



# *Electron–Atom and Electron–Molecule Collisions*

*Edited by Juergen Hinze*

# Electron Molecule Collisions Physics Of Atoms And Molecules

**Francois Frémont**



## **Electron Molecule Collisions Physics Of Atoms And Molecules:**

*Introduction to the Theory of Collisions of Electrons with Atoms and Molecules* Satya P. Khare, 2002 An understanding of the collisions between micro particles is of great importance for the number of fields belonging to physics chemistry astrophysics biophysics etc The present book a theory for electron atom and molecule collisions is developed using non relativistic quantum mechanics in a systematic and lucid manner The scattering theory is an essential part of the quantum mechanics course of all universities During the last 30 years the author has lectured on the topics presented in this book collisions physics photon atom collisions electron atom and electron molecule collisions electron photon delayed coincidence technique etc at many institutions including Wayne State University Detroit MI The University of Western Ontario Canada and The Meerut University India The present book is the outcome of those lectures and is written to serve as a textbook for post graduate and pre PhD students and as a reference book for researchers

**Electron-Molecule Collisions** Isao Shimamura, Kazuo Takayanagi, 2013-11-11 Scattering phenomena play an important role in modern physics Many significant discoveries have been made through collision experiments Amongst diverse kinds of collision systems this book sheds light on the collision of an electron with a molecule The electron molecule collision provides a basic scattering problem It is scattering by a nonspherical multicentered composite particle with its centers having degrees of freedom of motion The molecule can even disintegrate Le dissociate or ionize into fragments some or all of which may also be molecules Although it is a difficult problem the recent theoretical experimental and computational progress has been so significant as to warrant publication of a book that specializes in this field The progress owes partly to technical developments in measurements and computations No less important has been the great and continuing stimulus from such fields of application as astrophysics the physics of the earth's upper atmosphere laser physics radiation physics the physics of gas discharges magnetohydrodynamic power generation and so on This book aims at introducing the reader to the problem of electron molecule collisions elucidating the physics behind the phenomena and reviewing to some extent up to date important results This book should be appropriate for graduate reading in physics and chemistry We also believe that investigators in atomic and molecular physics will benefit much from this book

**Electron-Atom and Electron-Molecule Collisions** Jürgen Hinze, 2013-11-11 The papers collected in this volume have been presented during a workshop on Electron Atom and Molecule Collisions held at the Centre for Interdisciplinary Studies of the University of Bielefeld in May 1980 This workshop part of a larger program concerned with the Properties and Reactions of Isolated Molecules and Atoms focused on the theory and computational techniques for the quantitative description of electron scattering phenomena With the advances which have been made in the accurate quantum mechanical characterisation of bound states of atoms and molecules the more complicated description of the unbound systems and resonances important in electron collision processes has matured too As explicated in detail in the articles of this volume the theory for the quantitative explanation of elastic and inelastic electron

molecule collisions of photo and multiple photon ionization and even for electron impact ionization is well developed in a form which lends itself to a complete quantitative ab initio interpretation and prediction of the observable effects. Many of the experiences gained and the techniques which have evolved over the years in the computational characterization of bound states have become an essential basis for this development. To be sure much needs to be done before we have a complete and detailed theoretical understanding of the known collisional processes and of the phenomena and effects which may still be uncovered with the continuing refinement of the experimental techniques.

**Introduction to the Theory of Collisions of Electrons with Atoms and Molecules** Satya Prakash Khare, 2012-10-21 An understanding of the collisions between micro particles is of great importance for the number of fields belonging to physics chemistry astrophysics biophysics etc. The present book a theory for electron atom and molecule collisions is developed using non relativistic quantum mechanics in a systematic and lucid manner. The scattering theory is an essential part of the quantum mechanics course of all universities. During the last 30 years the author has lectured on the topics presented in this book collisions physics photon atom collisions electron atom and electron molecule collisions electron photon delayed coincidence technique etc at many institutions including Wayne State University Detroit MI The University of Western Ontario Canada and The Meerut University India. The present book is the outcome of those lectures and is written to serve as a textbook for post graduate and pre PhD students and as a reference book for researchers.

**Introduction to the Theory of Collisions of Electrons with Atoms and Molecules** Khare Satya Prakash, 2013-03-26 An understanding of the collisions between micro particles is of great importance for the number of fields belonging to physics chemistry astrophysics biophysics etc. The present book a theory for electron atom and molecule collisions is developed using non relativistic quantum mechanics in a systematic and lucid manner. The scattering theory is an essential part of the quantum mechanics course of all universities. During the last 30 years the author has lectured on the topics presented in this book collisions physics photon atom collisions electron atom and electron molecule collisions electron photon delayed coincidence technique etc at many institutions including Wayne State University Detroit MI The University of Western Ontario Canada and The Meerut University India. The present book is the outcome of those lectures and is written to serve as a textbook for post graduate and pre PhD students and as a reference book for researchers.

