

PRELIMINARIES

A. THE IMPORTANCE OF NUCLEAR PHYSICS

Nuclear physics, i.e. the study of the nucleus of the atom, is a fundamental discipline to understand the universe. Nuclear physics provides key answers both to problems from the infinitely small and the extremely large. Few examples are listed below:

- The nuclear strong force is one of the fundamental forces in nature.
- Nuclear fusion powers the stars, such as the Sun.
- Radioactivity warms the core of the Earth and has implication in the delaying the cooling process of the Earth and protection from solar wind (Earth magnetic field).
- Nuclear power plants, both fission and (potentially) fusion, are important energy production methods.
- Radiotherapy is important in cancer treatment and cancer diagnostics (imaging).
- Carbon dating, based on radioactive decay, is very useful in geology and palaeontology.

B. OBJECTIVES AND OUTCOMES

The objectives and learning outcomes for the nuclear physics part of the module are:

- Knowing the terminology and notation of nuclear physics.
- Understanding physical reasoning behind models of the nucleus.
- Understanding processes such as radioactive decay, fission, fusion.
- Becoming aware of applications of nuclear physics in science, technology, and medicine.

C. SYLLABUS

1. Nuclear Properties
2. The Inter-Nucleon Potential
3. Nuclear Models
4. Nuclear Decays and Reactions
5. Interaction of Radiation with Matter
6. Applications of Nuclear Physics

D. SUGGESTED READING

Eisberg and Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles (Wiley 2nd Edition):

Chapter 15; Chapter 16, sections 16-1,16-2,16-3,16-5,16-9 and 16-10

KS Krane: Introductory Nuclear Physics (Wiley):

Chapter 1; Chapter 3; Chapter 4, sections 4.1 and 4.4; Chapter 5, sections 5.1 and 5.2; Chapter 7 up to section 7.6 inclusive; Chapter 8, sections 8.1-8.4; Chapter 9, section 9.1; Chapter 13, sections 13.1-13.3 and sections 13.5,13.6; Chapter 14, Chapters 19 and 20.