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AREA OF RESEARCH:	Theory of Laser-Matter Interactions: Quantum Control, Multiphoton Processes and Nonlinear Optics. Relativistic Dynamics. Computational Physics.

2. Education

1976 Ph.D in Theoretical Physics, Jagiellonian University, Cracow, Poland. Dissertation: "Momenta distributions of spectator nucleons at the disintegration of the deuteron by a high energy particle".

1972-76 Post-graduate study in Theoretical Physics , Jagiellonian University, Faculty of Mathematics and Physics, Cracow, Poland.

1972 M.Sc. and B.Sc. in Physics (Theoretical Physics), Jagiellonian University, Cracow, Poland.

1967-72 Studies of Physics, Jagiellonian University, Cracow, Poland.

3. Employment:

1987- Senior Research Associate, Department of Chemistry, University of Sherbrooke, Sherbrooke, Quebec, J1K 2R1, Canada.

1986-87 Researcher, Electrical Engineering Division, Photonics and Sensors Section, National Research Council, Ottawa, Ontario K1A 0R8.

4. Research Experience

a) **Dynamics of Molecules in Intense Laser Fields (1987-1999)**
(Nonlinear, multiphoton, nonperturbative effects and Quantum Control)

i) Laser control of chemical reactions: proposal of using chirped pulses to the bond selective control of vibrational excitation and dissociation, Refs. 11, 14, 16, 26, work reviewed in Nature, 360, 103 (1992). Laser control of **isomerization** of triatomic molecules using two infrared lasers, Ref. 19.

ii) Competition **dissociation-ionization** in diatomics in intense laser fields (Coulomb explosions), Refs.15, 20, 22 ,29. Coulomb explosion imaging of molecular wave functions using ultrashort laser pulses - a new method for measurement of the quantum state, Refs. 31 and 39. Laser phase directional control of photo-ionization and dissociation using two-color laser fields, Refs. 35 and 37 (coherent control).

iii) Algorithmic aspects: introduction of a new numerical method for solving the time-dependent Schrödinger equation using the Bessel-Fourier basis, Ref. 15 and a wave function splitting method allowing to recover the lost electron flux in absorbing potentials ,Refs. 25, 29.

b) **Nonlinear Optics and Computational Electromagnetics**

i) Propagation of intense laser pulses in gases - numerical solutions of Maxwell-Schrödinger equation. Resonant laser pulses propagation in N-level systems. Generation of solitons, Refs. 8, 9, 12.

ii) Generation of **high frequency harmonics** by atoms and molecules, Refs. 13, 17 and 18.

iii) Numerical solutions of nonlinear Maxwell equations for the design of nonlinear waveguides based on quantum well structures in GaAs (research project at National Research Council, Ottawa), 1986-87.

(iv) Numerical solutions of Maxwell equations using the Galerkin method for studying scattering of radar waves by objects with complex geometry (consulting for the Rockwell Science Center): numerical and analytic treatment of singularities in Green functions.

c) **Relativistic Dynamics of N-particles**

i) Action-at-a-distance theory in relativistic N-particles dynamics (Intermediate theory between non-relativistic dynamics and quantum field theory), 1976-1985.

ii) Quantum, relativistic theory of scattering of high energy particles on bound states (nuclei,atoms), evaluation of relativistic corrections to the standard models (Ph.D. Thesis), 1972-76.

4. Refereed Publications in Scientific Periodicals

1. S. Chelkowski, Z. Chylinski and J. Pszon, "Deuteron disintegration by the high energy electron", Acta Physica Polonica, B5, 183 (1974).

2. S. Chelkowski, J. Nietendel and R. Suchanek, "No interaction theorems in relativistic dynamics of N-particles", Acta Physica Polonica, B11, 809, (1980).

3. S. Chelkowski and R. Suchanek, "Asymptotic integration of Currie-Hill equations in relativistic N-particle dynamics", Acta Physica Polonica, B12, 1013 (1981)

4. S. Chelkowski and J. Nietendel, "Lagrangian formulation of instantaneous relativistic N-particle dynamics", Acta Physica Polonica, B13, 421 (1981).

