

Lev Kaplan

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Education

9/91 – 6/96

Harvard University

Ph.D. in physics, June 1996.
M.A. in physics, June 1993.
Thesis Title: Topics in Effective Field Theories.
Advisors: Prof. Howard Georgi and Prof. Eric Heller.

Cambridge, MA

9/87 – 6/91

University of Pennsylvania

B.A. in physics and mathematics.

Philadelphia, PA

Employment

7/03 – present

Tulane University

New Orleans, LA

Assistant Professor: Quantum and wave chaos; Wave function structure and transport in non-integrable, disordered, and many-body interacting systems; Long-time semiclassical methods and quantum-classical correspondence; Quantum information and computation.

Recent applications: Quantum gate optimization; Superradiance in electron transport; Casimir forces in chaotic geometries; Statistics of rogue ocean waves; Time ordering in qubits and interacting systems; Quantum fidelity and decoherence; Quantization ambiguity; Time reversal in random matrix theory; Quantum dots in coulomb blockade regime; Branched electron flow in random potentials; Quantum kicked maps and quantum graphs; Two-body random interactions in nuclei; Large matrix eigenvalue problems.

Teaching: General Physics I (Fall 2003) and II (Spring 2004 & 2005), calculus based sequence for first-year undergraduate students; Graduate Quantum Mechanics I (Fall 2004) and II (Spring 2005); Introductory Physics II (Spring 2006, Lagniappe 2006), algebra-based sequence for premedical students; Graduate Theoretical Mechanics (Spring 2006, Fall 2007 & 2009); Great Ideas in Science (Fall 2006, Spring & Fall 2008), conceptual physics for non-science majors; Computational Physics and Engineering (Spring 2007 & 2009), new course for advanced undergraduates and graduate students; Mysteries of the Quantum World (Fall 2008 & 2009), new interdisciplinary course for first-year students. Overall instructor evaluation (average): 4.71/5 (undergraduate); 4.92/5 (graduate). Supervising several graduate and undergraduate students.

9/05 – 12/05

Harvard University

Visiting Scholar

Cambridge, MA

9/99 – 8/03	University of Washington <i>Research Assistant Professor and national Institute for Nuclear Theory Fellow</i> <i>Teaching:</i> Classical Mechanics for first-year graduate students (Autumn 2000 and Autumn 2001).	Seattle, WA
7/96 – 8/99	Harvard University <i>Junior Fellow, Society of Fellows</i>	Cambridge, MA
9/91 – 6/96	Harvard University <i>Research Assistant:</i> Effective field theories in particle physics, including QCD and extensions to the standard model. <i>Teaching Fellow:</i> Introductory Quantum Field Theory.	Cambridge, MA

Fellowships and Awards

National Science Foundation CAREER Award (2006–2011).

Louisiana Board of Regents Support Fund grant (2004–2007).

Tulane Research Enhancement Fund (2007).

Graduate Studies Students Association award for teaching excellence (2007).

Fellow, national Institute for Nuclear Theory (1999–2003).

Junior Fellow, Harvard Society of Fellows (1996–1999).

National Science Foundation Fellowship (1991–1994).

Other Activities

Lead organizer, Workshop on Complex Systems and Quantum Chaos, Seattle, March 13-16, 2000, involving forty participants from ten countries.

Referee for Physical Review Letters, Physical Review A, Physical Review C, Physical Review E, Annals of Physics, Journal of Physics A, Journal of Physics D, Journal of Physics: Condensed Matter, Physica B, European Physical Journal B, Nonlinearity, Israel Science Foundation, DOE Office of Nuclear Physics.

Created new interdisciplinary undergraduate program in Engineering Physics (launched Fall 2007) and new dual-degree engineering program with Vanderbilt University and Johns Hopkins University (launched Fall 2008).

Publications

- (48) L. Kaplan and Y. Alhassid, “Interaction Matrix Element Fluctuations in Ballistic Quantum Dots: Dynamical Effects,” in preparation.
- (47) A. M. Smith and L. Kaplan, “Wave Function Statistics for Chaotic Dynamical Systems,” submitted (July 2009).
- (46) R. Höhmann, U. Kuhl, H.-J. Stöckmann, L. Kaplan, and E. J. Heller, “Freak Waves in the Linear Regime: A Microwave Study,” in preparation.

