

# David P. Feldman

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## Education

- 1998 Ph.D., Physics. University of California, Davis
- 1991 B.A., Physics. Carleton College, Northfield, MN.

## Current Position

- 1998–Present **Professor of Physics and Mathematics**, College of the Atlantic, Bar Harbor, ME.
- 2017 Director, Complex Systems Summer School, Santa Fe Institute, Santa Fe, NM.

## Past Positions

- 12.2011–6.2012 Visiting Professor, Department of Applied Physics, Kigali Institute of Science and Technology, Kigali, Rwanda
- 2006–2009 Co-Director, Beijing Complex Systems Summer School, Sponsored by the Santa Fe Institute in cooperation with The Institute of Theoretical Physics, Chinese Academy of Sciences.
- 1.2003–7.2007 Associate Dean for Academic Affairs, College of the Atlantic, Bar Harbor, ME
- 6.2001–7.2007 Associate Graduate Faculty, Department of Physics and Astronomy, University of Maine, Orono, ME.
- 8.1991–6.1993 Math and Physics Teacher, The McCallie School, Chattanooga, TN.

## Honors and Awards

- U.S. Fulbright Lecturer, Rwanda, 2012
- Graduate Student Travel Award. University of California, Davis, 1998.
- Dissertation Year Fellowship. University of California, Davis, 1997-98.
- Chancellor's Teaching Fellowship. University of California, Davis, Spring, 1996.
- Nominated, Outstanding Graduate Student Teaching Award, University of California, Davis. 1993-1994.
- Non-resident Tuition Fellowship. University of California, Davis, 1993-94.
- Distinction, Senior Thesis: The Physics of Snowflake Formation. Carleton College. 1991.

## Teaching Experience

### College of the Atlantic (1998–Present)

- Applied and Mathematical Statistics (1)
- Calculus I (10)
- Calculus II (9)
- Calculus III (7)

- Chaos and Complex Systems (3)
- Introduction to Chaos and Fractals (14)
- Chaotic Dynamical Systems (1)
- Dynamical Systems (1)
- Complex Networks (1)
- Introduction to Computer Science (2)
- Differential Equations (5)
- Fractals and Scaling (1)
- Gender and Science (1)
- The Internet (1)
- Linear Algebra (5)
- Making the Bomb (3)
- Physics I (7)
- Physics II (3)
- Physics III (3)
- Physics and Mathematics of Sustainable Energy (6)
- Proofs and Mathematical Structures (1)
- Introduction to Quantum Mechanics (1)
- Real Analysis (1)
- Research Projects (2)
- Thermodynamics (2)

(#) = Number of times course taught

### Massive Open Online Courses (2014–Present)

All courses offered as part of the Santa Fe Institute's Complexity Explorer project: <http://www.complexityexplorer.org>

- Chaos and Dynamical Systems. January–March, 2014. Enrollment: 5,091.
- Chaos and Dynamical Systems. January–March, 2015. Enrollment: 2,044.
- Chaos and Dynamical Systems. July–, 2016. Enrollment: 1,600.
- Fractals and Scaling. September–October, 2015. Enrollment: 1606.
- Fractals and Scaling. February–April, 2017. Enrollment: ongoing.

### Kigali Institute of Science and Technology (2011–2012)

- Atomic and Molecular Physics (Phy3312)
- Computational Physics (Phy3323)
- General Physics I (Phy3114)
- Mathematical Physics II (Phy3315)
- Statistical Physics (Phy3412)

### University of California, Davis (1993–1998)

- Chancellor's Teaching Fellow
- Teaching Assistant for Physics 104AB (Mathematical Methods for Physics), Physics 9ABCD (Introductory Physics with Calculus)
- Co-Mentor, Minority Undergraduate Participation in the Physical Science Program

## The McCallie School (1991–93)

- Courses Taught: Quantitative Physical Science and Geometry
- Co-Dean of the Freshman Class
- Participated in new faculty mentor program
- Other Duties: Co-advisor to the African-American student association, Dormitory advisor, Assistant coach of varsity lacrosse and junior-school cross country teams

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## Grants

Maine Space Grant Consortium. “Participatory Learning Through Community Energy.” \$10,000. 2017. (Anna E. Demeo, co-PI)

Henry David Thoreau Foundation. “Connecting Environmental Leadership and Sustainable Business.” \$20,000. 2017. (Anna E. Demeo, Jay Friedlander, and Doreen Stabinsky, co-PIs)

Henry David Thoreau Foundation. “Henry David Thoreau Environmental Leaders Initiative.” \$40,000. 2016. (Anna E. Demeo and Doreen Stabinsky, co-PIs)

Maine Space Grant Consortium. “Seed Funds for Collaboration with Trinity Washington University.” \$12,079. 2015. (Anna E. Demeo, co-PI)

