

Rajarshi Roy

Curriculum Vitae

ROY, Rajarshi Department of Physics
University of Maryland
College Park, MD 20742

Educational Background

B. Sc. (Honours) in Physics, St. Stephen's College, Delhi University, 1973
M.Sc. in Physics, Delhi University, 1975
M.A. in Physics, University of Rochester, 1977
Ph. D. in Physics, University of Rochester, 1981

Employment History

Professor, Department of Physics, Institute of Physical Science
and Technology and Institute for Research in Electronics and
Applied Physics, University of Maryland, 1999 -
Chair, School of Physics, Georgia Institute of Technology, 1996 – 1999
Professor of Physics, Georgia Institute of Technology, 1993 - 1999
Associate Professor of Physics, Georgia Institute of Technology, 1987-1992
Visitor and Consultant, AT&T Bell Laboratories, Murray Hill, 1987
Assistant Professor of Physics, Georgia Institute of Technology, 1982-1986
Postdoctoral Research Associate, JILA, University of Colorado, 1981-1982

Current Fields of Interest

Quantum Electronics/optics, noise and nonlinear dynamics in optical systems, laser physics, semiconductor and solid state lasers, fiber and integrated optics, optical bistability, control of spatio-temporal systems, experimental statistical physics.

Research Experience:

Communication with Chaotic Lasers: Experimentally demonstrated communication with chaotic erbium doped fiber laser systems (1998). Demonstrated polarization encoding of information (2002).

Synchronization of Chaotic Lasers: Experimentally demonstrated synchronization of chaotic lasers (1994) and proposed their use for digital communications.

Control of chaos in laser systems: Experimental and theoretical study of nonlinear dynamics of intracavity doubled, diode laser pumped Nd: YAG lasers. Discovered technique for the elimination of chaotic instabilities. Demonstrated dynamical control of a chaotic laser (1992). This was the first demonstration of control of chaos in an optical system.

Four Wave Mixing in optical fibers: Theoretical and experimental studies of four wave mixing in single mode optical fibers. Nonlinear dynamics of coupled wave propagation. Discovered and verified a new conservation law for simultaneous four wave mixing processes in a nonlinear medium (1991,1994, 1998).

Observation of Stochastic Resonance: Observed the phenomenon of stochastic resonance in a ring laser. This is the first observation of the enhancement of signal to noise ratio through the addition of injected noise in an optical device (1988). This phenomenon has since been observed in passive optical bistability, magnetoelastic ribbons and electron paramagnetic resonance systems, and is conjectured to play a role in visual and auditory processing.

Laser Physics and Optical Bistability: Discovered and investigated optical bistability in two-mode lasers. This was the first observation of macroscopic intensity changes initiated by microscopic quantum fluctuations (1980). We also made the first quantitative observations on the existence of a first order phase transition analogy in lasers. Analytic solutions to the equations for absorptive and dispersive optical bistability were obtained.

Laser Noise Measurement and Analysis: A new statistical technique based on the concept of first passage times allows quantum fluctuations and external noise in lasers to be quantitatively measured (1985). This technique has been extensively used to investigate a variety of laser systems by several groups.

Acousto-optic Unidirectional Device for Ring Lasers: Discovered that acousto-optic gratings could selectably enforce unidirectional operation in ring lasers. Applied to c.w. and mode-locked titanium doped sapphire and dye lasers. This technique has been applied to different solid state laser systems by other researchers. This paper was also the first to report mode-locking of a Ti:sapphire laser (1987).

Semiconductor Lasers: Theoretical and experimental studies of mode hopping in semiconductor lasers. Quantum noise effects in mode locked external cavity semiconductor lasers. New scaling laws for dynamical hysteresis in bistable systems were discovered (1990, 1995).

Raman Spectroscopy: Discovered very low pressure collisional line narrowing in carbon dioxide. We also determined the rotational constants of the carbon dioxide molecule for certain states with high precision (1982). The laser system used for these studies was unique for its high power and narrow linewidth.

Control of Laser Noise: Participated in the development of the first techniques for the control and modification of laser lineshapes by acousto-optic and electro-optic modulation techniques (1982).

Patent

"Variable Output Coupler and Deviationless Tuner", R. Roy and A.W. Yu, U.S. Patent #4, 723, 841.

PUBLICATIONS

1. "Dye Laser Statistics and the Phase Transition", Rajarshi Roy and L. Mandel, *Opt. Comm.* **23**, 306 (1977).
2. "The Dye Laser and the Laser with a Saturable Absorber: a Comparison of the Time Dependent Density Matrix Equations", Rajarshi Roy, *Opt. Comm.* **30**, 90 (1979).
3. "Photon Distributions of Lasers with First Order Phase Transition Analogies", Rajarshi Roy, *Phys. Rev.* **A20**, 2093 (1979).
4. "Analytic Solutions of the Absorptive Optical Bistability Equations", Rajarshi Roy and M.S. Zubairy, *Opt. Comm.* **32**, 163 (1980).
5. "Beyond the Mean Field Theory of Dispersive Optical Bistability", Rajarshi Roy and M.S. Zubairy, *Phys. Rev.* **A21**, 274 (1980).
6. "Optical Bistability and the First Order Phase Transition in a Dye Ring Laser", Rajarshi Roy and L. Mandel, *Opt. Comm.* **34**, 133 (1980).
7. "Effect of Flow Velocity on the Photon Statistics of a c.w. Dye Laser", R. Short, Rajarshi Roy and L. Mandel, *App. Phys. Lett.* **37**, 973 (1980).
8. "Effect of Backscattering on the Behavior of a Dye Ring Laser", Rajarshi Roy and L. Mandel, *Opt. Comm.* **35**, 247 (1980).
9. "First Passage Time Distributions Under the Influence of Quantum Fluctuations of a Laser", Rajarshi Roy, R. Short, J. Durnin and L. Mandel, *Phys. Rev. Lett.* **45**, 1486 (1980).
10. K. Kaminishi, Rajarshi Roy, R. Short and L. Mandel, *Phys. Rev.* **A24**, 370 (1981).

