

## PREFACE

The Second International Symposium “Atomic Cluster Collisions: Structure and dynamics from the nuclear to the biological scale” (ISACC 2007) was organized as a satellite meeting of the XXVth International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC 2007, Freiburg, Germany) by the Frankfurt Institute for Advanced Studies (FIAS) and Gesellschaft für Schwerionenforschung (GSI) and was held on July 19–23, 2007 at GSI, Darmstadt, Germany. ISACC was recognized by the European Physical Society (EPS) as a Europhysics Conference.

ISACC started as the international symposium on atomic cluster collisions in St. Petersburg, Russia in 2003. ISACC 2007 promoted significantly the growth and exchange of scientific information on the structure and properties of nuclear, atomic, molecular, biological and complex cluster systems studied by means of photonic, electronic, heavy particle and atomic collisions. In the symposium, particular attention was devoted to dynamical phenomena, many-body effects taking place in the clusters, molecular and biological systems, which include problems of fusion and fission, fragmentation, collective electron excitations, phase transitions and many more. Both experimental and theoretical aspects of cluster physics, uniquely placed between nuclear physics on one hand and atomic, molecular, condensed matter and solid state physics on the other, were the subject of the symposium.

The venue of the symposium was the Gesellschaft für Schwerionenforschung (GSI) at Darmstadt, which is one of the world-renowned research centers in the field of heavy ion physics. Several superheavy elements were synthesized here for the first time. This was a very natural location for a symposium on cluster science, since cluster properties of the nuclei are very thoroughly investigated and often appear as a prototype for similar phenomena in other many-body systems of various degrees of complexity.

The Symposium brought together more than 120 leading scientists in the field of atomic cluster physics from around the world. The special emphasis of the Symposium was on 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.

Part A of this book describes clustering phenomena at nuclear and sub-nuclear scales. It surveys recent advances in the synthesis of superheavy elements, clustering phenomena in fission and fusion processes of heavy nuclei and the properties of heavy and superheavy nuclei in supernova experiments.

Part B is devoted to recent advances in the understanding of structure and essential properties, such as nanomagnetism, electronic and geometric shell effects, of selected atomic cluster systems and confined atoms. Both theoretical and experimental aspects of the field are discussed.

Part C describes recent advances in electron, photon and ion cluster collisions. These include the problem of molecular rotation in external fields, electron scattering on neon droplets, dynamical screening of atoms by fullerene cages, photoionization and fragmentation of fullerene ions, and collisions of molecules with cluster ions.

Part D is devoted to the problem of clusters on a surface. In particular, it describes the recent efforts in infrared spectroscopy and thermal desorption of clusters on self-assembled monolayers and the atomistic approach to the simulation of the nanoindentation process.

Part E deals with the problems of phase transitions, fission, fusion and fragmentation in finite systems. In focus are quantum structuring of  $^4\text{H}$  atoms around ionic dopants, phase transitions in polypeptides, and dissociation of charged rare gas clusters.

Part F of the book contains a discussion of clusters in laser fields. These include the dynamics of metal clusters in laser fields: phase, amplitude and polarization shaping by interferometric pulse generation.

Part G reports on recent advances in the understanding of clustering phenomenon in systems of various degrees of complexity. This chapter includes the description of structure and stability of novel objects: electron–positron quantum droplets. The new data on spectroscopy of chromophores

in the gas phase is covered, and energy landscape analysis as a computational tool for analysis of complex molecular systems is discussed.

Part H reports on recent advances in the understanding of structure and dynamics of biomolecules. These include a novel theoretical framework for the interpretation of NMR recidular dipolar couplings of unfolded proteins, computational simulation of antibody:antigen unbinding, mechanisms of magnetoreception in birds and biophysical modeling of fragment distributions of DNA plasmids after heavy ion irradiation.

Part I includes the discussion of several important biological problems manifesting themselves at the mesoscopic scale, in which dynamics, clustering and other properties of matter at smaller scales play the essential role. Case studies presented in this chapter include molecular and nuclear mechanisms of ion cancer therapy and analysis of gene expression patterns in the *Drosophila* embryo.

The subjects of the chapters in this book correspond to the sessions in the Symposium.

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