



## CONTENTS

### **I. Photon Impact**

#### **1. Atomic Photolionization. I**

V.S. Senashenko and A. Wagué	2
Resonance photoabsorption by the two-electron systems between the $n=2$ and $n=3$ thresholds.	
U.I. Safranova, V. S. Senashenko and D. S. Victorov	4
Photoionization of two-electron systems accompanied by excitation of the residual ion to the states with $n=2$ .	
U.I. Safranova and V. S. Senashenko	6
Resonance photoabsorption of three-electron atomic systems.	
S.I. Strakhova and V. A. Shakirov	8
Interaction of quasi-stationary states of the type "particle-hole" and "two particle-two holes" in the spectra of the atoms of heavy inert gases: Neon.	
T. Noro, H. S. Taylor and R. Yaris	9
Resonance partial widths and partial photoionization rates using the rotated coordinate method.	
H. Hofmann and E. Trefftz	10
Excitation of CII lines by photoionization of neutral carbon.	
H.E. Saraph	12
OIV: Bound states, oscillator strengths and photoionization cross sections.	

#### **2. Atomic Photoionization. II**

Hoang Binh Dy and Henri Van Regemorter	13
Bound-bound and bound-free transitions involving high Rydberg states.	
Young Soon Kim, Akiva Ron, H. K. Tseng and R. H. Pratt	14
Energy dependence of low energy photoelectron angular distributions and matrix elements for high Z elements.	
Steven T. Manson, Alfred Msezane, Anthony F. Starace and Siamak Shahabi	16
Photoionization of chalcogen and halogen atoms: Cross sections and angular distributions.	
Keh-Ning Huang and Anthony F. Starace	18
<i>Ab initio</i> treatment of final state spin orbit interaction: Photoionization of the 6s electron in cesium.	
U. Heinzmann, F. Schäfers, K. Thimm, A. Wolcke and J. Kessler	20
Apparatus for studying photoelectron polarization by means of circularly polarized synchrotron radiation.	
U. Heinzmann and F. Schäfers	22
The Fano effect at xenon atoms using circularly polarized synchrotron radiation.	

<b>U. Heinzmann and G. Schönhense</b>	<b>24</b>
An apparatus for the measurement of spin polarization of photoelectrons produced by unpolarized radiation at unpolarized atoms.	
<b>U. Heinzmann, G. Schönhense and J. Kessler</b>	<b>26</b>
Polarization of photoelectrons ejected by unpolarized light from xenon atoms.	
<b>H. Hanashiro, Y. Suzuki, A. Mikuni, T. Sasaki, S. Ohtani, T. Hino, A. Yagishita, T. Takayanagi, K. Wakiya, H. Suzuki and Y. Danjo</b>	<b>28</b>
Post-collision interaction in photoexcited argon LMM Auger processes.	
<b>Junya Mizuno, Takeshi Ishihara and Tsutomu Watanabe</b>	<b>30</b>
Electron correlation in the Auger process following photoionization near the threshold.	
<b>R. A. Rosenberg, M. G. White, G. Thornton and D. A. Shirley</b>	<b>32</b>
The photoelectron spectra of atomic Ba at selected autoionizing resonances.	
<b>F. Combet Farnoux and M. Ben Amar</b>	<b>34</b>
Theoretical evidence of super-Coster-Kronig transitions in nickel spectra: <i>Ab initio</i> calculations.	
<b>3. Molecular (Dissociative) Photoionization</b>	
<b>K. Köllmann, P. M. Guyon, K. Ito, I. Nenner and L. F. A. Ferreira</b>	<b>36</b>
Dissociative autoionization of hydrogen and deuterium by photon impact.	
<b>B. van Wingerden, Ph. E. van der Leeuw, F. J. de Heer and M. J. van der Wiel</b>	<b>38</b>
Formation of energetic D <sup>+</sup> fragments from D <sub>2</sub> by photoexcitation in the 25—40 eV range.	
<b>Masatoshi Nakamura and Yoshihiro Iida</b>	<b>40</b>
Photoelectron spectroscopy of several gases using He resonance lines.	
<b>I. Nenner, L. F. A. Ferreira, K. Köllmann, P. Morin, P.M. Guyon and K. Ito</b>	<b>42</b>
Resonant and non-resonant autoionization of O <sub>2</sub> in photo-selected super-excited states using synchrotron radiation.	
<b>P. M. Dehmer and J. L. Dehmer</b>	<b>44</b>
Photoelectron spectroscopy using a supersonic molecular beam source. Renner-Teller splitting in the bending vibration of N <sub>2</sub> O <sup>+</sup> X <sup>2</sup> Π at 584 Å.	
<b>S. Wallace, J. R. Swanson, D. Dill and J. L. Dehmer</b>	<b>46</b>
Molecular photoelectron branching ratios and angular distributions from 0 to 10 Ry. Effects of shape resonances and nuclear motion.	
<b>Suehiro Iwata</b>	<b>48</b>
The Gaussian-plane wave function for calculation of molecular photoionization cross section.	
<b>C. E. Brion, A. P. Hitchcock and M. J. van der Wiel</b>	<b>50</b>
Dipole oscillator strengths for ionic fragmentation of N <sub>2</sub> O and CO <sub>2</sub> (10—75eV).	
<b>C.E. Brion, K. H. Tan, M. J. van der Wiel and Ph. E. van der Leeuw</b>	<b>52</b>
Dipole oscillator strengths for the photoabsorption, photoionization and fragmentation of molecular oxygen.	

M. Sasanuma, E. Ishiguro, T. Hayaishi, H. Masuko, Y. Morioka, T. Nakajima and M. Nakamura Photoionization of SF <sub>6</sub> in the XUV region.	54
<b>4. Photodissociation</b>	
H. Schmoranzer and R. Zietz Radiative dissociation of selectively excited vibrational levels of the B state of H <sub>2</sub> .	56
M. Glass-Maujean, K. Köllmann and K. Ito Upper limit of the cross section for photodissociation of H <sub>2</sub> into excited atoms in the range 620–350 Å.	58
K. Shobatake, R.K. Sparks, L.R. Carlson and Y.T. Lee Energy disposal in the photodissociation of CH <sub>3</sub> I at 266 nm.	60
L. Malegat, C. Pernot, G. Bouchoux, J. Durup, J.-B. Ozenne and M. Tadjeeddine Angular distribution of photo-predissociation fragments from CH <sub>3</sub> I.	62
K.K. Datta, Samir Saha and A.K. Barua Photodissociation of HeH <sup>++</sup> by electronic transition.	64
<b>5. Photodetachment and Multiphoton Processes</b>	
Chris H. Greene Hyperspherical analysis of H <sup>-</sup> 1P <sup>0</sup> resonances near H (n=3).	66
R. N. Compton, G. D. Alton, A. D. Williamson and A. E. Carter Lifetime of He <sup>-</sup> formed through collisions of He <sup>+</sup> and Ca vapor.	68
R.A. Falk, D. Leep and R. Geballe Photodetachment of K <sup>-</sup> to the 4 <sup>2</sup> S <sub>1/2</sub> , 4 <sup>2</sup> P <sub>1/2</sub> and 4 <sup>2</sup> P <sub>3/2</sub> levels of K.	70
H.S. Brandi and L. Davidovich Atomic ionization by strong laser fields.	72
Shih-I Chu Complex scaling approach for atomic photoionization in intense radiation and magnetic fields.	74
A. Tip Atoms interacting with a quantized radiation mode.	76
R.K. Sharma and K.C. Mathur Two-photon ionization of helium from 2 <sup>3</sup> S state.	78
L.A. Lompre, B. Mathieu, G. Mainfray and G. Watel Three-photon, two-photon ionization of metastable 2 <sup>1</sup> S and 2 <sup>3</sup> S helium atoms.	80
C.B. Collins, J.A. Anderson, F.W. Lee, P.A. Vicharelli, D.Popescu and Iovitzu Popescu Multiphoton ionization of Cs <sub>2</sub> dimers through dissociative molecular states.	82
C.H. Chen, S.D. Kramer, D.W. Clark and M.G. Payne Lifetimes and absorption cross section measurements of selected rotational states of NO <sub>2</sub> ( <sup>2</sup> B <sub>2</sub> ).	83

## II Electron-Atom Collisions

<b>6. Elastic Scattering. I</b>	
Smio Tani	86
Separable-factor expansion of perturbation Hamiltonian and its application to electron hydrogen-atom scattering.	
Leonard Rosenberg and Larry Spruch	88
Non-singular variational principle for the scattering length for the target wave function imprecisely known.	
M. Dash Khan, C.A. Falcon and A.S. Ghosh	90
Low energy electron—hydrogen scattering.	
Lee Mu-Tao, Ione Iga and J.C. Nogueira	92
Elastic scattering of electron by hydrogen atoms in the adiabatic approximation (electron—H scattering).	
A.R. Tančić	94
Calculation of momentum-transfer cross section for slow electrons in helium.	
Kou Tsing-Tsuan, Chao Yong-Fang, Pan Shou-Fu, Xu Hong-Shan and Ding Pi-Zhu	96
The calculation of total cross sections for the scattering of slow electrons by nitrogen, oxygen and neon atoms.	
D. Davidović, M. Amusya, N. Cherepkov and V. Sosnivker	98
Elastic scattering of electrons by atoms with great polarizability.	
W.R. Newell, D.F.C. Brewer and A.C.H. Smith	100
Elastic differential electron scattering from He, Ne, Ar, and Kr for incident electron energies from 7.5 eV to 20 eV.	
<b>7. Elastic Scattering. II</b>	
S.K. Srivastava, H. Tanaka, A. Chutjian, D. Register and S. Trajmar	102
Cross sections for elastic scattering of intermediate-energy electrons by Ar and Kr.	
D.F. Register, S. Trajmar and S.K. Srivastava	104
Absolute elastic differential electron scattering cross sections for He; A proposed calibration standard from 5 to 200 eV.	
M. Klewer, M.J.M. Beerlage and M.J. van der Wiel	106
Spin polarisation in elastic scattering of 5—300 eV electrons from xenon.	
M.K. Srivastava	108
A two potential approach for electron—atom elastic scattering at low and intermediate energies.	
M.K. Srivastava and M. Lal	110
Electron—atom elastic scattering at intermediate and high energies.	
A. Birman and S. Rosendorff	112
Elastic e—H scattering at 50, 100, and 200 eV in a modified approach to the Glauber approximation.	

