CURRICULUM VITAE OF GEORGE ALLAN HAGEDORN

DATE AND PLACE OF BIRTH:

18 October 1953
Santa Monica, California.

EDUCATION:

1974	B.A., summa cum laude in Mathematics, summa cum laude in Physics, and with distinction in all subjects. Cornell University, Ithaca, New York.
1975	M.A. in Mathematics. Princeton University, Princeton, New Jersey.
1978	Ph.D. in Mathematics. Princeton University, Princeton, New Jersey.

PROFESSIONAL EMPLOYMENT:

1978–1980	Research Associate, The Rockefeller University, New York, New York.
1980–1983	Assistant Professor of Mathematics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
Fall 1981	Visiting Assistant Professor, Courant Institute of Mathematical Sciences, New York University, New York, New York.
1983–1988	Associate Professor of Mathematics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
1988–2014	Professor of Mathematics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
2014–present	Professor Emeritus, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

HONORS AND AWARDS:

1974	Phi Beta Kappa, Phi Kappa Phi.
1974–1977	National Science Foundation Graduate Fellow.
1981–1983	National Science Foundation Research Grant MCS–8100738.
1983–1986	National Science Foundation Research Grant MCS–8301277.
1986–1988	National Science Foundation Research Grant DMS–8601536.
1988–1990	National Science Foundation Research Grant DMS–8801360.
1990–1992	National Science Foundation Research Grant DMS–9001635.
1994–1997	National Science Foundation Research Grant DMS–9403401.
1996–2000	National Science Foundation Research Grant INT–9512919.
1997–2000	National Science Foundation Research Grant DMS–9703751.
2000–2004	National Science Foundation Research Grant DMS–0071692.
2003–2007	National Science Foundation Research Grant DMS–0303586.
2006–2010	National Science Foundation Research Grant DMS–0600944.
2009–2013	National Science Foundation Research Grant DMS–0907165.
2012–2016	National Science Foundation Research Grant DMS–1210982.

2008 Nominated for the Dannie Heineman Prize in Mathematical Physics (administered jointly by the American Physical Society and the American Institute of Physics).

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

1972 – 2014	American Mathematical Society.
2014 – present	Emeritus Member, American Mathematical Society.
1979 – [life member]	International Association of Mathematical Physicists.

PROFESSIONAL SERVICE:

Member of the Program Committee for National Meetings of the American Mathematical Society, 1/1/1988 — 12/31/1990.

Member of the Steering Committee of the Southeastern Atlantic Regional Conference on Differential Equations, 10/1987 — 10/1990. Chairman 10/1989 — 10/1990.

Chairman of the Program Committee for the 1991 Joint Annual Meeting of the American Mathematical Society and the Mathematical Association of America.

Director of Virginia Tech's Center for Statistical Mechanics, Mathematical Physics, and Theoretical Chemistry, 1/1997 — present.

Member of the Scientific Advisory Committee for the Conference, "Spectral Theory and Mathematical Physics, A Conference in Honor of Barry Simon's 60th Birthday." California Institute of Technology, Pasadena, California, March 2006.

Coorganizer for the Banff workshop, "Workshop on Mathematical Methods in Quantum Molecular Dynamics." Banff International Research Station, April 2013.

Coorganizer for the Oberwolfach workshop, "Mathematical Methods in Quantum Molecular Dynamics." Mathematisches Forschungsinstitut Oberwolfach, May 2015.

Coorganizer for the Banff workshop, "Workshop on Exploiting New Advances in Mathematics to Improve Calculations in Quantum Molecular Dynamics." Banff International Research Station, January 2016.

EDITORIAL BOARDS:

Associate Editor, Journal of Mathematical Analysis and Applications, 1/1/1997 — 4/1/2005.

GRADUATE THESES DIRECTED:

Winfried R.E. Weiss, Mathematics Masters Thesis: Approximate Solutions to the Wave Equation for a Medium with One Discontinuity. (August 1983).

Jan Dereziński, Mathematics Ph. D. Dissertation: Existence and Analyticity of Many Body Scattering Amplitudes at Low Energies. (August 1985).

Sam L. Robinson, Mathematics Ph. D. Dissertation: The Semiclassical Limit of Quantum Dynamics. (July 1986).

Armin Kargol, Physics Ph. D. Dissertation: The Born–Oppenheimer Approximation in Scattering Theory. (May 1994).

Keith Humfeld, Physics Masters Project and Report: A High Order Correction to the Energy of a One Dimensional Model of an H_2^+ Molecule. (August 1998).

Steven W. Jilcott, Mathematics Ph. D. Dissertation: Time–Dependent Perturbation and the Born–Oppenheimer Approximation. (April 2000).

Julio H. Toloza, Physics Ph. D. Dissertation: Exponentially Accurate Error Estimates of Quasiclassical Eigenvalues. (December 2002).

Ivan Rothstein, Mathematics Ph. D. Dissertation: Semiclassical Scattering for Two and Three Body Systems. (August 2004).

Sharon M. Hughes, Mathematics Ph. D. Dissertation: Born–Oppenheimer Expansion for Diatomic Molecules with Large Angular Momentum. (October 2007).

Mark S. Herman, Mathematics Ph. D. Dissertation: Born–Oppenheimer Corrections Near a Renner–Teller Crossing. (July 2008).

Adam S. Bowman, Mathematics Masters Thesis: The Born–Oppenheimer Approximation for Triatomic Molecules with Large Angular Momentum in Two Dimensions. (December 2010).

Adam S. Bowman, Mathematics Ph. D. Dissertation: Toward a Rigorous Justification of the Three–Body Impact Parameter. Approximation (February 2014).

Stephanie N. Gamble, Mathematics Masters Thesis: Vibrational Energies of the Hydrogen Bonds in $H_3O_2^-$ and $H_5O_2^+$. (May 2016).

