Bibliography

[1] A. Zewail and R. Bernstein, "Real-time laser femtochemistry: Viewing the transition from reagents to products," in *The Chemical Bond*, A. Zewail, ed., (Academic Press, Inc., Boston, 1992), pp. 223–279.

[2] A. Zewail, *Femtochemistry – Ultrafast Dynamics of the Chemical Bond, Vols. I and II* (World Scientific, Singapore, 1994).

[3] M. El-Sayed, I. Tanaka, and Y. Molin, *Ultrafast Processes in Chemistry and Photobiology – Chemistry for the 21st century* (IUPAC, Blackwell Scientific, Oxford, 1994).

[4] D. Wiersma, *Femtosecond Reaction Dynamics* (Royal Academiy of Arts and Sciences, North Holland, Amsterdam, 1994).

[5] J. Manz and A. Castleman, Jr., "special issue on femtochemistry," J. Phys. Chem. **97,** 12423–12644 (1993).

[6] *Femtosecond Chemistry*, J. Manz and L. Wöste, eds., (VCH, Weinheim, 1995), Vol. 1 and 2.

[7] M. Chergui, *Femtochemistry – Ultrafast Chemical and Physical Processes in Molecular Systems* (World Scientific, Singapore, 1996).

[8] *Ultrafast Phenomena XI*, T. Elsässer, J. Fujimoto, D. A. Wiersma, and W. Zinth, eds., (Springer, Berlin, 1998).

[9] A. H. Zewail, "Femtochemistry," J. Phys. Chem. A **104,** 5660–5694 (2000).

[10] M. Shapiro and P. Brumer, "The equivalence of unimolecular decay product yields in pulsed and cw laser excitation," J. Chem. Phys. **84,** 540–541 (1986).

[11] P. Brumer and M. Shapiro, "Control of unimolecular reactions using coherent light," Chem. Phys. Lett. **126,** 541–546 (1986).

[12] P. Brumer and M. Shapiro, "Laser control of molecular processes," Ann. Rev. Phys. Chem. **43,** 257–282 (1992).

[13] M. Shapiro, C. Zhidang, and P. Brumer, "Simultaneous control of selectivity and yield of molecular dissociation: pulsed incoherent interference control," Chem. Phys. **217,** 325–340 (1997).

[14] B. Sheehy, B. Walker, and L. F. DiMauro, "Phase control in the two-color photodissociation of HD^+," Phys. Rev. Lett. **74,** 4799–4802 (1995).

[15] D. J.Tannor and S. A. Rice, "Control of selectivity of chemical reaction via control of wave packet evolution," J. Chem. Phys. **83,** 5013–5018 (1985).

[16] R. I. Gordon and S. A. Rice, "Active control of the dynamics of atoms and molecules," Am. Rev. Phys. Chem. **48,** 601–641 (1987).

[17] A. P. Peirce, M. A. Dahleh, and H. Rabiz, "Optimal control of quantum-mechanical systems: existence, numerical approximation, and applications," Phys. Rev. A **37,** 4950–4964 (1988).

[18] R. I. Cukier, C. Denk, and M. Morillo, "Control of tunneling processes with an external field in a four-level system: an analytic approach," Chem. Phys. **217,** 179–199 (1997).

[19] J. Cao and K. R. Wilson, "A simple physical picture for quantum control of wave packet localization," J. Chem. Phys. **107,** 1441–1450 (1997).

[20] A. Rice and M. Zhao, *Optical control of molecular dynamics* (Wiley, New York, 2000).

[21] Z. Li, R. Zadoyan, A. V. Apkarian, and C. C. Martens, "Femtosecond many-body dynamics of caging: Experiment and simulation of I_2 photodissociation-recombination in solid Ar," J. Phys. Chem. **99,** 7453–7465 (1995).

[22] N. F. Scherer, D. M. Jonas, and G. R. Fleming, "Femtosecond wave packet and chemical reaction dynamics of iodine in solution: Tunable probe study of motion along the reaction coordinate," J. Chem. Phys. **99,** 153–168 (1993).

[23] M. Sterling, R. Zadoyan, and V. A. Apkarian, "Interrogation and control of condensed phase chemical dynamics with linearly chirped pulses: I_2 in solid Kr," J. Chem. Phys. **104,** 6497–6506 (1996).

[24] J. Xu, N. Schwentner, S. Hennig, and M. Chergui, "Ultrafast Intramolecular and Caging Dynamics of I_2 in CCl_4 from Resonance Raman Spectroscopy," J. Raman Spectr. **28,** 433–443 (1997).

[25] R. Zadoyan, Z. Li, P. Ashjian, C. C. Martens, and V. A. Apkarian, "Femtosecond dynamics of coherent photodissociation-recombination of I_2 isolated in matrix Ar," Chem. Phys. Lett. **218,** 504–514 (1994).

[26] R. Zadoyan, Z. Li, C. C. Martens, and V. A. Apkarian, "The breaking and remaking of a bond: Caging of I_2 in solid Kr," J. Chem. Phys. **101,** 6648–6657 (1994).

[27] R. Zadoyan, M. Sterling, and V. A. Apkarian, "Dynamical spectroscopy of many-body interactions: Coherent vibrations and predissociation of I_2(B) in solid Kr," J. Chem. Soc., Faraday Trans. **92,** 1821–1829 (1996).

[28] R. Zadoyan, M. Sterling, M. Ovchinnikov, and V. A. Apkarian, "Predissociation Dynamics of I_2(B) in Liquid CCl_4 Observed Through Femtosecond Pump-Probe Measurements: Electronic Caging Through Solvent Symmetry," J. Chem. Phys. **107,** 8446–8460 (1997).