<b>George A. Khayrallah</b>	114
Asymmetry in scattering of electrons from hydrogen: Exchange-corrected Glauber approximation.	
<b>A. Reitan</b>	116
Relativistic Glauber amplitudes for elastic electron scattering by hydrogen atoms and hydrogen-like ions.	
<b>A. Reitan</b>	118
Fresnel and recoil corrections to the Glauber theory of elastic electron scattering by hydrogen atoms and hydrogen-like ions.	
<b>A. Reitan</b>	119
Glauber theory for elastic electron scattering from a Thomas-Fermi atom.	
<b>S.S. Taylal, A.N. Tripathi and M.K. Srivastava</b>	120
Elastic scattering of electrons by helium in two-potential eikonal approximation.	
<b>B.B. Srivastava, S.S. Dhal and R. Shingal</b>	122
A two-potential approximation for elastic scattering of electrons from complex atoms.	
<b>A.C. Roy and N.C. Sil</b>	124
Elastic scattering of electrons from helium in the Wallace's second-order eikonal approximation.	
<b>T.T. Gien</b>	126
Elastic electron-lithium scattering at intermediate energies with the inclusion of Glauber exchange effect.	
<b>8. Inelastic Scattering: Theory. I</b>	
<b>N.C. Sil and S.K. Sur</b>	128
Glauber cross sections for 1s-nlm excitation of hydrogen by electron impact.	
<b>W.C. Fon</b>	130
A unitarized Born treatment of alignment and orientation parameters for 2 <sup>1</sup> P excitation of He atom by electron impact.	
<b>W.C. Fon, K.A. Berrington and A.E. Kingston</b>	132
The excitation of n=2 states of helium by electron impact.	
<b>G.P. Gupta and K.C. Mathur</b>	134
Excitation of S states of He by electron at intermediate energies.	
<b>G.D. Meneses and Gy. Csanak</b>	136
The application of the first order many-body theory for the calculation of orientation and alignment parameters of the 2 <sup>1</sup> P and 3 <sup>1</sup> P states of helium.	
<b>Luiz Eugênio Machado, Emerson Pires Leal and György Csanak</b>	137
The application of the first order many body theory for the calculation of the differential cross sections of the excitation of the	
3s [1 $\frac{1}{2}$ ]° (J=1,2) and 3s' [1 $\frac{1}{2}$ ]° (J=0,1) states of neon.	
<b>N.T. Padial, G.D. Meneses and Gy. Csanak</b>	138
The application of the first order many body theory to the calculation of the differential cross section for the electron impact excitation of the	
4s [1 $\frac{1}{2}$ ]° (J=1,2), 4s' [1 $\frac{1}{2}$ ]° (J=0,1) states of argon.	

T. Scott, H.S. Taylor and P. Driessen	140
Application of the many body theory to elastic and inelastic scattering of electrons off helium and other rare gas atoms.	
V.V. Balashov, I.V. Kozhevnikov and A.I. Magunov	142
Excitation and ionization of atoms by intermediate energy electron impact.	
V.V. Balashov, E.G. Berezhko, N.M. Kabachnik and A.I. Magunov	143
Excitation of resonance transitions in atoms calculated in the DWBA with optical potentials.	
S.S. Taval and A.N. Tripathi	144
Gläuber generalized oscillator strength for allowed transitions of lithium atom.	
<b>9. Inelastic Scattering: Theory. II</b>	
S. Khalid and H. Kleinpoppen	146
Differential cross section of interference between direct and exchange interaction in polarized electron impact excitation of polarized atoms.	
A.P. Blinov and V.D. Ob'edkov	148
Role of fine-structure splitting in scattering of polarized electrons.	
Yu.A. Kukharenko	150
About the effective potential of interaction of slow electrons with atoms and molecules.	
M.A. Braun and V.I. Ochkur	152
Semiclassical version of Born-Coulomb approximation for the scattering of electrons by ions. Excitation, ionization, double scattering.	
W.R. Garrett and Philip W. Coulter	154
Microscopic optical potential treatment of inelastic $e^-$ -He $^*$ scattering.	
Takashi Fujimoto and Takako Kato	156
Excitation cross section of helium-like ions as inferred from relative intensities of coronal emission lines.	
Shinobu Nakazaki and Tasuke Hashino	158
Electron impact excitation of positive ions by the Coulomb-Born-Bely approximation.	
Takeshi Ishihara and Hajime Narumi	160
Treatment of long range Coulomb interaction in the eikonal approximation.	
<b>10. Inelastic Scattering: Experiment. I</b>	
P.J.O. Teubner, S.J. Buckman and J. Furst	162
Orientation and alignment parameters for the electron impact excitation of the resonant states of sodium.	
H.W. Hermann, I.V. Hertel and M.H. Kelley	164
Orientation and coherence in $e^- + Na$ scattering: $3^3P - 3^3S$ and $3^3P - 3^3D$ transitions.	
E. Weigold, L. Frost and K.J. Nygaard	166
Large momentum transfer electron-photon correlations for the 2p state of atomic hydrogen.	
R. McAdams, M.T. Hollywood, A. Crowe and J.F. Williams	168
Alignment and orientation of He( $2^1P$ ) in low energy electron collisions.	

A. Zaidi, I. McGregor and H. Kleinpoppen Vector polarisation and degree of coherence from electron—photon coincidences of the 253.7 nm intercombination line of mercury.	170
A. Chutjian, R. Hippler, I. McGregor and H. Kleinpoppen Differential cross section measurements for electron impact excitation of He(3'D) with sub-meV resolution using a coincidence technique.	172
B. Van Zyl, G.H. Dunn, D.W.O. Heddle and G.E. Chamberlain Benchmark cross sections for electron impact excitation of n'S levels of He.	174
L.M. Volkova, A.M. Devyatov, E.A. Kralkina and A.S. Mechennov Determination of the effective cross section for direct and stepwise excitation of helium.	176
H.G.M. Heideman, W. van de Water, J. van Eck and L.J.M. van Moergestel The effect of electron correlations on the polarization of atomic line radiation excited by electron impact.	178
Gérard Joyez Anisotropic threshold excitation of S states of helium by electron impact.	180
<b>11. Inelastic Scattering: Experiment. II</b>	
V.E. Dobryshin, V.M. Shustrjakov and V.I. Rachovsky Excitation of ${}^3P_1$ state of calcium by electron impact.	182
A. Lahmam-Bennani and A. Duguet Inelastic scattering of keV electrons from neon and NH <sub>3</sub> .	184
H. Schmoranzer, H. Grabe and J. Imschweiler Measurement of electron exchange contributions to the large angle scattering cross sections of 30 keV-electrons.	186
W.R. Newell, M. Khakoo and A.C.H. Smith High resolution electron scattering from atomic and excited molecular oxygen.	188
S.K. Srivastava and L. Vušković Cross sections for elastic and inelastic excitations in Na by intermediate energy electrons.	190
L. Vušković and S.K. Srivastava Scattering of intermediate energy electrons by potassium.	192
A. Lahmam-Bennani and A. Duguet Electron correlation effects in neon.	194
W.T. Rogers, J.Ø. Olsen, M. Reading and G.H. Dunn Electron impact excitation of the Zn II 4 $^2P$ and 5 $^2S$ levels.	196
<b>12. Ionization of Neutral Atoms</b>	
Joseph A. Kunc Binary encounter collisional ionization of (n, l) states of hydrogen.	198
K. Stephan, H. Helm and T.D. Märk Absolute partial electron impact ionization cross section functions for He, Ne, Ar and Kr from threshold up to 180 eV.	200
M. Eckhardt, K.-H. Schartner and H.F. Beyer Electron impact ionization of 2s- and 2p-electrons of neon.	202

<b>H. Winter and P. Varga</b>	<b>204</b>
Apparent cross sections for production of singly and doubly charged metastable noble gas ions by electron impact.	
<b>Kurt K. Jung and Erhard Schubert</b>	<b>206</b>
Angular correlations of the outgoing electrons after ionizing collisions of low energy electrons with helium atoms.	
<b>B. van Wingerden, J.T. Kimman, B. Piraux, C.J. Joachain and F.J. de Heer</b>	<b>208</b>
Absolute triple differential cross sections for scattering of 200—2800 eV electrons incident on helium.	
<b>A. Giardini-Guidoni, R. Fantoni, R. Tiribelli, G. Stefani and R. Camilloni</b>	<b>210</b>
Absolute ( $e$ , $2e$ ) coplanar symmetric cross section measured for valence orbitals of Ne and Xe.	
<b>A. Giardini-Guidoni, R. Fantoni, R. Marconero, R. Camilloni and G. Stefani</b>	<b>212</b>
Inadequacy of Hartree-Fock single particle model in describing intermediate state of Xe.	
<b>13. Ionization of Ions and Dielectronic Recombination</b>	
<b>Yukap Hahn</b>	<b>214</b>
Auger contribution to electron impact ionization.	
<b>Akio Tsuji, Hiroshi Kotegawa and Hajime Narumi</b>	<b>216</b>
Ionization of hydrogenic ions by charged particles in the Glauber approximation.	
<b>Yong-Ki Kim and Kwok-tsang Cheng</b>	<b>218</b>
Bethe cross sections for ionization of $C^{3+}$ , $N^{4+}$ , and $O^{5+}$ .	
<b>Mitio Inokuti, Kwok-tsang Cheng and J.L. Dehmer</b>	<b>220</b>
The Bethe total cross section for inelastic collisions of fast charged particles with $C^-$ , $O^-$ , and $F^-$ ions.	
<b>R. Becker, R. Frodl, H. Klein, A. Müller, E. Salzborn and H. Winter</b>	<b>222</b>
Measurement of cross sections for electron impact ionization of ions up to 810 eV.	
<b>A. Müller and R. Frodl</b>	<b>224</b>
Multiple ionization of argon ions by electron impact.	
<b>D.H. Crandall and R.A. Phaneuf</b>	<b>226</b>
Electron impact ionization of oxygen ions -- $O^{3+}$ , $O^{4+}$ , $O^{5+}$ .	
<b>J. Dubau and L. Steenman-Clark</b>	<b>228</b>
Dielectronic recombination of H-like ions.	
<b>Y. Hahn, J. Gau, R. Luddy and J.A. Retter</b>	<b>230</b>
Dielectronic recombination rate for positive ions.	
<b>14. Autoionization and Resonances</b>	
<b>V.V. Balashov and A.N. Grum-Grzhimailo</b>	<b>232</b>
Excitation of the autoionizing states of alkali atoms by fast electrons in ( $e$ , $2e$ ) process.	

