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# Relativistic Collisions of Structured Atomic Particles

 Springer

# Relativistic Atomic Collisions

**Michael Schulz**



## **Relativistic Atomic Collisions:**

*Relativistic Atomic Collisions* Jörg Eichler, Walter Ernst Meyerhof, 1995 Introduction Part I Theoretical Methods Relativistic Kinematics Fields of Moving Charges Relativistic Electron Motion Ion Atom Collisions Part II Elementary Atomic Processes Excitation and Ionization Ionization Many Electrons Charge Exchange Radiative Electron Capture Electron Positron Pair Production Part III Experimental Methods Charge State Preparation Target Arrangements Cross Section Determination Appendix Bibliography Index Relativistic Collisions of Structured Atomic Particles Alexander Voitkiv, Joachim Ullrich, 2008-07-20 During the last two decades the explorations of different processes accompanying ion atom collisions at high impact energies have been a subject of much interest. This interest was generated not only by the advent of accelerators of relativistic heavy ions which enabled one to investigate these collisions in an experiment and possible applications of obtained results in other fields of physics but also by the variety of physical mechanisms underlying the atomic collisional phenomena at high impact energies. Often highly charged projectiles produced at accelerators of heavy ions are not fully stripped ions but carry one or more very tightly bound electrons. In collisions with atomic targets these electrons can be excited or lost and this may occur simultaneously with electronic transitions in the target. The present book concentrates on and may serve as an introduction to theoretical methods which are used to describe the projectile electron transitions occurring in high energy collisions between ions and neutral atoms. Special attention is given to relativistic impact energies and highly charged projectiles. Experimental results are used merely as illustrations and tests for theory. This book will be useful to graduate students and professional scientists who are interested in studying atomic collisions occurring at high impact energies. It assumes that the reader possesses the basic knowledge in classical electrodynamics and nonrelativistic and relativistic quantum mechanics.

**Lectures on Ion-Atom Collisions** Jörg Eichler, 2005-09-23 Atomic collisions offer some unique opportunities to study atomic structure and reaction mechanisms in experiment and theory especially for projectiles of high atomic number provided by modern accelerators. The book is meant as an introduction into the field and provides some basic theoretical understanding of the atomic processes occurring when a projectile hits another atom. It also furnishes the tools for a mathematical description however without going deeper into the technical details which can be found in the literature given. With this aim the focus is on reactions in which only a single active electron participates. Collisional excitation, ionization and charge transfer are discussed for collision velocities ranging from slow to comparable to the speed of light. For the highest projectile velocities energy can be converted into mass so that electron positron pairs are created. In addition to the systematic treatment a theoretical section specializes on electron-electron correlations and three chapters are devoted to selected highlights bordering to surface science and to physics with antiprotons. Simple access to the theory of collisions between ions and atoms. Systematic treatment of basic features needed for an understanding. Mathematical details are omitted and referred to references. In order to bear out the essential ideas most clearly a single active electron is

assumed in most cases In selected examples theoretical results are confronted with experiment Discussion supported by a large number of illustrations Selected highlights in borderline fields are presented *Theory of Relativistic Ion-atomic Collisions* Jörg Eichler,1990 *Electron-Atom Collisions* Maurizio Dapor,2022-03-07 Electron collisions with atoms ions and molecules have been investigated since the earliest years of the last century because of their pervasiveness and importance in fields ranging from astrophysics and plasma physics to atmospheric and condensed matter physics Written in an accessible yet rigorous style this book introduces the theory of electron atom scattering into both the non relativistic and relativistic quantum frameworks The book also includes exercises with an increasing degree of difficulty to allow the reader to become familiar with the subject [Relativistic Theory of Atoms and Molecules II](#) Pekka Pyykkö,2012-12-06 Relativistic effects are of major importance for understanding the properties of heavier atoms and molecules This book is still the only comprehensive bibliography on related calculations The material is organized by subject into tables containing a concise characterization Together with Volume I Lecture Notes in Chemistry Vol 41 ISBN 3 540 17167 3 the literature until 1992 is now covered and 6577 references with titles are given in the two books The book will provide a convenient reference for theoretical chemists and atomic and molecular physicists interested in the properties of heavier elements Contents Introduction One particle problems Quantum electrodynamical effects Multielectron atoms methods Multielectron atoms results Symmetry Molecular calculations Solid state theory Relativistic effects and heavy element chemistry Corrections to Volume I Some comments on notations and terminology List of acronyms and symbols Bibliography **R-Matrix Theory of Atomic Collisions** Philip George Burke,2011-03-28 Commencing with a self contained overview of atomic collision theory this monograph presents recent developments of R matrix theory and its applications to a wide range of atomic molecular and optical processes These developments include the electron and photon collisions with atoms ions and molecules which are required in the analysis of laboratory and astrophysical plasmas multiphoton processes required in the analysis of superintense laser interactions with atoms and molecules and positron collisions with atoms and molecules required in antimatter studies of scientific and technological importance Basic mathematical results and general and widely used R matrix computer programs are summarized in the appendices **Relativistic Theory of Atoms and Molecules III** Pekka Pyykkö,2013-06-29 Relativistic effects are of major importance for understanding the properties of heavier atoms and molecules Volumes I III of Relativistic Theory of Atoms and Molecules constitute the only available bibliography on related calculations In Volume III 3792 new references covering 1993 1999 are added to the database The material is characterized by an analysis of the respective papers The volume gives the user a comprehensive bibliography on relativistic atomic and molecular calculations including studies on the Dirac equation and related solid state work **Ion-Atom Collisions** Michael Schulz,2019-10-21 The few body problem FBP the essence of which is the Schrödinger equation is not solvable for more than two interacting particles Atomic collisions are ideally suited to study the FBP because the underlying force is essentially

understood and because simple systems can be studied for which kinematically complete experiments are feasible The book would cover various experimental and theoretical approaches in atomic collision research