[29] R. Zadoyan, J. Almy, and V. A. Apkarian, "Lattice dynamics from the "eyes" of the chromophore - Real-time studies of I_2 isolated in rare gas matrices," J. Chem. Soc., Faraday Trans. **108,** 255–269 (1997).

[30] A. V. Benderskii, R. Zadoyan, and V. A. Apkarian, "Caged Spin-Orbit Excited I*($^2P_{1/2}$) + I*($^2P_{1/2}$) Atom Pairs in Liquids and in Cryogenic Matrices: Spectroscopy and Dipolar Quenching," J. Chem. Phys. **107,** 8437–8445 (1997).

[31] C. F. Bardeen, J. Che, K. R. Wilson, V. V. Yakovlev, V. A. Apkarian, C. C. Martens, R. Zadoyan, B. Kohler, and M. Messina, "Quantum control of I_2 in the gas phase and in condensed phase solid Kr matrix," J. Chem. Phys. **106,** 8486–8503 (1997).

[32] M. Bargheer, K. Donovang, P. Dietrich, and N. Schwentner, "Extraction of potentials and dynamics from condensed-phase pump-probe spectra: Application to I_2 in Kr matrices," J. Chem. Phys. **111,** 8556–8564 (1999).

[33] I. Almy, K. Kizer, R. Zadoyan, and V. Apkarian, "Resonant Raman, Hot, and Cold Luminescence of Iodine in Rare Gas Matrixes," J. Phys. Chem. A **104,** 3508–3520 (2000).

[34] T. Kobayashi and A. Shirakawa, "Tunable visible and near-infrared pulse generator in a 5 fs regime," Appl. Phys. B **70,** 239–246 (2000).

[35] E. Riedle, M. Beutter, S. Lochbrunner, J. Piel, S. Schenkl, S. Sporlein, and W. Zinth, "Generation of 10 to 50 fs pulses tunable through all of the visible and the NIR," Appl. Phys. B **71,** 457–465 (2000).

[36] V. A. Apkarian and N. Schwentner, "Molecular Photodynamics in Rare Gas Solids," Chem. Rev. **99,** 1481 – 1514 (1999).

[37] M. Ovchinikov and V. Apkarian, "Mixed-order semiclassical dynamics in coherent state representation: The connection between phonon sidebands and guest-host dynamics," J. Chem. Phys. **108,** 2277–2284 (1998).

[38] R. B. Gerber, A. B. McCoy, and A. B. Garcia-Vela, "Photochemical reactions in weakly bound clusters," Annu. Rev. Phys. Chem. **45,** 275–314 (1994).

[39] M. Gruebele, G. Roberts, M. Dantus, R. M. Bowman, and A. H. Zewail, "Femtosecond Temporal Spectroscopy and Direct Inversion to the Potential: Application to Iodine," Chem. Phys. Lett. **166,** 459–469 (1990).

[40] C. Wan, M. Gupta, J. Baskin, Z. Kim, and A. Zewail, "Caging phenomena in reactions: Femtosecond observation of coherent, collisional confinement," J. Chem. Phys. **106,** 4353–4356 (1997).

[41] Q. Liu, J.-K. Wang, and A. Zewail, "Femtosecond dynamics of dissociation and recombination in solvent cages," Nature **364,** 427–430 (1993).

[42] C. Lienau and A. H. Zewail, "Femtochemistry at high pressures. Solvent effect in the gas-to liquid transition region," Chem. Phys. Lett. **222,** 224–232 (1994).

[43] C. Lienau, J. C. Williamson, and A. H. Zewail, "Femtochemistry at high pressures. The dynamics of an elementary reaction in the gas-liquid transition region," Chem. Phys. Lett. **213,** 289–296 (1993).

[44] Q. Liu, C. Wan, and A. H. Zewail, "Femtosecond reaction dynamics in the gas-to-liquid transition region: Observation of a three-phase density dependence," J. Chem. Phys. **105,** 5294–5297 (1996).

[45] R. Zadoyan, N. Schwentner, and V. A. Apkarian, "Wavepacket diagnosis with chirped probe pulses," Chem. Phys. **233,** 353 – 363 (1998).

[46] M. Bargheer, M. Gühr, P. Dietrich, and N. Schwentner, "Femtosecond spectroscopy of fragment cage dynamics: I_2 in Kr," Phys. Chem. Chem. Phys. **4,** 75–81 (2002).

[47] D. L. Huestis and N. E. Schlotter, "Diatomics-in-molecules potential surfaces for the triatomic rare gas halides: Rg_2X," J. Chem. Phys. **69,** 3100–3107 (1978).

[48] W. R. Wadt and P. Hay, "The low-lying electronic states of Ar_2F," Appl. Phys. Lett. **30,** 573–575 (1977).

[49] W. R. Wadt and P. J. Hay, "Electronic states of Ar_2F and Kr_2F," J. Chem. Phys. **68,** 3850–3886 (1978).

[50] G. Hoffman and M. Colletto, "An ab initio study of some noble gas monohalides," J. Chem. Phys. **114,** 2219–2227 (2001).

[51] T. H. Dunning, Jr. and P. J. Hay, "The covalent and ionic states of the rare gas monofluorides," J. Chem. Phys. **69,** 134–149 (1978).

[52] *Excimer Lasers*, C. Rhodes, ed., (Springer-Verlag, Berlin Heidelberg, 1984).

[53] H. Kunttu and V. Apkarian, "Photodissociation of F_2 in crystalline krypton: effect of molecule-lattice prealignment," Chem. Phys. Lett. **171,** 423–429 (1990).

[54] H. Kunttu, J. Feld, R. Alimi, A. Becker, and V. Apkarian, "Charge transfer and radiative dissociation dynamics in fluorine-doped solid krypton and argon," J. Chem. Phys. **92,** 4856–4875 (1990).

