PHYSICS 851
Quantum Mechanics I
Fall 2003
Professor *Vladimir Zelevinsky*

Lectures: Monday, Wednesday, Friday 10:20 - 11:10, Room 1420 BPS
Office hours: Tuesday 1:00 - 3:00 or by appointment, Room 202 Cyclotron; Phone 333-6331; e-mail ZELEVINSKY@nscl.msu.edu
Textbook: *Albert Messiah*, Quantum Mechanics, volumes 1,2
Grading: Homework 30% (assigned every week on Wednesday), Quizzes 10%, Midterm exam 20% (end of October), Final exam 40%.

Tentative program:

1. Foundations of quantum mechanics. De Broglie waves. Bohr-Sommerfeld quantization. Correspondence principle. [Chapter 1]
2. Wave function, superposition principle. Coordinate and momentum representation. Uncertainty relation. Motion and spreading of the wave packet. [Chapters 2,4]
3. Schrödinger equation. Operators and expectation values. Continuity equation. Ehrenfest theorems. [Chapter 2]
4. One-dimensional motion. Boundary conditions and quantization. Discrete and continuous spectrum. Scattering and tunneling. [Chapter 3]
5. Hilbert space and operators. Completeness and orthogonality. Commutators and measurability. Heisenberg representation, operator equations of motion. Symmetry and conservation laws. [Chapters 5,7,8]
6. Periodic potential. Band structure of solids.
7. Semiclassical approximation. Quantization rules. Counting of states. Barrier penetration. [Chapter 6]
8. Harmonic oscillator. Coherent states. [Chapter 12]
9. Three-dimensional motion. Reduction of a two-body problem. Central field. Separation of variables. Two- and three-dimensional harmonic oscillator. Spherical functions and Legendre polynomials. Orbital momentum. Parity. Radial equation. [Chapter 9]
10. Magnetic field. Landau levels.
11. Hydrogen atom (discrete spectrum). [Chapter 11]
12. Scattering. Amplitude and cross section. Phase shifts. Resonances. Born approximation. [Chapter 10]