PUBLICATIONS:

1. Hagedorn, G.A.: Asymptotic Completeness for a Class of Four Particle Schrödinger Operators. Bull. Amer. Math. Soc. **84**, 155–156 (1978).

2. Hagedorn, G.A.: Asymptotic Completeness for Classes of Two, Three, and Four Particle Schrödinger Operators. Transactions Amer. Math. Soc. **258**, 1–75 (1980).

3. Hagedorn, G.A.: Born Series for (2 Cluster) → (2 Cluster) Scattering of Two, Three, and Four Particle Schrödinger Operators. Commun. Math. Phys. **66**, 77–94 (1979).

4. Hagedorn, G.A.: A Link Between Scattering Resonances and Dilation Analytic Resonances in Few Body Quantum Mechanics. Commun. Math. Phys. **65**, 181–188 (1979).

5. Hagedorn, G.A.: Semiclassical Quantum Mechanics for Coherent States, in *Mathematical Problems in Theoretical Physics,* ed. by K. Osterwalder, Berlin, Heidelberg, New York, Springer Verlag, 1980.

6. Hagedorn, G.A.: Semiclassical Quantum Mechanics I: The $\hbar \to 0$ Limit for Coherent States. Commun. Math. Phys. **71**, 77–93 (1980).

7. Hagedorn, G.A.: Semiclassical Quantum Mechanics II: The Large Mass Asymptotics for Coherent States, in *Trends in Applications of Pure Mathematics to Mechanics Vol. III.* ed. by R.J. Knops, London, Pitman, 1981.

8. Hagedorn, G.A.: A Time Dependent Born-Oppenheimer Approximation. Commun. Math. Phys. **77**, 1–19 (1980).

9. Hagedorn, G.A.: Semiclassical Quantum Mechanics III: The Large Order Asymptotics and More General States. Ann. Phys. **135**, 58–70 (1981).

10. Hagedorn, G.A.: Asymptotic Completeness for the Impact Parameter Approximation to Three Particle Scattering. Ann. Inst. H. Poincaré Sect. A. **36**, 19–40 (1982).

11. Hagedorn, G.A.: An Analog of the RAGE Theorem for the Impact Parameter Approximation to Three Particle Scattering. Ann. Inst. H. Poincaré Sect. A. **38**, 59–68 (1983).

12. Hagedorn, G.A. and Perry, P.A.: Asymptotic Completeness for Certain Three Body Schrödinger Operators. Comm. Pure Appl. Math. **36**, 213–232 (1983).

13. Hagedorn, G.A.: A Particle Limit for the Wave Equation with a Variable Wave Speed. Comm. Pure Appl. Math. **37**, 91–100 (1984).

14. Hagedorn, G.A. and Perry, P.A.: Asymptotic Completeness for Few Body Schrödinger Operators, in *Differential Equations,* North Holland Mathematics Series #92, ed. by I. Knowles and R. Lewis, Amsterdam, New York, Oxford, North Holland, 1984.

15. Hagedorn, G.A. and Perry, P.A.: Asymptotic Completeness for Certain Four Body Schrödinger Operators. J. Functional Analysis **65**, 172–203 (1986).

16. Weiss, W.R.E. and Hagedorn, G.A.: Reflection and Transmission of High Frequency Pulses at an Interface. Transpt. Theory Stat. Phys. **14**, 539–565 (1985).

17. Hagedorn, G.A.: Review of *Scattering Theory for Many-Body Quantum Mechanical Systems - Rigorous Results,* by Israel M. Sigal. SIAM Review **27**, 103 (1985).

18. Hagedorn, G.A.: Semiclassical Quantum Mechanics IV: Large Order Asymptotics and More General States in More Than One Dimension. Ann. Inst. H. Poincaré Sect. A. **42**, 363–374 (1985).

19. Hagedorn, G.A.: Review of *Scattering Theory by the Enss Method,* by Peter A. Perry. SIAM Review **27**, 274–275 (1985).

20. Hagedorn, G.A., Loss, M., and Slawny, J.: Non–Stochasticity of Time Dependent Quadratic Hamiltonians and the Spectra of Canonical Transformations. J. Phys. A. **19**, 521–531 (1986).

21. Hagedorn, G.A.: High Order Corrections to the Time-Dependent Born-Oppenheimer Approximation I: Smooth Potentials. Ann. Math. **124**, 571-590 (1986). Erratum **126**, 219 (1987).

22. Hagedorn, G.A.: High Order Corrections to the Time-Independent Born-Oppenheimer Approximation I: Smooth Potentials. Ann. Inst. H. Poincaré Sect. A. **47**, 1–16 (1987).

23. Hagedorn, G.A.: High Order Corrections to the Time-Independent Born-Oppenheimer Approximation II: Diatomic Coulomb Systems. Commun. Math. Phys. **116**, 23–44 (1988).

24. Hagedorn, G.A.: High Order Corrections to the Time-Dependent Born-Oppenheimer Approximation II: Coulomb Systems. Commun. Math. Phys. **117**, 387–403 (1988).

25. Hagedorn, G.A.: Multiple Scales and the Time-Independent Born-Oppenheimer Approximation, in *Differential Equations and Applications, Vol. 1*, ed by R. Aftabizadeh. Athens, Ohio, Ohio University Press, 1989.

26. Hagedorn, G.A.: Analysis of a Nontrivial, Explicitly Solvable Multichannel Scattering System. Ann. Inst. H. Poincaré Sect. A. **51**, 1–22 (1989).

27. Hagedorn, G.A.: Review of *Quantum Scattering and Spectral Theory*, by D. B. Pearson. SIAM Review **31**, 506 (1989).

