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Hans Kleinpoppen · Bernd Lohmann
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Perfect/Complete Scattering Experiments

Probing Quantum Mechanics on Atomic
and Molecular Collisions and Coincidences

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Herbert Walther

Foreword

The experimental and theoretical study of atomic and molecular collision processes has progressed rapidly in recent years. This is partly because a detailed knowledge of these processes is required in many applications and partly because a study of collision processes provides an ideal means of understanding the dynamics of many-particle systems at a quantum level. On the experimental side, advances include the absolute measurement of cross sections, the development of coincidence techniques using very high-resolution electron beams, and the application of light sources including synchrotron radiation and intense laser sources. On the theoretical side, developments include methods which allow highly accurate excitation and ionization cross sections to be calculated at low and intermediate energies. Of particular importance in this work is the close collaboration between experiment and theory where the accuracy of new theory and calculations can be verified by detailed experiments. The development of experimental methods and the close coordination between experiment and theory is clearly expressed in this book. In particular, the emphasis on experimental methods which provide data on perfect/complete scattering experiments enables a deep insight into the collision mechanism to be obtained which is used to provide a stringent test of theory. This has formed a basis for the development of theoretical methods, which have been used world-wide, to predict with confidence data for collision processes of importance in applications which cannot themselves be easily studied in the laboratory. Three areas of research are reviewed in this book: (i) the analysis of atomic collisions including electron, atom, and ion collisions with atoms and ions, (ii) Auger emission and inner-shell hole experiments, and (iii) complete experiments in atomic photoionization. Together, they provide an up-to-date reference for research in these fundamental areas of atomic and molecular collision processes which will have wide applicability.

Belfast

Philip G. Burke

Preface

This book on *Perfect and-or Complete Scattering Experiments as a means for Probing Quantum Mechanics on Atomic and Molecular Collisions and Coincidences* is an approach to the theme of its title and also represents a Dedication to Herbert Walther who died on July 22, 2007 in Garching, Germany.

Herbert Walther's achievements in physics will best be described by the many events which have taken place and referred to him in the past. We particularly like to refer to Wolfgang Ketterle's and Gerhard Rempe's Memorial Article in *Physics Today* 79, June 2007; it describes well Herbert Walther's passion for his scientific work, his world-wide recognition, his strength and stimulating teaching ability, and also his way of organizing scientific meetings and conferences. It is clear that Herbert Walther will be remembered by a very large scientific community and, of course, by his immediate family. We, the Authors of this book, are most pleased and feel honored to dedicate this book to Herbert Walther.

Combining the random of data, atomic and molecular scattering physics, using and applying the up-to-date knowledge of the theoretical applications and the experimental methods reveals a wealth of information which even encounters strange and new areas of collision and coincidence physics. As a hint, we mention the field of quantum information which might be seen as the successor of polarization analysis.

We, the Authors of this book—Alexei Grum-Grzhimailo, Bernd Lohmann, and Hans Kleinpoppen—like to thank in the highest way many of our colleagues and friends for their continual supports and advices on the completion of this comprehensive book. We are particularly impressed by the effectiveness and completion of the research involved in the many sections and subsections. Many insights and knowledges on detailed atomic and molecular collision physics will be evident and apprehensive.

We are thankful to Prof. Uwe Becker, and Dr. Burkhard Langer and the GPTA GmbH company, for providing many of the experimental data, and for generous financial support to one of us, BL, which eventually enables for the finalization of this book.

Bernd Lohmann is particularly dearful to Claudia for the very most support while editing this book, and to ongrowing little Tanya watching the miracles happening around her. Both of them for standing tall, and, giving and providing all the necessities needed to complete and finalize this book.

Hans Kleinpoppen is particularly thankful to Mrs. Helga von Kosing for her constant concerns and helpfulness in dealings with editing this book.

During the final procedures of this book, we received the message of the passing away of Prof. Vsevolod V. Balashov, who has been a close collaborator, a colleague, a friend, and a supervisor over the years to all of us. We all, in the scientific community, will certainly miss him. This simply shows the speed of life and science.

