. For students unable to use these software options, SASC will assist faculty by offering virtual proctoring options in these specific cases only. Please contact SASC for more information.

All requests for disability related accommodations must originate with SASC. If a student directly approaches you for disability related accommodation and you have not received a letter from SASC, please inform the student to contact SASC using the information provided on our syllabus. You should not accept any disability related documentation from the student.

Required Syllabi Statements: The University Senate Undergraduate and Graduate Councils have authorized that the following required statements appear in all teaching syllabi (graduate and undergraduate courses) on the Stony Brook Campus. https://www.stonybrook.edu/commcms/provost/faculty/handbook/academic_policies/syllabus_statement.php

Student Accessibility Support Services (SASC):

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631)632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential. <https://www.stonybrook.edu/commcms/studentaffairs/sasc/facstaff/syllabus.php>

[In addition, this statement on emergency evacuation is often included, but not required:]

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website: <https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-people-physical-disabilities>

Academic Integrity Statement:

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. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at: http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management Statement

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

University Policies: As we prepare for a new semester, it is important that you are aware of these significant University policies and procedures when preparing for and managing your undergraduate classes.

Instructional/Student Responsibilities: The University Senate's Undergraduate Council updated the University's statement of Minimal Instruction and Students Responsibilities in Fall 2008. Please review carefully. Also listed are the Minimal Undergraduate Student Responsibilities. You may wish to copy these for your classes or direct students to the website. Both statements may be found in the Academic Policies and Regulations section of the on-line Undergraduate Bulletin: https://www.stonybrook.edu/sb/bulletin/current/policiesandregulations/policies_expectations/min_instructional_student_resp.php

Student Participation in University-Sponsored Activities: Students may be required to miss class as a result of their participation in an event or activity sponsored by the University. Please see the Undergraduate Bulletin for the policy regulating the accommodations that should be made for these students: https://www.stonybrook.edu/sb/bulletin/current/policiesandregulations/policies_expectations/participation_univspnsored_activities.php

Withdrawals from Classes: The academic calendar, published in the Undergraduate Class Schedule, lists various dates that students must follow. Only the Arts and Sciences Committee on Academic Standing and Appeals or the Engineering and Applied Sciences Committee on Academic Standing may grant permission for a student to withdraw from a course after the deadline. The same is true of withdrawals that will result in an academic under-load. A note from the instructor is not sufficient to secure withdrawal from a course in the above circumstances.

Exceptions to University and College Graduation Requirements: Neither individual faculty members nor departments may grant waivers or substitutions for general education requirements or any other College-wide or University-wide requirements. Students should be directed to the Division of Undergraduate Education or the CEAS Undergraduate Student Office for information about the process for requesting and exception.

Continuing students who followed the DEC at their point of matriculation will continue to do so until they graduate.

Religious Holiday Statement: All faculty should be familiar with the Religious Holiday Statement and Academic Calendar found on the Office of the Provost website: https://www.stonybrook.edu/commcms/provost/faculty/handbook/employment/religious_holidays_policy

The Academic Calendar can also be found on the Registrar's website: https://www.stonybrook.edu/commcms/registrar/calendars/academic_calendars

It is important that you respond appropriately to all student requests for accommodation. A good practice is to remind students at the beginning of the course that they should notify you of all potential conflicts prior to the end of the add/drop period.

Student Success Resources: One concern often expressed by faculty is not being sure where to refer students who need assistance. A new Student Success Website can be found at: https://www.stonybrook.edu/commcms/du/student_success/index.php

Another helpful resource is the Division of Undergraduate Education website: <https://www.stonybrook.edu/commcms/duel/index.html>

Academic Success and Tutoring Center: Please be sure that your students are aware of the available services. Information can be found at: http://www.stonybrook.edu/commcms/academic_success/

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. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health and Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic judiciary website at: https://www.stonybrook.edu/commcms/academic_integrity/

Responding to Student Disruptions in the Classroom (face to face or remote instruction): Faculty should be aware of the policies related to student disruptions in the classroom. You can find this information at the following link: <https://www.stonybrook.edu/commcms/studentaffairs/ucs/policies/disruption>

Please be advised that Dr. Julian Pessier, Director, University Counseling and Psychological Services and I are available to meet with you and your department to discuss this or related matters of concern.

Red Book

The Red Book is a comprehensive online resource, organized by issue, for Stony Brook faculty and staff. It includes signs to look for and step-by-step suggestions on how to respond to student situations including emotional distress, disruptive behavior, medical emergency, or other concern that requires support or intervention. Information is provided on resources to contact, including the University Police Department (UPD), Student Conduct and Community Standards, the CARE Team, Counseling and Psychological Services (CAPS), the Student Support Team, and more. Access the Red Book at: <https://www.stonybrook.edu/commcms/studentaffairs/redbook/>

How can I report a student of concern?

Familiarize yourself with the link at the top of the Red Book called "Report a Student of Concern." In an emergency, call University Police at (631) 632-3333 (333 from a campus phone). For all other situations, send an email to care@stonybrook.edu or call (631) 632-CARE (2273) during regular business hours (M-F, 9 am-5 pm). A CARE Team or Student Support Team member will provide you and/or the students for whom there is a concern with guidance and assistance.

What should I say when I am speaking with a student and have concerns about their well-being?

We ask that you complete Kognito, a 40-minute online simulation which presents different situations and offers suggestions on the approach and language to use when speaking with a student you are concerned about. The simulation consists of you playing the role of an instructor engaging in challenging conversations with three different students. Each student is dealing with different concerns that affect their well-being including overwhelming stress, paranoia, social isolation, and thoughts of suicide. The simulation uses an avatar to depict the instructor role. While the avatar is not representative of all identities and roles on our campus, the simulation provides valuable tools. Follow the steps below to complete the simulation:

Go to: <https://www.kognitocampus.com/>

Create a new account

Enter the Enrollment Key: sbucares For technical support issues, contact Kognito at (866) 449-8834.