**Electron-Atom and Electron-Molecule Collisions** Jurgen Hinze, 2014-01-15

*Electron Collisions with Molecules, Clusters, and Surfaces* H. Ehrhardt, L.A. Morgan, 2013-06-29 This volume contains the invited papers and selected contributed papers presented at the biennial International Symposium on ELECTRON COLLISIONS WITH MOLECULES CLUSTERS AND SURFACES held at Royal Holloway University of London from 29th to 30th July 1993. This Symposium was a Satellite Meeting of the XVIII International Conference on the Physics of Electronic and Atomic Collisions ICPEAC and follows a 16 year tradition of Satellite Conferences in related areas of collisions held in association with previous ICPEACs. In the past each of these electron molecule symposia covered the broad field of electron

molecule scattering at rather low energies but also included hot topics This time as well as covering the whole field well defined electron collisions with clusters and with particles in the complex potential of a surface were emphasized Not many details are known about such collisions although they become more and more important in surface characterisation plasma wall interactions electron induced desorption and reorganisation of adsorbed particles Recently much work theoretical and experimental has been devoted to electron collisions with rather large carbon silicon and halogen containing molecules These problems are of relevance in plasma assisted thin film formation and etching of surfaces and can now be approached with advanced theoretical methods and experimental equipment

Computational Methods for Electron—Molecule Collisions Franco A. Gianturco, W.M. Huo, 2013-06-29 The collision of electrons with molecules and molecular ions is a fundamental process in atomic and molecular physics and in chemistry At high incident electron energies electron molecule collisions are used to deduce molecular geometries oscillator strengths for optically allowed transitions and in the case of electron impact ionization to probe the momentum distribution of the molecule itself When the incident electron energy is comparable to or below those of the molecular valence electrons the physics involved is particularly rich Correlation and exchange effects necessary to describe such collision processes bear a close resemblance to similar effects in the theory of electronic structure in molecules Compound state formations in the form of resonances and virtual states manifest themselves in experimental observables which provide details of the electron molecule interactions Rotational excitations by low energy electron collisions exemplify energy transfer between the electronic and nuclear motion The role of nonadiabatic interaction is raised here When the final vibrational state is in the continuum molecular dissociation occurs Dissociative recombination and dissociative attachment are examples of such fragmentation processes In addition to its fundamental nature the study of electron molecule collisions is also motivated by its relation to other fields of study and by its technological applications The study of planetary atmospheres and the interstellar medium necessarily involve collision processes of electrons with molecules and molecular ions

Photon and Electron Collisions with Atoms and Molecules Philip G. Burke, Charles J. Joachain, 2012-12-06 Research on photon and electron collisions with atomic and molecular targets and their ions has seen a rapid increase in interest both experimentally and theoretically in recent years This is partly because these processes provide an ideal means of investigating the dynamics of many particle systems at a fundamental level and partly because their detailed understanding is required in many other fields particularly astrophysics plasma physics and controlled thermonuclear fusion laser physics atmospheric processes isotope separation radiation physics and chemistry and surface science In recent years a number of important advances have been made both on the experimental side and on the theoretical side On the experimental side these include absolute measurements of cross sections experiments using coincidence techniques the use of polarised beams and targets the development of very high energy resolution electron beams the use of synchrotron radiation sources and ion storage rings the study of laser assisted atomic collisions the

interaction of super intense lasers with atoms and molecules and the increasing number of studies using positron beams

Physics of Atoms and Molecules B. H. Bransden, Charles Jean Joachain, 1983 Presents a unified account of the physics of atoms and molecules at a level suitable for undergraduate courses of physics and physical chemistry      Collisions of Electrons with Atoms and Molecules G.F. Drukarev, 2012-12-06 This book is a short outline of the present state of the theory of electron collisions with atomic particles atoms molecules and ions It is addressed to those who by nature of their work need detailed information about the cross sections of various processes of electron collisions with atomic particles experimentalists working in plasma physics optics quantum electronics atmospheric and space physics etc Some of the cross sections have been measured But in many important cases the only source of information is theoretical calculation The numerous theoretical papers dealing with electronic collision processes contain various approximations The inter relation between them and the level of their accuracy is often difficult to understand without a systematic study of the theory of atomic collisions not to mention that theoretical considerations are necessary for the consistent interpretation of experimental results The main constituents of the book are 1 General theory with special emphasis on the topics most important for understanding and discussing electron collisions with atomic particles      **Molecular Processes in Plasmas**

