PREFACE to LECTURES ON QUANTUM MECHANICS

P-453, the course on quantum mechanics designed for junior and senior undergraduates at the University of Michigan, has a diverse audience that includes (in about equal proportions)

1. Students going on to physics graduate courses in which the concepts introduced here will be developed and applied in a more rigorous manner.

2. Students going on to advanced courses outside of pure physics in which the concepts of quantum mechanics are discussed and applied at about the present level of sophistication.

3. Students for whom this course represents the last formal exposure to the subject but who will need to understand quantum mechanics for their work or study situations.

In addition, the class usually enrolls a few physics, astronomy, and engineering graduate students.

In an attempt to meet the needs of this diverse audience we alter the typical sequence of presentation so that a student who stops with just one term still has a quantitative, physical understanding of the way atoms interact with radiation. To this end we begin considering the field and the atom in nearly parallel ways:

> We regard the electromagnetic field as a system with discrete states of excitation; it is described with a linear superposition of orthogonal functions that are established by the geometry of the boundary that defines the field; for example, these functions will be sinusoidal if the field is bounded by a rectangular enclosure.
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> We also regard the atom as a system with discrete states of excitation; it is described with a superposition of orthogonal functions, the forms of which are established by geometry of the potential that describes the atom. These functions [e.g. Legendre polynomials for spherically- symmetric atoms] are similar in many ways to the familiar sines and cosines.
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> Moreover, in many discussions we use "atoms" that are describable with familiar functions [e.g. a particle confined in a deep rectangular potential] so that the learning of new physics is not confused with the learning of new mathematics.

We assume that the student is familiar with modern physics at the level typical of a 3rd semester university course (e.g. Michigan's P-242)

The key topics include:

1. The Bohr model as used to explain Rutherford scattering of alpha particles, the energy levels of hydrogen, the positions of optical and x-ray lines in atomic spectra, and the Franck-Hertz experiment.

2. The Pauli exclusion principle as the basis for the periodic table.

3. The Photoelectric effect, its applications (e.g. photomultipliers), and its inverse (e.g. X-rays from deceleration of charged particles; light emission from cathode ray tubes)

4. Interference phenomena a) neutron and electron diffraction; Davisson-Germer experiment b) X-ray diffraction from crystals; Bragg theory c) two-slit and thin films interference d) diffraction limits to optical image resolution.

5. phenomenology of low energy nuclear physics a) neutrons/protons as constituents of stable nuclei b) radioactive decay of nuclei [alpha, beta, gamma]

6. Mathematics: We assume a basic knowledge of differential equations, some complex variables, some linear algebra.

Finally it should be said that this set of lecture notes is not yet equivalent to a complete text. You will find it handy to have available at least one text of the sort listed below.

USEFUL REFERENCES

(ordering roughly alphabetical; *not* in order of estimated utility, within each category)

Texts at the intermediate undergraduate level (often with a title such as "Modern Physics)" that cover a range of topics including an introduction to quantum mechanics include those by: a) Beiser b) Brehm and Mullin c) Eisberg and Resnick) Ohanian e) Serway f) Tipler. I strongly recommend Feynman's small, paperback volume *QED*.

Texts at the intermediate undergraduate level that emphasize quantum mechanics per se (which often have titles such as "Quantum Physics") include those by: a) Feynman Lectures in Physics, volume III b) Taylor and Wheeler [MIT series] c) Wichmann [Berkeley Series]

Texts at the at the advanced undergraduate level (usually designated with a title such as "Introduction to Quantum Mechanics") include those by: a) Anderson b) Bohm c) Gasiorowicz d) Liboff e) Park f) Pauling and Wilson g) Powell and Crasemann h) Saxon i) Winter j) Townsend, k) Griffith

Texts at the beginning graduate level that may be useful to P-453 students include those by: a) Ballentine b) Cohen-Tannoudji, Diu, and Laloe c) Dicke and Wittke d) Merzbacher e) Ziock f) Schiff g) Messiah h) Davidoff i) Sakurai

The texts listed above are those marketed to physics; in addition you may find useful treatments in recent texts designed for students of physical chemistry, materials science, aeronomy, and quantum electronics.