

Fall 2014

UCSD DEPARTMENT OF PHYSICS    Physics 130B

**Physics 130b: Quantum Mechanics II**

**Instructor:**

Prof. Brian Keating  
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Office: SERF Building Room 322a  
Office Hours: Tuesday 3:00-4:00pm

**Teaching Assistant:** Shauna Kravec [skravec@ucsd.edu](mailto:skravec@ucsd.edu) Office hour: Thursday 1pm in Mayer Hall room 4206.

**Course Schedule:** Lectures MWF at 11-11:50am, Pepper Canyon Hall 121. Discussion section: Wednesdays 4-4:50pm, Warren Lecture Hall Room 2205.

**About this course:** This course is the second of three courses dedicated to an advanced undergraduate lecture series on Quantum Mechanics. Topics include perturbation theory, angular momentum/spin, quantum applications and experiments.

**Grading:** Homework 30% , Quiz 10%, Midterm Exam 20%, Class Participation 10%, Final Exam 30%. For both homework and exams (and class participation) I give *lots* of partial credit. For homework, you may obtain help from any source but you must write up your own work. A note sheet (size 8.5"x11") in your own handwriting may be used for the quiz, mid-term and final examinations, which are, otherwise, closed book. UCSD's Policy on Academic Integrity must be observed and cheating will result in full disciplinary action. See: <http://senate.ucsd.edu/manual/appendices/app2.htm>

**Course Text:** David Griffiths, *Introduction to Quantum Mechanics*, (Pearson Prentice Hall, Upper Saddle River, NJ, 2005), *2nd edition*. Many of the homework problems will be assigned from Griffiths.

**Homework:** Homework will be assigned from the textbook and/or "mini-projects". Homework must be turned in on-time for full credit. 10% per day will be subtracted for late assignments up to a maximum of -50%.

**Class Participation:** I expect everyone to attend every lecture and discussion section, and be on time. Habitual lateness will negatively impact your grade. You are also expected and encouraged to ask questions, participate in discussion, and, of course, correct the myriad errors that I make during the course.

**Physics 130A Review Quiz:** There will be a 50 minute quiz on topics from 130A on Friday 17 October 2014, in class.

**Midterm Exam:** The midterm exam will be on Friday 7 November 2014, in class.

**Final Exam:** Time and Location to be announced in class and on the website.

**You can not take the quiz, midterm or final early or late for any reason.**

**Supplementary Particle Data Book:** Today, please contact the *Particle Data Group* and ask for a hardcopy of the 300 page “Particle Physics Booklet”, not the 1100(!) page “Review of Particle Properties” (unless you hate trees). Their email is here: [http://pdg.lbl.gov/receive\\_our\\_products.html](http://pdg.lbl.gov/receive_our_products.html)

### **Course Outline:**

In rough order, we will cover the following topics:

1. Brief Review of Physics 130A (make sure we are all on the same page).
2. Hydrogen Atom
3. Time Independent perturbation theory
4. Perturbing the Hydrogen Atom
5. Spin-1/2 (should be review from 130a)
6. Adding angular momenta, Stern-Gerlach experiment
7. WKB Approximation, nuclear decay
8. Time-Dependent perturbation theory
9. Scattering Theory

Throughout the course I will highlight several famous and/or beautiful and/or foundation experiments in QM. These will include the Stern-Gerlach experiment, the MASER and LASER, particle accelerators, 21cm astronomy and many others.

The Physics 130 sequence, from the UCSD Course Catalog:

130A. Quantum Physics I (4)

Development of quantum mechanics. Wave mechanics; measurement postulate and measurement problem. Piecewise constant potentials, simple harmonic oscillator, central field and the hydrogen atom. Three hours lecture, one-hour discussion session. **Prerequisites:** Physics 100B and 110A. (S)

**130B. Quantum Physics II (4)**

**Matrix mechanics, angular momentum, spin, and the two-state system. Approximation methods and the hydrogen spectrum. Identical particles, atomic and nuclear structures. Scattering theory. Three hours lecture, one-hour discussion session. Prerequisites: Physics 130A. (F)**

130C. Quantum Physics III (4)

Quantized electromagnetic fields and introductory quantum optics. Symmetry and conservation laws. Introductory many-body physics. Density matrix, quantum coherence and dissipation. The relativistic electron. Three-hour lecture, one-hour discussion session. **Prerequisites:** Physics 130B. (W)