PHYSICS 137B - QUANTUM MECHANICS II
Spring 2021

Hi folks! Welcome to Physics 137B. We'll be doing a lot of great quantum mechanics this semester. I'm sorry we have to do things remote this semester, but I think it will all work out ok.
Please feel free to contact me if you have any questions.
Mike Crommie

Class Time: Tues./Thurs. 9:30am – 11am: Live Zoom lectures will start at 9:40am, Zoom lectures will be posted shortly after class on Tues./Thurs. on google drive as well as on Prof. Crommie's Youtube channel (google "michael f. crommie youtube"). I have some other class lectures there…, please look for yours… (or you can use the files that I put on googledrive… I will send you a link).

Zoom invite: https://berkeley.zoom.us/j/9132768870

Instructor: Prof. Mike Crommie. **Office**: Birge 345.

e-mail: crommie@berkeley.edu. **Office hours:** Right after class Tues./Thurs. 11-12

TA: Carl Marth. **email:** cbmarth@berkeley.edu **Office**: TBA. **Office hrs**: TBA.

Text: *Introduction to Quantum Mechanics, 3rd ed.* by David J. Griffiths, Published by Prentice Hall.

Grading:
Midterm Exam (in class) ------ 30%
Final Exam ---------- 43%
H. W. ---------- 27%

HW Policy: HW will typically be posted on Tuesday on the course website and will be due on Friday at midnight of the *following week* (i.e., Fri. of the week after being assigned). HW assignments must be turned in using Gradescope (make sure your HW file is legible). Short HW extensions are possible for extenuating circumstances, requests (with explanation) must be submitted to the GSI. Note: it is good for students to work together on the H.W., but each student is required to produce their own solution to a given problem and not just copy from a friend or the internet.

Course Content:
I) Identical particles
II) Addition of angular momentum
III) Time independent approximation methods
  a) Perturbation theory
  b) Variational principle
  c) WKB
IV) Time dependent perturbation theory
V) Scattering
VI) Advanced topics (time permitting)

Important Note: USE OTHER BOOKS IN THIS COURSE
There is no "one great book" on quantum mechanics. It is imperative that you seek out texts other than the class text to help you understand the concepts and problems.

Also Note: The main source for this course are the lectures. You are responsible for everything discussed in class.

Recommended books:
Introduction to Quantum Mechanics by Richard L. Liboff (Addison Wesley) (undergraduate level)
Principles of Quantum Mechanics by Ohanian (undergraduate level)
Elementary Q. M. by David Saxon (Holden day) (undergraduate level)
Introduction to the Quantum Theory by Park (McGraw Hill) (undergraduate level)
Quantum Mechanics by Bransden and Jochain (undergraduate level)
Feynman 3rd Lecture (undergraduate level)
Berkeley Physics Course, volume 4, Quantum Physics by E. H. Wichmann (undergraduate level)
Quantum Mechanics by Cohen-Tannoudji (John Wiley) (graduate/undergraduate level)
Lectures on Quantum Mechanics by G. Baym (Benjamin/Cummings) (graduate level)

137B Tentative List of Course Topics

1) Spin, magnetic moment, S in B-field, time-dependence, Stern-Gerlach, Larmor precession.

2) Systems of identical particles, manybody wavefunctions, exchange operator, symmetrization, Slater determinant, Bosons-Fermions, exchange forces and spin.

3) Addition of S, chemical bonding, Helium excited states

4) Time independent perturbation theory, 1^{st} order, 2^{nd} order

5) Degenerate perturbation theory

6) Fine structure of hydrogen: Relativistic correction + spin-orbit correction (splits j's), Zeeman (external B): weak, strong, intermediate

7) Hyperfine (splits S_{total}, 21cm line)

8) Variational method (upper bound on gnd state energy): Helium

9) WKB approximation: tunneling, quantization

10) Time dependent perturbation theory: turn on constant perturbation at t=0, sinusoidal perturbation, stimulated emission and absorption

11) Fermi's Golden Rule: Interaction of matter w/ light, dipole matrix element, selection rules $\Delta l = \pm 1$, $\Delta m = 0, \pm 1$

12) Scattering: classical definitions, quantum definitions, Born approximation derived from Fermi's golden rule, Born approximation derived from Greens fcn., scattering amplitude, partial wave expansion: low energy limit, δ_0 dominates, centrifugal barrier.

13) Possible Advanced Topics if time, depending on class interest: Quantum corrals, Landau levels, Dirac Equation, Path integral approach, Aharanov Bohm, Bell's inequality, Kronig-Penney, Josephson Junctions, Berry's phase.