[55] R. Sauerbrey, Y. Zhu, F. K. Tittel, and W. L. Wilson, "Optical emission and kinetic reactions of four-atomic rare gas halide exciplex Ar_3F," J. Chem. Phys. **85,** 1299–1302 (1986).

[56] V. Aquilanti, D. Cappelletti, V. Lorent, E. Luzzatti, and F. Pirani, "Molecular beam studies of weak interactions of open-shell atoms: The ground and lowest excited states of rare-gas halides," J. Phys. Chem. **97,** 2063–2071 (1993).

[57] V. Aquilanti, E. Luyyatti, F. Pirani, and G. G. Volpi, "Molecular beam studies of weak interactions for openßshell systems: The ground and lowest excited states of ArF, KrF and XeF," J. Chem. Phys. **89,** 6165–6175 (1988).

[58] M. Ovchinnikov and V. A. Apkarian, "Quantum interference in resonant Raman spectra of I_2 in condensed media," J. Chem. Phys. **106,** 5775–5778 (1997).

[59] A. A. Buchachenko and N. F. Stepanov, "Ar-I_2 interactions: The models based on the diatomics-in-molecule approach," J. Chem. Phys. **104,** 9913–9925 (1996).

[60] M. Ben-Nun, R. D. Levine, and G. R. Fleming, "Solvent-induced nonadiabatic transitions in iodine: An ultrafast pump-probe computational study," J. Chem. Phys. **105,** 3035–3056 (1996).

[61] M. Ben-Nun, R. D. Levine, D. M. Jonas, and G. R. Fleming, "Prompt solvent-induced electronic predissociation of femtosecond pumped iodine. A computational study," Chem. Phys. Lett. **245,** 629–638 (1995).

[62] M. Ovchinnikov and V. A. Apkarian, "Condensed phase spectroscopy from mixed-order semiclassical molecular dynamics: Absorption, emission, and resonant Raman spectra of I_2 isolated in solid Kr," J. Chem. Phys. **105,** 10312–10331 (1996).

[63] V. S. Batista and D. F. Coker, "Nonadiabatic molecular dynamics simulation of photodissociation and geminate recombination of I_2 liquid xenon," J. Chem. Phys. **105,** 4033–4054 (1996).

[64] V. S. Batista and D. F. Coker, "Nonadiabatic molecular dynamics simulation of ultrafast pump-probe experiments on I_2 in solid rare gases," J. Chem. Phys. **106,** 6923–6941 (1997).

[65] V. S. Batista and D. F. Coker, "Nonadiabatic molecular dynamics simulations of the photofragmentation and geminate recombination dynamics in size-selected I_2^- Ar_n cluster ions," J. Chem. Phys. **106,** 7102–7116 (1997), erratum: J. Chem. Phys. 110, 6583-6584 (1999).

[66] N. Yu, C. J. Margulis, and D. F. Coker, "Influence of solvation environment on excited state avoided crossings and photodissociation dynamics," J. Phys. Chem. B **105,** 6728–6737 (2001).

[67] R. Alimi, R. B. Gerber, and V. A. Apkarian, "Dynamics of molecular reactions in solids: Photodissociation of F_2 in crystalline Ar," J. Chem. Phys. **92,** 3551–3558 (1990).

[68] K. S. Kizer and V. A. Apkarian, "Orbital alignment during cage-exit of open-shell photofragments: F in solid Ar and Kr," J. Chem. Phys. **103,** 4945–4952 (1995).

[69] A. Krylov, R. Gerber, and V. Apkarian, "Adiabatic approximation and non-adiabatic effects for open-shell atoms in an inert solvent: F atoms in solid Kr," Chem. Phys. **189,** 261–272 (1994).

[70] A. Krylov and R. Gerber, "Reorientation dynamics of electronic orbitals in condensed phases: Simulations of the $F(^2P)$ atoms in solid Kr," Chem. Phys. Lett. **231,** 395 (1994).

[71] M. Y. Niv, M. Bargheer, and R. B. Gerber, "Photodissociation and recombination of F_2 molecule in $Ar_5 4$ cluster: Nonadiabatic molecular dynamics simulations," J. Chem. Phys. **113,** 6660–6672 (2000).

[72] R. B. Gerber, M. V. Korolkov, J. Manz, M. Y. Niv, and B. Schmidt, "A reflection principle for the control of molecular photodissociation in solids: model simulation for F_2 in Ar," Chem. Phys. Lett. **327,** 76–84 (2000).

[73] G. Chaban, R. Gerber, M. Korolkov, J. Manz, M. Niv, and B. Schmidt, "Photodissociation dynamics of molecular fluorine in an argon matrix induced by ultrashort laser pulses," J. Phys. Chem. A **105,** 2770–2782 (2001).

[74] M. Jacox, "Comparison of the electronic energy levels of diatomic molecules in the gas-phase and in inert solid matrices," J. Mol. Struct. **157,** 43–59 (1987).

[75] M. Chergui and N. Schwentner, "Cage Effect on the Photodissociation of Small Molecules in Van der Waals Clusters and Crystals," In *Trends in Chemical Physics*, D. J. Menon, ed.,**2,** 89–113 (Trivandum, India, 1992).

[76] M. E. Jacox, "The vibrational energy levels of small transient molecules isolated in neon and argon matrices," Chem. Phys. **189,** 149–170 (1994).

[77] V. Apkarian and V. Bondybey, "Special issue on: Photophysics of matrix isolated molecules,", 1994.

[78] V. E. Bondybey, A. M. Smith, and J. Agreiter, "New Developments in Matrix Isolation Spectroscopy," Chem. Rev. **96,** 2113–2134 (1996).

[79] M. Macler and M. C. Heaven, "Spectroscopy and relaxation dynamics of metastable electronically excited states of iodine in rare gas matrices," Chem. Phys. **151,** 219–232 (1991).