28. Hagedorn, G.A.: Adiabatic Expansions Near Eigenvalue Crossings. Ann. Phys. **196**, 278–295 (1989).

29. Hagedorn, G.A.: Electron Energy Level Crossings in the Time–Dependent Born–Oppenheimer Approximation. Theor. Chim. Acta. **77**, 163–190 (1990).

30. Hagedorn, G.A.: Proof of the Landau–Zener Formula in an Adiabatic Limit with Small Eigenvalue Gaps. Commun. Math. Phys. **136**, 433–449 (1991).

31. Hagedorn, G.A.: Time–Reversal Invariance and the Time–Dependent Born–Oppenheimer Approximation, in *Forty More Years of Ramifications: Spectral Asymptotics and Its Applications*, ed by S. A. Fulling and F. J. Narcowich. Discourses in Mathematics and Its Applications, No. 1, Texas A&M University Press, 1991.

32. Hagedorn, G.A.: Classification and Normal Forms for Quantum Eigenvalue Crossings. Astérisque **210**, 115–134 (1993).

33. Hagedorn, G.A.: Molecular Propagation through Electron Energy Level Crossings. Memoirs Amer. Math. Soc. **111 (536)**, 1–130 (1994).

34. Hagedorn, G.A.: Effects of Electron Energy Level Crossings on Molecular Propagation. *Differential Equations and Mathematical Physics: Proceedings of the International Conference, University of Alabama at Birmingham, March 13–17 1994*. ed. by I Knowles, 85–96 (1996).

35. Hagedorn, G.A.: Crossing the Interface between Chemistry and Mathematics. Notices Amer. Math. Soc. **43**, 297–299 (1996).

36. Hagedorn, G.A.: Classification and Normal Forms for Avoided Crossings of Quantum Mechanical Energy Levels. J. Phys. A. **31**, 369–383 (1998).

37. Hagedorn, G.A. and Joye, A.: Landau–Zener Transitions through Small Electronic Eigenvalue Gaps in the Born–Oppenheimer Approximation. Ann. Inst. H. Poincaré, Sect. A. **68**, 85–134 (1998).

38. Hagedorn, G.A.: Raising and Lowering Operators for Semiclassical Wave Packets. Ann. Phys. **269**, 77–104 (1998).

39. Hagedorn, G.A. and Robinson, S.L.: Bohr–Sommerfeld Quantization Rules in the Semiclassical Limit. J. Phys. A. **31**, 10113–10129 (1998).

40. Hagedorn, G.A. and Joye, A.: Molecular Propagation through Small Avoided Crossings of Electronic Energy Levels. Rev. Math. Phys. **11**, 41–101 (1999).

41. Hagedorn, G.A. and Meller, B.: Resonances in a Box. J. Math. Phys. **41**, 103–117 (2000).

42. Hagedorn, G.A. and Joye, A.: Semiclassical Dynamics with Exponentially Small Error Estimates. Commun. Math. Phys. **207**, 439–465 (1999).

43. Hagedorn, G.A. and Robinson, S.L.: Approximate Rydberg States of the Hydrogen Atom that are Concentrated near Kepler Orbits. Helv. Physica Acta. **72**, 316–340 (1999).

44. Hagedorn, G.A. and Joye, A.: Semiclassical Dynamics and Exponential Asymptotics, in *Differential Equations and Mathematical Physics: Proceedings of an International Conference held at the University of Alabama at Birmingham, March 16–20, 1999*. ed. by R. Weikard and G. Weinstein. pp. 181–195, 2000.

45. Hagedorn, G.A.: Molecular Propagation through Crossings and Avoided Crossings of Electron Energy Levels. *Equadiff 99 (Vol. 2) Proceedings of the International Conference on Differential Equations*. ed. by B. Fiedler, K. Gröger, and J. Sprekels. pp. 1235–1240, 2000.

46. Hagedorn, G.A. and Joye, A.: Exponentially Accurate Semiclassical Dynamics: Propagation, Localization, Ehrenfest Times, Scattering, and More General States. Ann. H. Poincaré **1**, 837–883 (2000).

47. Hagedorn, G.A. and Joye, A.: A Time–Dependent Born–Oppenheimer Approximation with Exponentially Small Error Estimates. Commun. Math. Phys. **223**, 583–626 (2001).

48. Hagedorn, G.A. and Joye, A.: Elementary Exponential Error Estimates for the Adiabatic Approximation. J. Math. Anal. Appl. **267**, 235–246 (2002).

49. Hagedorn, G.A.: Simplified Semiclassical Propagation Estimates. *Advances in Differential Equations and Mathematical Physics.* ed. by Y. Karpeshina, G. Stolz, R. Weikard, and Y. Zeng. Amer. Math. Soc. Contemporary Math. **327**, 151–160 (2003).

50. Hagedorn, G.A. and Joye, A.: Time Development of Exponentially Small Non–Adiabatic Transitions. Commun. Math. Phys. **250**, 393–423 (2004).

51. Hagedorn, G.A. and Toloza, J.H.: Exponentially Accurate Semiclassical Asymptotics of Low–Lying Eigenvalues for 2×2 Matrix Schrödinger Operators. J. Math. Anal. Appl. **312**, 300–329 (2005).

52. Hagedorn, G.A. and Joye, A.: Determination of Non–Adiabatic Scattering Wave Functions in a Born–Oppenheimer Model. Ann. H. Poincaré **6**, 937–990 (2005). Erratum **6**, 1197–1199 (2005).

53. Hagedorn, G.A., and Toloza, J.H.: Exponentially Accurate Quasimodes for the Time–Independent Born–Oppenheimer Approximation on a One–Dimensional Molecular System. Int. J. Quantum Chem. **105**, 463–477 (2005).

54. Hagedorn, G.A., Rousse, V., and Jilcott, S.W.: The AC Stark Effect, Time–Dependent Born–Oppenheimer Approximation, and Franck–Condon Factors. Ann. H. Poincaré **7**, 1065–1083 (2006).