11. "Optical Bistability Effects in a Ring Laser", L. Mandel, Rajarshi Roy and Surendra Singh, in Optical Bistability, ed. by C.M. Bowden, M. Ciftan and H. Robl, Plenum Press (1981).
10. "Investigations of the Photon Statistics and Correlations of a Dye Laser",
12. "Extracavity Laser Bandwidth and Bandshape Modifier", D.S. Elliott, Rajarshi Roy and S.J. Smith, Phys. Rev. **A26**, 12 (1982).
13. "Correlation Functions of a Dye Laser: Comparison Between Theory and Experiment", R. Short, L. Mandel and R. Roy, Phys. Rev. Lett. **49**, 647 (1982).
14. "Low Pressure Collisional Narrowing in CO₂", Rajarshi Roy, D.S. Elliott, D. Meschede, F.M. Pipkin and S.J. Smith, Chem. Phys. Lett. **93**, 603 (1982).
15. "Collisional Dependence of Spectral Lineshapes in CO₂ at Low Pressures", Rajarshi Roy, D.S. Elliott, D. Meschede, F.M. Pipkin and S.J. Smith, in Spectral Lineshapes, p. 651 ,ed. by K. Burnett, Walter de Gruyter, Berlin 1983.
16. "Role of Field Fluctuations in Nonlinear Absorption" D.S. Elliott, Rajarshi Roy and S.J. Smith, in Spectral Lineshapes, p. 989 ,ed. by K. Burnett, Walter de Gruyter, Berlin 1983.
17. "Theory of a Laser with a Stochastic Pump", R.F. Fox, G.E. James and Rajarshi Roy, Phys. Rev. Lett. **52**, 1778 (1984).
18. "Stochastic Pump Effects in Lasers", R.F. Fox, G.E. James and Rajarshi Roy, Phys. Rev. **A30**, 2482 (1984).
19. "Lasers with Fluctuating Pumps: Comparison of Theory and Experiment", Rajarshi Roy, R.F. Fox and G.E. James, pp. 32-46, in Proceedings of the Third Symposium on Lasers and Their Applications, Kanpur, India, ed. by H.D. Bist and J.D. Goella, Tata-McGraw Hill, 1984.
20. "Variable Transmission Output Coupler and Tuner for Ring Laser Systems", A.W. Yu, S. Zhu and Rajarshi Roy, App. Opt. **24**, 3610 (1985).
21. "Quantum Fluctuations, Pump Noise and the Growth of Laser Radiation", Rajarshi Roy, A.W. Yu and S. Zhu, Phys. Rev. Lett. **55**, 2794 (1985).
22. "Frustrated Total Internal Reflection: A Demonstration and Review", S. Zhu, A. W. Yu, D. Hawley and Rajarshi Roy, Am. J. Phys. **54**, 601 (1986).
23. "The First Passage Time Problem for Laser Turn On", S. Zhu, A.W. Yu, S. Singh and Rajarshi Roy, in Coherence, Cooperation and Fluctuations, ed. by F. Haake, L.M. Narducci and D.F. Walls, Cambridge University Press, 339 (1986).

24. "Statistical Fluctuations in Laser Transients", S. Zhu, A.W. Yu and Rajarshi Roy, Phys. Rev. **A34**, 4333 (1986).
25. "Acousto-Optic Modulator as a Unidirectional Device in a Ring Laser", Rajarshi Roy, P.A. Schulz and A. Walther, Opt. Lett. **12**, 672 (1987).
26. "Steady State Analysis of Strongly Colored Multiplicative Noise in a Dye Laser, R.F. Fox and Rajarshi Roy, Phys. Rev. **A35**, 1838 (1987).
27. "Tests of Numerical Algorithms for the Kubo Oscillator", R.F. Fox, Rajarshi Roy and A.W. Yu, J. Stat. Phys. **47**, 477 (1987).
28. "Noise Propagation from Pump to Secondary Lasers", A.W. Yu, G.P. Agrawal and Rajarshi Roy, Opt. Lett. **12**, 806 (1987).
29. "Effect of Injection Current Fluctuations on the Spectral Linewidth of Semiconductor Lasers", G.P. Agrawal and Rajarshi Roy, Phys. Rev. **A37**, 2495 (1988).
30. "Observation of Stochastic Resonance in a Ring Laser", B. McNamara, K. Wiesenfeld and Rajarshi Roy, Phys. Rev. Lett. **60**, 2626 (1988).
31. "A Fast, Accurate, Algorithm for Numerical Simulation of Exponentially Correlated Colored Noise", R.F. Fox, I.R. Gatland, Rajarshi Roy and G. Vemuri, Phys. Rev. **A38**, 5938 (1988).
32. "Power Spectra and Spatial Pattern Dynamics of a Ring Laser", A.W. Yu, G.P. Agrawal and Rajarshi Roy, J. Stat. Phys. **54**, 1223 (1989).
33. "Noise in Nearly Single Mode Semiconductor Lasers", G. Gray and Rajarshi Roy, Phys. Rev. **A40**, 2452 (1989).
34. "Super-regenerative Laser Receiver; Transient Dynamics of a Laser with an External Signal", G. Vemuri and Rajarshi Roy, Phys. Rev. **A39**, 2539 (1989).
35. "Stochastic Resonance in a Bistable Ring Laser", G. Vemuri and Rajarshi Roy, Phys. Rev. **A39**, 4668 (1989).
36. "Colored Noise in Dye Laser Fluctuations", Rajarshi Roy, A.W. Yu and S. Zhu, chapter in Noise in Nonlinear Dynamical Systems, ed. by F. Moss and P.V.E. McClintock, Cambridge University Press (1989).
37. "Intermittency and Chaos in Intracavity Doubled Lasers", G.E. James, E.M. Harrell II and Rajarshi Roy, in Coherence and Quantum Optics VI, ed. by J.H. Eberly, L. Mandel and E. Wolf, Plenum Press (1990).