[80] J. Helbing and M. Chergui, "Solvation of ion-pair states in non-polar media: I_2 in solid neon, argon and krypton," J. Chem. Phys. **115,** 6158–6172 (2001).

[81] H. K. J. Feld and V. A. Apkarian, "Photodissociation of F_2 and mobility of F atoms in crystalline argon," J. Chem. Phys. **93,** 1009 – 1020 (1990).

[82] C. Bressler, *Spektroskopie und Photomobilität von Fluor in Edelgasmatrizen* (Wissenschaft und Technik Verlag, Berlin, 1995), iSBN 3-928943-24-3.

[83] C. Bressler, W. G. Lawrence, and N. Schwentner, "Spectroscopy of F_2 in Ne matrices," J. Chem. Phys. **105,** 1318–1329 (1996).

[84] M. H. Hill and V. A. Apkarian, "Photodynamics of charge transfer and ion-pair states of Cl_2Xe complexes in liquid Ar," J. Chem. Phys. **105,** 4023–4032 (1996).

[85] P. Beeken, E. A. Hanson, and G. J. Flynn, "Photochemical and photophysical dynamics of diatomic iodine isolated in a rare gas cage," J. Chem. Phys. **78,** 5892–5899 (1983).

[86] R. Perutz, "Photochemical Reactions Involving Matrix-Isolated Atoms," Chem. Rev. **85,** 77–96 (1985).

[87] R. Alimi, R. B. Gerber, and V. A. Apkarian, "Photodissociation dynamics of F_2 in solid Kr: Theory versus experiment," Phys. Rev. Lett. **66,** 1295–1297 (1991).

[88] H. Kunttu, E. Sekreta, and V. A. Apkarian, "Photodissociation and charge transfer photodynamics in crystalline krypton doped with F_2 and Xe," J. Chem. Phys. **94,** 7819–7831 (1991).

[89] C. Bressler and N. Schwentner, "Penetration depths of photomobilized F atoms from a sandwich experiment," Phys. Rev. Lett. **76,** 648–651 (1996).

[90] M. Dickgießer and N. Schwentner, "Penetration depth of energetic F atoms from F_2 dissociation in layered rare gas samples," J. Chem. Phys. **113,** 8260–8265 (2000).

[91] A. Holleman and E. Wiberg, *Lehrbuch der Anorganischen Chemie* (Walter de Gruyter, Berlin, New York, 1985).

[92] F. Schreiner, J. Malm, and J. Hindman, "The preparation and nuclear magnetic resonance of krypton difluoride," J. Am. Chem. Soc. **87,** 25–28 (1965).

[93] J. J. Turner and G. C. Pimentel, "Krypton fluoride: preparation by the matrix isolation technique," Science **140,** 974–975 (1963).

[94] N. Bartlett and F. Sladky, "The chemistry of krypton, xenon and radon," University of California Radiation Laboratory Report 19658 (June 1970).

[95] W. F. Howard, Jr. and L. Andrews, "Synthesis of noble-gas dihalides by laser photolysis of matrix-isolated halogens," J. Am. Chem. Soc. **96,** 7864–7868 (1974).

[96] L. Khriachtchev, M. Petterson, N. Runeberg, J. Lundell, and M. Rasanen, "A stable argon compound," Nature **406,** 874–876 (2000).

[97] R. Gerber, "private communication,", 2001.

[98] J.-C. Diels and W. Rudolph, *Ultrashort laser pulse phenomena* (Academic Press, New York, 1996).

[99] J. Manz, "Molecular Wavepacket Dynamics: Theory For Experiments 1926-1996," In *Femtochemistry and Femtobiology*, V. Sundström, ed., pp. 1–222 (World Scientific, Singapore, 1997).

[100] D. Tannor, *Introduction to Quantum Mechanics: A Time Dependent Perspective* (University Science Press, Sausalito, 2001).

[101] P. Ehrenfest, "Bemerkung über die angenäherte Gültigkeit der klassischen Mechanik innerhalb der Quantenmechanik," Z. Phys. **45,** 455–457 (1927).

[102] K. Thompson and N. Makri, "Rigorous forward-backward semiclassical formulation of many-body dynamics," Rhys. Rev. E. **59,** 4729–4732 (1999).

[103] A. Donoso and C. Martens, "Quantum Tunneling Using Entangled Classical Trajectories," Phys. Rev. Lett. **87,** 223202 (2001).

[104] J. Franck, "Elementary processes of photochemical reactions," Trans. Faraday Soc. **21,** 536–542 (1925).

[105] L. LAndau and E. Lifschitz, *Lehrbuch der theoretischen Physik* (Verlag Harri Deutsch, 1990), Vol. III, Quantenmechanik.

[106] C. Zener, "Non-adiabatic crossing of energy levels," Proc. R. Soc. **137,** 696–702 (1932).

[107] A. Arthurs and A. Dalgarno, "The theory of scattering by a rigid rotator," Proc. R. Soc. A **256,** 540–551 (1960).

[108] F. O. Ellison, "A Method of Diatomics in Molecule. I. General Theory and Application to H_2O," J. Am. Chem. Soc. **69,** 3540–3544 (1963).

[109] F. Naumkin, "The ArClF van der Waals complex as an example of how atoms inside a molecule interact with those outside," Chem. Phys. **213,** 33–43 (1996).

[110] I. Last and T. George, "Semiempirical study of polyatomic rare gas halides: application to the Xe_nCl systems," J. Chem. Phys. **87,** 1183–1193 (1987).

[111] I. Last and T. George, "Interaction of Xe^+ and Cl^- ions and their formed molecules with a Xe solid," J. Chem. Phys. **86,** 3787–3794 (1987).

[112] *The Diatomics-in-Molecules Method and the Chemical Bond*, Z. Maksic, ed., (Springer, New York, 1990).