5. S. Chelkowski, "Physically realistic model of instantaneous predictive relativistic dynamics", Acta Physica Polonica, B16, 403 (1985).

6. J. Chrostowski and S. Chelkowski, "Analysis of optical rib waveguide with a nonlinear substrate", Optics Letters, 12, 528 (1987).

7. S. Chelkowski and J. Chrostowski, "Scaling rules for slab waveguides with nonlinear substrate", Applied Optics, 26,3681 (1987).

8. S. Chelkowski and A.D. Bandrauk, "Coherent propagation of intense ultrashort laser pulses in a molecular multilevel medium", J. Chem. Phys. 89,3618 (1988).

9. S. Chelkowski and A.D. Bandrauk, "Multilevel nonlinear effects in the amplification of ultrashort laser pulses in CO_2 ", J. Opt. Soc. Am. B, 7, 90 (1989).

10. S. Chelkowski and A. D. Bandrauk, "Coherent interaction of an ultra- short zero area pulse with a Morse oscillator", Phys. Rev. A, 41 6480 (1990)

11. S. Chelkowski, A. D. Bandrauk and P. Corkum, "Efficient molecular dissociation by a chirped, ultrashort, infrared laser pulse", Phys. Rev. Lett. 65, 2355 (1990)

12. A. D. Bandrauk, S. Chelkowski and H. B. Wang, "Optical pulse propagation in nondegenerate multilevel systems: I - Resonant equidistant levels ", Physica D50, 31 (1991)

13. S. Chelkowski and A. D. Bandrauk, "Harmonic and nonharmonic frequency generation by molecular vibrations strongly driven by laser radiation", Phys. Rev. A44, 788 (1991)

14. S. Chelkowski and A. D. Bandrauk, "Selective excitation of local bond molecular vibrations using intense chirped infrared pulses", Chem. Phys. Lett. 186, 264 (1991)

15. S. Chelkowski, T. Zuo and A. D. Bandrauk, "Ionization rates of H_2^+ in an intense laser field by numerical integration of the time dependent Schrödinger equation", Phys. Rev. A46, R5342 (1992)

16. S. Chelkowski and A. D. Bandrauk, "Control of molecular vibrational excitation and dissociation by chirped intense infrared laser pulses: rotational effects", J. Chem. Phys. 99, 4279 (1993)

17. T. Zuo, S. Chelkowski and A.D. Bandrauk, "Harmonic generation by the hydrogen molecular ion in intense laser fields", Phys.Rev. A48, 3837 (1993)

18. T. Zuo, S.Chelkowski and A.D. Bandrauk, "Photon-emission spectra of the H_2^+ molecular ion in an intense laser field", Phys. Rev. A49, 3943 (1994)

19. S. Chelkowski an A.D. Bandrauk, "Picosecond Isomerization of a Linear Triatomic Molecule with Two Intense Infrared Laser Pulses", Chem. Phys. Lett. 233, 185 (1995)

20. S. Chelkowski, T. Zuo, O.Atabek and A.D. Bandrauk, "Dissociation, ionization and Coulomb explosion of H_2^+ in an intense laser field by numerical integration of the time-dependent Schrödinger equation", Phys. Rev. A. 52, 2977 (1995)

21. S. Chelkowski and G.N. Gibson, "Adiabatic climbing of vibrational ladders using Raman transitions with a chirped pump laser", Phys. Rev. A. 52, R3417 (1995)

22. S. Chelkowski and A. D. Bandrauk, "Two step Coulomb explosions of diatoms in intense laser fields", J. Phys. B.: At. Mol. Phys. 28, L1 (1995)

23. S.Chelkowski, A. Conjusteau, T.Zuo, and A.D.Bandrauk, "Dissociative ionization of H_2^+ in an intense laser field: Charge-resonance -enhanced ionization, Coulomb explosion, and harmonic generation at 600 nm", Phys.Rev. A 54, 3235 (1996).