38. "Intermittency and Chaos in Intracavity Doubled Lasers II", G.E. James, E.M. Harrell II and Rajarshi Roy, *Phys. Rev.* **A41**, 2778 (1990).
39. "Detection of Weak Signals Via the Decay of Unstable States", I. Littler, S. Balle, K. Bergmann, G. Vemuri and Rajarshi Roy, *Phys. Rev.* **A41**, 4131 (1990).
40. "Super-regenerative Laser Receiver: Theory and Experiment", I. Littler, S. Balle, K. Bergmann, G. Vemuri and Rajarshi Roy, in Coherence and Quantum Optics VI, ed. by J.H. Eberly, L. Mandel and E. Wolf, Plenum Press (1990).
41. "Exact Results on Light Scattered from Atoms Pumped by Coherent and Chaotic Fields of Arbitrary Bandwidth", G. Vemuri, Rajarshi Roy and G.S. Agarwal, *Phys. Rev.* **A41**, 2749 (1990).
42. "Bidirectional Laser with an Injected Signal; a Digital Detector", G. Vemuri, G. Gray and Rajarshi Roy, in Coherence and Quantum Optics VI, ed. by J.H. Eberly, L. Mandel and E. Wolf, Plenum Press (1990).
43. "Stochastic Resonance in Bistable Systems", L. Fabiny, G. Vemuri and Rajarshi Roy, in Coherence and Quantum Optics VI, ed. by J.H. Eberly, L. Mandel and E. Wolf, Plenum Press (1990).
44. "Quantum Noise Initiated Mode Hopping in Semiconductor Lasers", G. Gray and Rajarshi Roy, in Coherence and Quantum Optics VI, ed. by J.H. Eberly, L. Mandel and E. Wolf, Plenum Press (1990).
45. "Two Pulse Nonlinear Excitations in Optical Fibers", J. Thompson and Rajarshi Roy, in Coherence and Quantum Optics VI, ed. by J.H. Eberly, L. Mandel and E. Wolf, Plenum Press (1990).
46. "Stochastic Resonance", R. Roy, *Optics News*, Vol **15**, 18 (1989).
47. "Elimination of Chaos in Intracavity Doubled Nd: YAG Lasers", G.E. James, E.M. Harrell II, C. Bracikowski, K. Wiesenfeld and Rajarshi Roy, *Opt. Lett.* **15**, 1141 (1990).
48. "Effect of Injected Field Statistics on the Transient Dynamics of a Q-Switched Laser", G. Vemuri and Rajarshi Roy, *Opt. Comm.* **77**, 318 (1990).
49. "Transient Dynamics of a Laser with an Injected Signal", P. Jung, G. Vemuri and Rajarshi Roy, *Opt. Comm.* **78**, 58 (1990).
50. "Observation of Antiphase States in a Multimode Laser", K. Wiesenfeld, C. Bracikowski, G.E. James and Rajarshi Roy, *Phys. Rev. Lett.* **65**, 1749 (1990).

51. "Scaling Law for Dynamical Hysteresis", P. Jung, G. Gray, Rajarshi Roy and Paul Mandel, *Phys. Rev. Lett.* **65**, 1873 (1990).
52. "Erratum: Tests of Numerical Simulation Algorithms for the Kubo Oscillator", R.F. Fox and Rajarshi Roy, *J. Stat. Phys.* **58**, 395 (1990).
53. "Bistability and Mode-Hopping in a Semiconductor Laser", G. Gray and Rajarshi Roy, *J. Opt. Soc. Am.* **B8**, 632 (1991).
54. "Stochastic Mode-Locking Theory for External-Cavity Semiconductor Lasers", K. Hsu, C.M. Verber and Rajarshi Roy, *J. Opt. Soc. Am.* **B8**, 262 (1991).
55. "Deterministic Fluctuations in an Intracavity Doubled Solid State Laser", C. Bracikowski and Rajarshi Roy, in Laser Noise, ed. by Rajarshi Roy (Proceedings of the Laser Noise conference, published by SPIE, 1991).
56. "Multiple Four-Wave Mixing Processes in an Optical Fiber", J. Thompson and Rajarshi Roy, *Opt. Lett.* **16**, 557 (1991).
57. "Nonlinear Dynamics of Multiple Four-Wave Mixing Processes in a Single-Mode Optical Fiber", J. Thompson and Rajarshi Roy, *Phys. Rev.* **A43**, 4987 (1991).
58. "Energy Sharing in a Chaotic Multimode Laser", C. Bracikowski and Rajarshi Roy, *Phys. Rev.* **A43**, 6455 (1991).
59. "Chaos in a Multimode Solid State Laser System", C. Bracikowski and Rajarshi Roy, *Chaos* **1**, 49 (1991).
60. "Four Wave Mixing with Time Delayed Correlated Fields of Arbitrary Bandwidths and Pump Intensities", G. Vemuri, G. S. Agarwal, Rajarshi Roy, M.H. Anderson, J. Cooper, and S.J. Smith, *Phys. Rev.* **A44**, 6009 (1991). [10]
61. "Antiphase States in a Multimode Laser", K. Wiesenfeld, C. Bracikowski, G. James and Rajarshi Roy, p. 362, Nonlinear Dynamics in Optical Systems, ed. by N.B. Abraham, E. Garmire and P. Mandel (Optical Society of America, Washington, D.C. 1991).
62. "Chaos in Intracavity Second Harmonic Generation", G. James, E. Harrell, C. Bracikowski, K. Wiesenfeld and Rajarshi Roy, p. 260, Nonlinear Dynamics in Optical Systems, ed. by N.B. Abraham, E. Garmire and P. Mandel (Optical Society of America, Washington, D.C. 1991).
63. "Statistical Fluctuations in Multiple Four-Wave Mixing in a Single Mode Optical Fiber", J.R. Thompson and Rajarshi Roy, *Phys. Rev.* **A44**, 7605 (1991).