**Basic Atomic Interactions of Accelerated Heavy Ions in Matter** Inga Tolstikhina, Makoto Imai, Nicolas Winckler, Viacheslav Shevelko, 2018-02-28 This book provides an overview of the recent experimental and theoretical results on interactions of heavy ions with gaseous solid and plasma targets from the perspective of atomic physics The topics discussed comprise stopping power multiple electron loss and capture processes equilibrium and non equilibrium charge state fractions in penetration of fast ion beams through matter including relativistic domain It also addresses mean charge states and equilibrium target thickness in ion beam penetrations isotope effects in low energy electron capture lifetimes of heavy ion beams semi empirical formulae for effective cross sections The book is intended for researchers and graduate students working in atomic plasma and accelerator physics

**Electronic and Atomic Collisions** H. B. Gilbody, 1988 *Electronic and Atomic Collisions* Donald C. Lorents, Walter Ernst Meyerhof, James R. Peterson, 1986 *Coherence in Atomic Collision Physics* H.J. Beyer, Karl Blum, R. Hippler, 2013-11-21 During the last two decades the experimental investigation of atomic coherence phenomena has made rapid progress Detailed studies have been performed of angular correlations spin polarization effects angular momentum transfer and the alignment parameters which characterize the charge cloud of excited atoms The enormous growth in the number of these investigations was made possible through substantial development and application of new experimental technology the development of sophisticated theoretical models and numerical methods and a fine interplay between theory and experiment This interplay has resulted in a deeper understanding of the physical mechanisms of atomic collision processes It is the purpose of the chapters in this book to provide introductions for nonspecialists to the various fields of this area as well as to present new experimental and theoretical results and ideas The interest in spin dependent interactions in electron atom scattering has a long history it dates back to the early investigations of Mott in 1929 While the more traditional measurements in this field were concerned with the determination of spin polarization and asymmetries the range of investigations has been expanded enormously during the last few years and now includes many observables sensitive to one or more of the various spin dependent interactions The understanding of these effects requires a theoretical description of the orientation and alignment parameters of the target atoms of the formation of resonances of the influence of electron exchange processes and of the relativistic interactions inside the atom and between projectile and target

**Atomic Processes in Basic and Applied Physics** Viacheslav Shevelko, Hiro Tawara, 2012-05-31 The book is a comprehensive edition which considers the interactions of atoms ions and molecules with charged particles photons and laser fields and reflects the present understanding of atomic processes such as electron capture target and projectile ionisation photoabsorption and others occurring in most of laboratory and astrophysical plasma sources including many photon and many electron processes The material consists of selected papers written by leading scientists in various fields Theory of

Relativistic Ion-atom Collisions Jörg Eichler,1990      *The Physics of Electronic and Atomic Collisions* L.J. Dube,B.A. Mitchell,W. McConkey,C.E. Brion,2000-04-14 Annotation Contains the written versions of the invited talks presented at ICPEAC 19 3 plenary lectures 9 review talks 47 progress reports and 14 selected topics The papers address photon electron ionization electron atom electron molecule theory experiment electron ion positron and muon ion atom theory experiment charge transfer ion molecule Rydberg ultracold and ion ion collisions photoionization collisions with surfaces and clusters and novel techniques No index Annotation c by Book News Inc Portland Or      *Electronic and Atomic Collisions* J. Geddes,1988      **Relativistic Theory of Atoms and Molecules: 1993-1999** Pekka Pyykkö,1986      **Physics of Electronic and Atomic Collisions** Sheldon Datz,1982      **The Theory of Atomic Collisions** Sir Nevill Francis Mott,Harrie Stewart Wilson Massey,1933

## Unveiling the Energy of Verbal Beauty: An Emotional Sojourn through **Relativistic Atomic Collisions**

In a global inundated with displays and the cacophony of quick transmission, the profound power and emotional resonance of verbal beauty often fade in to obscurity, eclipsed by the constant assault of sound and distractions. However, situated within the lyrical pages of **Relativistic Atomic Collisions**, a interesting work of literary brilliance that impulses with raw thoughts, lies an wonderful trip waiting to be embarked upon. Penned by way of a virtuoso wordsmith, this mesmerizing opus manuals readers on a mental odyssey, gently revealing the latent potential and profound influence stuck within the complicated internet of language. Within the heart-wrenching expanse of the evocative examination, we shall embark upon an introspective exploration of the book is key themes, dissect its captivating publishing model, and immerse ourselves in the indelible effect it leaves upon the depths of readers souls.

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