1 Prerequisites

This course assumes familiarity with many of the topics in the “Advanced Quantum Physics” course.

2 Learning Outcomes and Assessment

At the end of the course, the students should be familiar with the following features of Particle Physics:

- how forces arise from virtual particle exchange (in outline only);
- the particle content and interactions of The Standard Model, together with an understanding of how to apply (spinless) Feynman Diagrams to make order-of-magnitude estimates for rates and signatures of allowed/disallowed Standard Model processes;
- the types of evidence upon which the three key parts of The Standard Model (i.e. electromagnetic, strong and weak), are founded;
- how to determine which hadron decays would or would not be consistent with the quark content of the Standard Model, with parity violation/conservation, with energy-momentum conservation, etc.

and with the following aspects of Nuclear Physics:

- the structure of nuclei, and simple nuclear models such as the liquid drop model and the shell model;
- techniques in scattering theory which are relevant in nuclear physics – partial waves, Born approximation and compound nucleus formation;
- the main types of nuclear decays, and with models for calculating these and the associated selection rules;
- the key features of nuclear fission and fusion and their applications;

3 Synopsis

INTRODUCTION

Matter and Forces: Matter and generations. Leptons, quarks, hadrons and nuclei. Forces and gauge bosons.

PARTICLE PHYSICS


NUCLEAR PHYSICS


Nuclear Structure: Magic numbers, the Nuclear Shell Model and its predictions, excited states of nuclei (vibrations and rotations).

Nuclear Decay: Radioactivity and dating. α decay. β decay, Fermi theory of β decay. γ decay.


BOOKS

Nuclear physics books (Krane is closest to the course):
  Introductory Nuclear Physics, Krane K S (Wiley 1988).

**Particle physics books** (Perkins is closest to the course; Thomson or Griffiths are good if you want to go beyond):

- Particle Physics, Martin B R & Shaw G (3rd edn Wiley 2008).
- Introduction to Elementary Particles, Griffiths D J (2nd edn Wiley 2009).
- Modern Particle Physics, Thomson, M A (CUP 2013)

**Introductory books that cover the whole course**, (at a lower level generally):

- Nuclear and Particle Physics, Martin B R (2nd edn Wiley 2009).