64. "Amplification of Intrinsic Noise in a Chaotic Multimode Laser System", C. Bracikowski, R.F. Fox and Rajarshi Roy, *Phys. Rev.* **A45**, 403 (1992).
65. "Pulse Fluctuation Statistics of an Actively Mode-Locked Semiconductor Laser", K. Hsu, C. Verber and Rajarshi Roy, *App. Phys. Lett.* **60**, 307 (1992).
66. "Regenerative Amplification of a Weak c.w. Optical Signal in an Active Frequency Shifted Feedback Cavity", I. Littler, K. Bergmann and Rajarshi Roy, *Opt. Comm.* **87**, 53 (1992).
68. "Nonlinear Dynamics in an Optical Fiber", J.R. Thompson and Rajarshi Roy, p.101, Proceedings of the First Experimental Chaos Conference ed. by S. Vohra et. al. (World Scientific, 1992).
69. "Intensity Fluctuations of a Chaotic Multimode Laser", C. Bracikowski and Rajarshi Roy, p. 92, Proceedings of the First Experimental Chaos Conference ed. by S. Vohra et. al.(World Scientific, 1992).
70. "Dynamical Control of a Chaotic Laser: Experimental Stabilization of a Globally Coupled System", Rajarshi Roy, T.W. Murphy, T.D. Maier, Z. Gills and E. Hunt, *Phys. Rev. Lett.* **68**, 1259 (1992).
71. "Reply to the Comment by Rao on PRL 65, 1873 (1990)", by P. Jung, G. Gray, R. Roy and P. Mandel, *Phys. Rev. Lett.* **68**, 1437 (1992).
72. "Tracking Unstable Steady States: Extending the Stability Regime of a Multimode Laser System", by Z. Gills, C. Iwata, Rajarshi Roy, I. B. Schwartz and I. Triandaf, *Phys. Rev. Lett.* **69**, 3169 (1992).
73. "Coherence and Phase Dynamics of Spatially Coupled Solid State Lasers", L. Fabiny, P. Colet, Rajarshi Roy and D. Lenstra, *Phys. Rev.* **A47**, 4287 (1993).
74. "Dynamics of a Multimode Laser with Nonlinear, Birefringent Intracavity Elements", Rajarshi Roy, C. Bracikowski and G. James, p. 309 - 329, Recent Developments in Quantum Optics, ed. R. Inguva (Plenum Press, New York 1993).
75. "Experimental Synchronization of Chaotic Lasers", Rajarshi Roy and K. Scott Thornburg, *Phys. Rev. Lett.* **72**, 2009 (1994).
76. "Parameter Dependence of Multivariable Laser Transients", S. Balle, M. San Miguel, N. B. Abraham, J.R. Tredicce, R. Alvarez, E. D'Angelo, A.Gambhir, K. Scott Thornburg and Rajarshi Roy, *Phys. Rev. Lett.* **72**, 3501 (1994).
77. "Controlling Chaotic Lasers", Rajarshi Roy, Z. Gills and K. Scott Thornburg, *Optics and Photonics News*, p. 8-15, May (1994).

78. "Experimental Test of a Conservation Law for Multiple Four-Wave-Mixing Processes in Nonlinear Optical Media", D. Hart, A. Judy, Rajarshi Roy, Kroum Stoev and T.A.B. Kennedy, *Phys. Rev.* **A50**, 1807 (1994).
79. "Controlling Hyperchaos in a Multimode Laser Model", P. Colet, R. Roy and K. Wiesenfeld, *Phys. Rev.* **E 50**, 3453 (1994).
80. "Digital Communication with Synchronized Chaotic Lasers", Pere Colet and Rajarshi Roy, *Optics Letters* **19**, 2056 (1994).
81. "Scaling Laws for Dynamical Hysteresis in a Multidimensional Laser System", A. Hohl, H.J.C. Van der Linden, Rajarshi Roy, G. Goldsztein, F. Broner and S. H. Strogatz, *Phys. Rev. Lett.* **74**, 2220 (1995).
82. "Determinism and Stochasticity of Power Dropout Events in a Semiconductor laser with External Feedback", H.J.C. van der Linden, Angela Hohl and Rajarshi Roy, *Opt. Lett.* **20**, 2396 (1995).
83. "Nonlinear Time Series Analysis of Chaotic Laser Dynamics", Z. Gills, C. Liu, Rajarshi Roy and H. D. I. Abarbanel, *Phys. Rev.* **A53**, 440-453 (1996).
84. "Fast Polarization Dynamics of an Erbium Doped Fiber Ring Laser", Quinton Williams and Rajarshi Roy, *Opt. Lett.* **21**, 1478 (1996).
85. "Noise Amplification in a Stochastic Ikeda Model", J. Garcia-Ojalvo and Rajarshi Roy, *Phys. Lett. A* **224**, 51 (1996).
86. "Chaos and Coherence in Coupled Lasers", K. Scott Thornburg, M. Moeller, Rajarshi Roy, R. Li, T. Carr and T. Erneux, *Phys. Rev.* **E55**, 3865 (1997).
87. "Influence of Noise on Chaotic Laser Dynamics", C. Liu, Rajarshi Roy, H.D.I. Abarbanel, Z. Gills and K. Nunes, *Phys. Rev.* **E 55**, 6483-6500 (1997).
88. "Encoding and Decoding Messages with Chaotic Lasers", P.M. Alsing, A. Gavrielides, V. Kovanis, Rajarshi Roy and K.S. Thornburg, Jr., *Phys. Rev.* **E 56**, 6302 - 6310 (1997).
89. "Fast Intra-cavity Polarization Dynamics of an Erbium Doped Fiber Ring Laser", Q. L. Williams, J. Garcia-Ojalvo and Rajarshi Roy, *Phys. Rev.* **A55**, 2376 (1997).
90. "Intracavity Chaotic Dynamics in Ring Lasers with an Injected Signal", J. Garcia-Ojalvo and R. Roy, *Phys. Lett. A* **229**, 362 (1997).
91. "Communication with Chaotic Lasers", G.D. VanWiggeren and Rajarshi Roy, *Science* **279**, 1198 (1998).

