Fourth Year Particle Physics, 2004

Assessment:
2 assignments worth 15% each.
1 3 hour partially open book exam.


Course Outline

1 Introduction

• Basic Concepts
• Reactions and Decays
• Spherical Harmonics and Orbital Angular Momentum
• Bosons and Fermions (Reading)
• Pauli Exclusion Principle (Reading)
• Example of an application to Particle Physics (Reading)
• Particles and Antiparticles (Reading)
• Quarks and Leptons (Reading)
• Cross Sections and Decay Rates
• Special Relativity (Reading)
• Relativistic 4-vectors
• Units in Particle Physics
• Interactions and Fields in Particle Physics
• The Yukawa Theory
• The Boson Propagator
• Electromagnetic Interactions (Reading)
• Weak Interactions (Reading)
• The Strong Force (Reading)
2 Accelerators and Particle Detectors

- Linear Accelerators
- Synchrotrons
- Electron Synchrotrons
- Colliding Beam Machines
- Particle Interactions with Matter
- Radiation Loss of Electrons
- Particle Detectors
- Scintillators
- Calorimeters
- Hadronic Calorimeters
- Multiwire Chambers
- Drift Chambers
- Cherenkov Detectors
- Semiconductor Detectors

3 Isospin

- Isospin in the Pion-Nucleon System
- Strangeness and Isospin

4 Invariance Principles and Conservation Laws

- Parity
- Intrinsic Parities
- The Parities of Particles and Anti-Particles
- Charge Conjugation Invariance
- Eigenstates of the C-operator
• Time Reversal Invariance
• CPT invariance

5 Phase Shifts

• Phase Shifts
• The Breit-Wigner Resonance Formula
• Example of a resonance. $e^+ + e^- \rightarrow Z^0$
• Quark model of Hadron Structure

6 Neutral Mesons

• The Neutral K-meson.
• Strangeness Oscillations.
• Regeneration.
• The $B^0_d$ meson.
• The $B^0_s$ meson.
• The $D^0$ meson.

7 The Weak Interaction in More detail

• The Left Handed Weak interaction.
• Pion decay in detail.
• The CKM matrix.
• CP violation.
8 Neutino Oscilations

• Basic Formalism.
• Results of Seminal Experiments.
• CKM matrix for Neutrinos.