

Particle Physics

Lecturer : Dr F Muheim

Form: 18 lectures

Time: Tuesday & Thursday 9.00 Spring Term

Location: JCMB Room 6206

Synopsis

The *Standard Model* of particle physics is today's remarkably successful theory with which we are able to understand the fundamental constituents of matter, i.e. *quarks* and *leptons*, and their interactions. The aim of this course is to describe the Standard Model, how symmetries and conservation laws are used to classify the different constituents and interactions, and to learn how to calculate transition rates for particle reactions and decays.

Prerequisites

Nuclear & Particle Physics (P3), Quantum Mechanics (P3)

Syllabus

Introduction: An overview of the elementary particles and forces.

Kinematics and Dynamics: Natural units, relativistic kinematics. Cross sections and decay rates, resonances.

Symmetries and Conservation Laws: Angular Momentum, Spin, Isospin. Charge-, parity- and time-reversal symmetry.

Hadrons and Quarks: Strangeness, masses and magnetic moments, SU(3) flavour, quark model and colour.

Quantum Electro Dynamics (QED): Klein-Gordon and Dirac equation, antiparticles, Feynman diagrams, electron-positron annihilations.

Strong Interactions: Elastic electron-proton scattering and Deep Inelastic Scattering, parton model. Colour forces, gluons, QCD, confinement, running coupling constants.

Weak Interactions: Beta and Muon decay, parity violation, charged and neutral currents, Cabibbo angle, GIM mechanism, CKM matrix, CP violation.

Gauge theories: Lagrangian, gauge invariance, Standard model, W and Z bosons, Higgs mechanism, GUTs.

Experimental Methods: How to measure charged tracks, neutral particles. Particle identification. Tracking devices, calorimeters.

Recommended text(s)

- D.H. Perkins, *Introduction to High Energy Physics, 4th Edition*, Cambridge University Press (2000).
- F. Halzen & A.D. Martin, *Quarks & Leptons*, Wiley (1984).

- D. Griffiths, *Introduction to Elementary Particles*, Wiley (1987).

The course does not follow one particular text but the above cover most of the syllabus. All the books are available in the JCMB library.

Franz Muheim

5 Jan 2004