

## Preface

The International Symposium "Atomic Cluster Collisions: fission, fusion, electron, ion and photon impact" (ISACC 2003, a Europhysics Conference) was held in St. Petersburg, Russia, July 18-21, 2003 as a satellite meeting of the XXIII<sup>rd</sup> International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC 2003, Stockholm, Sweden, July 23-29, 2003). The ISACC 2003 took place at the former Palace of Grand-Duke Vladimir (nowadays used as the House of Scientists) located in the heart of St. Petersburg, near the Hermitage Museum. This international symposium promoted the growth and exchange of scientific information on the structure and properties of atomic cluster systems studied by means of photonic, electronic and atomic collisions. Particular attention during the symposium was devoted to dynamical phenomena, many-body effects taking place in cluster systems, which include problems of fusion and fission, fragmentation, collective electron excitations, phase transitions and many more. Both experimental and theoretical aspects of atomic cluster physics, which is uniquely placed between atomic and molecular physics on the one hand and solid state physics on the other, were discussed at the symposium.

St. Petersburg was a very natural location for a symposium on cluster science: much of the development of modern many-body theory in atomic physics has taken place there, and a strong school of atomic theorists, spread over several institutions and equipped with powerful computational techniques, has already made a considerable impact on the formulation of new methods of calculation for atomic and molecular clusters.

The symposium brought together more than 100 leading scientists in the field of atomic cluster physics from around the world. The special emphasis of the Symposium was devoted to the new methods of investigation of the structure and properties of atomic clusters, the collective excitations in photoabsorption and photoionization processes of atomic clusters, fission and fusion dynamics of clusters, cluster dynamics in the laser field, resonance processes in electron-cluster collisions, the interaction of ions, including multiply charged ions, with metal clusters and fullerenes and the processes of cluster deposition on a surface as well as of cluster collisions on a surface. The aim of the symposium was to

present the most recent achievements in all these fields of atomic cluster science. These proceedings, we hope, bear witness that this goal has been fulfilled.

The introduction to this book surveys the general aspects of atomic cluster science and outlines some of its important new challenges. It contains an important definition of a cluster, as a new physical system possessing its own specific properties and features. This definition is important to establish that atomic cluster science is a new field of modern physics in its own right. It is highly multidisciplinary and has numerous links with traditional branches of physics and chemistry.

The first chapter of this book is devoted to recent advances in the understanding of structure and essential properties of selected atomic cluster systems, fullerenes and confined atoms. Both theoretical and experimental aspects of the field are discussed.

The second chapter covers the recent advances in the field of photo processes involving atomic clusters and fullerenes. Collective excitations of electrons as well as specific interference effects play a very significant role in the photo processes as is shown in this chapter by a number of examples.

The third chapter focuses on the problem of fission dynamics of atomic clusters. Parallels with similar processes in nuclear physics are presented. It is demonstrated that cluster and fragmentation phenomena in atomic cluster physics and in nuclear physics have many features in common. Some of the new challenges of both fields of endeavour are presented.

The fourth chapter of this book describes the problems of electron-cluster collisions. Special emphasis in this chapter is placed on the polarization and collective excitation effects. Both theoretical and experimental aspects of electron-cluster collisions are discussed.

The fifth chapter deals with the behaviour of atomic clusters in laser fields. The ionization (including multiphoton), collective dynamics of electrons in the system in the presence of the laser field and the laser induced dynamics of molecules and clusters are thoroughly described.

The sixth chapter is devoted to the physics of ionic collisions with fullerenes and metal clusters. It covers a broad spectrum of problems in this field from both experimental and theoretical points of view. The results of the very recent measurements are reported.

The last, seventh, chapter in this book is devoted to the problem of the interaction of an atomic cluster with a surface. The problems of cluster deposition and formation at a surface as well as collision processes involving clusters deposited at a surface are considered in this chapter through a number of illustrative examples. The subjects of the chapters in this book correspond to the sessions in the symposium.

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