Stirling, Berlin
Münster
Moscow

Hans Kleinpoppen
Bernd Lohmann
Alexei N. Grum-Grzhimailo

Contents

1	Introductory Remarks	1
2	Analysis of Atomic Collisions	5
2.1	Classification of Atomic Collision Processes	5
2.2	Approaches to Complete/Perfect Scattering Experiments	8
2.3	Basic Atomic and Molecular Scattering Processes	9
2.3.1	Total and Differential Cross Section	9
2.3.2	Analysis of Atomic Photoionization and Scattering Processes	12
2.3.3	Experimental Methods for Measuring Photoionization Cross Sections Including Applications of Synchrotron Radiation	13
2.3.4	Results for the Total Cross Sections	23
2.3.5	Differential Cross Sections, Partial Wave Analysis and Ramsauer-Townsend Effect	27
2.3.6	Resonance Structures	34
2.4	Coincidence Experiments	44
2.4.1	Scheme of a Typical Electron–Photon Coincidence Experiment	45
2.4.2	The λ – χ Representation of the $^1S_0 \rightarrow ^1P_0 \rightarrow ^1S_0$ Excitation/De-excitation Process	49
2.4.3	Quantum Mechanical Coherence in the Electron Impact Excitation of Atoms	51
2.4.4	Alignment and Orientation	54
2.4.5	Super-Elastically Scattered Electrons	58
2.4.6	(e , $2e$) and Multi-ionization Processes	59
2.5	Spin Effects in Atomic Collisions	62
2.5.1	Degree of Polarization for Electrons and Single-Electron Atoms and Ions	62
2.5.2	Spin and Angular Correlation Experiments Including Photon Polarization Detection	65
2.5.3	Scattering Processes with Polarized Electrons and Polarized Single Electron Atoms	72

2.5.4	Production of Polarized Atoms	76
2.5.5	Universal Apparatus for Scattering of Polarized Electrons on Polarized Atoms.	78
2.5.6	Advanced Implementations and Developments	87
2.6	Ion–Atom and Atom–Atom Collision Processes	89
2.6.1	Impact Parameter Representation in the Classical Approximation	90
2.6.2	Quasi-Molecular Bonds	91
2.6.3	Potential Scattering and Quantum Mechanical Structure Effects	98
2.6.4	Coincidence and Spin Experiments	102
2.6.5	Antiproton–Atom Collisions	108
3	Auger Emission and Inner Shell Hole Experiments	111
3.1	Basic KLL Auger Transitions	111
3.2	Auger Matrix Elements in jj Coupling	113
3.3	Excited Sodium KLL Auger Transitions.	122
3.3.1	Relative and Absolute Line Intensities.	124
3.3.2	Interpretation and Analysis of Spectra.	125
3.3.3	Designation of States.	125
3.3.4	Auger Transition Energies	126
3.3.5	Auger Rates and Relative Intensities	127
3.3.6	Angular Distribution	131
3.3.7	Angular Distribution for an Unresolved Resonance	134
3.3.8	Angular Distribution: Anisotropy Coefficients α_2	135
3.4	Advanced Experiments: Resonant $Ar^*(2p_{1/2}^{-1}4s_{1/2} + 3d_{3/2})_{J=1}$ Auger Emission.	140
3.4.1	Theoretical Considerations	141
3.4.2	Experimental Set-Up	142
3.4.3	Numerical Methods	144
3.4.4	Numerical Versus Experimental Results.	145
3.5	Generation and Detection of Inner Shell Holes	151
3.5.1	Polarization States of Photons	151
3.5.2	Photoexcitation State Multipoles	154
3.5.3	State Multipoles of Photoionization.	155
3.5.4	Orientation and Alignment of Inner Shell Photoionization.	164
3.5.5	Photoionization of Open Shell Atoms	169
3.5.6	Photoionization of the Radionucleides	178
3.5.7	State Multipoles of Electron Impact Excitation.	179
3.6	Tasking Complete Experiments in Atomic Auger Decay	184
3.7	Molecular Auger Processes: Angle Resolved Auger Emission from CO Molecules	188
3.7.1	Theoretical Framework	189

3.7.2	Numerical Results	193
3.7.3	Auger Emission from Fixed-in-Space Molecules	196
4	Complete Experiments in Atomic Photoionization	201
4.1	General Theoretical Background	201
4.1.1	Formalized Definition of Complete Experiments	201
4.1.2	Multipole Expansion of Photoionization Amplitude	202
4.1.3	What is the Complete Experiment on Atomic Photoionization?	204
4.1.4	Counting the Number of Independent Amplitudes	207
4.1.5	Theoretical Methods for Calculating Photoionization Amplitudes	209
4.2	Photoelectron Spectrometry	210
4.2.1	Angular Distribution of Photoelectrons	210
4.2.2	Spin Polarization of Photoelectrons	214
4.3	Polarimetry of the Residual Ion	222
4.3.1	General Features of the Residual Ion Alignment and Orientation	222
4.3.2	Secondary Electron Spectrometry	225
4.3.3	Secondary Fluorescence Polarimetry	230
4.4	Coincidence Photoelectron–Auger Electron Spectrometry	238
4.5	Coincidence Photoelectron–Fluorescence Spectrometry	244
4.6	Photoionization of Polarized Atoms	247
4.6.1	Angular Distribution of Photoelectrons from Polarized Atoms and Dichroism	247
4.6.2	Photoionization of Atoms Polarized by Laser Optical Pumping	249
4.6.3	Photoionization of Atoms Polarized by Magnetic Field	254
4.6.4	Resonant Two-Colour Two-Photon Ionization	257
4.7	Non-Resonant Multiphoton Ionization	267
4.8	Photoionization in the Region of Resonance	273
4.8.1	Scanning Across Resonances	273
4.8.2	Photoinduced Resonant Auger Decay	278
4.9	Non-Dipole Effects	283
5	Concluding Remarks	293
	References	297
	Index	319