DAVID W. MCLAUGHLIN

PROVOST, NEW YORK UNIVERSITY
PROFESSOR, MATHEMATICS AND NEURAL SCIENCE

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http://www.cns.nyu.edu/associates/McLaughlin.php (Center for Neural Science, NYU)

PERSONAL DATA:
Married: Wife – Ruth Ann
Children: Richard, Kenneth, Erin-Rose, Alisan

EDUCATION:
Creighton University, B.S., 1966
Indiana University, M.S., 1969
Indiana University, Ph.D., 1971

Ph.D. Advisor: L. Schulman

EMPLOYMENT:

1970-1972	Assistant Professor, Mathematics, New York University
1972-1974	Assistant Professor, Mathematics, Iowa State University
1974-1979	Associate Professor, Mathematics, University of Arizona
1979-1989	Professor, Mathematics, University of Arizona
1989-1994	Professor, Mathematics, Princeton University
1994-	Professor, Mathematics, New York University
2000-	Professor, Mathematics and Neural Science, New York University
2000-	Adjunct Professor of Biomathematics, Mt. Sinai Medical School
2002-	Provost, New York University

APPOINTMENTS:

1986-1989	Chairman, Program in Applied Mathematics, University of Arizona
1986-1989	Co-director of Arizona AFOSR, Center of Math. Sciences
1992-1994	Director, Program in Applied and Computational Mathematics, Princeton
1994-2003	Director, Courant Institute of Mathematical Sciences
2003-	Provost, New York University

HONORS:

1966-70	NDEA Title IV Fellow
1969-70	NSF National Fellowship
1976	Lester Ford Award by American Mathematics (with J. B. Keller)
1978	"The Soliton - A New Concept in Applied Science" Acknowledged by Citation Index as a "Citation Classic"
1979	Member, US-USSR Academy Exchange on Solitons
1992	Plenary Address SIAM Conf. on Dynamical Systems (Snowbird)
1994	Invited Address, Int'l Cong. Maths., Zurich
1995	IX David Alcaraz Spinola Award, Univ. Mexico
2000	Elected, Fellow of the American Academy of Arts and Sciences
2003	Elected, National Academy of Sciences
2003	Elected Fellow of the American Association for the Advancement of Science
2009	Elected, Fellow of the Society for Industrial and Applied Mathematics (SIAM-Inaugural class of Fellows)
2010	Creighton University Alumni Merit Award

SERVICE:

2001-2003	Chairman, SIAM Activity Group on Dynamical Systems
2003-2005	Chairman, Board of Mathematical Sciences and their Applications, National Academy of Sciences
2011-	Member, Division Committee on Engineering and Physical Sciences of the National Academies (DEPSCOM)
2011-	Member, Founding Board of Trustees of the Institute for Computational and Experimental Research (ICERM) of Brown University

GRANTS:

1972-2006	National Science Foundation
1983-2004	Air Force Office of Scientific Research
1996-2005	Sloan Foundation (with R. Shapley)
2000-2003	National Science Foundation VIGRE Program – Courant Institute
2002-2004	National Science Foundation Mathematical Biology (with D. Cai)
2005-2009	National Science Foundation Mathematics and Neuroscience
2006-2008	Schwartz Foundation (with D. Cai)- Program in Neurobiology
2006-2009	NIH-NIE (with R. Shapley)

AFFILIATIONS:
American Academy of Arts and Sciences
American Association for the Advancement of the Sciences
American Mathematical Society
National Academy of the Sciences
New York Academy of the Sciences
Society for Industrial and Applied Mathematicians (SIAM)

SPECIALIZATION:
Mathematical neuroscience; applied mathematics; nonlinear waves

CURRENT RESEARCH INTERESTS:
Modeling of the primary visual cortex

PH.D. STUDENTS:

1975-1978	E.A. Overman, (Co-director with F.A. Hopf)
1975-1979	M.G. Forest
1984-1988	H. Adachihara, (Co-director with A. Newell)
1987-1991	S. Jin (Co-director with D. Levermore)
1987-1991	C. Schober
1988-1991	H. Roitner (Co-director with N. Ercolani)
1989-1991	O. Wright
1989-1993	Y. Li
1989-1997	Y. Chen
1990-1994	J. Bronski
1995-1999	R. Goodman (Co-director with A. Majda)
1996-2000	D. Nykamp (Co-director with R. Shapley
2005-2009	M. Patel