<b>N.L.S. Martin and K.J. Ross</b>	<b>234</b>
Angular correlations between scattered and ejected electrons in electron impact autoionization of cadmium vapour.	
<b>W. van de Water and H.G.M. Heideman</b>	<b>236</b>
Tests of shake-down and semiclassical model for post-collision interaction.	
<b>D. Roy, A. Poulin, J.D. Carette, M.J. Hubin-Franksin and J. Delwiche</b>	<b>238</b>
Electron impact excitation in the 24—29 eV region of argon.	
<b>D. Rassi and K.J. Ross</b>	<b>240</b>
The Auger and autoionization spectrum of free barium atoms excited by low energy electron impact.	
<b>R.A. Rosenberg, S.-T. Lee and D.A. Shirley</b>	<b>242</b>
The ejected electron spectra of atomic Yb and Ba.	
<b>Charles W. Clark and Chris H. Greene</b>	<b>244</b>
Hyperspherical approach to three electron dynamics.	
<b>H.G.M. Heideman, W.B. Westerveld and J. van Eck</b>	<b>246</b>
Excitation of the $(2p^2) ^3P$ doubly excited state of helium by electrons.	
<b>P. Mitchell, J.A. Baxter and J. Comer</b>	<b>248</b>
Electron energy loss studies of the excitation of autoionizing states in neon and argon.	
<b>V.V. Balashov, N.M. Kabachnik, I.P. Sazhina and A.N. Tkatchov</b>	<b>250</b>
Correlation study of “giant resonance” in La.	
<b>Kwong T. Chung</b>	<b>252</b>
A single particle projection operator—Saddle point technique for multiply excited states.	
<b>B.R. Junker</b>	<b>254</b>
A new variational technique for the complex coordinate method.	
<b>N.V. Orlova, U.I. Safranova, V.S. Senashenko and G.A. Simonov</b>	<b>256</b>
Relationship between the lifetimes of the $(1s2s2p)^4P_{3/2}$ and ${}^4P_{1/2}$ autoionization states of three-electron systems.	
<b>15. Inner-Shell Excitation and Ionization</b>	
<b>H. Suzuki, M. Muto, T. Takayanagi, K. Wakiya and S. Ohtani</b>	<b>258</b>
Auger-electron spectra of rare-gas atoms by electron impact near threshold.	
<b>T. Takayanagi, A. Nakashio, C. Hirota, H. Suzuki and K. Wakiya</b>	<b>260</b>
Cross sections for Ar-L <sub>2,3</sub> , Kr-M <sub>4,5</sub> , and Xe-N <sub>4,5</sub> ionizations by electron impact.	
<b>V.I. Zaporozchenko, V.V. Kantsel and G.N. Kashin</b>	<b>262</b>
Measurement of ionization cross sections of inner shells by AES.	
<b>W. Sandner and C.E. Theodosiou</b>	<b>263</b>
Double differential ionization cross section for neon K-shell by electron impact.	
<b>A. Lahmam-Bennani and A. Duguet</b>	<b>265</b>
Effective contribution of the 1s electrons of Ar and Ne to the Bethe sum rule.	
<b>M. Aydinol, R. Hippler, I. McGregor and H. Kleinpoppen</b>	<b>266</b>
Angular distribution of X radiation following electron bombardment of free atoms.	

H. Genz, D.H.H. Hoffmann, W. Löw and A. Richter Energy dependence of the $L_\beta/L_\alpha$ branching ratio after L-shell ionization by relativistic electrons.	268
D.H.H. Hoffmann, C. Brendel, P. Eschwey, H. Genz, U. Kuhn, W. Löw and A. Richter K-, L- and M-shell ionization by relativistic electron impact: Cross sections and scaling behaviour.	270
M. Kamiya, Y. Kinoshita, A. Kuwako, K. Ishii, S. Morita, and M. Oyamada Density effect in K-shell ionizations by ultrarelativistic electrons.	272
E.G. Berezhko and N.M. Kabachnik DWBA calculations of inner-shell vacancy alignment.	274

### III. Electron-Molecule Collisions

<b>16. Vibrationally Elastic and Inelastic Scattering: Theory. I</b>	
H. Takagi, H. Nakamura and Y. Itikawa Elastic scattering of electrons from $H_2^+$ and studies of dynamic processes in the $H_2^+ + e$ system.	278
E. Ficocelli Varracchio Effective potential theory of $e^- - H_2$ rotational excitation.	280
G.P. Gupta and K.C. Mathur Rotational excitation of $H_2$ molecule by electron impact.	282
Ashok Jain, A.N. Tripathi and M.K. Srivastava Elastic scattering of electrons by hydrogen molecule at intermediate and high energies.	284
Kenneth J. LaGattuta Glauber approximation for $e^- + H_2(\text{g.s.}) \rightarrow e^- + H_2^*$ in a Gaussian basis.	286
Avner Klonover and Uzi Kaldor <i>Ab initio</i> calculations of low energy electron-molecule scattering with polarization.	288
<b>17. Vibrationally Elastic and Inelastic Scattering: Theory. II</b>	
Vo Ky Lan, M. Le Dourneuf and B.I. Schneider Rotational excitation of diatomic polar molecules by slow electron impact. Practical implementation of the frame transformation theory.	290
B.I. Schneider, M. Le Dourneuf and Vo Ky Lan Resonant vibrational excitation of diatomic molecules by electron impact. An <i>ab initio</i> R-matrix calculation for $e^- - N_2$ .	292
B.D. Buckley, P.G. Burke and L.A. Collins The R-matrix theory for electron-molecule collisions.	294
Kazuhiro Ishida and Isao Shimamura R-matrix method for scattering of electrons by polyatomic molecules.	296

<b>L.A. Collins, W.D. Robb and M.A. Morrison</b>	298
Low-energy electron-molecule collisions: Single-center iterative close-coupling method.	
<b>J. Siegel, J.L. Dehmer and D. Dill</b>	300
Effects of shape resonances, nuclear motion, and dipole fields on electron-molecule scattering from 0—100 eV.	
<b>B.H. Choi and Robert T. Poe</b>	302
Vibrational excitation in low energy electron-carbon monoxide scattering: A hybrid theory calculation.	
<b>James C. Sun, B.H. Choi and Robert T. Poe</b>	304
Electron-carbon dioxide scattering at intermediate and high energies; Two-potential approach.	
<b>S.P. Khare and Deo Raj</b>	306
Elastic scattering of electrons by CO molecules.	
<b>18. Vibrationally Elastic and Inelastic Scattering: Experiment</b>	
<b>W.R. Newell, D.F.C. Brewer and A.C.H. Smith</b>	308
Elastic differential electron scattering from the polyatomic molecules CH <sub>4</sub> , C <sub>2</sub> H <sub>2</sub> and C <sub>2</sub> H <sub>4</sub> .	
<b>Hiroshi Tanaka and Ara Chutjian</b>	310
Electron-impact cross sections for v = 0 → 1 vibrational excitation in CO at electron energies of 3 to 100 eV.	
<b>Hiroyuki Nishimura, David F. Register and Sandor Trajmar</b>	312
Elastic scattering and vibrational excitation of CO <sub>2</sub> by 4, 10, 20 and 50 eV electrons.	
<b>H. Nishimura</b>	314
Elastic scattering cross sections of H <sub>2</sub> O by low energy electrons.	
<b>H. Daimon, T. Kondow and K. Kuchitsu</b>	316
Measurement of the differential cross sections for elastic scattering of electrons (70—500 eV) by CCl <sub>4</sub> and As <sub>4</sub> molecules.	
<b>A.V. Phelps, D. Levron and K. Tachibana</b>	318
A consistent set of electron collision cross sections for N <sub>2</sub> .	
<b>L.C. Pitchford</b>	320
Accuracy of cross sections derived from swarm experiments.	
<b>K. Rohr</b>	322
Scattering of electrons by halocarbon molecules CCl <sub>3</sub> F and CCl <sub>2</sub> F <sub>2</sub> for collision energies below 10 eV.	
<b>K. Rohr</b>	324
Collision processes in e-CH <sub>4</sub> scattering at low energies.	
<b>T. Yamamoto, T. Okada, T. Suzuki and H. Tanaka</b>	326
New features in the vibrational excitation in O <sub>2</sub> by electron impact in the 2—20 eV region.	
<b>Kurt K. Jung and Marion A.M. Kadisch</b>	328
Vibrational excitation of cis- and trans-2-butene by low energy electrons.	
<b>Czesław Szmytkowski</b>	330
Vibrational excitation of OCS by electron impact at low energy.	

Michel Tronc and Roger Azria	332
High energy shape resonances in molecules: Resonant vibrational excitation in CO <sub>2</sub> and CO.	
J.B. Hasted, S. Kadifachi and T. Solov'yev	334
Total cross-sections for resonant scattering of electrons by diatomic and polyatomic molecules.	
Donal J. Burns, Ralph D. Hight and Charles R. Hummer	336
Measured lifetimes for the B <sup>2</sup> Σ <sub>u</sub> <sup>+</sup> and the A <sup>2</sup> Π <sub>u</sub> states in CO <sub>2</sub> .	
<b>19. Dissociation. I</b>	
M. Sizun and S. Goursaud	338
A classical trajectory study of the CO <sub>2</sub> 2Σ <sub>g</sub> <sup>+</sup> dissociation.	
T. Fujita, T. Iwai, K. Ogura, S. Watanabe and Y. Watanabe	340
Dissociative excitation of water molecule by electron impact.	
George V. Nazaroff	342
Dissociative attachment in H <sub>2</sub> and D <sub>2</sub> in the 10 eV region.	
Joseph C.Y. Chen	344
Effect of vibrational and rotational states on dissociation attachment in (e, H <sub>2</sub> ) collision.	
G.F. Drukarev and S.A. Pozdneev	346
Calculation of dissociative attachment cross section to F <sub>2</sub> , Cl <sub>2</sub> and I <sub>2</sub> molecules.	
J.M. Wadehra and J.N. Bardsley	348
Vibrational excitation and dissociative excitation in electron collisions with H <sub>2</sub> , D <sub>2</sub> and F <sub>2</sub> .	
C. Derkits, J.M. Wadehra and J.N. Bardsley	350
Dissociative recombination of electrons with H <sub>2</sub> <sup>+</sup> ions.	
R. Locht and J. Momigny	352
Dissociative ionization by low energy electron impact. Ion energy distribution of N <sup>2+</sup> from N <sub>2</sub> and O <sup>2+</sup> from O <sub>2</sub> .	
J.L. Olivier, R. Locht and J. Momigny	354
Dissociative ionization of CH <sub>4</sub> and CD <sub>4</sub> by low energy electron impact. The proton formation.	
R. Abouaf and D. Teillet-Billy	356
Predissociations in the dissociative attachment processes leading to C <sup>-</sup> /CO and F <sup>-</sup> /HF.	
R. Abouaf, R. Azria, Y. Le Coat, D. Teillet-Billy, M. Tronc and D. Simon	358
Structures in dissociative attachment cross sections of H <sub>2</sub> S and H <sub>2</sub> Se.	
R. Azria, M. Tronc, Y. Le Coat and D. Simon	360
Differential cross section for negative ion formation in HCl.	
<b>20. Dissociation. II</b>	
Morihide Higo and Teiichiro Ogawa	362
Kinetic energy distribution of the excited hydrogen atom produced by controlled electron impact on HCl.	