24. C.M. Dion, S. Chelkowski, A.D. Bandrauk, H. Umeda and Y. Fujimura, "Numerical simulation of the isomerization of HCN by two perpendicular intense IR laser pulses", J. Chem. Phys. 105, 9083 (1996).

25. S. Chelkowski and A.D. Bandrauk, "Wave-function splitting technique for calculating above threshold ionization electron spectra", Int. J. Quant.Chem.: Quantum Chem.Symp. 30, 473 (1996).

26. S.Chelkowski and A.D. Bandrauk, "Raman chirped adiabatic passage: a new method for selective excitation of high vibrational states", J. Raman. Spect.28, 459 (1997)

27. S.Chelkowski and A.D.Bandrauk, "Above threshold ionization electron spectra from a dissociating molecular ion calculated using the wave-function splitting technique", Laser Physics, 7, 797 (1997)

28. A.D. Bandrauk, S.Chelkowski, H.Yu and E.Constant, "Enhanced harmonic generation in extended molecular systems by two-color excitation" , Phys.Rev.A 56, R2537 (1997).

29. S.Chelkowski, C.Foisy and A.D.Bandrauk, "Electron-nuclear dynamics of multiphoton H_2^+ dissociative ionization in intense laser fields", Phys.Rev.A 57,1176 (1998).

30. T.D.G. Walsh, F.A. Ilkov, S.L. Chin, F. Châteauneuf, T.T.Nguyen-Dang, S.Chelkowski, A.D. Bandrauk, and O. Atabek, Laser-induced processes during Coulomb explosion of H_2 in a Ti-sapphire laser pulse", Phys.Rev. A **58**, 3922 (1998).

31. S.Chelkowski, P.B.Corkum and A.D.Bandrauk,"Femtosecond Coulomb explosion imaging of vibrational wave functions", Phys.Rev.Lett. 82, 3416 (1999).

32. A. D. Bandrauk, S.Chelkowski, and P.B. Corkum, " Measuring nuclear wave functions by Las er Coulomb Explosion Imaging" , Int.J.Quant.Chem. 75, 951 (1999).

33. F. Legaré, S.Chelkowski and A.D. Bandrauk, "Laser pulse control of Raman processes by chirped non-adiabatic passage", J. Raman Spec., 31, 15 (2000).

34. S.Chelkowski and A.D.Bandrauk, "Electron-nuclear dynamics of H_2^+ in intense two-color laser fields: asymmetries in electron ATI spectra", Laser Phys. 10, 216 (2000).

35. A. D. Bandrauk and S.Chelkowski, "Asymmetric electron-nuclear dynamics in two-color laser fields: laser phase directional control of photo-fragments in H_2^+ ", Phys.Rev.Lett. 84, 3562 (2000).

36. F. Legaré, S. Chelkowski, and A.D. Bandrauk, " Preparation and alignment of highly vibrationally excited molecules by CARP - chirped adiabatic Raman passage", Chem. Phys. Lett. 329, 469 (2000).

37. A. D. Bandrauk, S.Chelkowski, and M. Zamojski, "Phase directional control of photo-fragments in dissociative-ionization using two-color intense laser pulses", Phys. Rev. A 63, 023409 (2001).

38. A. D. Bandrauk and S.Chelkowski, " On laser Coulomb explosion imaging of proton motion", Chem.Phys. Lett. 336, 518 (2001).

39. A.D. Bandrauk and S.Chelkowski, "Dynamic Imaging of Nuclear Wave functions from Coulomb Explosion and Phototelectron Spectra with ultrashort UV Laser Pulses", Phys.Rev.Lett. **87**, 273004 (2001).

40. S. Chelkowski and A.D. Bandrauk, "Measuring moving nuclear wave packets using laser Coulomb explosion imaging, L.C.E.I.", Phys.Rev. A.**65**,023403 (2002).

41. S. Chelkowski and A.D. Bandrauk, "Sensitivity of spatial photo-electron distributions to the absolute phase of an ultrashort intense laser pulse", Phys.Rev.A **65** (Rapid Comm.), 061802 (2002)

42. A.D. Bandrauk, S. Chelkowski, and J. Levesque, "Quasi-static models of the laser control of the dissociative ionization of H_2^+ and HD^+ at high intensities", Las. Phys. **12**, 468 (2002).

