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Lectures on Flavor Physics

Springer

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Preface

This volume contains the written versions of some selected lectures delivered at the "41. Internationale Universitätswochen für Theoretische Physik" in Schladming, Austria. The 41st "Schladming Winter School" took place during the period February 22nd–28th, 2003. The theme of the School was "Flavor Physics".

Flavor physics is one of the hot topics in contemporary elementary particle physics, because it relates to fundamental questions like the origin of masses, the size and strength of CP violation, or the oscillations between various neutrino species. One thus explores the Standard Model as well as its possible extensions and related phenomena in astrophysics and cosmology. The lectures collected in this volume deal with important (theoretical) developments at various length scales. At low energies and for light quarks, one is able to analyze the strong interactions in terms of an effective field theory, as described in Jürg Gasser's lectures on light-quark dynamics. The interrelation between precisely calculable electroweak and the much more difficult strong interactions comes into play in precision QED observables, like the anomalous magnetic moment of the muon as discussed in the lectures by Marc Knecht. In fact, the presently available precision data might already give a glimpse at physics beyond the Standard Model.

The issue of CP violation in kaon and B-meson systems is addressed in the lectures by Andrzej Buras. Only with the advent of the B-factories, CP violation in the Standard Model could be measured beyond the kaon system, and one is now testing the unitarity of the CKM matrix and tries to understand the fundamental mechanism underlying CP violation. The richness of this field is underlined by the lectures of Matthias Neubert, who presents a new scheme to systematically calculate strong-interaction effects in certain B-decays and also dwells on the unitarity triangle. Last but not least, with the recent measurements of neutrino oscillations at Super-Kamiokande, SNO, and Kamland, the review on the foundations of the various forms of flavor transitions in vacuum and in media by Walter Grimus is very timely.

At the School, we had further lectures on the experimental status of B-decays (by D. Hitlin) as well as neutrino physics (by G. Drexlin), on lattice calculations of flavor-physics matrix elements (by G. Martinelli), and an in-

troduction to supersymmetry (by H. Dreiner). They are not included here, but their essential content can be found from other sources in the literature.

Here, we should like to express our sincere gratitude to the lecturers for all their efforts in preparing and presenting their lectures. We are especially grateful to those colleagues who managed to find time to write up their lectures. We thank also the main sponsors of the School, the Austrian Federal Ministry for Education, Science, and Culture as well as the Government of Styria, for providing financial support. In addition, we acknowledge the contributions from the University of Graz and the valuable organisational and technical assistance by the town of Schladming, Ricoh Austria, and Hornig Graz. Furthermore, we are grateful to our secretaries, S. Fuchs and E. Monschein, a number of graduate students from our institute, and, last but not least, our colleagues from the organizing committee for their valuable assistance in preparing and running the school.

Bonn and Graz,
December 2003

Ulf-G. Meißner
Willibald Plessas

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Neutrino Physics – Theory

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