92. "Dynamical Evolution of Multiple Four Wave Mixing Processes in an Optical Fiber", Darlene Hart, A. Judy, Rajarshi Roy and J. W. Beletic, *Phys. Rev.* **E 57**, 4757 - 4774 (1998).
93. "Optical Communication with Chaotic Waveforms", G.D. VanWiggeren and Rajarshi Roy, *Phys. Rev. Lett.* **81**, 3547 (1998).
94. "Polarization based data storage in fiber ring lasers", J. Garcia-Ojalvo and Rajarshi Roy, *Quant. Semiclass. Opt.* **10**, 723 (1998).
95. "Blowout Bifurcation in a System of Coupled Chaotic Lasers", P. Ashwin, J. Terry, K.S. Thornburg, Jr., and Rajarshi Roy, *Phys. Rev.* **E 58**, 7186 (1998).
96. "Chaotic Communication with Time-Delayed Optical Systems", G.D. VanWiggeren and Rajarshi Roy, *Int. Jour. Bif. and Chaos* **9**, 2129 (1999).
97. "Synchronization of Chaos in an Array of Three Lasers", J.R. Terry, K. Scott Thornburg, D. DeShazer, G.D. Van Wiggeren, S. Zhu, P. Ashwin and Rajarshi Roy, *Phys. Rev.* **E59**, 4036 (1999).
98. "Transmission of Linearly Polarized Light through a single mode fiber with random fluctuations of birefringence", G.D. VanWiggeren and Rajarshi Roy, *Applied Optics* **38**, 3888 (1999).
99. "High-speed fiber-optic polarization analyzer: measurements of the polarization dynamics of an erbium doped fiber ring laser", G.D. VanWiggeren and Rajarshi Roy, *Opt. Comm.* **164**, 107 – 120 (1999).
100. "Dynamics of activated escape, and its observation in a semiconductor laser", J. Hales, A. Zhukov, Rajarshi Roy and M. I. Dykman, *Phys. Rev. Lett.* **85**, 78 – 81 (2000).
101. "Synchronization of chaos in a coupled laser system", S. Zhu, X. Chen, X. Liu, K.S. Thornburg, G.D. VanWiggeren and Rajarshi Roy, in *Frontiers of Laser Physics and Quantum Optics*, ed. Z. Xu, S. Xie, S-Y. Zhu and M.O. Scully, Springer- Verlag (Berlin, 2000).
102. "General synchronization of chaos in a system of two non-identical lasers", S. Zhu, L. Xiang, X. Chen, K.S. Thornburg, G.D. VanWiggeren and Rajarshi Roy, *Chinese Physics* **9**, 337 – 341 (2000).
103. "Coherence, Chaos and Communication: Exploring and Applying Nonlinear Laser Dynamics", Rajarshi Roy, pp. 260-278, *Fundamental Issues of Nonlinear Laser Dynamics*, ed. B. Krauskopf and D. Lenstra (American Institute of Physics, New York) (2000).

104. "Spatiotemporal Communication with Synchronized Optical Chaos", J. Garcia-Ojalvo and Rajarshi Roy, Phys. Rev. Lett. **86**, 5204-5207 (2001).
105. "Detecting Phase Synchronization in a Chaotic Laser Array", D. DeShazer, R. Breban, E. Ott and Rajarshi Roy, Phys. Rev. Lett. **87**, 044101 (2001).
106. "Parallel Communication with optical spatiotemporal chaos", J. Garcia-Ojalvo and Rajarshi Roy, IEEE Trans. Circuits and Systems **48**, 1491 (2001).
107. "Communication with Dynamically Fluctuating States of Light Polarization", G.D. VanWiggeren and Rajarshi Roy, Phys. Rev. Lett. **88**, 097903 (2002).
108. "Signal or Noise? A nonlinear dynamics approach to spatiotemporal communication", G.D. VanWiggeren, J. Garcia-Ojalvo and Rajarshi Roy, Chapter in **Nonlinear Dynamics and Chaos: Where do we go from here?**, ed. J. Hogan et al., IOP Publishing (2002).
109. "Chaotic Function generator: complex dynamics and its control in a loss-modulated Nd:YAG Laser", R. Meucci, R. McAllister and Rajarshi Roy, Phys. Rev. **E 66**, 026216 (2002).
110. "Communicating with optical spatiotemporal chaos", J. Garcia-Ojalvo and Rajarshi Roy, , invited article, Proceedings SPIE vol. 4646, *Physics and Simulation of Optoelectronic Devices X*, edited by Peter Blood, Marek Osinski, and Yasuhiko Arakawa, pp. 525-532 (2002). ISBN 0-8194-4385-9
111. "Influence of stochasticity on multiple four-wave-mixing processes in an optical fiber ", B. Khubchandani, P.N. Guzdar and Rajarshi Roy, Phys. Rev. **E 66**, 066609 (2002).
112. "Measuring intense rotation and dissipation in turbulent flows", B. W. Zeff, D. D. Lanterman, R. McAllister, Rajarshi Roy, E. J. Kostelich and D. P. Lathrop, Nature **421**, 146 (2003).
113. "Hilbert Phase Analysis of the Dynamics of a Semiconductor Laser with Optical Feedback", W-S. Lam, P.N. Guzdar and Rajarshi Roy, to appear, Phys. Rev. **E 67**, 025604(RC) (2003).
114. "Competition between two frequencies for phase synchronization of a chaotic laser", R. McAllister, R. Meucci, D. J. DeShazer and Rajarshi Roy, to appear, Phys. Rev. **E 67**, 015202(RC) (2003).
115. "Bursting dynamics of a fiber laser with an injected signal", D. J. DeShazer, J. García-Ojalvo and Rajarshi Roy, to appear Phys. Rev. E (2003).