POSTDOCTORAL ADVISEES:

1990-1993	D. Muraki
1993-1994	X. Wang
1993-1996	T. Ueda
1997-2000	D. Cai
1997-2000	J. Wielaard
1999-2003	L. Tao
2001-2003	A. Guillamon
2003-2006	A. Rangan
2010-present	J. Zhang

SELECT PUBLICATIONS:

1. Cai, D.; Tao, L.; Shkarayev, M.; Rangan, A; McLaughlin, D.; Kovacic, G. The Role of Fluctuations in Coarse-Grained Descriptions of Neuronal Networks. *Comm. Math. Sci.* **10** (2012), no. 1, 307-354.

2. Cai, D.; Rangan, A.; McLaughlin, D. Quantifying Neuronal Network Dynamics through Coarse-Grained Event-Trees. *PNAS,* **105** (2008), no. 31, 10990-10995.

3. Cai, D.; Rangan, A.; McLaughlin, D. Neuronal Information Encoding and Reduction of Dimension Network Dynamics. *SIAM*, 40 (2007), no. 2.

4. Cai, D.; Tao, L.; Rangan, A.; McLaughlin, D. Kinetic Theory for Neuronal Network Dynamics. *Comm. Math. Sci.* **4** (2006), no. 1, 97-127.

5. Guillamon, A.; McLaughlin, D.; Rinzel, J. Estimation of Synaptic Conductances. *J. Physiology-Paris* **100** (2006), no. 1-3, 31-42.

6. Tao, L.; Cai, D.; McLaughlin, D.; Shelley, M. J.; Shapley, R. Orientation Selectivity in Visual Cortex by Fluctuation-Controlled Criticality. *PNAS* **103** (2006), no. 34, 12911-12916.

7. Cai, D.; Rangan, A.; McLaughlin, D. Architectural and synaptic mechanisms underlying coherent spontaneous activity in V1. *PNAS* **102** (2005), no. 16, 5868- 5873.

8. Rangan, A.; Cai, D.; McLaughlin, D. Modeling the spatiotemporal cortical activity associated with the line-motion illusion in primary visual cortex. *PNAS* **102** (2005), no. 52, 18793-18800.

9. Cai, D.; Tao, L.; McLaughlin, D. An Embedded Network Approach for Scale-Up of Fluctuation-Driven Systems with Preservation of Spike Information. *PNAS* **101** (2004), no. 39, 14288-14293.

10. Cai, D.; Tao, L.; Shelley, M.; McLaughlin, D. An effective kinetic representation of fluctuation-driven neuronal networks with application to simple and complex cells in visual cortex. *PNAS* **101** (2004), no. 20, 7757-7762.

11. Tao, L.; Shelley, M.; McLaughlin, D.; Shapley, R. An egalitarian network model for the emergence of simple and complex cells in visual cortex. *PNAS* **101** (2004), no. 1, 366-371.

12. McLaughlin, D.; Shapley, R.; Shelley, M. Large-scale modeling of the primary visual cortex: influence of cortical architecture upon neuronal response. *J. Physiol. Paris* **97** (2003), no. 2-3, 237-252.

13. McLaughlin, D.; Shapley, R.; Shelley, M.; Jin, J. High Conductance Dynamics of the Primary Visual Cortex. *Perspectives and Problems in Nonlinear Science: A celebratory volume in honor of Lawrence Sirovich.* Springer-Verlag, New York, 2003.

14. Cai, D.; McLaughlin, D.; McLaughlin, K. T. R. The Nonlinear Schrödinger Equation as both a PDE and a Dynamical System. *Handbook of Dynamical Systems*, *vol. 2,* 599-678. North-Holland, Amsterdam, 2002.

15. Shapley, R.; McLaughlin, D.; Shelley, M. Orientation Selectivity: models and neural mechanisms. *The Handbook of Brain Theory and Neural Networks*, 2nd ed. MIT Press, Cambridge, Mass., 2002.