I. Nishiyama, T. Kondow and K. Kuchitsu Kinetic energy distribution of H and D atoms (n=4) produced by the electron impact on HCN and DCN.	364
N. Kouchi, M. Ohno, K. Ito, N. Oda and Y. Hatano Translational spectroscopy of electron impact dissociation of molecules isoelectronic and isosymmetric with H <sub>2</sub> O by Doppler profile measurements of Balmer- $\alpha$ emission.	366
J.M. Kurepa and M.D. Tasić Absolute emission cross-section of NH(c' $\Pi$ → b' $\Sigma^+$ , 0—0) vibrational band of ammonia.	368
A. Huetz, F. Gresteau, R.I. Hall and J. Mazeau Dissociative attachment in N <sub>2</sub> .	370
David Spence and P.D. Burrow Cross section for resonant dissociation of N <sub>2</sub> by electron impact.	372
J.M. Ajello and A. Chutjian Line shapes for attachment of threshold electrons to SF <sub>6</sub> and CFCl <sub>3</sub> : Threshold photoelectron (TPSA) studies of Xe, CO and C <sub>2</sub> H <sub>2</sub> .	374
J.B. Hasted, D. Mathur and S.U. Khan Trap recombination processes of cluster ions.	376
<b>21. Electronic Excitation and Ionization</b>	
W.R. Newell, M. Khakoo and A.C.H. Smith High resolution inelastic electron scattering from molecular oxygen.	378
Hiroyuki Nishimura, David C. Cartwright and Sandor Trajmar Electron energy-loss spectra in molecular fluorine.	380
J.W. McConkey and H.W. Dassen Electron-impact excitation of H <sub>2</sub> — Individual line polarizations.	382
A.U. Hazi Cross sections for electronic excitation of molecules by electron impact.	384
A.U. Hazi Theoretical study of negative ion resonances in molecules.	386
J.J. Jureta, J.N.H. Brunt, F.H. Read, G.C. King, P. Hammond and S. Cvejanović Feshbach resonances in H <sub>2</sub> , HD <sup>-</sup> and D <sub>2</sub> <sup>-</sup> .	388
T.N. Rescigno Theoretical study of electron impact deexcitation of KrF and XeF excimers.	389
P. Marmet and M. Proulx High resolution electroionization data of NH <sub>3</sub> and ND <sub>3</sub> near threshold.	390
H. Helm, Y.B. Kim, T.D. Märk, J. Ramler, G. Sejkora and K. Stephan Single and double electron impact ionization of NO <sub>2</sub> .	392
Y. Mori, T. Kitagawa, T. Yamamoto and S. Nagahara Electron impact ionization of acetic acid associates.	394
A. Giardini-Guidoni, R. Fantoni, R. Camilloni and G. Stefani (e, 2e) spectroscopy on oriented molecules: Effects of the orientation on momentum density.	396

C.E Brion, I.E. McCarthy, I. Suzuki and E. Weigold Electronic binding energies and momentum distributions for the valence orbitals of hydrogen fluoride.	398
---	-----

## **22. Inner-Shell Excitation and Ionization**

David Shaw, George C. King and Frank H. Read Inner shell excitation in atoms and molecules using electron impact with high resolution.	400
G.C. King, J.W. McConkey, F.H. Read and B. Dobson Negative ion resonances associated with inner shell excited states of N <sub>2</sub> , CO, CO <sub>2</sub> , N <sub>2</sub> O and NO.	402
D. Teillet-Billy and J.P. Ziesel K-shell excited negative-ion resonances in CO and N <sub>2</sub> .	404
C.E. Brion and A.P. Hitchcock K-shell excitation of small molecules by electron impact.	406
N. Oda, F. Nishimura and T. Osawa Generalized oscillator strengths for K-shell excitation and ionization of N <sub>2</sub> by electron impact.	408
H.-U. Chun Electron induced X-ray satellites in light element atoms and chemical bonding.	410

## **IV. Ion (Atom)-Atom Collisions**

### **23. Molecular Potentials**

V. Aquilanti, E. Luzzatti, F. Pirani and G.G. Volpi Cross sections for collisions of O ( <sup>3</sup> P) atoms with partial analysis of population of magnetic sublevels.	412
Yoshio Matsuura, Osamu Kanazaki and Kuniya Fukuda Potential curves of 1 <sub>u</sub> states of rare gas dimers from VUV emission continua.	414
H. Schmoranzer, R. Wanik and H. Krüger Determination of excimer potential curves from bound-free fluorescence intensities.	416
H. Schmoranzer and R. Wanik Measurement of keV-electron impact excited intensity normalized excimer bound-free fluorescence spectra.	418
John S. Risley and Ronald E. Olson Total scattering cross sections of protons by He, Ne and Ar.	420
G.K. Ivanov Interatomic interaction in the electron excited quasi-molecules.	422
James S. Cohen and P. Jeffrey Hay JWKB calculation of momentum-transfer cross sections for a shielded Coulomb potential: Uranium ions.	424
G. Peach Low-energy collisions between alkali and rare-gas atoms.	426

<b>24. Theory of Collisions Involving H and He</b>	
S.C. Mukherjee and Shaymal Datta	428
Charge transfer in $\text{He}^{2+}$ —H(1s) collisions.	
S.C. Mukherjee and S.K. Sur	430
Glauber scattering amplitude for $1^1\text{S} \rightarrow n^1\text{P}$ excitation of helium by proton impact.	
S.C. Mukherjee, Shyamal Dutta and Kanika Roy	432
$\text{He}^+(2s)$ formation in fast $\text{He}^+$ —H collision.	
S.P. Ojha and P. Tiwari	434
Excitation of helium by impact of hydrogen atoms.	
Victor Franco	435
Theory for collisions between arbitrary ions or atoms.	
V. Maruhn-Rezvani, N. Grün and W. Scheid.	436
A numerical solution of the Schrödinger equation for atomic collisions.	
N.C. Sil, P.K. Roy and B.C. Saha	438
Charge exchange cross section in $\text{H}^+$ —H collisions.	
B.L. Moiseiwitsch and S.G. Stockman	440
Electron capture at relativistic energies.	
George H. Gillespie and Mitio Inokuti	442
Elastic and inelastic atom-atom cross sections at high velocities for $Z \leq 18$ .	
<b>25. Excitation Transfer in Low-Energy Collisions. I</b>	
P. Skalinski and L. Krause	444
Depolarization of $4^2\text{P}$ potassium atoms induced in resonant collisions.	
T. Yabuzaki, T. Manabe and T. Ogawa	446
Collisional transfer between orientation and alignment of atoms excited by a single mode laser beam.	
J. Pascale and M.Y. Perrin	448
Energy dependence of the total cross sections for $\text{K}(4^2\text{P}_{j_1m_1}) \rightarrow 4^2\text{P}_{j_2m_2}$ + He collisions.	
J. Cuvellier, J. Berlande, C. Benoit, M.Y. Perrin, J.M. Mestdagh and J. De Mesmay	450
Crossed beam determination of energy dependence of fine structure transitions in $\text{K}(4\text{P})$ —He collisions.	
F. Masnou-Seeuws, C. Courbin-Gaussorgues and M. Philippe	452
Model potential calculations for LiNe, KNe and KHe molecular systems: Oscillations in velocity dependent fine structure changing cross sections.	
F. Masnou-Seeuws, M. Philippe, E. Roueff and A. Spielfeld	454
Interference effects in Na—Ne differential cross sections.	
K. Fukuda, S. Oku and N. Yasumaru	456
Excitation transfer between excited levels of He ( $n = 3, 4$ ) by dye laser pumping.	
Hellmut Haberland and Peter Oesterlin	458
Energy transfer between metastable helium and ground state neon atoms.	

T. Fukuyama and P.E. Siska He*( $2^1S$ , $2^3S$ ) + Ne differential scattering: Adiabatic entrance channel potentials and primary exit channels.	460
B. Sayer, M. Ferray, J.P. Visticot and J. Lozingot Experimental investigation of the Cs( $7S$ ) and Cs( $5D_{5/2}$ , $m=1/2$ )—rare gas interaction.	462
<b>26. Excitation Transfer in Low-Energy Collisions. II</b>	
E.I. Dashevskaya, E.E. Nikitin and A.I. Reznikov Semiclassical calculation of interference effects in slow nonelastic atomic collisions.	464
E.A. Yukov Collisional relaxation of the iodine atom levels $5^2P_{1/2}$ , $5^2P_{3/2}$ .	466
H.D. Meyer, C.W. McCurdy and W.H. Miller Classical model for electronic degrees of freedom in non-adiabatic collision processes.	468
V. Aquilanti, P. Casavecchia, G. Grossi and A. Laganà Coupling schemes and decoupling approximations in the theory of low energy atomic collisions.	470
Frederick H. Mies A multichannel distorted wave approximation.	472
E.N. Fortson Collisional broadening of optical transitions to metastable levels.	474
Kiyoshi Ueda, Takashi Fujimoto and Kuniya Fukuda Observation of the induced-dipole transitions for alkaline-earth atoms colliding with rare gas atoms.	476
<b>27. Excitation and Charge Transfer in Medium-Energy Collisions. I</b>	
John S. Risley and R.D. Britt Single and double electron transfer cross sections for protons on atomic and molecular targets.	478
C. Harel and A. Salin Charge exchange and excitation in He $^{2+}$ —He collisions in the keV range.	480
E.G. Berezhko, N.M. Kabachnik and V.V. Sizov Inner-shell alignment of atoms due to electron capture in ion—atom collisions.	482
N. Shimakura, S. Kita, T. Okamoto, Y. Sato and H. Inouye TOF experiment on the Li atom states produced in charge transfer: Li $^+$ —Li and Li $^+$ —Na.	484
Seiji Tsurubuchi, Tetsuya Masuda and Tsuruji Iwai Interference behavior of optical excitation function in Li $^+$ —He collision.	486
H.J. Andrä, H. Winter and R. Rauchfuß He I $3^3P$ density matrix from medium energy He $^+$ —Ne collisions with impact parameter selection.	488
Rei Okasaka and Kuniya Fukuda Spectroscopic studies of collisions between rare-gas ion or light-atom ion and rare gas at 1—10 keV energy range.	490

<b>28. Excitation and Charge Transfer in Medium-Energy Collisions. II</b>	
J.B. Hasted, S. Sharma, D. Mathur and T.N. Solovyev	492
Collision spectroscopy of doubly charged nitrogen ions.	
Atsushi Matsumoto, Seiji Tsurubuchi, Tsuruji Iwai, Shunsuke Ohtani, Kazuhiko Okuno and Yozaburo Kaneko	494
Electron capture into Ar II excited state by Ar <sup>2+</sup> impact on Na (0.2—12 keV).	
P. Bisgaard, T. Andersen, E. Horsdal Pedersen and B. Vinther Sørensen	496
Charge transfer in Mg <sup>++</sup> —Mg collisions.	
P. Bisgaard, T. Andersen and B. Vinther Sørensen	498
Study of the optical emission in quasi-two-electron systems: Mg(3s <sup>2</sup> ), Mg(3s3p <sup>3</sup> P)—He, Ne, Ar and Mg <sup>+</sup> —Na, 1—80 keV.	
B. Andressen and E. Veje	500
Outer-shell excitations of Zn II levels in Zn <sup>+</sup> —He, Ne, Ar, Kr collisions.	
Akio Itoh, Masatoshi Asari and Fumio Fukuzawa	502
Additive rule in the charge-changing process of He beam.	
V.M. Lavrov, Yu. F. Bydin and S.S. Godakov	504
On disturbance of periodicity in oscillation of cross sections in interference of quasimolecular states.	
V. Sidis and J.P. Gauyacq	506
“Incorrect dissociation” and population sharing.	
Arnold Russek, Donald B. Kimball, Jr. and Michael J. Cavagnero	508
Angular momentum effects in atom—atom scattering.	
H. Yagisawa, M. Namiki and H. Nakamura	510
Rotationally induced transitions in atomic collisions.	
<b>29. Metastable Formation by Charge Transfer and Related Topics. I</b>	
T. Nagata	512
Single-electron capture cross sections for H <sup>+</sup> ions and H(1s) atoms incident upon Cs, Rb and K vapors.	
A. Valance and M. El Maddarsi	514
Application of semiclassical theory of inelastic scattering to H <sup>+</sup> + Cs → H(2s) + Cs <sup>+</sup> .	
A. Valance, Q. Nguyen-Tuan and K. Trinh Duc	516
Cs <sup>+</sup> + Rb and H <sup>+</sup> + Na charge exchange calculations.	
A. Valance and M. El Maddarsi	518
Differential cross section calculation for elastic scattering of H(1S) on Cs and inelastic scattering via H <sup>-</sup> + Cs <sup>+</sup> at 50 eV.	
M. El Maddarsi and P. Pradel	520
Differential cross sections for elastic scattering of atomic hydrogen from cesium vapour.	
P. Pradel, G. Spiess, V. Sidis and C Kubach	522
Differential cross sections for the near resonant charge transfer process H <sup>+</sup> + Cs → H(2s) + Cs <sup>+</sup> at low energy.	

