Nuclear Physics I

Physics 551

Spring 2004

Instructor: **Norbert Pietralla**
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Lectures: Mondays, Wednesdays, Fridays 11:45 - 12:40
Room P-123 First meeting: Jan 26

Topics:

I. Basic Concepts
   Units, sizes, conventions, nuclear chart, cross section, brief history and prospectives

II. Nucleon Structure
   Elementary particles and forces, overview over the basic hadrons, isospin, parity

III. Deuteron and Nuclear Force
   two-nucleon systems, scattering, properties of the deuteron, properties of the nuclear force, meson-exchange model

IV. Nuclear Properties
   Radii, density, mass formula, binding energy, separation energies, drip lines, fission, ground state spin, magnetic dipole moments of odd-mass nuclei, independent-particle shell model, magic numbers

V. Nuclear Astrophysics
   Stellar energy production, nucleosynthesis, hydrogen burning, CNO-cycle, solar neutrino problem, neutrino oscillations, nuclear physics of supernovae and neutron stars

VI. Electroweak decay processes
   Transition rates, Fermi's golden rule, γ-decay, Weisskopf units and collectivity, β-decay, isospin mixing, parity violation

VII. Nuclear collective motion

Geometrical model, vibrations, giant resonances, rotations, deformation phase transitions, interacting boson model

VIII. Microscopic nuclear structure models

Many-body basis states, mean field, Tamm-Dancoff approximation, random phase approximation, pairing, interacting shell model, Nilsson model

IX. Nuclear reactions

Nuclear resonance fluorescence, Coulomb excitation, compound nucleus formation, direct reaction, optical model, scattering

X. Accelerators

electrostatic accelerators, cyclotrons, synchrotrons, storage rings, γ-ray sources, linear accelerators, visit of the Stony Brook TANDEM-LINAC ion-beam accelerator

XI. Detectors and counting statistics

Interaction of radiation with matter, stopping power, gas-filled counters, scintillators, semiconductor detectors, energy measurements, mean value and variance, background, coincidence measurements, angular correlations, measurement of nuclear level lifetimes

XII. and **Nuclear Physics II:**

Contemporary topics in nuclear physics research

Grading: 20% mid-term exam, 30% end-term exam, 50% homework

last updated 1/15/2004