16. Shelley, M.; McLaughlin, D. Coarse-grained reduction and analysis of a network model of Cortical Response: I. Drifting Grating Stimuli. *J. Comput. Neurosci.* **12** (2002), no. 2, 97-122.

17. Shelley M.; McLaughlin D.; Shapley R.; Wielaard J. States of high conductance in a large-scale model of the visual cortex. *J. Comput. Neurosci.* **13** (2002), no. 2, 93-109.

18. Cai, D.; Majda, A. J.; McLaughlin, D. W.; Tabak. E. G. Dispersive Wave Turbulence in One Dimension. *Physica D* **152-153** (2001), 551-572.

19. Cai, D.; McLaughlin, D. ; Shatah, J. Spatiotemporal Chaos in Spatially Extended Systems. *Math. Comput. Simulation* **55** (2001), no. 4-6, 329-340.

20. Goodman, R.; Majda, A.; McLaughlin, D. Modulations in the Leading Edges of Midlatitude Storm Tracks. *SIAM J. Appl. Math.* **62** (2001), no. 3, 746-776.

21. McLaughlin, D.; Shapley, R.; Shelley, M.; Tao, L. Complex Cells in a Simple Cell Network Model of V1 Cortex. *Soc. Neurosci. (Abs)* **27** (2001).

22. Shapley, R.; McLaughlin, D.; Shelley, M.; Wielaard, J. Lateral Inhibition Generates Simple Cells in a Model of V1 Cortex. *Invest. Ophthalmol. Vis. Sci.* **42** (2001), Supp. #3901.

23. Wielaard, D.J.; Shelley, M.; McLaughlin, D.; Shapley, R. How Simple Cells are Made in a Nonlinear Network Model of the Visual Cortex. *J. Neurosci.* **21** (2001), no. 14, 5203-5211.

24. Cai, D.; McLaughlin, D. Chaotic and Turbulent Behavior of Unstable 1-D Nonlinear Dispersive Waves. *J. Math. Phys.* **41** (2000), no. 6, 4125-4153.

25. Chen, Y.; McLaughlin, D. Diffraction Effects on Diffusive Bistable Optical Arrays. *Physica D* **138** (2000), 163-195.

26. Forest, M. G.; Wright, O.; McLaughlin, D.; Muraki, D. Non-Focusing Instabilities in Coupled, Integrable Nonlinear Schrödinger PDE's. *Journal of Nonlinear Science* **10** (2000), 291-331.

27. Kim, S.; McLaughlin, D.; Potasek, M. Propagation of the Electromagnetic Field in Optical Limiting Reverse Saturable Absorbers. *Phys. Rev. A* **61** (2000), 025801-1 - 025801-4.

28. McLaughlin, D.; Shapley, R.; Shelley, M.; Wielaard, J. A Neuronal Network Model of the Macaque Primary Visual Cortex V1: Orientation Tuning and Dynamics in the Input Layer 4C. *Proc. Nat. Acad.* **97** (2000), no. 14, 8087-8092.

29. Potasek, M.; Kim, S.; McLaughlin, D. All Optical-Power Limiting. *J. Nonlinear Opt. Phys. Mater.* **9** (2000), 343-364.

30. Cai, D.; Majda, A.; McLaughlin, D.; Tabak, E. Spectral Bifurcations in Dispersive Wave Turbulence. *PNAS* **96** (1999), 14216-14221.

31. Cai, D.; McLaughlin, D.; Shatah, J. Spatial-Temporal Chaos and Effective Stochastic Dynamics for a Near Integrable Nonlinear System. *Phys. Lett. A* **253** (1999), 280-86.

32. Chen, Y.; McLaughlin, D. Focusing-Defocusing Effects for Diffusion Dominated Bistable Optical Arrays. *J. Opt. Soc. Am. B* **16** (1999)**,** no. 7, 1087-1098.

33. Jin, S.; Levermore, D.; McLaughlin, D. The Semiclassical Limit of the Defocusing NLS Hierarchy. *Comm. Pure Appl. Math.* **52** (1999), no. 5, 613-654.