Conference Proceedings Edited:

Laser Noise, ed. by Rajarshi Roy (Vol. 1376, Proc. SPIE, 1991).

Chaos in Optics, ed. by Rajarshi Roy (Vol. 2039, Proc. SPIE, 1993).

Book Reviews

1. "Review of Fourier Optics: An Introduction, by E.G. Steward", Rajarshi Roy, J. Opt. Soc. Am. **A1**, 792 (1984).
2. "Review of Concepts of Quantum Optics, by P.L. Knight and L. Allen, J. Opt. Soc. Am. **B1**, 761 (1984).
3. "Review of Masers and Lasers: An Historical Approach, by M. Bertolotti, Am. J. Phys. **53**, 507 (1985).

Invited lectures and Colloquia (from 1986)

University of California, San Diego (1986)
Stanford University (1986)
Brown University (1986)
MIT, Lincoln Laboratory (1986)
Southern Tech (1986)
Georgia Southern College (1986)
Lehigh University (1987)
Rensselaer Polytechnic (1987)
International Workshop on Laser Instabilities, Italy (1987)
Universitat Kaiserslautern (1987)
University of Perugia (1987)
Universitat Ulm (1987)
Universitat Augsburg (1987)
Conference on External Noise in Nonlinear Systems, Los Alamos (1988)
University of California, Santa Barbara (1988)
University of Colorado (1988)
APS Meeting of the Southeastern Section, Raleigh (1988)
University of Delhi (1988)
National Physical Laboratory, India (1988)
University of Texas, Austin (1989)
University of New Mexico (1989)
Ohio State University (1989)
Case Western Reserve University (1989)
Conference on Noise in Nonlinear Systems, Torino, Italy (1989)

University of Perugia (1989)
University of Georgia, Athens (1989)
University of Rochester, Institute of Optics (1990)
Purdue University (1990)
Physics of Semiconductor Lasers Conference, Aspen, Colorado (1990)
U.S.-U.S.S.R. Conference on Chaos and Nonlinear Dynamics,
Tarusa, USSR, organized by U.S.S.R Academy of Sciences (1990)
Universitat Kaiserslautern (1990)
International Conference on Quantum Optics, India (1991)
Redstone Arsenal, Huntsville, Alabama (1991)
Emory University (1991)
Free University of Amsterdam (1991)
Georgia Tech, School of Mathematics (1991)
Nonlinear Science Workshop, National Science Foundation (1991)
Naval Research Laboratory (1991)
Emory University, Department of Anatomy and Cell Biology (1992)
University of Arkansas (1992)
NATO Conference on Stochastic Resonance, San Diego (1992)
Universitat Kaiserslautern (1992)
NATO Conference on Dynamical Measures of Complexity and Chaos (1992)
SIAM Conference on Applications of Dynamical Systems (1992)
Dynamics Days Arizona (1993)
Wooster College (1993)
University of Central Florida (1993)
Tulane University (1993)
Advanced Solid State Lasers, OSA, New Orleans (1993)
Phillips Laboratory, Kirtland AFB, Albuquerque (1993)
University of Florida, Gainesville (1993)
CLEO/QUELS Baltimore (1993)
Laser Optics '93, St. Petersburg, Russia (1993)
NATO "Gran Finale" Conference on Nonlinear Science, Como (1993)
Second Experimental Chaos Conference (1993)
Optical Society of America Annual Meeting (1993)
Duke University (1994)
American Physical Society, March Meeting (1994)
Harvard University (1994)
University of Arizona (1994)
Army Research Office Workshop on Chaos and Fractals, Huntsville (1994)
Coherence, Correlation and Control NSF Workshop, U. Michigan (1994)
ICTP Workshop on Nonlinear Analysis of Time Series, Trieste (1994)
Army Research Office Workshop on Nonlinear Dynamics in Science and
Engineering, Georgia Tech (1994)
University of California Nonlinear Science Conference, Santa Barbara (1995)
Phillips Laboratory, Albuquerque (1995)
University of Pennsylvania (1995)
Texas A&M University (1995)