- (45) T.-W. Lee, S. D. Huver, H. Lee, L. Kaplan, S. B. McCracken, C. Min, D. B. Uskov, C. D. Wildfeuer, G. Veronis, and J. P. Dowling, “Optimization of Quantum Interferometric Metrological Sensors in the Presence of Photon Loss,” submitted (July 2009).
- (44) G. L. Celardo and L. Kaplan, “Superradiance Transition in One-Dimensional Nanostructures: An Effective Non-Hermitian Hamiltonian Formalism” *Phys. Rev. B* **79**, 155108 (2009), arXiv:0901.0305.
- (43) D. Uskov, L. Kaplan, A. M. Smith, S. D. Huver, and J. P. Dowling, “Maximal Success Probabilities of Linear-Optical Quantum Gates,” *Phys. Rev. A* **79**, 042326 (2009) (also selected for Virtual Journal of Quantum Information), arXiv:0808.1926.
- (42) S. A. Fulling, L. Kaplan, K. Kirsten, Z. H. Liu, and K. A. Milton, “Vacuum Stress and Closed Paths in Rectangles, Pistons, and Pistols,” *J. Phys. A* **42**, 155402 (2009), arXiv:0806.2468.
- (41) E. J. Heller, L. Kaplan, and A. Dahlen, “Refraction of a Gaussian Seaway,” *J. Geophys. Res.* **113**, C09023 (2008), arXiv:0801.0613.
- (40) L. Kaplan and Y. Alhassid, “Interaction Matrix Element Fluctuations in Ballistic Quantum Dots: Random Wave Model,” *Phys. Rev. B* **78**, 085305 (2008) (also selected for Virtual Journal of Nanoscale Science & Technology), arXiv:0802.2410.
- (39) E. J. Heller, L. Kaplan, and F. Pollmann, “Inflationary Dynamics for Matrix Eigenvalue Problems,” *Proc. Natl. Acad. Sci. USA* **105**, 7631 (2008), arXiv:0712.4093.
- (38) L. Kaplan and Y. Alhassid, “Interaction Matrix Element Fluctuations in Quantum Dots,” Workshop on Nuclei and Mesoscopic Physics (WNMP07), *AIP Conference Proceedings* **995**, 192, ed. by P. Danielewicz, P. Piecuch, and V. Zelevinsky (2008), arXiv:0712.4095.
- (37) R. Estrada, S. A. Fulling, L. Kaplan, K. Kirsten, Z. Liu, and K. A. Milton, “Vacuum Stress-Energy Density and Its Gravitational Implications,” *J. Phys. A: Math. Theor.* **41**, 164055 (2008).
- (36) L. Kaplan, F. Leyvraz, C. Pineda, and T. H. Seligman “A Trivial Observation on Time Reversal in Random Matrix Theory,” *J. Phys. A: Math. Theor.* **40**, F1063 (2007) (fast track communication), arXiv:0709.3353.
- (35) S. A. Fulling, L. Kaplan, and J. H. Wilson, “Vacuum Energy and Repulsive Casimir Forces in Quantum Star Graphs,” *Phys. Rev. A* **76**, 012118 (2007), arXiv:quant-ph/0703248.
- (34) Kh. Kh. Shakov, J. H. McGuire, L. Kaplan, A. Chalastaras, and D. Uskov, “Sudden Switching in Qubits,” *J. Phys. B* **39**, 1361 (2006), arXiv:quant-ph/0503086.
- (33) J. H. McGuire, L. Kaplan, Kh. Kh. Shakov, A. Chalastaras, A. M. Smith, A. Godunov, H. Schmidt-Böcking, and D. Uskov, “How Time Works in Quantum Systems: Overview of Time Ordering and Time Correlation in Weakly Perturbed Atomic Collisions and in Strongly Perturbed Qubits,” arXiv:quant-ph/0512254.
- (32) A. Chalastaras, L. Kaplan, Kh. Kh. Shakov, M. Smith, and J. H. McGuire, “An Overview of Simply Pulsed Qubits,” arXiv:quant-ph/0507138.