34. McLaughlin, D.; Shapley, R.; Shelley, M.; Wielaard, J. Modeling of Orientation Dynamics in Visual Cortex. *Soc. Neurosci. (Abs)* **25** (1999).

35. McLaughlin, D.; Shelley, M. Point Neuron and Mean Firing Rate Models of an Input Layer of the Primary Visual Cortex. Preprint, 1999.

36. McLaughlin, D. W.; Shatah, J. Homoclinic orbits for PDE's. *Recent advances in partial differential equations (Venice 1996),* 281-299. Proceedings of Symposia in Applied Mathematics, 54. American Mathematical Society, Providence, R.I., 1998.

37. Bronski, J. C.; McLaughlin, D.; Shelley, M. On the Stability of Time-Harmonic Localized States in a Disordered Nonlinear Medium. *J. Statist. Phys.* **88** (1997), no. 5-6, 1077-1115.

38. Li, Y.; McLaughlin, D. Homoclinic Orbits and Chaos in Discretized Perturbed NLS Systems. I. Homoclinic Orbits. *J. Nonlinear Sci.* **7** (1997), no. 3, 211-269.

39. Majda, A.; McLaughlin, D. W.; Tabak, E. A One-Dimensional Model for Dispersive Wave Turbulence. *J. Nonlinear Sci.* **7** (1997), no. 1, 9-44.

40. Li, Y.; McLaughlin, D. W.; Shatah, J.; Wiggins, S. Persistent homoclinic orbits for a perturbed nonlinear Schrödinger equation. *Comm. Pure Appl. Math.* **49** (1996), no. 11, 1175--1255.

41. McLaughlin, D.; Muraki, D.J.; Shelley, M. Self-Focused Optical Structures in a Nematic Liquid Crystal. *Physica D* 97 (1996), no. 4, 471-497.

42. McLaughlin, D. W.; Overman, E. A., II; Wiggins, S.; Xiong, C. Homoclinic orbits in a four-dimensional model of a perturbed NLS equation: a geometric singular perturbation study. *Dynamics reported*, 190-287. Dynamics Reported: Expositions in Dynamical Systems (New Series), 5. Springer, Berlin, 1996.

43. McLaughlin, D.; Shatah, J. Melnikov Analysis for PDE's. *Dynamical systems and probabilistic methods in partial differential equations (Berkeley, CA, 1994),* 51—100. Lectures in Applied Mathematics, 31. American Mathematical Society, Providence, RI, 1996.

44. Calini, A.; Ercolani, N. M.; McLaughlin, D.; Schober, C. M. Melnikov Analysis of Numerically Induced Chaos in the Nonlinear Schrödinger Equation. *Physica D* **89** (1995), 227-260.

45. McLaughlin, D. W. Whiskered tori and chaotic behavior in nonlinear waves. *Proceedings of the International Congress of Mathematicians, Vol. 1, 2 (Zürich, 1994),* 1484—1493. Birkhäuser, Basel, 1995.

46. McLaughlin, D.; Muraki, D.; Shelley, M.; Wang, X. A Paraxial Model for Optical Self-Focusing in a Nematic Liquid-Crystal. *Physica D* 88 (1995), no. 1, 55-81.

47. McLaughlin, D. W.; Overman, E. A. Whiskered Tori for Integrable PDEs: Chaotic Behavior in Near Integrable PDEs. *Surveys in Applied Mathematics, vol. 1, 83-203.* Plenum, New York, 1994.

48. Bronski, J. C.; McLaughlin, D.W. Semiclassical behavior in the NLS equation: optical shocks---focusing instabilities. *Singular limits of dispersive waves (Lyon, 1991), 21-38*. NATO Advanced Science Institutes Series B: Physics. Plenum, New York, 1994.

49. Jin, S.; Levermore, C. D.; McLaughlin, D.W. The behavior of solutions of the NLS equation in the semiclassical limit. *Singular limits of dispersive waves (Lyon, 1991),* 235—255. NATO Advanced Science Institutes Series B: Physics, 320. Plenum, New York, 1994.