[113] J. Tully and R. Preston, "Trajectory surface hopping approach to nonadiabatic molecular collisions: The reaction of H^+ with D_2," J. Chem. Phys. **55,** 562–572 (1971).

[114] J. Tully, "Molecular dynamics with electronic transitions," J. Chem. Phys. **93,** 1061–1071 (1990).

[115] M. Gühr, M. Bargheer, P. Dietrich, and N. Schwentner, "Predissociation and Vibrational Relaxation in the B state of I_2 in Kr Matrix," J. Phys. Chem. submitted (2002).

[116] M. Gühr, "Schwingungsrelaxation und Prädissoziation von Jodmolekülen in Edelgasmatrizen,", Diploma Thesis, Institut für Experimentalphysik, FU-Berlin, 2001.

[117] B. Garraway and K.-A. Suominen, "Wave packet dynamics: New physics and chemistry in femto time," Rep. Prog. Phys. **58,** 365–419 (1995).

[118] C. Cohen-Tannoudji, *Quantum Mechanics* (John Wiley and Sons, New York, 1977).

[119] M. Klein and J. Venables, *Rare gas solids* (Academic Press, London, 1976).

[120] M. Dickgiesser and N. Schwentner, "Optimization of Exciton-Induced Detection of Atoms at Interfaces," J. Phys. Chem. A **104,** 3743–3749 (2000).

[121] A. B. Alekseyev, H. Liebermann, R. J. Buenker, and D. B. Kokh, "Relativistic configuration interaction study of the ClF molecule and its emission spectra from 0^+ ion-pair states," J. Chem. Phys. **112,** 2274–2284 (2000).

[122] M. E. Fajardo, V. A. Apkarian, A. Moustakas, H. Krueger, and E. Weitz, "Absorption Spectra of Intermolecular Charge-Transfer Transitions between Xenon and Halogen Molecules (F_2, Cl_2, Br_2) in liquid xenon," J. Phys. Chem. **92,** 357–360 (1988).

[123] H. Kuzmany, *Festkörperspektroskopie* (Springer Verlag, Berlin, Heidelberg, 1990).

[124] W. Fowler and W. Beall, *Physics of Color Centers* (Academic Press, New York, 1986), (eds.).

[125] N. Schwentner, "Dynamics of localized excitations from energy and time resolved spectroscopy," Appl. Opt. **19,** 4104–4114 (1980).

[126] K. Huang and A. Rhys, "A theory of light-absorption and non-radiative transitions in F-centers," Proc. Roy. Soc. London A **204,** 406–423 (1950).

[127] D. Halliday, M. Potter, J. Mullins, and A. Brinkman, "Photoluminescence study of a bulk vapour grown CdTe crystal," Journal of Crystal Growth **220,** 30–38 (2000).

[128] V. E. Bondybey and C. Fletcher, "Photophysics of Cl_2 in rare gas solids," J. Chem. Phys. **64,** 3615–3620 (1976).

[129] H. H. Mohammed, A. M. Taleb, and J. Fournier, "Rare-gas matrix shift calculations of CO Cameron bands," Chem. Phys. **91,** 267–272 (1984).

[130] N. Schwentner, C. Bressler, W. Lawrence, J. Xu, and M. Chergui, "Environmental effects on the energetics and photo-induced dynamics of molecular states," Chem. Phys. **189,** 205–216 (1994).

[131] C. Bressler, W. Lawrence, and N. Schwentner, "Rydberg and charge transfer states of F atoms in neon matrices," J. Chem. Phys. **102,** 48–56 (1995).

[132] B. Ault and L. Andrews, "Absorption and emission spectra of matrix-isolated XeF, KrF, $XeCl$ and $XeBr$," J. Chem. Phys. **65,** 4192–4201 (1976).

[133] V. A. Alekseev and D. W. Setser, "Optical-optical double-resonance spectroscopic study of four ion-pair states of ClF and identification of the ClF$(A^3\Pi_1)$ valence state," J. Chem. Phys. **107,** 4771–4782 (1997).

[134] P. Gürtler, H. Kunz, and J. LeCalvé, "VUV spectroscopy of the Cl_2 molecule trapped in pure neon, pure argon or mixed neon-argon matrices," J. Chem. Phys. **91,** 6020 – 6028 (1989).

[135] E. U. Condon, "A theory of intensity distribution in band systems," Phys. Rev. **28,** 1182–1201 (1926).

[136] M. Karavitis, R. Zadoyan, and V. Apkarian, "Time resolved coherent anti-Stokes Raman scattering of I_2 isolated in matrix argon: Vibrational dynamics on the ground electronic state," J. Chem. Phys. **114,** 4131–4140 (2001).

[137] G. Herzberg, *Molecular Spectra and Molecular Structure. I. Spectra of Diatomic Molecules* (Van Nostrand Reinhold Co., New York, 1950).

[138] L. Brus, "Electronic transition dipole moments and excited-state alignment in linear molecules, with application to diatomic rare gas halide," J. Mol. Spectr. **64,** 376–381 (1977).

[139] H. Haken and H. Wolf, *Molekülphysik und Quantenchemie* (Springer, Berlin, 1998).

[140] A. C. Albrecht, "Polarizations and Assignments of transitions: The method of photoselection," J. Mol. Spectr. **6,** 84–108 (1961).

[141] J. Michl and E. Thulstrup, *Spectroscopy with polarized light* (VCH Publishers, New York, 1986).

[142] D. S. Kliger, *Polarized Light in Optics and Spectroscopy* (Academic Press, Boston, 1990).

[143] E. Schreiber, *Femtosecond real-time spectroscopy of small molecules and clusters, Springer Tr. Mod. Phys. 143* (Springer Verlag, Berlin, 1998).