Plenary Speaker, Seventh Coherence and Quantum Optics Conference,
Rochester (1995)
Plenary Speaker, SIAM Conference on Dynamical Systems, Snowbird (1995)
International Workshop on Nonlinear Dynamics, Pohang, Korea (1995)
Korea University (1995)
Ajou University, Korea (1995)
Royal Society of Edinburgh Conference on Chaos in Nature (1995)
Imperial College, London (1995)
University of Strathclyde, Glasgow (1995)
IEEE/LEOS Annual Meeting, San Francisco (1995)
University of California, Davis (1995)
Cornell University (1996)
Pennsylvania State University (1996)
Army Research Office Workshop, Durham (1996)
Heraeus Foundation Physics and Dynamics Conference, Berlin (1996)
Fluctuations, Disorder and Nonlinearity, Crete (1996)
University of Houston (1996)
University of Maryland (1996)
International Conference on Dynamical Systems, Bangalore (1997)
University of Alabama, Birmingham (1997)
Suzhou University, China (1997)
Beijing Normal University (1997)
University of Nice, France (1997)
Control of Chaos Conference, Montecatini (1997)
SIAM Dynamical Systems Conference (1997)
Georgia State University (1997)
Texas A&M University (1997)
Auburn University (1998)
CREOL, University of Central Florida (1998)
Michigan State University (1998)
Ohio University (1998)
Workshop on Pattern Formation in Continuous and Coupled Systems, University
of Minnesota (1998)
Workshop on Synchronization, Pattern Formation and Spatio-Temporal Chaos,
Santiago (Spain) (1998)
University of Barcelona (1998)
Universitat Polytechnica de Catalunya (1998)
Oak Ridge National Laboratory (1998)
University of New Mexico (1998)
LEOS Lecture in Albuquerque (1998)
University of Maryland, Department of Physics (1999)
Jawaharlal Nehru University, Department of Physics (1999)
15th Annual California Conference on Nonlinear Science, Napa Valley (1999)
SIAM Conference on Applications of Dynamical Systems (three invited
presentations), Snowbird (1999)

Fourth International Congress on Industrial and Applied Mathematics, Edinburgh (1999)
Boston University, Electrical and Computer Engineering (1999)
Fifth Experimental Chaos Conference, Orlando (1999)
ATR Laser Chaos Workshop, Kyoto, Japan (1999)
IEEE/LEOS Annual Conference (1999)
Plasma Physics Seminar, University of Maryland (1999)
Applied Dynamics Seminar, University of Maryland (1999)
Foundations and Frontiers Seminar, University of Maryland (1999)
Control and Dynamical Systems Lecture Series, University of Maryland (1999)
OSA/LEOS Washington Chapter Lecture (1999)
Naval Research Laboratory (1999)
APS March Meeting (2000)
Pacific Northwest Association of Colleges (2000)
Keynote Speaker, Spring School on Laser Dynamics, Holland (2000)
George Mason University (2000)
Dynamics Days (2001)
Winter School on Chaotic Communications, UCSD (2001), three lectures.
Georgia Tech Nonlinear Dynamics Seminar (2001)
University of Arizona Applied Math Colloquium (2001)
U.S. Naval Academy (2001)
Colston Research Society Conference, Bristol, U.K. (2001)
SIAM Dynamical Systems Conference (2001)
Gordon Conference on Nonlinear Science (2001)
University of Oregon Physics Colloquium (2002)
UMD-NIST Symposium on Optics (2002)
Rank Symposium, U.K., Keynote speaker (2002)
Dynamics Days Asia-Pacific, Hangzhou, China (2002)
SIAM50 Conference, Philadelphia (2002)
Optical Society of America (2002)
Foundations and Frontiers of Physics, Maryland (2003)

Recognitions

Monie A. Ferst Young Faculty Award of Sigma Xi, 1987.
Best Paper Award from Sigma Xi, 1992.
Fellow of the Optical Society of America.
Fellow of the American Physical Society.
Finalist, Discover Awards for Technical Innovation, 1999.

Responsibilities

Editorial Board Member, Journal of the European Optical Society B (Quantum and Semiclassical Optics), 1994 - 1997.

Editorial Board, International Journal of Bifurcation and Chaos (World-Scientific), 1998 –

Editorial Board, Physica D, 2002 -

Organized a conference on Chaos in Physical Systems, American Physical Society (1986).

Program Committee for solid state and liquid lasers for CLEO 1990

Chair for Laser Noise SPIE Symposium at OPTCON 1990 (Optical Society Annual Meeting, Boston, 1990)

Invited to the XX Solvay Conference (Quantum Optics), Brussels 1991.

Program Committee for Nonlinear Dynamics in Optical Systems II conference, Austria, 1992.

Chair for Symposium on Chaos and Instabilities in Laser Systems, OSA Annual Meeting, Albuquerque, 1992.

Chair for conference on Chaos in Optics, SPIE Annual Meeting, San Diego, 1993.

Dean Search Committee, College of Sciences, Georgia Tech, 1993.

Member of the 1994 Charles H. Townes Award Committee of the Optical Society of America.

Co-organizer (with Shui-Nee Chow) of Army Research Office Workshop on Chaos and Nonlinear Dynamics at Georgia Tech, 1994.

Program Committee for Laser Optics '95, St. Petersburg, Russia 1995.

Organizing Committee for Nonlinear Dynamics in Optical Systems, Rochester, 1995.

Symposium Organizer, Laser Array Dynamics, SIAM Dynamical Systems Conference, 1997.

Symposium Organizer, Control and Synchronization of Chaotic Optical Systems, Annual Meeting of the Optical Society of America, 1997.

Member of the 1998 and 1999 Charles H. Townes Award Committee of the Optical Society of America.

Organizing Committee for Dynamics Days (2002).

Chair, Gordon Conference on Nonlinear Science, 2003.

Serve as referee and reviewer for Physical Review A, Physical Review E, Physical Review Letters, Journal of the Optical Society of America A and B, Optics Letters, American Journal of Physics, IEEE Journal of Quantum Electronics, Applied Physics Letters, Applied Physics B, Journal of Applied Physics, Physics Letters, Modern Optics, Optics Communications, Journal of the European Optical Society B (Quantum Optics), Canadian Journal of Physics, Research Corporation, the U.S. Department of Energy and the National Science Foundation, Army Research Office, reviewer for national funding agencies of the Netherlands, Australia, U.K., Korea, and Germany.