Environmental Protection Agency Environmental Education Program. “Elementary Teacher Training in Sustainable Energy.” \$18,505. 2011. (Anna E. Demeo, Co-PI)

Maine Space Grant Consortium Research and Higher Education Program. “Research and Education for Sustainable Energy.” \$95,194. 2010-2011. (Anna E. Demeo, Co-PI)

Maine Space Grant Consortium Education and Seed Research Program. “A Project-based Class in Residential Windpower.” Award SG-09-27. \$4,967. 2009-10. (Anna E. Demeo, Co-PI)

National Science Foundation, Office of International Science and Engineering, Global Scientists and Engineers Program, “Santa Fe Institute’s Complex Systems Summer School in Beijing, China.” Award OSIE-0623953. \$115,909. 2006-09.

Maine Space Grant Consortium Higher Education. “Adding a Laboratory Component to a Novel Introductory Course in Chaos and Fractals.” Award SG-05-31. \$4,081. 2005-06.

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## Books

[#] = Citations as of January 2017 according to google scholar

D.P. Feldman. *Chaos and Fractals: An Elementary Introduction*. Oxford University Press. 2012. ISBN 9780199566440. 425 pages. 333 figures. 282 end-of-chapter exercises. [37]

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## Teaching Materials

D.P. Feldman and A.P. Wesolowski. Solutions Manual for *Chaos and Fractals: An Elementary Introduction*. 2012–13. 174 pages.

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## Peer-Reviewed Publications

[#] = Citations as of January 2017 according to google scholar

google scholar h-index: 13. total citations 1279.

A.E. Demeo, D.P. Feldman, and M.L. Peterson. A Human Ecological Approach to Energy Literacy through Hands-on Projects: An Essential Component of Effectively Addressing Climate Change. *Journal of Sustainability Education*. Vol. 4, January 2013. [5]

M.D. Robinson, D.P. Feldman, and S.R. McKay. Local Entropy and Structure in a Two-Dimensional Frustrated System. *Chaos*. 21(3). 037114. 2011. [13]

D.P. Feldman, C.S. McTague, and J.P. Crutchfield. The Organization of Intrinsic Computation: Complexity-Entropy Diagrams and the Diversity of Natural Information Processing. *Chaos*. 18:043106. 2008. [99]

D.P. Feldman and J.P. Crutchfield, Synchronizing to Periodicity: The Transient Information and Synchronization Time of Periodic Sequences. *Advances in Complex Systems*. 7(3-4): 329-355, 2004. [26]

D.P. Feldman and J.P. Crutchfield, Structural Information in Two-Dimensional Patterns: Entropy Convergence and Excess Entropy. *Physical Review E*. 67:051104. 2003. [104]

J.P. Crutchfield and D.P. Feldman. Regularities Unseen, Randomness Observed: The Entropy Convergence Hierarchy. *Chaos*. 15: 25-54, 2003. [298]

J.P. Crutchfield and D.P. Feldman, Synchronizing to the Environment: Information Theoretic Constraints on Agent Learning. *Advances in Complex Systems*. 4: 251-264, 2001. [27]

J.P. Crutchfield, D.P. Feldman, and C. R. Shalizi. Comment I on “Simple Measure for Complexity.” *Physical Review E*. 62:2996-7, 2000. [56]

D. P. Feldman and J.P. Crutchfield. Statistical Measures of Complexity: Why? *Physics Letters A*, 238:244-52, 1998. [328]

J.P. Crutchfield and D.P. Feldman, Statistical Complexity of Simple 1D Spin Systems. *Physical Review E*. 55:R1239-42, 1997. [112]

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## Unpublished Reports and Lecture Notes

[#] = Citations as of January 2017 according to google scholar

D.P. Feldman. Computational Mechanics of Classical Spin Systems, Ph.D. Dissertation, Physics Department, University of California, Davis, September, 1998. [30]

D.P. Feldman and J.P. Crutchfield. Discovering Non-Critical Organization: Statistical Mechanical, Information Theoretic, and Computational Views of Patterns in Simple One-Dimensional Spin Systems. Santa Fe Institute Working Paper 98-04-026. [80]

D.P. Feldman. Information Theory, Excess Entropy and Statistical Complexity: Discovering and Quantifying Statistical Structure. Developed in conjunction with series of lectures given at the Santa Fe Institute, July 1997. [47]

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## Invited Book Reviews

D.P. Feldman. Review of *Introduction to Modern Dynamics: Chaos, Networks, Space and Time*. *Physics Today*, 68(12):56, 2015.

D.P. Feldman. Review of *Complex and Adaptive Dynamical Systems*. *Physics Today*, 62(7):58-9, 2009.

D.P. Feldman. Review of *Monte Carlo Methods in Statistical Physics*. *Computing in Science & Engineering*, 2:73-4, 2000.