[144] M. Bargheer, "Wellenpaketdynamik von Jodmolekülen in Krypton Matrizen,", Diploma Thesis, Institut für Experimentalphysik, FU-Berlin, 1999.

[145] V. A. Alekseev, D. W. Setser, and J. Tellinghuisen, "The D' $\rightarrow$ A' Transition in ClF," J. Mol. Spectr. **194,** 61 – 72 (1999).

[146] V. A. Alekseev, D. W. Setser, and J. Tellinghuisen, "The A ($^3\Pi_1$) state of ClF," J. Mol. Spectr. **195,** 162 – 171 (1999).

[147] V. A. Alekseev and D. W. Setser, "Electronic Spectroscopy and Structure of ClF," Bulletin of the Korean Chemical Society **21,** 9 – 22 (2000).

[148] D. B. Kokh, V. A. Alekseev, and D. W. Setser, "Analysis of the bound-free emission spectra from the $E(0^+)$ and $f(0^+)$ ion-pair states of ClF to obtain potentials for the ion-pair and repulsive valence states," J. Chem. Phys. **109,** 1763–1771 (1998).

[149] D. Pilipovich, H. H. Rogers, and R. D. Wilson, "Chlorine Trifluoride Oxide. II. Photochemical Synthesis," Inorg. Chem. **11,** 2192–2194 (1972).

[150] G. P. Zhitneva, "Role of the reaction ClF_2+Cl$\rightarrow$ 2ClF in the photolysis of chlorine monofluoride," Kinet. Katal. pp. 690–694 (1986).

[151] R. Steunenberg and R. Vogel, "The Absorption Spectrum of Fluorine," J. Am. Chem. Soc. **78,** 901–902 (1956).

[152] A. L. G. Rees, "Electronic spectrum and dissociation energy of fluorine," J. Chem. Phys. **26,** 1567–1571 (1957).

[153] J. B. Burkholder and E. J. Bair, "Potential energy parameters and shapes of the vibrational components of the 345 nm system of chlorine," J. Phys. Chem. **87,** 1859–1863 (1983).

[154] H. Schmitz and H. Schumacher, "Das Absorptionsspektrum von ClF_3," Z. Naturforschung **2a,** 363 (1947).

[155] T. O. Nelson, D. W. Setser, and J. Qin, "Interpretation of the two-photon, laser-assisted reactions of xenon with Cl_2, F_2, and ClF and krypton with F_2," J. Phys. Chem. **97,** 2585–2595 (1993).

[156] I. S. McDermid, "Potential-energy curves, Franck-Condon factors and laser excitation spectrum $B^3\Pi(0^+) - X^1\Sigma^+$ system of chlorine monofluoride," J. Chem. Soc., Faraday Trans. 2 **77,** 519–530 (1981).

[157] R. Coombe, D. Pilipovich, and R. K. Horne, "Chemical Generation of Electronically Excited ClF (B $^3\Pi_{0^+}$) and the B $\rightarrow$ X Emission spectrum," J. Phys. Chem **82,** 2484 – 2489 (1978).

[158] A. Alekseyev, "private communication,".

[159] A. H. Nielsen and E. A. Jones, "The analysis of the infrared spectrum of clorine monofluoride," J. Chem. Phys. **19,** 1117 –1121 (1951).

[160] J. A. Coxon, "Dissociation Energies of Diatomic Halogen Fluorides," Chem. Phys. Lett. **33,** 136 – 140 (1975).

[161] G. Mamantov, E. J. Vasini, M. C. Moulton, D. G. Vickroy, and T. Maekawa, "Chlorine-Fluorine system at low temperatures: Characterization of the ClF_2 radical," J. Chem. Phys. **54,** 3419–3421 (1971).

[162] L. Andrews, F. Chi, and A. Arkell, "Matrix infrared spectrum and vibrational analysis of the FClO intermediate," J. Am. Chem. Soc. **96,** 1997 (1974).

[163] C. Naulin, J. Lambard, and R. Bougon, "Vibrational spectra of the chlorine monofluoride ClF in cryogenic solutions," J. Chem. Phys. **76,** 3371–3377 (1982).

[164] M. Diegelmann, K. Hohla, and K. Kompa, "Interhalogen UV laser on the 285 nm band of ClF," Opt. Commun. **29,** 334–338 (1979).

[165] M. Diegelmann, H. P. Grieneisen, K. Hohla, X.-Y. Hu, J. Krasinski, and K. L. Kompa, "New TEA-Lasers Based on D' -> A' Transitions in Halogen Monofluoride Compounds: ClF, BrF,

IF," Appl. Phys. **23,** 283 – 287 (1980).

[166] M. Diegelmann, K. Hohla, F. Rebentrost, and K. L. Kompa, "Diatomic interhalogen laser molecules: Fluorescence spectroscopy and reaction kinetics," J. Chem. Phys. **76,** 1233 – 1246 (1982).

[167] F. Alberti, K. Huber, and E. Looi, "The lowest Rydberg Complex of ClF: $c^3\Pi$ and $C^1\Pi$," J. Mol. Spectr. **102,** 289–296 (1983).

[168] K. Darvesh, R. Boyd, and S. Peyerimhoff, "Electronically excited states of chlorine monofluoride: a multi-reference configuration interaction study," Chem. Phys. **121,** 361–369 (1988).

[169] F.-M. Tao and W. Klemperer, "The van der Waals potential-energy surfaces and the structures of ArClF and ArCl2," J. Chem. Phys. **97,** 440–451 (1992).

[170] S. Harris, S. Novick, and W. Klemperer, "Intermolecular potential between an atom and a diatomic molecule: The strucure of ArClF," J. Chem. Phys. **61,** 193–197 (1974).