P. Pradel and M. El Maddarsi Differential electron attachment cross sections for H(1s) colliding with a cesium vapour target.	524
A.S. Schlachter, K.R. Stalder and J.W. Stearns D <sup>-</sup> formation by charge-transfer collisions of 0.3 to 10-keV deuterium ions and atoms in cesium, rubidium, and sodium vapors.	526
P. Hvelplund and K. Tollund Electron capture by keV C,O,F,P, and Cl atoms in Na vapour.	528
C. Reynaud, J. Pommier, Vu Ngoc Tuan and M. Barat. Relative abundance of He(2 <sup>3</sup> S) and He(2 <sup>1</sup> S) formed by charge exchange on alkali vapor.	530
V. Sidis and C. Kubach Systematic theoretical investigation of charge exchange in He <sup>+</sup> /alkali-atom collisions.	532
M.J. Coggiola, T.D. Gaily, K.T. Gillen and J.R. Peterson Study of optical emission in collisions of He* with atomic and molecular targets.	534
T. Matsuo, N. Kobayashi and Y. Kaneko Study of low energy charge transfer reactions by the time-of-flight technique.	536
<b>30. Metastable Formation by Charge Transfer and Related Topics. II</b>	
Ya. A. Teplova, I.S. Dmitriev and V.S. Nikolaev The cross section for capture of an electron by the helium-like metastable ions of light elements.	538
Ya. A. Teplova, I.S. Dmitriev, Zh.M. Konovalova and Yu.A. Fainberg Formation of metastable ions with two and three electrons in different gases.	540
B. Hird, S.P. Ali and H.C. Suk $\sigma_{21}$ cross section for nitrogen ions in rare gas targets.	542
U. Thielman, J. Krutein and M. Barat Electron capture in N <sup>+</sup> —Ne collisions—Influence of metastable ions.	544
M. Matić, V. Sidis, B. Čobić and M. Vujović Charge transfer of O <sup>+</sup> 2S and 2D state in Ar, Kr and Xe.	546
M. Vujović, M. Matić and B. Čobić Energy loss identification of N <sup>+(5S)</sup> state through collisional de-excitation.	548
Yukinori Sato and John H. Moore Electron capture in N <sup>++</sup> —He and N <sup>++</sup> —Ne collisions.	550
F.W. Meyer and H.J. Kim Measurement of H atom Rydberg-state population by a transmission method.	552
M. Kimura, T. Egawa and T. Iwai He I-excitation in collisions of He <sup>m</sup> , He <sup>g</sup> and He <sup>+</sup> with He.	554

<b>31. Electron Capture by Multiply Charged Ions: Theory</b>	
L.A. Bureyeva and L.P. Presnyakov Excitation and charge exchange at ionic collisions.	556
L.P. Presnyakov and V.P. Shevelko One-electron charge exchange of multiply charged ions with atoms at intermediate and large relative velocities.	558
E.G. Berezhko and N.M. Kabachnik The angular distribution and polarization of X-rays emitted by an incoming particle in ion—atom charge-transfer collisions.	560
J. Eichler and F.T. Chan Approach to electron capture into arbitrary principal shells of fast projectiles.	562
L. Opradolce, P. Valiron and R. McCarroll Electron capture by Ar <sup>6+</sup> ions from He in the keV energy range.	564
J. Vaaben and K. Taulbjerg Connection between choice of translation factors and size of MO basis in charge-transfer calculations.	566
C.D. Lin Theory of electron transfer in ion—atom collisions.	568
J.S. Briggs and L. Dubé Approximate evaluation of the second Born cross-section for charge exchange.	570
J.S. Briggs and K. Taulbjerg Charge transfer by a double-scattering mechanism involving target electrons.	571
E.L. Duman, L.G. Menshykov and B.M. Smirnov The hydrogen atom destruction in collisions with multicharged ion.	572
M. Lal, M.K. Strivastava and A.N. Tripathi Charge transfer cross sections for $\alpha$ -particles colliding with hydrogenic ions.	574
D. Basu and S. Mukherjee Ion—ion capture collisions in the continuum distorted wave approximation.	576
D.M. Bhattacharyya and Puspajit Mandal Charge transfer in ion—atom collisions.	578
<b>32. Electron Capture by Multiply Charged Ions: Experiment</b>	
V.V. Afrosimov, A.A. Basalaev, G.A. Leiko and M.N. Panov Electron states of particles formed in He <sup>+2</sup> —noble gas atom collisions.	580
B.A. Huber, H.J. Kahlert, H. Schrey and K. Wiesemann Charge transfer collisions of multiply charged ions.	582
D.E. Post, R.A. Hulse, E. Hinnov and S. Suckewer Charge exchange recombination for highly ionized iron.	584
A. Andersen and P. Hvelplund Electron capture by fast He <sup>++</sup> ions in atomic and molecular hydrogen.	586

H.K. Haugen, P. Hvelplund and H. Knudsen.	588
Highly charged $\text{Au}^{q+}$ ( $v \gtrsim v_0$ ) ion interaction with static gases. Electron capture, ionization, and excitation.	
W.L. Nutt, R.W. McCullough and H.B. Gilbody	590
One-electron capture by low energy doubly charged ions in H and $\text{H}_2$ .	
T.V. Goffe, M.B. Shah and H.B. Gilbody	592
One-electron capture and loss by fast multiply charged boron and carbon ions in H and $\text{H}_2$ .	
K. Okuno, T. Koizumi and Y. Kaneko	594
Symmetric resonance multiple-charge-transfer of $\text{Ar}^{++}$ , $\text{Kr}^{++}$ , $\text{Xe}^{++}$ and $\text{Kr}^{+++}$ in their own gases from 0.04 eV to 3.8 keV.	
K.H. Berkner, W.G. Graham, R.V. Pyle, A.S. Schlachter and J.W. Stearns	596
Charge-state dependence of electron loss from H by collisions with heavy, highly stripped ions.	
S. Bliman, N. Chan-Tung, S. Dousson, B. Jacquot and Van Houtte	598
Argon ion charge exchange collisions on argon atom in the energy range 0.75 to 15 keV/charge.	
C.L. Cocke, T.J. Gray and E. Justiniano	600
Production of low-velocity highly-ionized recoil ions by heavy-ion bombardment of Ne.	
H.F. Beyer, R. Mann, F. Folkmann and K.-H. Schartner	602
Selective electron capture by highly charged very slow ions: I. Method.	
R. Mann, H.F. Beyer, K.-H. Schartner and F. Folkmann	604
Selective electron capture by highly charged very slow ions: II. Spectroscopic results.	
M. Sakisaka, N. Maeda, N. Kobayashi and T. Kusakabe	606
Charge spectra of target atoms excited by energetic ions.	

### 33. Electron Detachment

V.A. Esaulov	608
$\text{H}^-$ scattering by H.	
J. Geddes, J. Hill, M.B. Shah, T.V. Goffe and H.B. Gilbody	610
Electron detachment by $\text{H}^-$ ions in H and $\text{H}_2$ .	
J.P. Gauyacq	612
<i>Ab initio</i> study of detachment process in low energy $\text{H}^-$ —He collisions.	
John S. Risley and Peter D. Tennyson	614
Single and double electron detachment cross sections for $\text{H}^-$ on atomic and molecular gas targets.	
V.A. Esaulov and Vu Ngoc Tuan	615
$\text{H}^-$ scattering by Na.	
C. de Vreugd, R.W. Wijnaendts van Resandt and J. Los	617
Electron detachment in collisions of negative halogen ions and noble gases.	
R.L. Champion, L.D. Doverspike, E. Herbst, S. Haywood, B.K. Annis and S. Datz	618
The collisional induced dissociation and electron detachment cross sections for the $\text{UF}_6^-$ —rare gas systems.	

<b>34. Outer-Shell Ionization</b>	
M. Sataka, K. Okuno, J. Urakawa and N. Oda	620
Doubly differential cross sections of electron ejected from argon by 5—20 keV H <sup>+</sup> , H <sub>2</sub> <sup>+</sup> and He <sup>+</sup> .	
N. Oda and F. Nishimura	622
Energy and angular distributions of electrons ejected from He and H <sub>2</sub> bombarded by equal velocity H <sub>2</sub> <sup>+</sup> and He <sup>+</sup> ions.	
S.N. Tiwary	624
Ionization of He by He <sup>+</sup> ion impact.	
M. Eugene Rudd and J. Macek	626
A new description of electron ejection by low energy protons.	
L.H. Toburen and Steven T. Manson	628
Differential cross sections for ionization of krypton by fast protons: Theory and experiment.	
L.H. Toburen	630
Secondary electron emission in collisions of 1.2 MeV C <sup>+</sup> ions with He, Ne, Ar, and CH <sub>4</sub> .	
George H. Gillespie	632
Born cross sections for the impact ionization of helium by fast lithium atoms and ions.	
I.S. Dmitriev, V.S. Nikolaev, Ya. A. Teplova and Yu. A. Fainberg	634
The cross sections for loss of a pair of electrons from the outer K- and L-shells of fast ions.	
V.A. Sidorovich, V.S. Nikolaev, V.V. Beloshitsky and V.V. Goloviznin	636
Role of transitions with different changes of the electron orbital angular momentum projection in the proton ionization of the 1s and 2s states of hydrogen-like ions.	
C.R. Garibotti and J.E. Miraglia	638
Ionization of hydrogenlike atoms by fast stripped ions.	
Hajime Ishimaru, K. Muto, Z. Igarashi, S. Hiramatsu, S. Shibata, J.E. Griffin and M. Inokuti	640
Measurement of ionization cross section of gaseous molecule for 0.02—385 GeV protons.	
<b>35. Electron Spectroscopy of Autoionization Electrons in Slow Collisions</b>	
T. Takayanagi, A. Yagishita, A. Wada, K. Wakiya and H. Suzuki	642
Electron spectra emitted from core excited Na and K atoms in Na <sup>+</sup> + He and K <sup>+</sup> + He collisions.	
A. Yagishita, K. Wakiya, T. Takayanagi, H. Suzuki and F. Koike	644
Electron spectra resulting from molecular autoionization in low energy Li <sup>+</sup> + He collisions.	
A. Yagishita, K. Wakiya, T. Takayanagi, H. Suzuki and F. Koike	646
Excitation of autoionizing states of inert-gas atoms in collisions with Li <sup>+</sup> ions.	
R. Morgenstern, A. Niehaus and G. Zimmermann	648
Study of charge exchange into autoionizing states in collisions of Ne-ions.	