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## Selected Invited Talks and Seminars

Predictable Unpredictability: Strange Attractors and the Butterfly Effect. Eagle Hill Institute. Steuben, ME. August 8, 2013.

Local Complexity for Heterogeneous Spatial Systems. Information in Dynamical Systems and Complex Systems Workshop. Burlington, VT. July 18–19, 2013.

Complexity, Unpredictability, and Synchronization: Information Theoretic Measures of Structure and Randomness. IDyOM Workshop on Information and Neural Dynamics in the Perception of Musical Structure. Goldsmiths College, London, UK. March 17, 2013.

Strange Attractors and the The Butterfly Effect: The Mathematics of Chaos. Science Café sponsored by the Mount Desert Island Biological Laboratory and McKay's Public House, Bar Harbor, ME. Feb. 6, 2013.

Chaos and Complex Systems: In the Classroom and Beyond. Smith Institute for Applied Research, Invitational Symposium. Johnson C. Smith University, Charlotte, NC. Oct. 26, 2012.

Energy 101: Why Electric Cars Matter. Electric Car Day, Seal Cove Auto Museum, Seal Cove, ME. Aug. 9, 2012.

Chaos and Dynamical Systems. Exploring Complexity in Science & Technology from an SFI Perspective. Santa Fe Institute. Feb. 6, 2011.

Complexity and Frustration. Santa Fe Institute workshop on Randomness, Structure, and Causality: Measures of complexity from theory to applications. Jan. 10–13, 2011.

Three Lectures on Complex Systems: (1) Introduction to Dynamical Systems, (2) Measuring Randomness and Structure and (3) Network Structure and Dynamics; Networks in the Real World. Exploring Complexity in Science and Technology from a Santa Fe Institute Perspective, Sponsored by the Santa Fe Institute. Portland, OR. May 19-21, 2010.

An Introduction to Sustainable Energy. National Honor Society Earth Day Speaker, Mount Desert Island High School. 30 April 2010.

Thoughts on Complex Networks Research. ITP/SFI Workshop on Frontiers in Complex Systems: Complex Social Networks and Urban Dynamics. Beijing, China. July 2009.

Some Foundational Tools and Concepts for Complex Systems: Entropy, Information, Computation, and Complexity. (A series of five lectures.) Santa Fe Institute Complex Systems Summer School. Beijing, China. July 2008.

An Introduction to Statistical Complexity. Mathematical Interdisciplinary Research at Warwick (MIR@W), February 18, 2008, University of Warwick.

The Objective Subjectivity of Complexity. Mathematical Interdisciplinary Research at Warwick (MIR@W), February 18, 2008, University of Warwick.

Some Foundational Tools and Concepts for Complex Systems: Entropy, Information, and Statistical Complexity. (A twelve-hour lecture series.) Complex Systems Summer School Institut des Systemes Complex de Paris Ile-de-France, Paris, France. August 2007.

Some Foundations in Complex Systems: Tools and Concepts: An Advanced Introduction. (A series of five lectures.) Santa Fe Institute Complex Systems Summer School. Beijing, China. July 2007.

Mathematics for Complex Systems: The Objective Relativity of Complexity and Entropy. XIV International Conference of the Society for Human Ecology. Bar Harbor, Maine. October 2006.

Some Foundations in Complex Systems: Tools and Concepts. (A series of four lectures.) Santa Fe Institute Complex Systems Summer School. Beijing, China. July 2006.

Exploring the Relationships between Complexity and Randomness: Complexity-Entropy Diagrams. Science of Complex Systems Seminar Series. Center for Computational Science and Engineering. University of California, Davis. 8 February 2006.

Racial Segregation in U.S. Cities: Using Computational Models to Understand the Gap between Individual Preferences and Neighborhood Outcomes. Olin Seminar Series, Olin College of Engineering, 7 December 2005.

Some Foundations in Complex Systems: Tools and Concepts. (A series of five lectures.) Santa Fe Institute Complex Systems Summer School. Beijing, China. July 2005.

The Complexity of Simple Periodic Sequences: The Unpredictability of Synchronizing to Periodic Patterns. Colby College Physics Colloquium. 7 October 2004.

Some Foundations in Complex Systems: Tools and Concepts. (A series of five lectures.) Santa Fe Institute Complex Systems Summer School. Qingdao University, Qingdao, Shandong Province, China. July 2004.

Approximately Nine Open Questions Concerning the Application of Information Theory to Describe Two-Dimensional Systems. Dynamics of Learning Group Presentation, Santa Fe Institute, 17 October 2002.

A Workshop on Information Theory for Agent-Based Modeling. TASK OEF Meeting, Santa Fe Institute, 9 October 2002.