- (31) K. Damborsky and L. Kaplan, "Scar Intensity Statistics in the Position Representation," *Phys. Rev. E* **72**, 066204 (2005), arXiv:nlin.CD/0510040.
- (30) L. Kaplan, "Brownian Motion Model of Quantization Ambiguity and Semiclassical Accuracy in Chaotic Systems," *Phys. Rev. E* **72**, 036214 (2005), arXiv:nlin.CD/0507046.
- (29) L. Kaplan, "Correlation Function Bootstrapping in Quantum Chaotic Systems," *Phys. Rev. E* **71**, 056212 (2005), arXiv:nlin.CD/0503058.
- (28) L. Kaplan, Kh. Kh. Shakov, A. Chalastaras, M. Maggio, A. L. Burin, and J. H. McGuire, "Time Ordering in Kicked Qubits," *Phys. Rev. A* **70**, 063401 (2004) (also selected for Virtual Journal of Quantum Information and Virtual Journal of Ultrafast Science), arXiv:quant-ph/0406177.
- (27) L. Kaplan, "Semiclassical Accuracy in Phase Space for Regular and Chaotic Dynamics," *Phys. Rev. E* **70**, 026223 (2004), arXiv:nlin.CD/0406054.
- (26) L. Kaplan, "Statistics of Branched Flow in a Weak Correlated Random Potential," *Phys. Rev. Lett.* **89**, 184103 (2002), arXiv:nlin.CD/0206040.
- (25) T. Papenbrock, L. Kaplan, and G. F. Bertsch, "Odd-even Binding Effect from Random Two-Body Interactions," *Phys. Rev. B* **65**, 235120 (2002), arXiv:cond-mat/0202493.
- (24) L. Kaplan, "Eigenstate Structure in Graphs and Disordered Lattices," *Phys. Rev. E* **64**, 036225 (2001), arXiv:nlin.CD/0101048.
- (23) W. E. Bies, L. Kaplan, and E. J. Heller, "Scarring Effects on Tunneling in Chaotic Double-Well Potentials," *Phys. Rev. E* **64**, 016204 (2001), arXiv:nlin.CD/0007037.
- (22) L. Kaplan, T. Papenbrock, and C. W. Johnson, "Spin Structure of Many-Body Systems with Two-Body Random Interactions," *Phys. Rev. C* **63**, 014307 (2001), arXiv:nucl-th/0007013.
- (21) W. E. Bies, L. Kaplan, M. R. Haggerty, and E. J. Heller, "Localization of Eigenfunctions in the Stadium Billiard," *Phys. Rev. E* **63**, 066214 (2001), arXiv:nlin.CD/0004024.
- (20) L. Kaplan, "Structure of Quantum Chaotic Wavefunctions: Ergodicity, Localization, and Transport," invited article for special issue of *Physica E* **9**, 502-8 (2001), arXiv:chao-dyn/9911003.
- (19) L. Kaplan and T. Papenbrock, "Wave Function Structure in Two-Body Random Matrix Ensembles," *Phys. Rev. Lett.* **84**, 4553-6 (2000), arXiv:nucl-th/9911038.
- (18) L. Kaplan, "Periodic Orbit Effects on Conductance Peak Heights in a Chaotic Quantum Dot," *Phys. Rev. E* **62**, 3476-88 (2000) (also selected for Virtual Journal of Nanoscale Science & Technology), arXiv:nlin.CD/0003013.
- (17) L. Kaplan and E. J. Heller, "Short-Time Effects on Eigenstate Structure in Sinai Billiards and Related Systems," *Phys. Rev. E* **62**, 409-26 (2000), arXiv:chao-dyn/9910030.
- (16) L. Kaplan and E. J. Heller, "Theory of Eigenfunction Scarring," NATO ASI series volume Supersymmetry and Trace Formulae: Chaos and Disorder, ed. by I. V. Lerner, J. P. Keating, and D. E. Khmelnitskii (Plenum, 1999).