55. Hagedorn, G.A. and Joye, A.: Mathematical Analysis of Born–Oppenheimer Approximations. *Spectral Theory and Mathematical Physics: A Festschrift in Honor of Barry Simon's 60$^{\text{th}}$ Birthday. Part I: Quantum Field Theory, Statistical Mechanics, and Nonrelativistic Quantum Systems*, ed. by F Gesztesy, P Deift, C Galvez, P Perry, and W. Schlag. Amer. Math. Soc. Proceedings of Symposia in Mathematics **76, part 1**, 203–226 (2007).

56. Hagedorn, G.A. and Joye, A.: Recent Results on Non–Adiabatic Transitions in Quantum Mechanics. In *Recent Advances in Differential Equations and Mathematical Physics*, ed. by N. Chernov, Y. Karpeshina, I. Knowles, R. Lewis, and R. Weikard. AMS Contemporary Mathematics Series. **412**, 183–198, 2006.

57. Hagedorn, G.A. and Joye, A.: A Mathematical Theory for Vibrational Levels Associated with Hydrogen Bonds I: The Symmetric Case. Commun. Math. Phys. **274**, 691–715 (2007).

58. Hagedorn, G.A. and Joye, A.: Vibrational Levels Associated with Hydrogen Bonds and Semiclassical Hamiltonian Normal Forms. *Adventures in Mathematical Physics: International Conference in Honor of Jean–Michel Combes on Transport and Spectral Problems in Quantum Mechanics, September 4–6, 2006*, ed. by François Germinet and Peter Hislop. Amer. Math. Soc. Contemporary Mathematics. **447**, 139–151, 2007.

59. Herman, M.S. and Hagedorn, G.A.: Does Møller–Plesset Perturbation Theory Converge? A Look at Two Electron Systems. Int. J. Quant. Chem. **109**, 210–225 (2009).

60. Hagedorn, G.A. and Joye, A.: A Mathematical Theory for Vibrational Levels Associated with Hydrogen Bonds II: The Non–Symmetric Case. Rev. Math. Phys. **21**, 279–313 (2009).

61. Hughes, S.M. and Hagedorn, G.A.: Diatomic Molecules with Large Angular Momentum in the Born–Oppenheimer Approximation. J. Phys. A: Math. Theor. **42**, article 035305 (2009).

62. Hagedorn, G.A. and Joye, A.: A Mathematical Theory for Vibrational Levels Associated with Hydrogen Bonds. Few Body Systems. **45**, 183–186 (2009).

63. Gradinaru, V., Hagedorn, G.A., and Joye, A.: Tunneling Dynamics and Spawning with Adaptive Semi–Classical Wave–Packets. J. Chem. Phys. **132**, article 184108 (2010).

64. Elgart, A. and Hagedorn, G.A.: An Adiabatic Theorem for Resonances. Comm. Pure Appl. Math. **64**, 1029–1058 (2011).

65. Gradinaru, V., Hagedorn, G.A., and Joye, A.: Exponentially Accurate Semiclassical Tunneling Wave Functions in One Dimension. J. Phys. A.: Math. Theor. **43**, article 474026 (2010).

66. Hagedorn, G.A. and Joye, A.: Non–Adiabatic Transitions in a Simple Born–Oppenheimer Scattering System. *Mathematical Results in Quantum Physics*, ed by P. Exner. 208–212, World Scientific, 2011.

67. Bourquin, R., Gradinaru, V. and Hagedorn, G.A.: Non–Adiabatic Transitions near Avoided Crossings: Theory and Numerics. J. Math. Chem. **50**, 602–619 (2012).

68. Hagedorn, G.A.: Quantum Adiabatic and Born–Oppenheimer Approximations. *Encyclopedia of Applied and Computational Mathematics*, ed by Björn Engquist. Springer Verlag (to appear).

69. Elgart, A. and Hagedorn, G.A.: A Note on the Switching Adiabatic Theorem. J. Math. Phys. **52**, article 102202 (2012).

70. Gradinaru, V. and Hagedorn, G.A.: Convergence of a Semiclassical Wavepacket Based Time–Splitting for the Schrödinger Equation. Numerische Mathematik. **126**, 53–73 (2014).

71. Hagedorn, G.A.: A Minimal Uncertainty Product for One Dimensional Semiclassical Wave Packets. *Spectral Analysis, Differential Equations and Mathematical Physics. A Festschrift for Fritz Gesztesy on the Occasion of his 60th birthday*, pp. 183–190. ed. by. H. Holden, B. Simon, and G. Teschl. 2013.

72. Hagedorn, G.A. and Valeev, E.F.: Molecular Resonance Raman and Rayleigh Scattering Stimulated by a Short Laser Pulse. J. Stat. Phys. **154**, 522–542 (2014).

73. Hagedorn, G.A.: Generating Function and a Rodrigues Formula for the Polynomials in d–Dimensional Semiclassical Wave Packets. Ann. Phys. **362**, 603–608 (2015).

74. Hagedorn, G.A. and Lasser, C.: Symmetric Kronecker Products and Semiclassical Wave Packets. SIAM J. Matrix Anal. Appl. **38**, 1560–1579 (2017)..

75. Hagedorn, G.A. and Lasser, C.: Molecular Quantum Dynamics. Snapshots on Modern Mathematics from Oberwolfach. https://publications.mfo.de/handle/mfo/1313.

PRESENTATIONS AND INVITED LECTURES:

1. Semiclassical Quantum Mechanics for Coherent States. International Conference on Mathematical Physics, Lausanne, Switzerland (International Association of Mathematical Physicists), August 1979.

2. Semiclassical Quantum Mechanics for Coherent States. Symposium on Trends in Applications of Pure Mathematics to Mechanics, Edinburgh, Scotland (International Society for the Interaction of Mechanics and Mathematics), September 1979.