G.N. Ogurtsov, V.M. Mikoushkin and I.P. Flaks Autoionization in multiply charged ion—atom collisions.	650
T. Watanabe, P.H. Woerlee and Yu. S. Gordeev The energy distribution of ejected electrons due to molecular orbital ionisation.	652
S. Hara and H. Sato Theoretical study of electron spectra ejected by molecular autoionization.	654
N. Stolterfoht Angular distribution of autoionization electrons from post-collisionally mixed states.	656
P. Ziem, W.H.E. Schwarz, R. Schilling and N. Stolterfoht The excitation of Li 1s2snl terms by proton impact.	658
D. Brandt, M. Prost and N. Stolterfoht Decay of collisionally excited autoionization states of He in the field of the slow Li <sup>+</sup> -projectile.	660
P. Bisgaard, J. Østgaard Olsen and N. Andersen Velocity dependence of Ne(2s, 2p) $\leftrightarrow$ 3d $\sigma$ subshell correlation for 15—60 keV Li <sup>+</sup> —Ne collisions.	662
<b>36. Inner-Shell Ionization: Coulomb Ionization</b>	
K. Sera, K. Ishii, S. Morita, M. Kamiya and A. Kuwako K-shell ionizations of aluminum and copper by 0.5—32 MeV protons.	664
Mario Milazzo and Gaetano Riccobono Effect of Coulomb repulsion in the inner shell ionization cross section by protons, deuterons and alpha particles.	666
V.P. Petukhov, E.A. Romanovsky, N.M. Kabachnik, V.V. Sizov and S.V. Ermakov Polarization of L-shell X-rays of Ag produced by proton impact.	668
T. Tonuma, Y. Awaya, T. Kambara, H. Kumagai, I. Kohno and S. Özkök Argon K $\alpha$ X-ray satellites by impact of nitrogen ion in the 4.7—7.8 MeV/amu energy range.	670
T. Mukoyama and L. Sarkadi Electronic relativistic effects in L-shell ionization by charged-particle impact.	671
K. Shima, T. Mikumo, Y. Tagishi, Y. Iguchi, T. Arai, H. Kano and M. Takasaki K shell ionization of Z=11—29 atoms by 40—100 MeV oxygen ion bombardments.	673
W. Jitschin, H. Kleinpoppen, R. Hippler and H.O. Lutz Alignment of the L <sub>3</sub> -subshell by proton impact ionization.	675
<b>37. Inner-Shell Ionization: Impact-Parameter Dependence</b>	
W.E. Meyerhof Ionization of the 2p $\sigma$ molecular orbital in heavy-ion collisions.	676
S. Andriamonje, J.F. Chemin and J. Roturier Measurements of gold L-shell ionization probability at large scattering angles.	678

M. Dost, S. Hoppenau, J. Kising and S. Röhl Z-dependence of K-shell ionization probability in central collisions of 7 MeV protons.	680
S. Hagmann, C.L. Cocke, E. Justiniano, J.R. Macdonald and H. Schmidt-Böcking Impact parameter dependence of K vacancy production in Cu <sup>q+</sup> —Kr collisions.	682
R. Anholt, W.E. Meyerhof and Ch. Stoller Impact parameter dependence of 1s $\sigma$ vacancy production in 4.6 MeV/amu Xe + Pb collisions.	684
J. Bossler, R. Hippler, R. Shanker and H.O. Lutz Impact parameter dependence of K and L vacancy production in slow ion—atom collisions.	686
Kjell Aashamar and Per A. Amundsen Impact parameter dependence of inner-shell ionization of light atoms by protons.	688
A.K. Kaminsky and M.I. Popova Impact parameter dependence of the probabilities of atomic ionization by nuclei.	690
R. Schuch, W. Lichtenberg, G. Nolte, H. Schmidt-Böcking and H.-J. Specht Impact-parameter dependence of K-shell excitation in near symmetric heavy ion collisions.	692
R. Schuch, G. Nolte, W. Lichtenberg and H. Schmidt-Böcking Interference effects in 2p $\sigma$ —1s $\sigma$ vacancy sharing.	694
G. Soff, J. Reinhardt, W. Betz, J. Kirsch, K.-H. Wietschorke, V. Oberacker, B. Müller and W. Greiner Multiple Coulomb excitation of electron configurations in superheavy quasimolecules.	696

### **38. Inner-Shell Ionization: X-Ray Spectra and Auger Spectra**

H. Tawara, P. Richard, K.A. Jamison, T.J. Gray, J. Newcomb and C. Schmiedekamp Fluorine K X-ray production by electron excitation, ionization and capture processes in F <sup>q+</sup> (q=1—9) + He collisions.	698
H. Tawara, P. Richard, P. Pepmiller, T.J. Gray, J. Hall and J. Newcomb Excitation and ionization of K-shell electron in F <sup>6+</sup> ions in collision with He gas target.	700
K. Kawatsura, K. Ozawa, F. Fujimoto, K. Komaki and M. Terasawa Single and double K-shell ionization in asymmetric ion—atom collisions for Z <sub>1</sub> , Z <sub>2</sub> ≤ 10.	702
D. Ridder and D. Schneider Auger-spectra of 100- to 500-keV P <sup>+</sup> -projectiles excited by carbon foils.	704
D. Schneider, M. Prost, R. DuBois, D. Ridder and N. Stolterfoht Electron spectra produced in high energy Ne on Ne collisions.	706
A.K. Kaminsky, N.G. Myakishev and M.I. Popova Doubly differential cross sections for atomic L-subshell ionization.	708

U.I. Safranova and V.S. Senashenko	710
Ratio of probabilities of the two-electron one-photon transitions of the L-and M-electrons to the K-shell with two vacancies.	
J. Richard Mowat and Erich Ormand	712
Two-electron, one-photon, inner-shell transitions in nitrogen ions.	
K. Maeda, H. Endo, M. Uda and Y. Sasa	714
Chemical effect reflected in fluorine K <sup>1</sup> L <sup>n</sup> , K <sup>2</sup> L <sup>n</sup> and RAE satellites induced by photon and electron impacts.	
M. Uda, H. Endo, K. Maeda, Y. Sasa and M. Kobayashi	716
Chemical effects through electron rearrangement prior to X-ray emission.	
H.F. Beyer, K.-H. Schartner and F. Folkmann	718
X-ray spectroscopy of highly excited recoil ions.	
A. van Wijngaarden, S.P. Goldman and G.W.F. Drake	720
Lamb shift measurements in hydrogenic ion beams by the anisotropy method.	
<b>39. Inner-Shell Ionization: Continuum X-Ray and Electron Emission. I</b>	
W. Wölfli, E. Morenzoni, Ch. Stoller, G. Bonani and M. Stöckli	722
X-ray transitions in superheavy quasi-molecules.	
Ch. Stoller, E. Morenzoni, W. Wölfli, W.E. Meyerhof, F. Folkmann, P. Vincent, P.H. Mokler and P. Armbruster	724
MO X-ray angular distributions from 1 GeV $^{208}\text{Pb} + ^{208}\text{Pb}$ and $^{209}\text{Bi} + ^{209}\text{Bi}$ collisions.	
W. Wölfli, Ch. Stoller, E. Morenzoni, M. Stöckli, P. Bürgy and G. Bonani	726
MO K X-ray anisotropies at low projectile energies.	
P.H. Mokler, W.N. Lennard and I.V. Mitchell	728
Linear polarization measurement for quasimolecular K radiation.	
V.K. Nikulin	730
The anisotropy of the X-radiation from transient quasi-molecules.	
H. Schmidt-Böcking, K. Bethge, W. Lichtenberg, G. Nolte, R. Schuch, H.J. Specht and K.E. Stiebing	732
A systematic study of the impact-parameter dependence of quasimolecular radiation.	
P. Vincent, D. Schwalm, H. Bokemeyer, H. Emling, E. Grosse and J.S. Greenberg	734
Selective observation of continuum radiation from the Pb + Pb quasi- molecule.	
W. Fritsch and U. Wille	736
Analytic expressions for the molecular-orbital X-ray spectrum in the classically forbidden region.	
H. Endo, M. Uda, Y. Sasa, Y. Terasaka, K. Maeda and M. Kobayashi	738
Search for bonding effects on REC and MO X-rays in heavy ion—atom collisions.	

<b>40. Inner-Shell Ionization: Continuum X-Ray and Electron Emission. II</b>	
E. Spindler, H.-D. Betz and F. Bell	740
Radiative electron capture in fast heavy ion—atom collisions.	
E. Spindler, H.-D. Betz and F. Bell	742
Bremsstrahlung of secondary electrons in fast ion—atom collisions.	
J.A. Tanis, S.M. Shafrroth and J.R. Mowat	744
Target thickness analysis of projectile K X-rays and REC for 40—80 MeV Cl on C.	
Yu. S. Gordeev, P.H. Woerlee, H. de Waard and F.W. Saris	746
Continuous electron spectra produced in Kr <sup>+</sup> —Kr collisions.	
P.H. Woerlee, Yu. S. Gordeev, H. de Waard and F.W. Saris	748
Continuous electron spectra produced in Ne <sup>+</sup> —Ne collisions.	
C. Kozhuharov, P. Kienle, E. Berdermann, H. Bokemeyer, J.S. Greenberg,	
Y. Nakayama, P. Vincent, H. Backe, L. Handschug and E. Kankeleit	750
Charge number and scattering angle dependence of the positron production in very heavy ion atom collisions.	
C.R. Vane, I.A. Sellin, M. Suter, S.B. Elston, G.D. Alton, R.S. Thoe and	
R. Laubert.	752
Target dependences for continuum capture processes in ion—atom collisions.	
I.A. Sellin, M. Suter, C.R. Vane, S.B. Elston, R.S. Thoe and G.D. Alton	754
Coincidence experiments concerning forward electron ejection.	
Chau-Chin Wei	756
Electron capture from silicon by protons.	
J.E. Miraglia and V.H. Ponce	758
Angular distribution of electrons captured to continuum states of a fast heavy charge.	
<b>41. Inner-Shell Ionization: MO Aspects. I. High Energy</b>	
W.N. Lennard, I.V. Mitchell, P. Mokler and G.C. Ball	760
Projectile charge state dependence of K X-ray production in heavy ion—atom single collisions.	
M. Suter, C.R. Vane, S.B. Elston, I.A. Sellin, R.S. Thoe and G.D. Alton	762
K-Auger electrons observed in coincidence with final projectile charge state in ion—atom collisions.	
A. Chetioui, J.P. Rozet, J.P. Briand and C. Stephan	764
K vacancy and capture cross sections for near symmetric collisions of 300 MeV Kr ions.	
J.P. Rozet and A. Chetioui	766
Influence of L-ionization variation with target thickness on K-X-ray yields induced by fast projectiles in solid targets.	
W.A. Schönfeldt and P.H. Mokler	768
Projectile L-subshell differentiation in 1.4 MeV/u Pb → Z <sub>2</sub> collisions.	
W.E. Meyerhof, A. Rüetschi, Ch. Stoller, M. Stöckli and W. Wölfl	770
L-vacancy production in near-symmetric heavy-ion collisions (Z>35).	