[171] V. Sorokin and A. Chichinin, "The 248 nm photodissociation of ClF_3: quantum yields for F and Cl atoms," Chem. Phys. Lett. **280,** 141–144 (1997).

[172] J. Qin, T. Nelson, and D. Setser, "Two-Photon Laser-Assisted Reaction between Xe and ClF," J. Phys. Chem. **95,** 5374–5378 (1991).

[173] E. S. Prochaska and L. Andrews, "Raman, infrared, and ultraviolet spectra of the chlorine difluoride free radical in solid nitrogen," Inorg. Chem. **16,** 339–343 (1977).

[174] A. Sannigrahi and S. Peyerimhoff, "Ab initio SCF and CI study of the electronic structure of chlorine difluoride cation and anion," Chem. Phys. Lett. **119,** 119–122 (1985).

[175] A. Sannigrahi and S. Peyerimhoff, "Ab initio SCF and CI study of the electronic structure and spectrum of the chlorine difluoride radical," Chem. Phys. Lett. **114,** 6–9 (1985).

[176] E. Prochaska, B. Ault, and L. Andrews, "Infrared, Raman and Ultraviolet Spectra of M^+ClF^- Species in Solid Argon," Inorg. Chem. **16,** 2021–2023 (1977).

[177] B. Ault, "A search for the HF_2 and $HClF$ neutral free radicals isolated in argon matrices," J. Chem. Phys. **68,** 4012–4016 (1978).

[178] L. Andrews, F. Chi, and A. Arkell, "Matrix infrared spectrum and vibrational analysis of the FClO intermediate," J. Am. Chem. Soc. **96,** 1997–2000 (1974).

[179] P. Bagus, B. Liu, and H. S. III, "Electronic structure and properties of krypton difluoride," J. Am. Chem. Soc. **94,** 6635–6641 (1972).

[180] A. Boate, J. Morton, and K. Preston, "EPR spectrum off Kr_2F," Chem. Phys. Lett. **54,** 579–581 (1978).

[181] E. Riedel, *Anorganische Chemie* (de Gruyter, Berlin, 1999).

[182] I. S. McDermid and J. B. Laudenslager, "Perturbations in the $B^3\pi(0^+)$ state of ClF: A new low-lying electronic state," Chem. Phys. Lett. **79,** 370–374 (1981).

[183] T. Wilhelm, J. Piel, and E. Riedle, "Sub-20-fs pulses tunable across the visible from a blue-pumped single-pass noncollinear parametric converter," Opt. Lett. **22,** 1494–1496 (1997).

[184] G. Cerullo, M. Nisoli, S. Stagira, and S. D. Silvestri, "Sub-8-fs pulses from an ultrabroadband optical parametric amplifier in the visible," Opt. Lett. **23,** 1283–1285 (1998).

[185] A. Shirakawa, I. Sakane, and T. Kobayashi, "Pulse-front-matched optical parametric amplification for sub-10-fs pulse generation tunable in the visible and near infrared," Opt. Lett. **23,** 1292–1294 (1998).

[186] R. Boyd, *Nonlinear Optics* (Academic Press, San Diego, 1992).

[187] E. Riedle, private communication.

[188] D. Kane and R. Trebino, "Characterization of arbitrary femtosecond pulses using frequency-resolved optical gating," IEEE J. Quant. Electr. **29,** 571–579 (1993).

[189] R. Trebino and D. J. Kane, "Using phase retrieval to measure the intensity and phase of ultrashort pulses: frequency-resolved optical gating," J. Opt. Soc. Am. A **10,** 1101–1111 (1993).

[190] N. Schmitt, "Phasen- und Amplitudenmessungen an ultrakurzen Lichtpulsen,", Diploma Thesis, Institut für Experimentalphysik, FU-Berlin, 1996.

[191] J. G. Caffrey, H. Kunz, and N. Schwentner, "Spectroscopy and photodissociation of chlorine monomers and clusters in Ar-matrices," J. Chem. Phys. **96,** 155 – 164 (1992).

[192] T. Ishiwata, H. Takekawa, and K. Obi, "Measurements of the radiative lifetimes of the Cl_2 ion-pair states by optical-optical double resonance," Chem. Phys **177,** 303 – 308 (1993).

[193] C. Bressler, W. Lawrence, and N. Schwentner, "Spectroscopy of argon fluoride and krypton fluoride exciplexes in rare gas matrices," J. Chem. Phys. **105,** 10178–10188 (1996).

[194] H. Kunz, "Photodissoziation von Cl_2 in Edelgasmatrizen und spektroskopische Untersuchung der Dissoziationsfragmente,", PhD Thesis, Freie Universität Berlin, 1991.

[195] M. Bargheer, J. Pietzner, P. Dietrich, and N. Schwentner, "Ultrafast laser-control of ionic-bond formation: ClF in argon solids," J. Chem. Phys. **115,** 9827–9834 (2001).

[196] M. Macler, M. Erickson, H.-S. Lin, and M. C. Heaven, "Electronic spectroscopy and fluorescence decay dynamics of matrix isolated IBr," J. Phys. Chem **96,** 4301–4306 (1992).

[197] V. E. Bondybey and L. E. Brus, "Rigid cage effect on ICl photodissociation and $B\ 0^+$ fluorescence in rare gas matrices," J. Chem. Phys. **62,** 620–629 (1975).

[198] J.-P. Nicolai and M. C. Heaven, "Laser excitation spectra for matrix isolated IF: observation of new low-lying electronic states," J. Chem. Phys. **87,** 3304 – 3312 (1987).

[199] C. A. Wight, B. S. Ault, and L. Andrews, "Laser-induced fluorescence and resonance raman spectra of interhalogen diatomics isolated in inert matrices at 12K," J. Mol. Spectr. **56,** 239–250 (1975).