43. A.D. Bandrauk, S.Chelkowski, and Nguyen Hong Son, "Measuring the electric field of few-cycle laser pulses by attosecond cross-correlation", Phys.Rev. Lett. **89**, 283903 (2002).

44. A.D. Bandrauk, S.Chelkowski,"LIED: Laser Induced Electron Diffraction by Intense Laser-Molecule Interaction - an Exact Non-Born-Oppenheimer Simulation of the One-Electron System :H_2^+ ", J. Molec. Struct. (Theochem) **591**, 199 (2002).

45. A.D. Bandrauk, S.Chelkowski, " Meausuring Molecular Wave functions using Laser Coulomb Explosion Imaging with Ultraviolet Lasers", Applied Physics B 74, s113 (2002).

46. A.D. Bandrauk, S.Chelkowski, and Nguyen Hong Son, "How to measure the duration of subfemtosecond XUV laser pulses using asymmetric photo-ionization", Phys.Rev. A, **68**, 041802 (2003).

47. S. Chelkowski, Nguyen Hong Son, and A.D. Bandrauk, "Measuring the Absolute Phase of an Ultrashort Intense Laser Pulse", Las.Phys.**13**,871 (2003).

48. J. Levesque, S.Chelkowski, and A.D. Bandrauk, "Isotopic Effects in the Laser Control of Dissociative Ionization at High Intensities: Role of Permanent Dipole Moments", J. Phys.Chem. **107**, 3457 (2003).

49. A.D. Bandrauk, S.Chelkowski, and I. Kawata, "Molecular Above-Threshold- Ionization Spectra: The Effect of Moving Nuclei", Phys.Rev. A **67**, 013407 (2003).

50. A.D. Bandrauk, S.Chelkowski, Nguyen Hong Son, "Controlling continuum harmonic generation with attosecond pulses", Appl.Phys.B **77**, 337 (2003).

51. A. Ben Haj Yedder, C. Le Bris, O. Atabek, S.Chelkowski, A.D. Bandrauk, "Optimal Control of Attosecond Pulse Synthesis from High-Order Harmonic Generation", Phys.Rev. A**69**, 041802 (2004).

52. S. Chelkowski, A.D. Bandrauk, and A. Apolonski, "Measurement of the Carrier-Envelope Phase of Few-Cycle Laser Pulses by Use of Asymmetric Ionization", Opt.Lett, **29**, 1557 (2004).

53. S.Chelkowski, A.D. Bandrauk, and A. Apolonski, "Phase Dependent Asymmetries in Strong-Field Photoionization by Few-Cycle Laser Pulses:, Phys. Rev. A **70**, 013815(2004).

54. S. Chelkowski, A.D. Bandrauk, and P.B. Corkum, "Muonic Molecules in Super-Intense Laser Fields", Phys.Rev.Lett. **93**, 083602 (2004).

55. S. Chelkowski, A.D. Bandrauk, and P.B. Corkum, "Muonic Molecules in Super-Intense Laser Fields: A Route to Laser Control of Nuclear Processes", Las.Phys. **14**, 473 (2004).

56. S. Chelkowski and A.D. Bandrauk, "Asymmetries in Strong-Field Photoionization by Few-Cycle Laser Pulses: kinetic-energy spectra and semi-classical explanation of the asymmetries of fast and slow electrons", Phys. Rev.A **71**, 053815 (2005).

57. A.D. Bandrauk, S.Chelkowski, and S. Goudreau, "Control of Harmonic Generation Using Two-Colour Femtosecond-Attosecond Laser Fields: Quantum and Classical Perspectives", J. Mod. Opt. **52**, 411 (2005).

58. G.L. Yudin, S.Chelkowski, J. Itatani, A.D. Bandrauk and P.B. Corkum, "Attosecond photoionization of coherently coupled electronic states" PRA **72**, 051401 (R) (2005).