Ph. D's Supervised

- S. Zhu: Ph.D 1987. Thesis entitled "Statistical Fluctuations in Laser Transients", presently Dean, College of Sciences and Professor of Physics at Suzhou University, PRC.
- A.W. Yu: Ph.D 1988. Thesis entitled "Stochastic Effects in Single and Multimode Lasers". Presently Principal Scientist with Hughes, Engineering Systems Division at NASA - Goddard.
- Glenn James: Ph. D. 1990. Thesis entitled "Models of Intracavity Frequency Doubled Lasers". Thesis jointly supervised with Prof. Evans Harrell of the School of Mathematics.
- G. Gray: Ph.D 1990. Thesis entitled "Noise in Semiconductor Lasers" Presidential Fellow. Postdoctoral fellow at the Institute of Optics, Rochester. Currently with Seagate, Minneapolis.
- G. Vemuri: Ph.D 1990. Thesis entitled "Signals and Noise in Lasers and Atom-Field Interactions". Postdoctoral fellow at the Joint Institute of Laboratory Astrophysics, University of Colorado, Boulder. Presently an Associate Professor at Indiana University-Purdue University - Indianapolis campus.
- J. Thompson: Ph.D 1991. Thesis entitled " Multiple Four Wave Mixing Processes in Single Mode Optical Fiber". Presently Associate Professor and Chair of the Physics Department, DePaul University.
- C. Bracikowski: Ph.D 1991. Thesis entitled " Fluctuations and

Chaos in a Multimode Solid State Laser System". Postdoctoral fellow at Leiden University. Associate Professor at Bloomsburg University, Pennsylvania.

- K. Hsu: Ph.D 1991. Thesis entitled "Stochastic Mode-Locking Theory and Short Pulse generation by active Mode-Locking of External Cavity Semiconductor Lasers". Thesis jointly supervised with Prof. Carl Verber of the School of Electrical Engineering. Head of Research and Development at Micron Optics, Atlanta.
- L. Fabiny Ph.D 1993. Thesis entitled "Dynamics of a Coupled Solid State Laser Array", Office of Naval Technology postdoctoral fellow at the Naval Research Laboratory, Permanent Staff of NRL. Now at Particle Measurement Systems, Boulder Colorado.
- Angela Hohl Ph.D 1995. Thesis entitled "Dynamics of Semiconductor Lasers with Injected Signals and External Feedback". NRC Postdoctoral Fellow, Phillips Laboratory, Albuquerque. Now at Firefly, Inc., Boston.
- Zelda Gills Ph.D 1995. Thesis entitled "Control of Irregular Intensity Fluctuations in a Chaotic Multimode Solid State Laser System". Member of Technical Staff, AT&T Fiber Optics Laboratory, Norcross, GA.
- Junfu Chen Ph.D 1995. Thesis entitled "Photorefractive effects in optical fibers: grating fabrication and characterization". (Jointly supervised with Nile Hartman).
- Darlene Hart Ph.D 1996. Thesis entitled "Nonlinear Dynamics of Multiwave Mixing in an Optical Fiber". ASEE Postdoctoral Fellow, Naval Research Lab. Now with General Dynamics, Whippany.
- Quinton Williams Ph.D 1996. Thesis entitled "Fast Temporal Dynamics of the Erbium Doped Fiber Ring Laser". Member of Staff, Lucent Technologies, Fiber Optics Laboratory, Norcross, GA.
- Scott Thornburg Ph.D 1998. Thesis entitled "Synchronization of Coupled Solid State Lasers". Member of Staff, Lucent Technologies, Fiber Optics Laboratory, Norcross, GA.
- Greg VanWiggeren Ph.D 2000. Thesis entitled "Chaotic Communication with Erbium-Doped Fiber Ring Lasers". Member of staff, Agilent Laboratories.
- David J. DeShazer Ph.D 2002. Thesis entitled "Synchronization of Chaotic Lasers". Member of staff, Dow-Corning Laboratories, Michigan.

Ryan McAllister Ph.D. 2003. Thesis entitled “Chaotic Dynamics of a Laser with Feedback”, post-doctoral fellow at Georgetown University, research on neuroscience.

Students jointly supervised at other universities

Clif Liu Ph.D 1996. Thesis entitled “Low Dimensional Chaos in a Solid State Laser”, University of California, San Diego. (Jointly supervised with Prof. Henry Abarbanel).

John Terry Ph.D 2000. Thesis entitled “Synchronization of Coupled Systems”, University of Surrey. Post-doctoral fellow at University of Warwick. (Jointly supervised with Prof. Peter Ashwin).

Doctoral Students Currently Supervised

Wing-Shun Lam Semiconductor laser dynamics, delay-differential equations

Bhaskar Khubchandani Multiwave mixing in optical fibers, propagation through nonlinear inhomogeneous media

Min-Young Kim Semiconductor lasers and fiber optics

Elizabeth Rogers Spatiotemporal communication and fiber lasers

Postdoctoral Fellows and Visiting Scientists:

Dr. Pere Colet: Fulbright Fellow (1991 - 1994).

Professor Robert Hilborn Sabbatical from Amherst College (1994).

Dr. Michael Moeller: Visiting Scholar (1994 - 1995), supported by funds from the DFG (Germany).

Dr. Jordi Garcia-Ojalvo: Supported by a Spanish Government Fellowship (1996-1997), 1999, 2002.

Dr. John Terry Supported by an EPSERC grant from U.K, collaboration with Prof. Peter Ashwin (1998-1999).

Dr. Henning Voss Supported by German Foundation (1999).

Dr. Riccardo Meucci

Supported by grant from Istituto di Nazionale Ottica Applicata (several months in 2001, 2002)

Dr. Atsushi Uchida

Supported by Japanese Government Fellowship for the Promotion of Science (2002 - 2004).

Dr. Fabien Rogister

Supported by FNRS, Belgium (2003)

Updated: 03/03/03