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51. McLaughlin, D. W.; Strain, J. A. Computing the weak limit of KdV. *Comm. Pure Appl. Math.* **47** (1994), no. 10, 1319--1364.

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53. Ercolani, N.; Forest, M. G.; McLaughlin, D.; Sinha, A. Strongly Nonlinear Modal Equations for Nearly Integrable PDEs. *J. Nonlinear Science* **3** (1993), 393-426.

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55. McLaughlin, D.; Ercolani, N.; Roitner, H. Attractors and transients for a perturbed periodic KdV equation: a nonlinear spectral analysis. *J. Nonlinear Sci.* **3** (1993), no. 4, 477-539.

56. McLaughlin, D.; Muraki, D.J.; Shelley, M. J. Light Interacting with Liquid Crystals. *Physica D* 68 (1993), no. 1, 116-126.

57. Ercolani, N.; Forest, M. G.; McLaughlin, D. W. Notes on Melnikov Integrals for Models of the Driven Pendulum Chain. Unpublished, 1992.

58. McLaughlin, D. W.; Schober, C. Chaotic and Homoclinic Behavior for Numerical Discretization of Nonlinear Schrödinger. *Physica D* **57** (1992), no. 3-4, 447-465.

59. Ercolani, N. M.; McLaughlin, D.W. Toward a topological classification of integrable PDEs. *The geometry of Hamiltonian systems (Berkeley, CA, 1989),* 111-129. *Mathematical Sciences Research Institute Publications,* 22. Springer, New York, 1991.

60. McLaughlin, D. W.; Pironneau, O. Some Notes on Beltrami Fields in Cartesian Geometry. *J. Math. Phys.* **32** (1991), no. 3, 797-804.

61. Bishop, A. R.; Flesch, R.; Forests, M. G.; McLaughlin, D.; Overman, E. A. Correlations between Chaos in a Perturbed Sine-Gordon Equation and a Truncated Model System. *SIAM J. Math.* Anal. **21** (1990), 1511-1536.

62. Bishop, A. R.; Forest, M. G.; McLaughlin, D.; Overman, E. A. A Modal Representation of Chaotic Attractors for the Driven, Damped Pendulum Chain. *Phys. Lett. A* 144 (1990), no. 1, 17-25.

63. Ercolani, N.; Forest, M. G.; McLaughlin, D. W. Geometry of the Modulational Instability. III. Homoclinic Orbits for the Periodic sine-Gordon Equation. *Physica D* **43** (1990), no. 2-3, 348-384.

64. Terrones, G.; McLaughlin, D. W.; Overman, E. A.; Pearlstein, A. J. Stability and Bifurcation of Spatially Coherent Solutions of the Damped-Driven NLS Equations. *SIAM J. Appl. Math.* **50** (1990), no. 3, 791-818.

65. Bishop, A.; McLaughlin, D.; Salerno, M. Global Coordinates for the Breather-Kink (Antikink) Sine-Gordon Phase Space: An Explicit Separatrix as a Possible Source of Chaos. *Phys. Rev. A (3)* **40** (1989), no. 11, 6463-6469.

66. Adachihara, H.; McLaughlin, D. W.; Moloney, J. V.; Newell, A. C. Solitary Waves as Fixed Points of Infinite Dimensional Maps in an Optical Bistable Ring Cavity: Analysis *J. Math. Phys.* **29** (1988), no. 1, 63-85.

67. Bishop, A.; Forest, M. G.; McLaughlin, D; Overman, E. Quasiperiodic Route to Chaos in a Near-Integrable PDE: Homoclinic Crossings. *Phys. Lett. A.* **127** (1988), no. 6-7, 335-340.

68. Chierchia, L.; Ercolani, N.; McLaughlin, D. On the Weak Limit of Rapidly Oscillating Waves. *Duke Math. J.* **55** (1987), 759-764.

69. Ercolani, N.; Forest, M. G.; McLaughlin, D. W.; Montgomery, R. Hamiltonian Structure for the Modulation Equations of a Sine-Gordon Wavetrain. *Duke Math. J.* **55** (1987), no. 4, 949-983.