59. G.L. Yudin, S.Chelkowski, A.D. Bandrauk, "Coulomb continuum effects in molecular interference", J.Phys.B. **39**, L17 (2006).

60. S. Chelkowski, G.L. Yudin, and A.D. Bandrauk, "Observing electron motion in molecules", J. Phys. B: At. Mol. Opt. Phys. **39**, S409 (2006).

61. D.S. Tchitchekova, S. Chelkowski, and A.D. Bandrauk, "Adiabatic Climbing of Vibrational Ladders using Raman Transitions with Chirped Pump Lasers: effect of Higher Electronic Surfaces and Control of the Shapes of Vibrational Wave Packets", J.Raman Spect. **38**, 927 (2007).

62. A. Staudte, D. Pavičić, S. Chelkowski, D. Zeidler, M. Meckel, H. Niikura, M. Schöffler, S. Schössler, B. Ulrich, P. P. Rajeev, Th. Weber, T. Jahnke, D.M. Villeneuve, A.D. Bandrauk, C.L. Cocke, P.B. Corkum, and R. Dörner, Phys.Rev.Lett., **98**, 073003 (2007).

63. S. Chelkowski, A.D. Bandrauk, A. Staudte, and P.B. Corkum, "Dynamic nuclear interference structures in Coulomb explosion of a hydrogen molecule", Phys.Rev. A **76**. 013405 (2007).

64. D. Tchitchekova, S. Chelkowski, A. D. Bandrauk, "Multiphoton Ion Pair Spectroscopy in Strong Fields for H_2 ", J. Phys. Chem A 111, 9340 (2007).

65. E. Lorin, S. Chelkowski , A. Bandrauk, "A numerical MaxwellSchrödinger model for intense lasermatter interaction and propagation", Computer Phys. Comm. **177** 908 (2007).

66. A.D. Bandrauk, S. Chelkowski, S. Kawai, and H. Lu, "Effect of nuclear motion on molecular high order harmonic generation", Phys.Rev.Lett. **101**, 153901 (2008).

67. E. Lorin, S. Chelkowski, and A.D Bandrauk, "Attosecond pulse generation from aligned molecules - dynamics and propagation in H_2^+", New J. of Phys. **10**, 025033 (2008).

68. A. D. Bandrauk, S .Chelkowski, and H. Lu, "Signatures of nuclear motion in molecular high-order harmonics and in the generation of attosecond pulse trains by ultrashort intense laser pulses", J. Phys. B **42**, 075602 (2009).

69. S. Chelkowski, A.D. Bandrauk, S. Chelkowski, J. Manz, P.B. Corkum, and G.L. Yudin, "Attosecond ionization of a coherent superposition of bound and dissociative molecular states", J. Phys. B **42**, 134001 (2009).

70. E. Lorin, S. Chelkowski, A. D. Bandrauk, "Mathematical Modelling of Boundary Conditions for Laser Molecule TDSES", Numerical Methods in PDES 25, 110 (2009).

71. S. Chelkowski and A.D. Bandrauk, "Visualizing electron delocalization, electron-proton correlations, and the Einstein-Podolsky-Rosen paradox during the photodissociation of a diatomic molecule using two ultrashort laser pulses", Phys.Rev A **81**, 062101 (2010).

72. D.S. Tchitchekova, H. Lu, S. Chelkowski and A.D. Bandrauk, "Molecular high-order harmonic generation in a nonlinear two-electron molecule: the equilateral H_3^+", J. Phys. B: At. Mol. Opt. Phys. **44**, 065601 (2011).

73. A.D. Bandrauk, S. Chelkowski, K.J. Yuan, "Laser Control of Collision-Recollision", Intl. Rev. At. Molec. Phys. **2**, 1-23 (2011). A direct link to the paper is:

"http://www.auburn.edu/academic/cosam/departments/physics/iramp/2_1/1_bandrauk_et

74. T. Bredtmann, S. Chelkowski, A.D. Bandrauk, "Monitoring Attosecond Electron Nuclear Motion, Phys. Rev. A **84**, 021401 (2011).