3. A Time Dependent Born–Oppenheimer Approximation. International Conference on Mathematical Physics (Poster Session), West Berlin, West Germany (International Association of Mathematical Physicists), August 1981.

4. Asymptotic Completeness for Few Body Schrödinger Operators. International Conference on Differential Equations, Birmingham, Alabama, March 1983.

5. A Particle Limit for the Wave Equation with a Variable Wave Speed. International Conference on Mathematical Physics (Poster Session), Boulder, Colorado (International Association of Mathematical Physicists), August 1983.

6. Multiple Scales and the Time–Independent Born-Oppenheimer Approximation. International Conference on Differential Equations and Mathematical Physics, Birmingham, Alabama, March 1986.

7. High Order Born-Oppenheimer Approximations. International Congress of Mathematical Physicists (Special Session on Schrodinger Operators), Marseille, France, July 1986.

8. High Order Born–Oppenheimer Approximations. Gordon Conference on Dynamics of Simple Systems in Chemistry and Physics (Poster Session), Brewster Academy, Wolfeboro, New Hampshire, August 1987.

9. Multiple Scales and High Order Born–Oppenheimer Approximations. International Congress of Mathematical Physicists (Poster Session). Swansea, Wales (International Association of Mathematical Physicists), July, 1988.

10. Electron Energy Level Crossings in the Time–Dependent Born–Oppenheimer Approximation. Special Session on Schrödinger Operators, Winter National Meeting of the American Mathematical Society, Louisville, Kentucky, January 1990.

11. Electron Energy Level Crossings in the Time–Dependent Born–Oppenheimer Approximation. 1990 Telluride Workshop on Geometric Phases. Telluride, Colorado, August 1990.

12. Electron Energy Level Crossings in the Time–Dependent Born–Oppenheimer Approximation. Gordon Conference on Dynamics of Simple Systems in Chemistry and Physics. Proctor Academy, Andover, New Hampshire, August 1990.

13. Electron Energy Level Crossings in the Time–Dependent Born–Oppenheimer Approximation. International Conference on Semiclassical Methods and Microlocal Analysis. Paris, France, February 1991.

14. Electron Energy Level Crossings: Their Classification and Effects on Molecular Propagation. International Colloquium on Semiclassical Methods. Nantes, France. June 1991.

15. Electron Energy Level Crossings in the Time–Dependent Born–Oppenheimer Approximation. IAMP–91 Tenth International Congress of Mathematical Physicists. Leipzig, Germany, August 1991.

16. Proof of the Landau–Zener Formula in an Adiabatic Limit with Small Eigenvalue Gaps. Georgia Tech – UAB International Conference on Differential Equations and Mathematical Physics. Atlanta, Georgia, March 1992.

17. Electron Energy Level Crossings in the Time–Dependent Born–Oppenheimer Approximation. Regional Meeting of the American Mathematical Society, Knoxville, Tennessee, March 1993.

18. Electron Energy Level Crossings in the Time–Dependent Born–Oppenheimer Approximation. Midwestern Conference on Differential Equations, Columbia, Missouri, November 1993.

19. Molecular Propagation through Electron Energy Level Crossings. The 1994 GIT–UAB International Conference on Differential Equations and Mathematical Physics. Birmingham, Alabama, March 1994.

20. Electron Energy Level Crossings in the Time–Dependent Born–Oppenheimer Approximation. Eleventh International Congress of Mathematical Physicists. Paris, France, July 1994.

21. Molecular Propagation through Electron Energy Level Crossings. (Poster Session). International Symposium on Computational Molecular Dynamics. Minnesota Supercomputer Institute, Minneapolis, Minnesota, October 1994.

22. Molecular Propagation through Avoided Crossings of Electron Energy Levels. Regional Meeting of the American Mathematical Society, Richmond, Virginia, November 1994.

23. Time–Dependent Born–Oppenheimer Theory. Département de Physique, Institut de Physique Théorique, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, June 1995.

24. Molecular Propagation through Electron Energy Level Crossings and Avoided Crossings. Institut für Theoretische Physique, Eidgenössische Technische Hochschule, Zürich, Switzerland, June 1995.

25. Molecular Propagation, Electron Energy Level Crossings, and Avoided Crossings. Institut für Analysis, Technische–Universität Braunschweig, Braunschweig, Germany, July 1995.

26. Molecular Propagation through Electron Energy Level Crossings and Avoided Crossings. Oberwolfach Conference on Schrödinger Operators, Oberwolfach, Germany, July 1995.

27. Molecular Propagation through Electron Energy Level Crossings and Avoided Crossings. Department of Mathematics and Physics, University of the Americas, Puebla, Mexico, November 1995.

28. Molecular Propagation through Electron Energy Level Crossings and Avoided Crossings. Physics Colloquium, Pontificia Universidad Catolica de Chile. Santiago, Chile, January 1996.

29. Molecular Propagation through Electron Energy Level Crossings and Avoided Crossings. Physics Colloquium, University of Córdoba. Córdoba, Argentina, February 1996.

30. Mathematical Opportunities in Chemical Physics. Conference on Geometry in Present Day Science. Mathematical Research Center at Aarhus University, Aarhus, Denmark, January 1997

31. Molecular Propagation through Electron Energy Level Crossings and Avoided Crossings. Analysis Seminar, Aarhus University. Aarhus, Denmark, January 1997.

32. Bohr–Sommerfeld Quantization Rules in the Semiclassical Limit. Georgia Tech–UAB International Conference on Differential Equations and Mathematical Physics. Georgia Institute of Technology, Atlanta, Georgia, March 1997.

33. Molecular Propagation through Small Avoided Crossings of Electron Energy Levels in the Born–Oppenheimer Approximation. Twelveth International Congress of Mathematical Physics. University of Queensland. Brisbane, Australia, July 1997.