- (15) L. Kaplan, "Scar and Antiscar Quantum Effects in Open Chaotic Systems," *Phys. Rev. E* **59**, 5325-37 (1999), arXiv:chao-dyn/9809013.
- (14) L. Kaplan, "Recent Developments in the Theory of Scarring," invited review article for *Nonlinearity* **12**, R1-R40 (1999), arXiv:chao-dyn/9810013.
- (13) L. Kaplan, "Quantization Ambiguity, Ergodicity, and Semiclassics," *New J. Phys.* **4**, 90 (2002), arXiv:quant-ph/9906065.
- (12) L. Kaplan and E. J. Heller, "Measuring Scars of Periodic Orbits," *Phys. Rev. E* **59**, 6609-28 (1999), arXiv:chao-dyn/9812011.
- (11) L. Kaplan, "Semiclassical Dynamical Localization and the Multiplicative Semiclassical Propagator," *Phys. Rev. Lett.* **81**, 3371-4 (1998), arXiv:chao-dyn/9809007.
- (10) L. Kaplan, "Multiplicative Semiclassical Dynamics and the Quantization Time," *Phys. Rev. E* **58**, 2983-91 (1998), arXiv:chao-dyn/9809006.
- (9) L. Kaplan, "Wavefunction Intensity Statistics from Unstable Periodic Orbits," *Phys. Rev. Lett.* **80**, 2582-5 (1998), arXiv:chao-dyn/9809012.
- (8) L. Kaplan and E. J. Heller, "Linear and Nonlinear Theory of Eigenfunction Scars," *Annals of Physics* **264**, 171-206 (1998), arXiv:chao-dyn/9809011.
- (7) L. Kaplan and E. J. Heller, "Weak Quantum Ergodicity," *Physica D* **121**, 1-18 (1998), arXiv:chao-dyn/9810002.
- (6) L. Kaplan, N. Maitra, and E. J. Heller, "Quantizing Constrained Systems: New Perspectives" *Phys. Rev. A* **56**, 2592-9 (1997), arXiv:quant-ph/9810037.
- (5) L. Kaplan and E. J. Heller, "Overcoming the Wall in the Semiclassical Baker's map," *Phys. Rev. Lett.* **76**, 1453-6 (1996), arXiv:chao-dyn/9809008.
- (4) H. Georgi, L. Kaplan, D. Morin, and A. Schenk, "Effects of Top Quark Compositeness," *Phys. Rev. D* **51**, 3888-94 (1995), arXiv:hep-ph/9410307.
- (3) C. D. Carone, H. Georgi, L. Kaplan, and D. Morin, "Decays of $l = 1$ Baryons: Quark Model versus Large N_C ," *Phys. Rev. D* **50**, 5793-807 (1994), arXiv:hep-ph/9406227.
- (2) H. Georgi, L. Kaplan, and D. Morin, "Nonperturbative Matching for Field Theories with Heavy Fermions," *Phys. Rev. D* **49**, 2457-61 (1994), arXiv:hep-ph/9310364.
- (1) S. N. Zhang, R. Van Berg, T. Trojak, B. Cox, S. Conetti, A. Blankman, S. Borodin, L. Kaplan, W. Kononenko, and W. Selove, "A high P_T muon trigger processor," *IEEE Trans. Nucl. Sci.* **39**, 814-20 (1992).

Selected Invited Presentations

“Quantum Wave Function Statistics Beyond Random Matrix Theory”, Quantum Chaos: Theory and Applications (65th birthday of Marcos Saraceno), Buenos Aires, December 2009.

“Quantum Vacuum Energy in Graphs and Billiards”, AMS 2009 Fall Central Section Meeting, Waco, Texas, October 2009.

“Interaction Matrix Element Fluctuations in Quantum Dots”, From Femtoscience to Nanoscience: Nuclei, Quantum Dots, and Nanostructures, Institute for Nuclear Theory, University of Washington, Seattle, July 23, 2009.

“Rogue Waves: Refraction of Gaussian Seas and Rare Event Statistics”, Nonlinear Dynamics in Quantum Systems: Conference in Commemoration of Boris Chirikov, Siberian Federal University, Krasnoyarsk, Russia, July 10, 2009.