75. E. Lorin, S. Chelkowski, and A.D. Bandrauk, "The WASP Model: A Micro-Macro System of Wave-Schrödinger-Plasma Equations for Filamentation" Commun. Comput. Phys. **9**, No. 2, pp. 406-440 (2011).

76. S. Chelkowski, T. Bredtmann, A.D. Bandrauk, "High Order Harmonic Generation from Coherent Electron Wave Packets Monitoring Attosecond Electrons", Phys. Rev. A 85, 033404 (2012).

77. A.D. Bandrauk, S. Chelkowski, H.Z. Lu "High Frequency Correlated Nuclear-Electron Motion in Molecules", in press, Chem. Phys. (2012).

78. E. Lorin, S. Chelkowski, E. Zaoui, A.D. Bandrauk, "Maxwell-Schrödinger Plasma Model for Quantum Filamentation", Physica D **241**, 1059 (2012).

5. Other publications

1. S. Chelkowski, "Influence of Final State Interaction on Momentum Distribution of Spectator Nucleon in Reaction x+d $\rightarrow$ x+p+n", Jagiellonian University preprint, TPJU-17/74 (Oct. 1974)

2. S. Chelkowski, Doctorate thesis " Distributions of the momenta of spectator nucleon at the deuteron disintegration by a high energy particle", written in the Institute of Physics, Jagiellonian University, Cracow (in Polish, 1976).

3. S. Chelkowski and A.D. Bandrauk, "Propagation of ultrashort laser pulses in an "N-level medium", in "Atomic and molecular processes with short intense laser pulses", NATO ASI Series B, Physics, Vol. 171, ed. A.D. Bandrauk, (Plenum, New York, 1988), p.59.

4. S. Chelkowski and A. D. Bandrauk, "Nonresonant nonlinear effects in amplification of ultrashort laser pulses in O_2 ", in: Topical meeting on optical properties of materials, 1986 Technical digest series, Vol.9 (Optical Society of America, Washington, D.C. 1986), p.139.

5. S. Chelkowski and A. D. Bandrauk, "Nonresonant effects in CO_2 amplifier", in "Disorder and nonlinearity", editors: A. R Bishop, D. K. Campbell and S. Pnevmatikos (Springer-Verlag Berlin Heidelberg 1989)

6. S. Chelkowski and A. D. Bandrauk, "Interaction des pulses lasers ultracourts avec un oscillateur de Morse", Annales de L'ACFAS, 58, (1990)

7. S. Chelkowski, A.D. Bandrauk and P.B. Corkum, "Dissociation of an ionic molecule by a chirped ultrashort laser pulse", Bull. of Am. Phys. Soc. 35, No. 7 , 1503 (1990)

8. S. Chelkowski and A.D. Bandrauk, "Control of molecular vibrational excitation and dissociation by chirped intense laser pulses", in Coherence Phenomena in Atoms and Molecules in Laser Fields, NATO ASI Series B: Physics Vol. 287, eds. A. D. Bandrauk and S. C. Wallace, (Plenum, New York, 1992), p. 333.

9. A.D. Bandrauk, S. Chelkowski, and T. Zuo, " H_2^+ : Harmonic generation", OSA Proceedings on Shortwavelength V, 1993, Vol.17, P. B. Corkum and M.D. Perry (eds).

10. S. Chelkowski and A. D. Bandrauk, "Harmonic Generation by N-level systems", Proceedings of ICOMP VI, Québec 1993, D.K.Evans and S.L.Chin eds., World Scientific (1994).

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14. C. Foisy, A.D. Bandrauk, and S. Chelkowski, "Scalable Program for the Solution of Schrödinger Equation for Intense Laser Pulses", *High Performance Computing Symposium (HPCS'96),* 1996, Ottawa, Canada",

15. S. Chelkowski, A.D. Bandrauk and A. Conjusteau, "Control of molecular vibrations and rotations using chirped intense laser pulses", proceedings of International Conference on Multiphoton Processes, ICOMP VII, Munich, Intnl. Phys. Conf. Ser. 154, 192-201 (1997).

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