[200] M. Bargheer, P. Dietrich, K. Donovang, and N. Schwentner, "Extraction of potentials and dynamics from condensed phase pump-probe spectra: Application to I_2 in Kr matrices," J. Chem. Phys. **111,** 8556–8564 (1999).

[201] G. Zerza, G. Slivinski, N. Schwentner, G. J. Hoffman, D. G. Imre, and V. A. Apkarian, "Spectroscopy of XeF in Ar and Ne Matrices," J. Chem. Phys. **99,** 8414–8423 (1993).

[202] M. E. Fajardo and V. A. Apkarian, "Cooperative photoabsorption induced charge transfer reaction dynamics in rare gas solids. I. Photodynamics of localized xenon chloride exciplexes," J. Chem. Phys. **85,** 5660–5681 (1986).

[203] M. Dickgießer and N. Schwentner, "Set-up combining synchrotron radiation-induced photochemistry with IR probing: $(HCl)_n$ in Kr matrix," Nucl. Instr. Meth. B **168,** 252–267 (2000).

[204] V. S. Batista, C. Margulis, and D. Coker, private communication .

[205] M. Bargheer, P. Dietrich, and N. Schwentner, "Spectroscopy and Photodissociation of ClF in Ar," J. Chem. Phys. **115,** 149–157 (2001).

[206] K. P. Huber and G. Herzberg, *Molecular Spectra and Molecular Structure. IV. Constants of Diatomic Molecules* (Van Nostrand Reinhold, New York, 1979).

[207] R. Rydberg, "Graphische Darstellung einiger bandenspektroskopischer Ergebnisse," Z. Phys. **73,** 376–385 (1931).

[208] O. Klein, "Zur Berechnung von Potentialkurven für zweiatomige Moleküle mit Hilfe von Spektraltermen," Z. Phys. **76,** 226–235 (1932).

[209] A. Rees, "The calculation of potential-energy curves from band-spectroscopic data," Proc. Phys. Soc. London A **59,** 998–1008 (1947).

[210] L. D. Landau and E. M. Lifschitz, *Lehrbuch der theoretischen Physik* (Akademie-Verlag, Berlin, 1979), Vol. I: Mechanik, Chap. 12.

[211] H. Dietz, G. Knopp, A. Materny, and V. Engel, "The perturbation of coherent wave-packet dynamics by atom-molecule collisions: the NaI + Ar system," Chem. Phys. Lett. **275,** 519–526 (1997).

[212] A. Heidenreich and J. Jortner, "Pump-Probe spectroscopy of ultrafast structural relaxation of electronically excited rare gas heteroclusters," J. Electr. Spectr. **106,** 187–197 (2000).

[213] A. Goldberg and J. Jortner, "Structural Relaxation Dynamics of Electronically Excited $XeAr_N$ Clusters," J. Chem. Phys. **107,** 8994–9017 (1997).

[214] C. Jeannin, M. Portella-Oberli, S. Jimenez, F. Vigliotti, B. Lang, and M. Chergui, "Femtosecond dynamics of electronic 'bubbles' in solid argon: viewing the inertial response and the bath coherences," Chem. Phys. Lett. **316,** 51–59 (2000).

[215] S. Jimenez, M. Chergui, G. Rojas-Lorenzo, and J. Rubayo-Soneira, "The medium response to an impulsive redistribution of charge in solid argon: Molecular dynamics simulations and normal mode analysis," J. Chem. Phys. **114,** 5264–5272 (2001).

[216] J. Baskin, M. Gupta, M. Chachisvilis, and A. Zewail, "Femtosecond dynamics of microscopic friction: nature of coherent versus diffusive motion from gas to liquid density," Chem. Phys. Lett. **275,** 437–444 (1997).

[217] J. Baskin, M. Chachisvilis, M. Gupta, and A. Zewail, "Femtosecond dynamics of solvation: Microscopic friction and coherent motion in dense fluids," J. Phys. Chem. A **102,** 4158–4171 (1998).

[218] I. Benjamin and K. Wilson, "Proposed experimental probes of chemical reaction molecular dynamics in solution: ICN photodissociation," J. Chem. Phys. **90,** 4176–97 (1989).

[219] M. Levenson and S. Kano, *Introduction to Nonlinear Laser Spectroscopy* (Academic Press, Boston, 1988).

[220] V. Bondybey and L. Brus, "Rigid cage photodissociation dynamics: A double minimum problem for ICl in Ne and Ar lattices," J. Chem. Phys. **64,** 3724–3731 (1976).

[221] A. I. Krylov and R. B. Gerber, "Photodissociation dynamics of HCl in solid Ar: Cage exit, nonadiabatic transitions, and recombination," J. Chem. Phys. **106,** 6574–6587 (1997).

[222] M. Y. Niv, A. I. Krylov, and R. B. Gerber, "Photodissociation, electronic relaxation and recombination of HCl in Ar_n(HCl) clusters - Non-adiabatic molecular dynamics simulations,"

Faraday Discuss. **108,** 243–254 (1997).

[223] T. Brixner, N. Damrauer, P. Niklaus, and G. Gerber, "Photoselective adaptive femtosecond quantum control in the liquid phase," Nature **414,** 57–60 (2001).

[224] B. Friedrich and D. Herschbach, "Alignment and trapping of molecules in intense laser fields," Phys. Rev. Lett. **74,** 4623–4626 (1995).

[225] J. Larsen, I. Wendt-Larsen, and H. Stapelfeldt, "Controlling the Branching Ratio of Photodissociation Using Aligned Molecules," Phys. Rev. Lett. **83,** 1123–1126 (1999).

[226] J. Larsen, K. Hald, N. Bjerre, and H. Stapelfeldt, "Three dimensional Alignment of Molecules Using Eliptically Polarized Laser Fields," Phys. Rev. Lett. **85,** 2470–2473 (2000).