Physics 5250:
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**: *Mon 2-3pm (or by appointment)*

- **Class meets**: *MWF 3-3:50 pm, in Duane Physics, G2B47*
- **Home page:** http://www.colorado.edu/physics/phys5250/
- **Graders**: *Michelle Sze michelle.sze@colorado.edu*, office hours JILA S377, Thurs 10am -11am or by appointment
- **Main Texts**: *by R. Shankar, Principles of Quantum Mechanics*
- **Other suggested reading:**
  - *Modern Quantum Mechanics*, J. J. Sakurai, Addison Wesley
  - *Quantum Mechanics*, by L. D. Landau and E. M. Lifshitz, Pergamon Press
  - *Quantum Mechanics*, by L. I. Schiff, McGraw-Hill
  - *Quantum Mechanics*, by C. Cohen-Tannoudji, B. Diu, F. Laloe
- **Course description**:*graduate course covering standard topics in nonrelativistic quantum mechanics, outlined below*
- **Prerequisites**: *electricity and magnetism, classical mechanics, basic mathematical physics, interest and desire to learn*

- **First day of class**: *Monday, August 24, 2015*
- **Homework (60%)**: *roughly every two weeks*
- **Final exam (40%)**: *tentatively 1:30-4pm, Wednesday, Dec 16, 2015*

Course outline:

- **Introduction**
  - review of Lagrangian, Hamiltonian and Hamilton-Jacobi formulation of classical mechanics
  - conflicts with experiments
  - key ideas in and coordinate formulation of quantum mechanics
- **Postulates and mathematical structure of quantum mechanics**
  - Hilbert space and Dirac notation
  - physical observables via Hermitian operators
  - Heisenberg uncertainty principle
  - measurement and probabilistic interpretation, density matrix
  - Schrodinger, Heisenberg and Interaction evolution
  - Feynman's path-integral formulation
- **Simple applications**
  - free particle
  - particle in a box
  - delta-function potential
  - linear potential

    - harmonic oscillator and coherent states
- **N-particles quantum mechanics**
    - Hilbert space
    - indistinguishable particles and permutation symmetry
    - bosons, fermions and anyons
    - Bose gas
    - Fermi gas
- **Symmetries and conservation laws**
    - translations
    - rotations
    - time-translations
    - parity
    - time-reversal
    - gauge "invariance" in quantum mechanics, Aharonov-Bohm effect, and Berry topological phase
- **Orbital angular momentum**
    - general formulation
    - representation theory of SO(3) rotations
- **Rotationally invariant problems**
    - free particle
    - isotropic harmonic oscillator
    - electron in a magnetic field, Landau levels and Quantum Hall effect
    - Hydrogen atom
- **Spin angular momentum**
    - Stern-Gerlach experiment
    - SU(2) spinor representation
    - addition of angular momenta
    - Zeeman Hamiltonian and splitting
    - spin from Dirac equation
    - spin precession and NMR
    - spin-orbit interaction

Official course details:

Homework details

- Homework assignments are roughly every two weeks, with solutions posted on D2L
- Homeworks are due in class on the due-date of the assignment
- 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.

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) 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) regarding any accomodation you might need regarding religious observances.