

Course – Rare B Decays: Theory and Applications

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Summary

Searching for new sources of Flavor and CP violation beyond the Standard Model is an important line of current research within the field of high-energy physics. Rare B decays lead one of the most important fronts in this search. This course will provide an introduction to the theory of Rare B decays, including the most relevant theoretical tools and approaches, with a special focus on *exclusive* modes. As a practical application –to serve as a “final project” for the course–, we will perform a fit to LHC data to uncover the famous “ $b \rightarrow s\ell\ell$ anomalies”.

Plan of the Course

Lecture 1. Introduction and Theory Basics

Motivation · Flavor Physics and B mesons · Effective Theories · The Weak Effective Lagrangian · Matching conditions in the Standard Model · Beyond the SM: examples.

Lecture 2. Decay amplitudes for selected processes

Inclusive B decays · Leptonic and semi-leptonic exclusive B Decays · Factorization with an example: $B \rightarrow \gamma\ell\nu$ · Factorization in $b \rightarrow s\gamma^{(*)}$ decays.

Lecture 3. Form Factors and Light-Cone Sum Rules

Heavy-to-light form factors · Large-recoil symmetry relations · Light-cone sum rules with B -meson distribution amplitudes · Calculation of $B \rightarrow K^{(*)}$ form factors.

Lecture 4. Decay rates and kinematic distributions

Angular distributions for three- and four-body decays · Kinematic symmetries in the $B \rightarrow V\ell\ell$ angular distribution · Optimised “clean” angular observables · Dilepton invariant-mass binning

Lecture 5. Fits to Wilson coefficients and Outlook

Model-independent fits: Philosophy · “Frequentist” statistical framework · Global fit to $b \rightarrow s\gamma$ and $b \rightarrow s\ell\ell$ data · Discussion of BSM interpretations · Outlook.
