LUNDS UNIVERSITET

Institutionen för teoretisk fysik

Forskarutbildningskurs i teoretisk fysik: *Färger, aromer och deras konsekvenser (Colours, Flavours and their Consequences) 5p*

Antagen av institutionsstyrelse 2004-03-26

Förkunskaper (prerequisites):

A basic knowledge of the standard model of elementary particles and basic familiarity with field theory is assumed. The knowledge corresponds roughly to FYS230, "Teoretisk Partikel Fysik" and an introductory course to field theory. For nontheory students this corresponds to an understanding of Feynmandiagrams.

Syfte (goal):

To give a thorough introduction to low energy particle physics, in particular to hadron and flavour physics.

Innehåll (Content):

1. Parameters of the Standard Model and Standard Form of Mixing Matrices: this counts the number of experimentally accessible parameters of the the standard model.

2. Lepton Mixing and Neutrinos: an introduction to the type of physics effects that mixing of states can produce. It also includes an overview of the solar neutrino problem.

3. Precise predictions from QCD at low energies: (Weinberg) sum rules and τ-lepton decays: an introduction to sum rules and a few of the simpler consequences. A short discussion of analyticity, unitarity and (hadronic) duality is included.

4. The unitarity triangle and other mechanisms for introducing CP-violation: This provides the basic underlying arguments for the "factory"-style experiments to be discussed later.

5. Symmetries in the QCD Lagrangian and some Consequences: This includes Chiral Symmetry, Heavy Quark Symmetry a discussion of the meaning of loops in nonrenormalizable theories and the concept of matching.

6. Semi-leptonic Decays at Low Energies: π and K. An overview of the physics underlying the determination of the light quark masses and mixings.

7. Semi-leptonic decays of Heavy Flavours: charm and bottom physics. A derivation of the Isgur-Wise relations and Heavy Quark Sum Rules.

8. Non-leptonic Decays:

   (a) Mixing Phenomena.

   (b) Short Distance QCD effects.

   (c) Long Distance QCD effects.

   This part treats the uncertainty in our evaluation of non-leptonic phenomena and the uncertainties on the predictions for CP violating effects.

9. Quark Masses: I will show how most of the techniques discussed above have to be put together in order to determine the quark masses from experiment.

10. Extensions of the standard model.

Practical Information

Lecturer: Johan Bijnens (bijnens@thep.lu.se)
Literature: Lecture notes will be available.
Idea is 2-3 lectures of 2 hours for about 10-11 weeks, Some lectures will be organized instead as exercises.

Examination:

Hand-in exercises and oral exam.

Handledare:

Johan Bijnens