

Preface

Within the wide and important field of plasma research, this tutorial book focuses on modern developments in the field of *particle containing plasmas*. A central issue is the inherent overlap of three scientific key problems of complex plasma physics: *Correlations*, *Dynamics* and *Reactivity*. Examples include

1. coupling effects of highly charged dust particles in plasma traps giving rise to strongly correlated plasmas states,
2. dynamics of multi-species plasmas and plasma-surface interaction, and
3. chemical processes in plasmas and on plasma boundaries.

In this book, these fundamental problems are approached by use of complementary experimental, computational, and theoretical methods combining the authors' expertise from plasma physics, surface and solid state physics, chemical physics, and materials science.

The central goal of this book is to provide graduate students and young researchers with the necessary knowledge base in the fast growing field of complex plasma research. The style of each chapter is review-like, i.e., the authors do not only focus on their own work but give a survey of the state of the art. For an easy access to the various aspects of complex plasmas by newcomers, each chapter opens with an introduction and overview on the particular topic, and also the basics, which are typically not covered in scientific journal publications, are explained in great detail. Furthermore, the chapters are enriched with many valuable background information, which should be of interest to a broad readership.

The first part of this book briefly introduces the very fundamentals of complex plasma physics. The chapter addresses the key questions and hot topics in modern complex plasma research and links them to the different chapters of this book. Part II is devoted to the field of quantum plasmas and their description with modern simulation techniques. In this part graphene, the rising star of condensed-matter physics, is introduced as a very recent and promising example for the broad applicability of (quantum) plasma physics. Part III covers strong correlation effects and order phenomena occurring in complex plasmas in traps and introduces the powerful numerical methods used for a first principle simulation of dusty plasmas. Part IV of this book deals with the issue of reactivity and surface processes, which have strong technological impact for nano-technological applications.

This book is based on tutorial lectures given at the Graduate Summer Institute on "Complex Plasmas" at the STEVENS INSTITUTE OF TECHNOLOGY, Hoboken, NJ (USA) from July 30-August 8, 2008. The workshop was jointly organized by the SFB-TR24 "FUNDAMENTALS OF COMPLEX PLASMAS" Greifswald / Kiel

(Germany) and Stevens. At the summer school there have been 28 tutorial talks by experts from US, Germany and Russia and was attended by about 110 participants—scientists and graduate students. The chapters in this book took into account the lively discussions at this summer school and should serve as valuable introductory material into the active field of complex plasmas.

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