34. Bohr–Sommerfeld Quantization Rules and the Rydberg States of Hydrogen. Regional Meeting of the American Mathematical Society, University of Louisville. Louisville, Kentucky, March 1998.

35. Molecular Propagation through Crossings and Avoided Crossings of Electron Energy Levels. Mathematics Colloquium, Rensselaer Polytechnic Institute. Troy, New York, April 1998.

36. Semiclassical Propagation of Wave Packets. Applied Mathematics Colloquium, University of São Paulo. São Paulo, Brazil, November 1998.

37. Semiclassical Propagation of Wave Packets. Physics Colloquium, University of Córdoba, Córdoba, Argentina, November 1998.

38. Raising and Lowering Operators for Semiclassical Wave Packets. GIT–UAB International Conference on Differential Equations and Mathematical Physics, University of Alabama at Birmingham, Birmingham, Alabama, March 1999.

39. Molecular Propagation through Crossings and Avoided Crossings of Electron Energy Levels. Dynamique et Résonance en Champs Intenses. Université de Bourgogne, Dijon, France, May 1999.

40. Dynamics of Semiclassical Wave Packets I: Raising and Lowering Operators. Mathematics Colloquium, Institut Fourier, Université de Grenoble I, Grenoble, France, June 1999.

41. Dynamics of Semiclassical Wave Packets II: Applications to Physical Systems. Mathematics Colloquium, Institut Fourier, Université de Grenoble I, Grenoble, France, June 1999.

42. Semiclassical Dynamics with Exponential Error Estimates. Théorie des Résonances, Centre International de Rencontres Mathématiques, Marseille–Luminy, France, June 1999.

43. Molecular Propagation through Crossings and Avoided Crossings of Electron Energy Levels. Equadiff 99, Freie Universität, Berlin, Germany, August 1999.

44. Semiclassical Dynamics with Exponentially Small Error Estimates. Sectional Meeting of the American Mathematical Society, University of North Carolina, Charlotte, North Carolina, October 1999.

45. A Review of Rigorous Results on Molecular Propagation. Workshop on Quantum Spectra and Dynamics, Technion, Haifa, Israel, and Hebrew University, Jerusalem, Israel, June–July 2000.

46. An Exponentially Accurate Time–Dependent Born–Oppenheimer Approximation. Analysis Seminar, Institut Fourier, Université de Grenoble I, Grenoble, France, July 2000.

47. An Exponentially Accurate Time–Dependent Born–Oppenheimer Approximation. PDE 2000 An International Conference on Partial Differential Equations. Technische Universität Clausthal, Clausthal–Zellerfeld, Germany, July 2000.

48. An Exponentially Accurate Time–Dependent Born–Oppenheimer Approximation. Sectional Meeting of the American Mathematical Society, University of Alabama at Birmingham, Birmingham, Alabama, November 2000.

49. A Review of Rigorous Results on Molecular Propagation. Functional Analysis Seminar, University of Tokyo, Tokyo, Japan, January 2001.

50. Rigorous Results on Molecular Propagation: Past, Present, and Hopes for the Future. Oberwolfach Meeting on Schrödinger Operators, Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Germany, May 2001.

51. A Time–Dependent Born–Oppenheimer Approximation with Exponentially Small Error Estimates. The 2002 UAB International Conference on Differential Equations and Mathematical Physics. University of Alabama at Birmingham, Birmingham, Alabama, March 2002.

52. Exponentially Accurate Semiclassical Approximations. Conference on Mathematical Results and Problems in Quantum Mechanics. Instituto de Física, University of São Paulo. São Paulo, Brazil, August 2002.

53. Semiclassical Dynamics and the Time-Dependent Born-Oppenheimer Approximation. Mathematical Analysis Seminar, Technische Universität München, München, Germany, November 2002.

54. A Review of Rigorous Results on Born-Oppenheimer Approximations. Theoretical Physics Seminar, Laboratoire de Physique Subatomique et de Cosmologie, Université de Grenoble I, Grenoble, France, May 2003.

55. Semiclassical Analysis of Low–Lying Eigenvalues: Results of Julio Toloza. Mathematical Physics Seminar, Institut Fourier, Université de Grenoble I, Grenoble, France, June 2003.

56. Time Development of Exponentially Small Non–Adiabatic Transitions. Mathematical Physics Seminar, Institut Fourier, Université de Grenoble I, Grenoble, France, September 2003.

57. A Review of Rigorous Results on Born–Oppenheimer Approximations. Mathematics Colloquium, Université de Nantes, Nantes, France, October 2003.

58. What can Mathematicians Prove about Molecular Propagation? Chemistry Colloquium, Colorado College, Colorado Springs, Colorado, November 2003.

59. A Review of Rigorous Results on Molecular Propagation. Mathematics Colloquium (Oliver Club Lecture), Cornell University, Ithaca, New York, November 2003.

60. Time Development of Exponentially Small Non–Adiabatic Transitions. Joint meeting of the American Mathematical Society and the Mexican Mathematical Society. Houston, Texas May 2004

61. The Time–Independent Born–Oppenheimer Approximation: Old and New Results. Mathematical Analysis Seminar Technische Universität München, München, Germany, June 2004.

62. The Time–Independent Born–Oppenheimer Approximation: Old and New Results. Mathematical Physics Working Group. Institut Fourier, Université de Grenoble I, Grenoble, France, June 2004.

63. Molecular Dynamics I: Semiclassical Wave Packets and the Adiabatic Expansion. Mathematical Physics Working Group. Institut Fourier, Université de Grenoble I, Grenoble, France, June 2004.

64. Molecular Dynamics II: The Time–Dependent Born–Oppenheimer Approximation and the Effects of Level Crossings. Mathematical Physics Working Group. Institut Fourier, Université de Grenoble I, Grenoble, France, June 2004.