Yukikazu Itikawa, 2007-07-19 A variety of plasmas include molecules rather than only ions or atoms Examples are ionospheres of the Earth and other planets stellar atmospheres gaseous discharges for use in various devices and processes and fusion plasmas in the edge region This book describes the role of molecules in those plasmas by showing elementary collision processes involving those molecules All possible processes are presented both for electron and ion collisions with the molecules On the basis of the accumulated knowledge in atomic and molecular physics a compact but informative description is given for each process Specific emphasis is placed on the feature which application people often tend to overlook      **Theory of Electron—Atom Collisions** Philip G. Burke, Charles J. Joachain, 2013-06-29 The authors aim to hone the theory of electron atom and electron ion collisions by developing mathematical equations and comparing their results to the wealth of recent experimental data This first of three parts focuses on potential scattering and will serve as an introduction to many of the concepts covered in Parts II and III As these processes occur in so many of the physical sciences researchers in astrophysics atmospheric physics plasma physics and laser physics will all benefit from the monograph

Atom - Molecule Collision Theory Richard Barry Bernstein, 2013-11-11 The broad field of molecular collisions is one of considerable current interest one in which there is a great deal of research activity both experimental and theoretical This is probably because elastic inelastic and reactive intermolecular collisions are of central importance in many of the fundamental processes of chemistry and physics One small area of this field namely atom molecule collisions is now beginning to be understood from first principles Although the more general subject of the collisions of polyatomic molecules is of great importance and intrinsic interest it is still too complex from the viewpoint of theoretical understanding However

for atoms and simple molecules the essential theory is well developed and computational methods are sufficiently advanced that calculations can now be favorably compared with experimental results This coming together of the subject and incidentally of physicists and chemists though still in an early stage signals that the time is ripe for an appraisal and review of the theoretical basis of atom molecule collisions It is especially important for the experimentalist in the field to have a working knowledge of the theory and computational methods required to describe the experimentally observable behavior of the system By now many of the alternative theoretical approaches and computational procedures have been tested and intercompared More or less optimal methods for dealing with each aspect are emerging In many cases working equations even schematic algorithms have been developed with assumptions and caveats delineated

**Classical Treatment of Collisions Between Ions and Atoms or Molecules** Francois Frémont, 2021-12-08 Since the beginning of the twentieth century many experimental and theoretical works have been devoted to collisions between highly charged ions and atomic and molecular targets It was realized that quantum mechanics is the only way a priori to describe such atomic phenomena However since quantum mechanics is very difficult to apply for collision systems with more than two particles classical methods were very soon introduced and applied to simple collision systems and subsequently to more complicated systems The results obtained by such classical methods were found to be surprisingly good and classical mechanics is now well established despite its approximations as a replacement for or competition with quantum mechanics in many cases In this book the author will focus on the development of classical methods for describing collisional and post collisional processes The results will be compared with those found using quantum mechanical models in order to demonstrate the ability of the classical approach to obtain many features and details of collision systems

*Physics of Atoms and Molecules* Brian Harold Bransden, Charles Jean Joachain, 2003 The study of atomic and molecular physics is a key component of undergraduate courses in physics because of its fundamental importance to the understanding of many aspects of modern physics The aim of this new edition is to provide a unified account of the subject within an undergraduate framework taking the opportunity to make improvements based on the teaching experience of users of the first edition and cover important new developments in the subject

*Supercomputing, Collision Processes, and Applications* Kenneth L. Bell, Keith A. Berrington, Derrick S.F. Crothers, Alan Hibbert, Kenneth T. Taylor, 2006-04-18 Professor Philip G Burke CBE FRS formally retired on 30 September 1998 To recognise this occasion some of his colleagues friends and former students decided to hold a conference in his honour and to present this volume as a dedication to his enormous contribution to the theoretical atomic physics community The conference and this volume of the invited talks reflect very closely those areas with which he has mostly been associated and his influence internationally on the development of atomic physics coupled with a parallel growth in supercomputing Phil's wide range of interests include electron atom molecule collisions scattering of photons and electrons by molecules adsorbed on surfaces collisions involving oriented and chiral molecules and the development of non perturbative methods for

studying multiphoton processes His development of the theory associated with such processes has enabled important advances to be made in our understanding of the associated physics the interpretation of experimental data has been invaluable in application to fusion processes and the study of astrophysical plasmas observed by both ground and space based telescopes We therefore offer this volume as our token of affection and respect to Philip G Burke with the hope that it may also fill a gap in the literature in these important fields      **Advances in Atomic, Molecular, and Optical Physics** ,2000-10-11 This series established in 1965 is concerned with recent developments in the general area of atomic molecular and optical physics The field is in a state of rapid growth as new experimental and theoretical techniques are used on many old and new problems Topics covered also include related applied areas such as atmospheric science astrophysics surface physics and laser physics Articles are written by distinguished experts who are active in their research fields The articles contain both relevant review material as well as detailed descriptions of important recent developments      **Nuclear Science Abstracts** ,1975      **Energy Research Abstracts** ,1989



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