D.H. Jakubassa and K. Taulbjerg	772
Relativistic treatment of $2p_{1/2}$ — $2p_{3/2}$ transitions in ion—atom collisions within the small-R expansion method.	
G. Presser, E. Scherer and J. Stähler	774
Inner-shell ionization produced by MeV fluorine and silicon projectiles.	
G. Presser, E. Scherer, J. Stähler and T. Thouw	776
Emission of characteristic and noncharacteristic X-rays induced by Cu, Se, Ag and Sb ions.	
<b>42. Inner-Shell Ionization: MO Aspects. II. Low Energy</b>	
J. Eichler, W. Fritsch and U. Wille	778
Molecular-orbital approach to ion—atom collisions with multiply charged projectiles.	
H.F. Beyer, K.-H. Schartner and R. Hippler	780
Ion impact ionization of both 2s-electrons of neon.	
V.V. Afrosimov, G.G. Meskhi, N.N. Tsarev and A.P. Shergin	782
Auger spectroscopy of demoting MO in $Kr^+—Kr$ quasimolecule.	
V.V. Afrosimov, Yu. S. Gordeev, A.P. Shergin and A.N. Zinoviev	784
Discrete structure in energy spectra of electrons produced in close $Kr^+—Kr$ collisions.	
W. Fritsch and U. Wille	786
Theoretical investigation of K—L vacancy sharing in slow Ne + Kr collisions.	
B. Fricke, W.-D. Sepp, T. Morović and A. Rosén	788
An improved calculation of the $2p\pi$ — $2p\sigma$ rotational coupling in heavy ion collision.	

## V. Ion(Atom)-Molecule and Molecule-Molecule Collisions

<b>43. Elastic Scattering</b>	
N. Hishinuma	790
H—D <sub>2</sub> and H—Ne total scattering cross sections at thermal energy.	
Joachim Schäfer	792
A discussion of the resonance structures of atom—diatom systems. Examples: He—H <sub>2</sub> , Xe—HD and H—CO.	
M.G. Dondi and F. Torello	794
A new H—H <sub>2</sub> spherical potential from high resolution molecular beam experiments.	
B. Brunetti, G. Liuti, E. Luzzatti, F. Pirani and F. Vecchiocattivi	796
Absolute total cross sections for collision in O—O <sub>2</sub> , O <sub>2</sub> —O <sub>2</sub> , O—N <sub>2</sub> , O <sub>2</sub> —N <sub>2</sub> systems.	
N. Andersen, M. Vedder, A. Russek and E. Pollack	798
Charge-state effect for quasi-elastic Ne/Ne <sup>+</sup> + D <sub>2</sub> scattering, 0.5—3.5 keV.	
Gregory A. Parker, Mark Keil and Aron Kuppermann	800
Anisotropic intermolecular potentials for He + CO <sub>2</sub> , N <sub>2</sub> O, and C <sub>2</sub> N <sub>2</sub> from differential cross section measurements.	

<b>44. Rotational and Vibrational Excitation</b>	
B.H. Choi, Robert T. Poe and K.T. Tang Rotational transitions and rate coefficients of the H + H <sub>2</sub> system.	802
Y. Itoh, N. Kobayashi and Y. Kaneko Vibrational and rotational excitation of n—H <sub>2</sub> and H <sub>2</sub> O by Li <sup>+</sup> impact above 100 eV.	804
D. Beck, U. Ross and W. Schepper Classical scattering from a rigid anisotropic potential shell of rotation symmetry. The bulge effect.	806
D. Beck, U. Ross and W. Schepper Rotationally inelastic, repulsive scattering of K—N <sub>2</sub> , CO, O <sub>2</sub> at 1 eV energies. The bulge effect.	808
Isao Shimamura A general rule for the cross sections for rotational transitions in collisions.	810
J.M. Launay Transfer of population and alignment in the rotational excitation of CO by H <sub>2</sub> at thermal energies.	812
E. Ficocelli Varracchio Adiabatic nuclei theory of heavy-particle scattering.	814
C.S. Lin A study of vibrational relaxation.	816
R.D. Sharma Inelastic cross-sections for atom—molecule collisions.	818
G. Bischof, V. Hermann, J. Krutein and F. Linder Isotope and time effects in vibrationally inelastic H <sup>+</sup> (D <sup>+</sup> )—CO <sub>2</sub> collisions at low energies.	819
A. Ellenbroek, J.P. Toennies and M. Wilde Observation of mode selective vibrational excitation of SF <sub>6</sub> in collisions with Li <sup>+</sup> ions at E <sub>CM</sub> = 4.40 eV.	821
Hao-Lin Chen and C. Borzileri Collisional relaxation of electronically excited uranium atoms in gases.	823
<b>45. Vibronic Processes by Charge Transfer. I</b>	
Pritam Prasad Ray and B.C. Saha Charge transfer in proton—hydrogen molecule collisions.	824
R.S. Peterson, M. Vedder and E. Pollack Charge exchange in D <sup>+</sup> + H <sub>2</sub> collisions.	826
Keith T. Gillen and Aart W. Kleyn Differential cross section measurements for He <sup>+</sup> + O <sub>2</sub> charge-transfer.	828
H. Schmidt, M. Konrad and F. Linder Crossed-beam measurements of charge transfer reactions for He <sup>+</sup> —N <sub>2</sub> and He <sup>+</sup> —O <sub>2</sub> in the 2—10 eV energy range.	830
V.M. Lavrov, M.R. Gochitashvili, V.A. Ankudinov and B.I. Kikiani Vibrational excitation of molecules in collision processes. Role of intermediate states.	832

M.R. Gochitashvili, V.A. Ankudinov, V.M. Lavrov and B.I. Kikiani Excitation of He atoms and N <sub>2</sub> <sup>+</sup> ions in slow He <sup>+</sup> —N <sub>2</sub> collisions.	834
A.V. Evseev, A.A. Radzig and B.M. Smirnov Asymptotic theory of molecular resonant charge transfer between diatomics.	836
<b>46. Vibronic Processes by Charge Transfer. II</b>	
J. Los, A.W. Kleyn and E.A. Gislason Vibronic excitation in atom—molecule collisions.	838
J.R. Sheridan and J.A. Enzweiler Excitation and quenching of O 6s <sup>3</sup> S <sub>1/2</sub> in collisions of 4 to 20 keV oxygen atoms with N <sub>2</sub> .	840
Nyle G. Utterback and Bert Van Zyl Low energy ionizing collisions between excited nitrogen beam molecules and N <sub>2</sub> , CO, NO, O <sub>2</sub> , and Ar target molecules.	842
S. Okada and K. Kodera Energy loss studies on ion-pair formation reactions for the K + SF <sub>6</sub> and NO systems.	844
M. Kimura and K. Lacmann Doubly differential cross sections of the reaction K + NO <sub>2</sub> → K <sup>+</sup> + NO <sub>2</sub> <sup>-</sup> .	846
B. Hird and S.P. Ali The existence of the negative ion of CH <sub>2</sub> .	847
George E. Zahr Mechanism for Penning ionization of Na by vibrationally excited N <sub>2</sub> .	848
W. Goy, V. Kohls and H. Morgner Penning ionisation of NO <sub>2</sub> by He(2 <sup>3</sup> S).	850
<b>47. Inelastic Processes Studied by Afterglow and Drift-Tube Techniques</b>	
Andrew J. Yencha and Konrad T. Wu Energy transfer processes in reactions of He(2 <sup>3</sup> S) and Ne( <sup>3</sup> P <sub>0,1,2</sub> ) with CS <sub>2</sub> .	852
J.B. Hasted, P.P. Ong, M.H. Khatri and D. Mathur Energy distribution of drifting ions.	854
Masaharu Tsuji, Hiroshi Obase, Mamoru Matsuo and Yukio Nishimura Ionization of CO <sub>2</sub> by metastable helium atoms and thermal helium ions.	856
Y. Ozaki, Y. Fukuda, T. Kondow and K. Kuchitsu Dissociative excitation of cyanides in rare gas flowing afterglow. I. Visible emission in the reaction of He <sup>M</sup> and Ar <sup>M</sup> with HCN, DCN and BrCN.	858
A.J. Yencha, Y. Ozaki, T. Kondow and K. Kuchitsu Dissociative excitation of cyanides in rare gas flowing afterglow. II. Anomalous vibrational and rotational populations of CN(B <sup>2</sup> Σ) produced from Ar <sup>M</sup> plus BrCN and their collisional relaxations.	860
T. Koizumi, K. Okuno and Y. Kaneko Drift tube study of charge transfer between Kr <sup>++</sup> and Ne.	862
Rainer Johnsen and Manfred A. Biondi Measurements of single-electron charge transfer between doubly charged ions and atoms or molecules at thermal energies.	864

<b>A.B. Rakshit and P. Warneck</b>	<b>866</b>
Charge transfer versus molecule displacement in interaction of CO <sub>2</sub> dimer ions with neutral molecules.	
<b>M. Takebe, Y. Satoh, K. Iinuma and K. Seto</b>	<b>868</b>
Measurement of the forward and backward rate coefficients of the clustering reactions Li <sup>+</sup> ion with noble gases and nitrogen gas in drift tube.	
<b>48. Penning and Associative Ionization</b>	
<b>W. Bußert, H. Hotop, J. Lorenzen and M.-W. Ruf</b>	<b>870</b>
Collisional autoionization processes involving laser-excited atoms.	
<b>V. Hoffmann and H. Morgner</b>	<b>872</b>
Interpretation of the angular distribution of electrons emitted in Penning ionisation of argon by metastable helium.	
<b>R.H. Neynaber and S.Y. Tang</b>	<b>874</b>
Penning and associative ionization in the metastable argon—metastable krypton system.	
<b>G. Poulaert, F. Brouillard, W. Claeys, P. Defrance and J.W. McGowan</b>	<b>876</b>
Associative ionisation in H <sup>+</sup> —H <sup>-</sup> and D <sup>+</sup> —D <sup>-</sup> collisions.	
<b>T.P. Parr, D. Hanson-Parr and R.M. Martin</b>	<b>878</b>
Energy dependence for ionization of HCl, CO, N <sub>2</sub> and O <sub>2</sub> by He(2 <sup>1</sup> S) and He(2 <sup>3</sup> S) atoms.	
<b>Fumihiro Koike</b>	<b>880</b>
Discretization of continuum electronic state in semiclassical treatment of atomic collisions.	
<b>A. Yokoyama, T. Ueno, S. Takao and Y. Hatano</b>	<b>882</b>
De-excitation rate constants of He(2 <sup>3</sup> S) and Ne( <sup>3</sup> P <sub>2</sub> , <sup>3</sup> P <sub>0</sub> and <sup>3</sup> P <sub>1</sub> ) by atoms and molecules using time-resolved optical emission and absorption spectroscopy.	
<b>Yukio Nishimura, Kazuhiro Matsubara, Yoshitsugu Oono and Shoichi Kai</b>	<b>884</b>
An empirical relation between quenching cross sections of metastable rare gas atoms and diameter of quenchers.	
<b>Toshiaki Munakata, Yoshiya Harada and Kozo Kuchitsu</b>	<b>886</b>
Correlation between the intensity of Penning electron spectra and the nature of molecular orbitals.	
<b>49. Reactive Scattering</b>	
<b>Aron Kuppermann and John P. Dwyer</b>	<b>888</b>
A simple model of dynamic resonances in collinear reactive scattering.	
<b>I. Kusunoki and Ch. Ottinger</b>	<b>890</b>
Chemiluminescent ion—molecule reactions: Rotational-vibrational state distributions of CH <sup>+</sup> (A' <sup>1</sup> Π) and CD <sup>+</sup> (A' <sup>1</sup> Π) from C <sup>+</sup> + H <sub>2</sub> and C <sup>+</sup> + D <sub>2</sub> collisions.	
<b>J. Bokor, R.T. Hawkins, C.K. Rhodes and D.J. Kligler</b>	<b>892</b>
Collisional properties of neutral and ionic species excited by multiphoton ultraviolet processes.	
<b>K.T. Tang, Y.Y. Yung, B.H. Choi and R.T. Poe</b>	<b>894</b>
Three-dimensional quantum mechanical studies of He + H <sub>2</sub> → HeH <sup>+</sup> + H reactive scattering.	