65. Non–Adiabatic Scattering Wave Functions in a Simple Born–Oppenheimer Model. The 2005 UAB International Conference on Differential Equations and Mathematical Physics. Birmingham, Alabama, March 2005.

66. Classification and Normal Forms for Generic Crossings of Minimal Multiplicity Eigenvalues in Quantum Mechanics. Analysis Seminar. Départment de Mathématiques, Université de Cergy–Pontoise, Cergy–Pontoise, France, June 2005.

67. Time–Dependent Semiclassical Approximations and Born–Oppenheimer Approximations. Mathematics Colloquium, Mathematisches Institut, Universität Tübingen, Tübingen, Germany, June 2005.

68. Semiclassical Dynamics and Propagation of Molecular Wave Packets. DFG Priority Program, "Multiscale Problems" Workshop 2005, Molecular Dynamics: Chemistry and Mathematics. Heinrich Fabri Institut, Blaubeuren, Germany, June 2005.

69. A Variety of Results Related to the Time–Dependent Born–Oppenheimer Approximation. Analysis Seminar. Départment de Mathématiques, Université de Cergy–Pontoise, Cergy–Pontoise, France, June 2005.

70. A Review of Rigorous Results on Molecular Propagation. Partial Differential Equations Seminar, University of Washington, Seattle, Washington, October 2005.

71. A Variety of Results on Adiabatic Quantum Mechanics. Workshop on Adiabatic Quantum Computing. Perimeter Institute, Waterloo, Ontario, Canada, February 2006.

72. Molecular Quantum Mechanics in the Born–Oppenheimer Limit. Spectral Theory and Mathematical Physics, A Conference in Honor of Barry Simon's 60th Birthday. California Institute of Technology, Pasadena, California, March 2006.

73. Rigorous Molecular Quantum Mechanics: Born-Oppenheimer and Beyond. “Moleküle im Rechner” Seminar, Freie Universität Berlin, Berlin, Germany, June 2006.

74. Molecular Quantum Mechanics: A Review of the Standard Born–Oppenheimer Theory and Modifications Concerning Hydrogen Bonding. Retirement Celebration Seminar for James Howland. University of Virginia, Charlottesville, Virginia, December 2006.

75. Does Moller–Plesset Perturbation Theory Converge? A Look at Two–Electron Systems. (jointly with Mark Herman). The 2007 Meeting of the Southeastern Theoretical Chemistry Association. Virginia Tech, Blacksburg, Virginia, May 2007.

76. A New Mathematical Model for Vibrational Levels of Hydrogen Bonds. Interdisciplinary Workshop on Mathematical Challenges in Quantum Chemistry Problems. Mathematics Research Centre, Warwick Mathematics Institute, Warwick University, Coventry, England, July 2007.

77. The Franck–Condon Effect for a Simple Molecular System subject to a Laser Pulse. Mathematical Physics Seminar, University of Virginia, Charlottesville, Virginia, November 2007.

78. The Time–Independent Born–Oppenheimer Approximation and Modifications for Hydrogen Bonding. Mathematical Physics Working Group. Institut Fourier, Université de Grenoble I, Grenoble, France, June 2008.

79. Molecular Quantum Mechanics: A Review of the Standard Born–Oppenheimer Theory and Modifications Concerning Hydrogen Bonding. Mathematical Physics Seminar, Centre de Physique Théorique, Université de Marseille, Luminy, France, June 2008.

80. The Time–Independent Born–Oppenheimer Theory of Molecular Quantum Mechanics and Modifications for Hydrogen Bonding. Problèmes Spectraux en Physique Mathématique, Institut Henri Poincaré, Paris, France, June 2008.

81. Does Moller–Plesset Perturbation Theory Converge? A Look at Two–Electron Systems. (jointly with Mark Herman). Poster Session, Mathematical and Algorithmic Challenges in Electronic Structure Theory, Institute for Mathematics and Its Applications, University of Minnesota, Minneapolis, Minnesota, September 2008.

82. The Time–Dependent Born–Oppenheimer Approximation, Crossings, Avoided Crossings, and Some Non-Adiabatic Transitions. Mathematical Methods on *Ab Initio* Quantum Chemistry, Laboratoire J.A. Dieudonné, Université de Nice–Sophia–Antipolis, Nice, France, November 2008.

83. Non–Adiabatic Scattering Wave Functions in a Simple Born–Oppenheimer Model. Poster Session, Chemical Dynamics: Challenges and Approaches, Institute for Mathematics and Its Applications, University of Minnesota, Minneapolis, Minnesota, January 2009.

84. The Time–Dependent Born–Oppenheimer Approximation, Crossings, and Avoided Crossings. Chemical Dynamics: Challenges and Approaches, Institute for Mathematics and Its Applications, University of Minnesota, Minneapolis, Minnesota, January 2009.

85. Non–adiabatic scattering wave functions in a simple Born–Oppenheimer model. (Poster Session). 2009 Annual meeting of the Southeastern Theoretical Chemistry Association, Duke University, Durham, North Carolina, May 2009.

86. Non–Adiabatic Transitions in a Simple Born–Oppenheimer Scattering System. Workshop on Open Systems: Non–Equilibrium Phenomena – Dissipation, Decoherence, Transport. Center for Theoretical Studies, Institute for Theoretical Physics, ETH Zürich, Switzerland, June 2009.

87. A Review of the Standard Born–Oppenheimer Theory for Molecules, and Modifications Concerning Hydrogen Bonding. Applied Mathematics Colloquium. ETH Zürich, Switzerland, October 2009.

88. Non–Adiabatic Transitions caused by Avoided Crossings of Electron Energy Levels. Workshop on Quantum–Classical Modeling of Chemical Phenomena. Center for Scientific Compuation and Mathematical Modeling. University of Maryland. College Park, Maryland, March 2010.