“Rogue Waves: Refraction of Gaussian Seas and Rare Event Statistics”, Penetrating Physics through Random Matrices (Symposium in honor of Hans Weidenmüller), UNAM, Cuernavaca, Mexico, Mar 4, 2009.

“Quantum Chaos: Electron Waves in Nanostructures and Freak Waves in the Ocean”, Quantum Vacuum Meeting, Texas A&M University, Aug 23, 2008.

“Interaction Matrix Element Fluctuations in Quantum Dots”, International Workshop: Chaos and Collectivity in Many-Body Systems, Max Planck Institute for the Physics of Complex Systems, Dresden, Mar 7, 2008.

“Interaction Matrix Element Fluctuations in Quantum Dots”, Workshop on Nuclei and Mesoscopic Physics, Mesoscopic Theory Center, East Lansing, Michigan, Oct 20, 2007.

“Quantum Chaos in Quantum Graphs”, Centro Internacional de Ciencias, Cuernavaca, Sep 17, 2007.

“Quantum Chaos in Quantum Graphs”, Texas A&M University, March 2, 2007.

“Quantum Chaos: Electron Waves in Nanostructures and Freak Waves in the Ocean”, University of New Orleans, Feb 7, 2007.

“Rogue Waves: Refraction of Gaussian Seas and Rare Event Statistics”, Centro Internacional de Ciencias, Cuernavaca, Mexico, Aug 15, 2006.

“Quantum Chaos: Electron Waves in Nanostructures and Freak Waves in the Ocean”, Tulane University, Apr 10, 2006.

“Refraction of Gaussian Seas: Rare Event Statistics”, Workshop on Rogue Waves, International Centre for Mathematical Sciences, Edinburgh, Dec 12, 2005.

“Interaction Matrix Elements in Quantum Dots”, Institute for Theoretical Atomic and Molecular Physics, Harvard University, Dec 8, 2005.

“Interaction Matrix Elements in Quantum Dots”, International Workshop “Correlations in quantum systems: quantum dots, quantum gases and nuclei”, Palma de Mallorca, Spain, Sep 27, 2005.

“Interaction Matrix Element Fluctuations in Quantum Dots”, Condensed Matter Physics Seminar, Yale University, Mar 3, 2005.

“Semiclassical Accuracy at Large Times”, Workshop on Semiclassical Approximation and Vacuum Energy,

Texas A&M University, Jan 15, 2005.

“Interaction Matrix Element Fluctuations in Quantum Dots”, Quantum Chaos in the 21st Century (Symposium in Honor of Thomas H. Seligman), Centro de Ciencias Fisicas, UNAM, Cuernavaca, Mexico, Aug 17, 2004.

“Quantum Chaos: Wave Function Structure, Localization, and Transport in Generic Systems”, University of New Orleans, Mar 31, 2004.

“Fine-Scale Quantum Ergodicity: Dynamical Effects vs. Random Matrix Theory”, Texas A&M joint seminar: Mathematical Physics and Harmonic Analysis+Applied Mathematics, Feb 23, 2004.

“Statistics of Branched Flow in a Weak Correlated Random Potential”, Dynamical Chaos in Classical and Quantum Physics conference, Budker Institute of Nuclear Physics, Novosibirsk, Russia, Aug 7, 2003.

“Long-Time Semiclassical Accuracy, Quantization Ambiguity, and Semiclassical Localization”, Semi-Classical Analysis program, Mathematical Sciences Research Institute, Berkeley, Apr 16, 2003.

“Non-Random Low-Lying States in Two-Body Random Matrix Ensembles”, program Chaos and Interactions: from Nuclei to Quantum Dots, Institute for Nuclear Theory, University of Washington, Seattle, Jul 9, 2002.

“Quantum Chaos: Wave Function Ergodicity, Localization, and Transport in Generic Systems”, Laboratory of Atomic and Solid State Physics seminar, Cornell University, Feb 12, 2002.

“Wave Function Structure, Ergodicity, and Localization in Quantum Chaotic Systems”, Dynamics Days 2002, International Conference on Chaos and Nonlinear Dynamics, Baltimore, Jan 5, 2002.