<b>Robin Shakeshaft and Larry Spruch</b>	<b>896</b>
The $H^+ + CH_4 \rightarrow H_2^+ + CH_3$ process in the double scattering model.	
<b>H.H. Lo and W.L. Fite</b>	<b>897</b>
Ion—molecule reaction of $UO^+$ with molecular oxygen.	
<b>Richard C. Stern and Neil C. Lang</b>	<b>899</b>
Reactions of U atoms with inorganic oxides, alcohols and halogenated methanes.	
<b>Akira Johgo and Yoshitada Murata</b>	<b>900</b>
Dynamics of the reaction of $N_2O^+$ with $D_2$ and $H_2$ .	
<b>Andrew J. Yencha, Adolf Münzer and Arend Niehaus</b>	<b>902</b>
State selected ion—molecule reaction studies by electron—ion coincidence spectroscopy: I. $H_2^{++}(H_2, H)H_3^+$ .	
<b>Andrew J. Yencha, Adolf Münzer and Arend Niehaus.</b>	<b>904</b>
State selected ion—molecule reaction studies by electron-ion coincidence spectroscopy: II. $H_2O^{++}(H_2O, OH)H_3O^+$ and $H_2S^{++}(H_2S, HS)H_3S^+$ .	
<b>F. Heismann and H.J. Loesch</b>	<b>906</b>
Translational and vibrational activation of chemical reactions.	
<b>Tomohiko Hirooka, Richard J. Buss, Piergiorgio Casavecchia, Steven J. Sibener and Yuan T. Lee</b>	<b>908</b>
A crossed molecular beam study of the reactions of $O(^3P) + C_6H_6, C_6D_6$ .	
<b>I. Alvarez, C. Cisneros, J.A. Ray, C.F. Barnett and A. Russek</b>	<b>910</b>
Possible isotope effect in dissociative collisions of $HD_2^+$ in $H_2$ .	
<b>C.H. Chen, J.P. Judish and M.G. Payne</b>	<b>912</b>
Kinetic studies of proton-excited gas mixtures.	

## VI. Special Topics

### 50. Collision Processes in External Fields

<b>A.R.P. Rau</b>	<b>914</b>
Photoionization near threshold in the presence of external fields.	
<b>H.G.P. Lins de Barros and H.S. Brandi</b>	<b>916</b>
Electron—hydrogen collision in the presence of circularly polarized coherent radiation.	
<b>C. Foglia</b>	<b>918</b>
Elastic electron—hydrogen collisions in electric field in eikonal approximation.	
<b>F. Roussel, P. Breger, G. Spiess and C. Manus</b>	<b>920</b>
Absolute measurements of the ion yield from laser-induced collisions in Na vapor at resonance.	
<b>Lothar Frommhold and Michael H. Proffitt</b>	<b>922</b>
The scattering of light by collisionally interacting pairs of atoms.	
<b>G. Ferrante, E. Fiordilino and C. Leone</b>	<b>924</b>
Laser-assisted rearrangement collisions.	
<b>G. Ferrante, S. Nuzzo and M. Zarcone</b>	<b>926</b>
Charged particle scattering in the presence of a magnetic and a laser field.	

## 51. Collision Processes Involving Highly Excited Atoms and Molecules

E. de Prunelé and J. Pascale	928
Collisions of high Rydberg atoms with neutral atoms or molecules.	
F. Gounand, P.R. Fournier and M. Hugon	930
Depopulation of Rydberg S and D states of rubidium in collision with ground-state rubidium atoms.	
M. Hugon, P.R. Fournier and F. Gounand	932
Collisional depopulation of non hydrogenic S and D Rydberg states of rubidium by helium.	
M. Hugon, F. Gounand, P.R. Fournier and J. Berlande	934
Collisional depopulation of Rydberg F states of rubidium at thermal energies.	
R.D. Rundel	936
Excitation of Rydberg atoms by NH <sub>3</sub> molecules: Semiquantal theory.	
F.G. Kellert, G.W. Foltz, K.A. Smith, R.D. Rundel, F.B. Dunning and R.F. Stebbings	938
Collisions of Xe(nf) Rydberg atoms with ammonia.	
E.J. Beiting, G.F. Hildebrandt, F.G. Kellert, G.W. Foltz, K.A. Smith, F.B. Dunning and R.F. Stebbings	940
Effects of background radiation on Rydberg atoms.	
Michio Matsuzawa	942
State-changing collisions of high-Rydberg atoms with neutral species.	
A. Hitachi, T. Doke, S. Kubota, C. Davies and T.A. King	944
De-excitation of highly excited He(n <sup>1,3</sup> S) by collisions with rare gases.	
R. Kachru, T.W. Mossberg and S.R. Hartmann	946
Relaxation of Rydberg S and D states in atomic sodium perturbed by He, Ne, Ar, Kr, or Xe.	
H. Hiraishi, M. Uematsu, T. Kondow, T. Fukuyama and K. Kuchitsu	948
Reaction of rare gas atoms and hydrogen molecules in highly excited Rydberg states. I. Collisional ionization.	
T. Kondow, H. Hiraishi, M. Uematsu, T. Fukuyama and K. Kuchitsu	950
Reaction of rare gas atoms and hydrogen molecules in highly excited Rydberg states. II. Rearrangement ionization.	
G. Baran, J. Boulmer, F. Devos and J.-C. Gauthier	952
Temperature dependence of depopulation rates in transitions between Rydberg levels of helium induced by electron collisions.	
Peter M. Koch	954
Electron scattering resonances in fast D(high n) collisions with N <sub>2</sub> .	
Peter M. Koch, James B. Bowlin and David Mariani	956
Double-resonance Stark spectroscopy as a probe of fast atomic collisions.	
Nobuyuki Toshima	958
Charge transfer processes involving highly excited hydrogen atoms.	
N.C. Sil and B.C. Saha	960
Transition of atomic hydrogen between highly excited states.	

H.J. Kim and F.W. Meyer n-scaling of electron-loss cross sections for fast H(n) <sup>0</sup> + N <sup>3+</sup> collisions.	962
<b>52. Collision Processes Involving Positrons, Mesons, and Muonium</b>	
Aparna Ray, Pritam Prasad Ray and B.C. Saha Positronium formation in e <sup>+</sup> -H <sub>2</sub> collisions.	964
Sunanda Guha and Puspajit Mandal Positronium formation in multi-electron atoms C, N, O and Ne.	966
Puspajit Mandal and Sunanda Guha Model potential approach for positron alkali-atom collisions.	968
Sunanda Guha and Puspajit Mandal Positronium formation in arbitrary excited ns states in alkali atoms.	970
T.T. Gien Total cross sections of e <sup>+</sup> -He collision in a modified Glauber method.	972
G. Hock On Coulomb distortion effects in K-shell ionizations by electrons and positrons.	974
S. Datz, J.H. Barrett, M.J. Alguard, R.L. Swent, R.H. Pantell, B.L. Berman and S.D. Bloom Coherent radiation from correlated collisions of positrons with Si.	976
James S. Cohen, Richard L. Martin and Willard R. Wadt A new model for negative meson moderation and capture.	978
G. Ya. Korenman and S.I. Rogovaya Primary level population in helium mesonic atoms.	980
R.J. Mikula, D.M. Garner, D.G. Fleming and J.H. Brewer $\mu^+$ charge exchange and muonium formation in low pressure gases.	982
D.G. Fleming, R.J. Mikula and D.M. Garner Muonium spin exchange in low pressure gases: Mu + O <sub>2</sub> , Mu + NO.	984
D.G. Fleming and D.M. Garner Muonium reaction dynamics and hydrogen isotope effects: Mu + X <sub>2</sub> , Mu + HX.	986
<b>53. Experimental Techniques</b>	
T.W. Mossberg, R. Kachru and S.R. Hartmann Stimulated photon echo measurements of atom—atom elastic scattering in buffered atomic vapors.	988
T. Shimizu, S. Kano, N. Konishi, N. Morita, T. Kasuga, F. Matsushima, H. Sasada and H. Kuze Molecular collisions studied by novel spectroscopic methods.	990
S. Trajmar and R.T. Brinkmann Effective path length corrections in beam—beam experiments.	992
E. Veje A simple dual function source for heavy ions.	994
W.R. Newell, D.F.C. Brewer and A.C.H. Smith Co-axial electrostatic velocity analyser.	996

J. Stähler and G. Presser	998
A low pressure multiwire proportional chamber for measurement of the impact parameter in ion—atom collision experiments.	
J.C. Brenot, J. Fayeton and J.C. Houver	1000
A fast multichannel time correlator.	
Masatoshi Tate, Isao H. Suzuki and Kogoro Maeda	1002
Computational analyses of miniature cylindrical analyzer suitable for angular distribution measurements of positive or negative charged particles.	
M. Eminyan and G. Lampel	1004
Optical measurement of electron spin polarization and development of the activated gallium arsenide source.	
Gérard Joyez	1006
Use of a microprocessor in scattering experiments.	
<b>54. Theoretical Techniques</b>	
Lawrence Wilets	1008
A classical many-body model for atomic collisions incorporating the Heisenberg and Pauli principles.	
Nanny Fröman and Per Olof Fröman	1009
Determination of the potential from experimental data on energies and widths of quasistationary levels.	
N. Fröman, P.O. Fröman and F. Karlsson	1010
Phase-integral calculation of quantal matrix elements between unbound states, without the use of wave functions.	
Nanny Fröman and Karl-Erik Thylwe	1012
Settling the question of the high-energy behaviour of phase shifts produced by repulsive, strongly singular, inverse-power potentials.	
Isao Shimamura and Mitio Inokuti	1014
Bounds on mean excitation energies in terms of oscillator-strength moments.	
S. Rosendorff and A. Birman	1016
Calculation of total cross-section and stopping-power for particle—hydrogen scattering.	
M. Klapisch and E. Gal	1018
A variational principle on the energy for electron—atom scattering.	
M. Le Dourneuf, B.I. Schneider and Vo Ky Lan	1020
Comparative merits of new methods for solving local coupled scattering equations. The variable phase, R-matrix propagator, Gailitis expansion methods.	
I.V. Komarov and A.P. Shcherbakov	1022
Catastrophes in scattering by spheroidal potential.	
S.P. Merkuriev and S.A. Pozdneev	1024
New numerical methods in three-body scattering problem.	
Erling Holøien	1026
The S-matrix states in electron—atom and electron—molecule collisions.	
Dipankar Chattarji and Partha Ghose	1028
On the dynamical origin of the quantum defect.	