70. Aceves, A.; Adachihara, H.; Jones, C.; Lerman, J. C.; McLaughlin, D. W.; Moloney, J. V.; Newell, A. C. Chaos and soherent structures in partial differential equations. (Santa Barbara, Calif., 1985) *Physica D* **18** (1986), no. 1-3, 85-112

71. Bishop, A. R.; Forest, M. G.; McLaughlin, D. A Quasi-Periodic Route to Chaos in a Near-Integrable pde. (with A. R. Bishop, M. G. Forest, and E. A. Overman), *Physica* **23 D** (1986), 293-328.

72. Bishop, A.; Mazor, A.; McLaughlin, D. Phase-Pulling and Space-Time Complexity in an AC Driven Damped One-Dimensional Sine-Gordon System. *Phys. Lett. A.* 119 (1986), no. 6, 273-279.

73. Bishop, A. R.; McLaughlin, D.; Overman, E. A. Coherence and Chaos in the Driven Damped Sine-Gordon Equation: Measurement of the Soliton Spectrum. *Physica D* **19** (1986), no. 1, 1-41.

74. Ercolani, N.; Forest, M.G.; McLaughlin, D. The Origin and Saturation of Modulational Instabilities Santa Barbara, Calif., 1985). *Physica D* **18** (1986), no. 1-3, 472-474.

75. Ercolani, N.; Forest, M. G.; McLaughlin, D. Modulational Instabilities of Periodic Sine-Gordon Waves: A Geometric Analysis. Nonlinear systems of partial differential equations in applied mathematics, Part 1 (Santa Fe, N.M., 1984), 149-166. Lectures in Applied Mathematics, 23. American Mathematical Society, Providence, R.I., 1986.

76. Ercolani, N.; Forest, M. G.; McLaughlin, D. Oscillations and Instabilities in Near Integrable PDEs. *Nonlinear systems of partial differential equations in applied mathematics, Part 1 (Santa Fe, N.M., 1984),* 3-46**.** Lectures in Applied Mathematics**,** 23**.** American Mathematical Society, Providence, R.I., 1986.

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79. Fesser, K.; McLaughlin, D.; Bishop, A.; Holian, B. Chaos and Nonlinear Modes in a Perturbed Toda Chain. *Phys. Rev. A.* 31 (1985), no. 4, 2728-2731.

80. McLaughlin, D.; Moloney, J. V.; Newell, A. C. New Class of Instabilities in Passive Optical Cavities. *Phys. Rev. Lett.* 54 (1985), no. 7, 681-684.

81. McLaughlin, D. W.; Papanicolaou, G.; Pironneau, O. Convection of Microstructure and Related Problems. *SIAM J. Appl. Math* **45** (1985), no. 5, 780-797.

82. Cushman-Rosin, B.; Papanicolaou, G.; McLaughlin, D.W. Interactions Between Mean Flow and Finite-Amplitude Mesoscale Eddies in a Barotropic Ocean. *Geophys. Astrophys. Fluid Dynamics*, 29 (1984), no. 4, 333-353.

83. Ercolani, N.; Forest, M.G.; McLaughlin, D. Modulational Stability of Two Phase Sine Gordon Wavetrains. *Studies in Appl. Math.* **71** (1984), no. 2, 91-101.

84. Forest, M. G.; McLaughlin, D. W. Modulations of Perturbed KdV Wavetrains. *SIAM J. Appl. Math.* **44** (1984), no. 2, 287-300.

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96. McLaughlin, D.; Scott, A. C. Perturbation Analysis of Fluxon Dynamics. *Phys. Rev. A.* 18 (1978), no. 4, 1652-1680.

97. Keener, J. P.; McLaughlin, D. Green's Function for a Linear Equation Associated with Solitons. *J. Math. Phys.* 18 (1977), no. 10, 2008-2013.

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102. McLaughlin, D. A Stochastic Gaussian Beam II. *J. Math. Phys.* **16** (1975), 100-103.

103. McLaughlin, D. W. Four Examples of the Inverse Method as a Canonical Transformation. *J. Math. Phys.* **16** (1975), 96-99; Erratum in **16** (1975), 1704.

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