89. The Born–Oppenheimer Approximation for Diatomic Molecules with Large Angular Momentum. Special Session on Spectral and Transport Properties of Schr̈dinger Operators, 2010 Spring Southeastern Sectional Meeting of the Amer. Math. Soc., Lexington, Kentucky, March 2010.

90. Non–Adiabatic Transitions in a Simple Born–Oppenheimer Model. QMath11: Mathematical Results in Quantum Physics. Hradec Králové, The Czech Republic. September 2010.

91. Vibrational Levels Associated with Hydrogen Bonds. Southeastern Atlantic Sectional Conference of the Society for Industrial and Applied Mathematics. University of North Carolina at Charlotte. Charlotte, North Carolina, March 2011.

92. Modified Born–Oppenheimer Approximations for Hydrogen Bonding. Oberwolfach Workshop on Mathematical Applications in Quantum Chemistry. Oberwolfach, Germany, July 2011.

93. Time–Dependent Semiclassical Quantum Mechanics: Theory and a Numerical Algorithm. Applied and Computational Mathematics Seminar, Department of Mathematics, University of Wisconsin. Madison, Wisconsin, October 2011.

94. Various Approaches to Semiclassical Quantum Dynamics. Analysis Seminar, School of Mathematics, Institute for Advanced Study. Princeton, New Jersey, March 2012.

95. A Simple Model for Molecular Resonance Raman Scattering. Special Session on Spectral Theory. Southeastern Sectional Meeting of the American Mathematical Society. University of South Florida. Tampa, Florida, March 2012.

96. A Simple Model for Molecular Raman Scattering. Mathematical Physics Seminar, Institut Fourier, Université de Grenoble I, Grenoble, France, June 2012.

97. A Simple Model for Molecular Raman Scattering. Oberseminar Numerik, Mathematisches Institut, Universität Tübingen, Tübingen, Germany, June 2012.

98. A Time–Splitting for the Semiclassical Schrödinger Equation. (jointly with Vasile Gradinaru). Oberseminar Numerik, Mathematisches Institut, Universität Tübingen, Tübingen, Germany, June 2012.

99. A Simple Model for Molecular Raman Scattering. Recent Developments in the Mathematical Analysis of Large Systems. Erwin Schrödinger Institute, Vienna, Austria, October 2012.

100. A Minimal Uncertainty Product for One Dimensional Semiclassical Wave Packets. South–Eastern Atlantic Regional Conference on Differential Equations. Wake Forest University, October 2012.

101. A Simple Model for Molecular Rayleigh and Raman Scattering. IMA Summit on the 2008–2009 Thematic Year on Mathematics and Chemistry. Chicago, Illinois, April 2013.

102. Molecular Resonance Raman and Rayleigh Scattering Stimulated by a Short Laser Pulse. Workshop on Mathematical Methods in Quantum Molecular Dynamics. Banff International Research Station. Banff, Alberta, Canada. April – May 2013.

103. Two Molecular Problems involving Electron Energy Level Crossings. Workshop on Conical Intersections in Mathematical Physics. Institut Henri Poincaré. Paris, France. May 2013.

104. Four lecture course at the Summer School on Mathematical and Computational Methods in Quantum Dynamics:
    1. Molecular Quantum Mechanics using Semiclassical Wave Packets.
    2. The Quantum Adiabatic Approximation.
    3. The Time–Dependent Born–Oppenheimer Approximation using Semiclassical Wave Packets.
    4. Some Numerical Techniques for the Semiclassical Schrödinger Equation.

    University of Wisconsin. Madison, Wisconsin. August 2013.

105. Some Theory and Numerics for Semiclassical Quantum Mechanics. Applied Math and Analysis Seminar, Duke University, Durham, North Carolina. September 2013.

106. The Time–Dependent Born–Oppenheimer Approximation and Non–Adiabatic Transitions. Mathematical and Numerical Methods for Complex Quantum Systems. University of Illinois at Chicago, Chicago, Illinois. March 2014.

107. Some Theory and Numerics for Semiclassical Quantum Mechanics. Mathematics Colloquium. University of Missouri, Columbia, Missouri. April 2014.

108. Stretching Vibrations of the Hydrogen Bond $HOHOH^-$. Workshop on Exploiting New Advances in Mathematics to Improve Calculations in Quantum Molecular Dynamics. Banff International Research Station. Banff, Alberta, Canada. January 2016.

109. Numerical Computation of Semiclassical Dynamics in Several Space Dimensions. Partial Differential Equations Seminar, University of Washington, Seattle, Washington, March 2016.

110. An Algorithm for Computing Semiclassical Dynamics in Several Space Dimensions. KI-Net Conference on Mathematical and Computational Methods in Quantum Chemistry. Yale University, New Haven, Connecticut, May 2016.

111. Non–Adiabatic Scattering Wave Functions in a Simple Born–Oppenheimer Model. Poster Session, KI-Net Conference on Mathematical and Computational Methods in Quantum Chemistry. Yale University, New Haven, Connecticut, May 2016.

112. Numerical Computation of Semiclassical Dynamics in Several Space Dimensions. Mathematics Colloquium, University of Texas at Dallas, Dallas, Texas, March 2017.

113. Theory and Numerics for Semiclassical Quantum Mechanics. Mini Workshop on WKB Analysis and Singularity Theory. Hokkaido University, Sapporo, Japan, December 2018.

114. Molecular Propagation through Conical Intersections of Electron Energy Levels. The 19th RIES–HOKUDAI International Symposium. Hokkaido University, Sapporo, Japan, December 2018.

115. Molecular Propagation through Conical Intersections of Electron Energy Levels. Results in Contemporary Mathematical Physics (in honor of Rafael Benguria). University of Chile, Santiago, Chile, December 2018.