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PH3520 (Particle Physics) Course Information

Welcome to PH33520! Information about the course can be found from the web page:

`http://www.pp.rhul.ac.uk/~cowan/particle.html`

Here some of this information is reviewed and the course content briefly described.

Lecture notes and books

Lecture notes will be distributed. These are intended to cover essentially all of the material of the course. If there's something in the notes or lectures that you'd like clarification on, please ask. Unless otherwise specified, you are responsible for all of the material in the lecture notes for the exam.

For further information, the book best suited for this course is *Particle Physics* by Martin and Shaw, which is available in the library. Other references are listed in the lecture notes.

Aims and objectives

Elementary particle physics is a large topic and there are limits on what we can hope to achieve in a single term. The main objectives of this course will be to become familiar with the principal concepts and building blocks of elementary particle physics and to see how they are related.

We will not spend much time with mathematically rigorous derivations, but rather we will concentrate on broader concepts. That is, we will usually not derive in detail but rather only motivate how theory leads to a certain prediction for the outcome of an experiment. We will, however, compare the prediction with experimental results and see what this implies. The course is intended to provide a broad overview that will allow you to continue with 4th year or postgraduate studies of particle physics in greater depth.

Problem sheets

Problem sheets are a vital part of this course and will form 10% of the mark. They should be handed in by the announced due date and time and should be turned into the box across from the department office. The policy for late submissions is set by the College Rules and can be found in the Physics Department Student Handbook. Briefly, work handed in up to 24 hours late gets a 10% penalty, for more than 24 hours late the mark is zero.

Discussion of the problems with fellow students is encouraged, copying is forbidden. Papers bearing a resemblance that cannot be accounted for other than by copying will not be credited.

PH3520 Course outline (approximate by week)

1. Overview of particle physics, units, special relativity, cross sections, decay rates.
2. Theoretical framework: Feynman diagrams, electromagnetic, weak and strong interactions, coupling strengths, virtual particles.
3. Particle accelerators: linear vs. circular, fixed target vs. colliding beams.
4. Particle detectors: ionization energy loss, tracking detectors, calorimeters, multicomponent detector systems.
5. Leptons: the electron, positron, muon, neutrino, τ lepton.
6. Hadrons: nuclear forces, the pion, strange particles, hadron resonances, the quark model of hadrons.
7. Inside hadrons: electron–proton scattering, the size of the proton, deep inelastic scattering, evidence for partons.
8. Heavy quarks: the GIM mechanism, discovery of charm, bottom, top quarks, the CKM matrix.
9. The electroweak standard model: theoretical need for W and Z, weak neutral currents, discovery of the W and Z, LEP physics.
10. Quantum chromodynamics: colour, the strong coupling constant, confinement, jets of hadrons.
11. The Higgs mechanism: gauge invariance and the need for the Higgs boson, properties of the Higgs, experimental searches for the Higgs.