

Physics 2170: Detailed syllabus

Course information:

- **Instructor:** [Professor Leo Radzihovsky](#)
 - **Office:** Duane Physics F623 (Gamow Tower)
 - **Phone:** 303-492-5436
 - **Email:** radzihov@colorado.edu (best way to reach me)
 - **Office Hours:** Monday, Friday 2 - 3 pm (or by appointment)
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- **Class meets:** Mon, Wed, Fri 1 - 1:50 pm, in Duane G2B47
 - **Home page:** <http://www.colorado.edu/physics/phys2170/>
 - **Graders:** Tingting Fan and Shane Rightley
 - **Required text:** [*"Modern Physics for Scientists and Engineers"*](#), 2nd ed. J. Taylor, C. D. Zafirators, M. Dubson
 - **Additional reading:** *"It's About Time"*, D. Mermin
 - **Course description:** *Introduction to Relativity and Quantum Mechanics*
 - **Prerequisites:** Phys 1110, Phys 1120, Calculus, interest and desire to learn
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- **First day of class:** Monday, January 10, 2011
 - **Homework (30%):** due weekly Wednesdays in class, unless otherwise specified
 - **Class participation (5%):** attendance and IClicker (available in the CU bookstore) answers
 - **Exam #1 (20%):** in class, Wed, Feb 16, 2011
 - **Exam #2 (20%):** in class, Fri, March 18, 2011
 - **Final exam (25%):** Duane G2B47 at 1:30 - 4:00 PM, Saturday, April 30, 2011
 - **Last day of class:** Friday, April 29, 2011
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Course description:

This course will introduce students to two pillars of modern physics: Einstein's Special Theory of Relativity and Quantum Physics. Special relativity provides a precise and well-tested description of nature, that includes motion at or near the limiting speed of light. It thereby extends the more familiar, but less complete Galileo and Newton's description of commonplace slowly moving objects (balls, bullets, trains, cars,...) to those moving at arbitrarily *high speeds*, including light itself. Students will learn basic principles and concepts of relativity, and will work to develop physical intuition and to acquire tools for a detailed description of high speed physical phenomena. Key concepts include reference frames, principles of relativity, simultaneity, time slowing and length contraction, velocity transformation, energy, momentum and relativistic mechanics. In a complementary way quantum mechanics furthermore extends the rules of classical (Newtonian) physics (valid only for everyday large objects, like bullets, balls and planets) to that of the *very small* objects, like electrons, neutrons, photons, and atoms. It thereby provides tools for the description of the microscopic world (e.g., at the atomic scale), and essential for understanding fundamentals of modern technology. Students will work to learn basic principles of quantum mechanics, such as the wave-particle duality, the uncertainty principle, and its probabilistic interpretation, and to acquire working tools (Schrodinger mechanics) for its application in a variety of simple applications.

Course outline:

- **Relativity**

- principles of relativity
- Galilean relativity
- constancy of speed of light
- relativity of time
- relativity of length
- Lorentz transformations
- velocity transformation
- Doppler effect
- mass
- momentum
- energy
- **Quantum Physics**
 - Problems with classical physics
 - blackbody radiation
 - photoelectric effect
 - Compton effect
 - atomic spectra and stability of matter
 - double-slit experiment
 - "Old" quantum physics
 - De Broglie's matter waves
 - Bohr model of Hydrogen atom
 - Schrodinger equation
 - postulates and interpretation
 - stationary eigenstates
 - nature of solutions
 - Simple problems in one dimension
 - free particle
 - particle in box
 - particle in a harmonic potential
 - tunneling
 - Problems in two and three dimensions
 - square box
 - harmonic oscillator
 - central-force problem
 - Hydrogen atom

Guiding principles of the instruction and pedagogy:

- People understand concepts better by seeing them in action and thinking about them than by hearing them explained.
- Understanding physics (and solving problems that test that understanding) is a learned skill, like cooking, or playing hockey or the piano. It takes time, effort, and practice...lots of practice
- People learn best by thinking about topics and discussing them with others.
- Students learn most when they take the responsibility for what is learned.

In keeping with these principles, there will be a substantial number of homework problems each week. While you are encouraged to work with other students, you are required to write up the answers in your own words. So each student's wording should be unique to the student. Typically you will need to spend between four and six hours outside of class to master the material.

In addition to office hours, I encourage you to take advantage of the physics [Help Room](#) that is open 40 hours per week, and there are always students and TAs there, although they are not necessarily

from 2170.

Students begin this class with a range of backgrounds in physics and math. As a result, it is impossible for each class to be perfectly matched to everyone's background. I will work hard to provide whatever help is necessary for every student, regardless of their background, to do well in the course and achieve all of the learning goals. However, it is your responsibility to recognize that you need that help, and to take advantage of its availability. You are welcome to set up an appointment or just drop by my office.

Physics is a difficult subject, but succeeding in this course is not. Follow these suggestions and you will do well:

- stay on top of it; it is easier than playing catch-up
- attend class regularly, participate and ask questions
- read the text before class; it will improve your grade and will save you time in the long run, guaranteed
- do homework early (not last minute), working in study groups is OK, but be “careful”; make sure you can do it on your own
- think hard about concepts and practice solving many problems...no pain, no gain

Official course details:

Homework details

- Homework assignments will be posted on the course webpage on Wednesdays
- Homeworks are due in class on the due-date of the assignment (usually Wednesday)
- You are encouraged to work together on the homework problems, but you must write up the answers in your own words.
- Homework is a large part of your grade, so failing to turn in more than one assignment, and thereby getting a 0 will have a big impact on your grade. Talk to me, *now*, if you will have a scheduling problem during the term so that you will be unable to complete any of the assignments. Permission for exceptions from the normal class work schedule must be requested in advance.
- It is best if you print out the assignment early, so you see the problems before class.

Exams

- There are two in-class midterm exams and a final (dates TBD)
- There are no early, late, or make-up exams
- Exams are closed book

Classroom conduct

To ensure a distraction free environment for all students, all laptop computers, MP3 players, cell phones, and similar devices are **not** to be used during lecture.

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. 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 policies at <http://www.colorado.edu/policies/classbehavior.html> and at http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

Honor code

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at <http://www.colorado.edu/policies/honor.html> and <http://www.colorado.edu/academics/honorcode/>

Bringing someone else's clicker to class to give them credit is a direct violation of the CU honor code - please do not do it, nor tolerate other people doing it. Please feel free to talk to me if anything is going on you are not comfortable with.

Disabilities

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

If you have a temporary medical condition or injury, see guidelines at <http://www.colorado.edu/disabilityservices/go.cgi?select=temporary.html>

Discrimination and Harassment

The University of Colorado at Boulder policy on Discrimination and Harassment, the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships apply to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of sexual harassment or discrimination or harassment based upon race, color, national origin, sex, age, disability, creed, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH, the above referenced policies and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at <http://www.colorado.edu/odh>

Religious observances

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please speak to me ([Professor Radzihovsky](mailto:ProfessorRadzihovsky)) regarding any accommodation you might need regarding religious observances.