Information Theory Applied to Two-Dimensional Glassy Systems. Dynamics of Learning Group Presentation, Santa Fe Institute, 27 August 2002.

The Transient Information and Synchronization Time of Periodic Sequences. Dynamics of Learning Group Presentation, Santa Fe Institute, 31 July 2001.

Regularities Unseen, Randomness Observed: The Interplay between Order and Disorder in Pattern-Forming Systems. Seminar, Cornell College, 14 February 2001.

Congregations Rich with Entropy: The Interplay between Order and Disorder in Pattern-Forming Systems. Seminar, Hiram College, 24 January 2001.

Regularities Unseen, Randomness Observed: Excess Entropy, Transient Information and the Entropy Convergence Hierarchy. Colloquium, Department of Physics and Astronomy, University of Maine, Orono, 12 May 2000.

Regularities Unseen, Randomness Observed. Faculty Seminar Series, College of the Atlantic, 5 October, 1999.

Discovering and Describing Patterns and Organization: an Introduction to Computational Mechanics. Lecture, Santa Fe Institute Complex Systems Summer School, 11 June 1998.

Discovering and Describing Patterns: A Computational Approach. Colloquium, University of California, Davis. 1 June, 1998.

Discovering and Describing Patterns: A Computational Approach. Seminar, Union College, 6 April, 1998.

Discovering and Describing Patterns: A Computational Approach. Seminar, University of New England, 31 March, 1998.

Discovering and Describing Patterns: A Computational Approach. Seminar, University of Puget Sound, 25 March, 1998.

Rule as the Sum of Rulelessness? Seminar, College of the Atlantic, 19 February, 1998.

Discovering Organization: Computational Mechanics of One-Dimensional Spin Systems. New England Complex Systems Institute International Conference on Complex Systems. 23 September, 1997.

Discovering Non-Critical Organization: Computational Mechanics of Simple One-Dimensional Spin Systems. 22 April, 1997. Invited seminar, Center for Nonlinear Studies, Los Alamos National Laboratory.

Discovering Non-Critical Organization: Computational Mechanics of Simple One-Dimensional Spin Systems. 12 November, 1996. Invited seminar, Santa Fe Institute.

Computational Mechanics of 1D Ising Systems. Ninth Annual Santa Fe Institute Complex Systems Summer School. June 1996.

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## Selected Contributed Presentations

D.P. Feldman. Dynamics and Chaos in a Nutshell: What Human Ecologists Might Want to Know. Roundtable on Mathematics and Complex Systems. International Conference of the Society for Human Ecology. Bar Harbor, ME. October 24, 2014.

D.P. Feldman and A.E. Demeo. An Interdisciplinary, Project-Based Class in Sustainable Energy. American Association of Physics Teachers (AAPT) Summer Meeting. Portland, OR. July 13, 2013.



D.P. Feldman. Predictable Unpredictability: A Introduction to the Mathematics of Chaos. College of the Atlantic. October 4, 2012.

D.P. Feldman. Predictable Unpredictability: The Mathematics of Chaos. Public Lecture. Kigali Institute of Science and Technology. June 8, 2012.

D.P. Feldman. Complexity vs. Entropy in Cellular Automata: Wedges not Edges. Computational Mechanics Group, Complexity Sciences Center, University of California, Davis. May 20, 2009.

S.K. Heller and D.P. Feldman. Emergent (Non)Majors: Communities and Connections in an Interdisciplinary College. Human Ecology Forum. College of the Atlantic. June 2008.

D.P. Feldman. The Political Economy of Peer-Reviewed Academic Publishing. Human Ecology Forum. College of the Atlantic. April 2006.

D.P. Feldman. Toward Two-Dimensional Measures of Structural Complexity. Computational Mechanics Group. Complexity Sciences Center and Department of Physics, University of California, Davis. March 2008.

D.P. Feldman. Segregation in U.S. Cities: Using Computational Models to Bridge the Gap between Individual Preferences and Neighborhood Outcomes. Human Ecology Forum. College of the Atlantic. May 2005.

M.D. Robinson, D.P. Feldman, and S.R. McKay. Local Ordering and Structure in the Ising Antiferromagnet on a Triangular Lattice with Quenched Dilution. March Meeting of the American Physical Society, Austin, 2003.

S.R. McKay, D.A. Kenneway, M.D. Robinson, and D. P. Feldman. Application of Information Theoretic Measures to Frustrated Ising Systems with Quenched Disorder. International Conference on Theoretical Physics. Paris, France. July, 2002.

D.A. Kenneway, S.R. McKay, and D.P. Feldman. A Comparison of Bimodal and Gaussian Two-dimensional Spin Glasses Using Information Theoretic Methods. Meeting of the New England Section of the American Physical Society. Brandeis University. April 6, 2002.

M.D. Robinson, D.P. Feldman, and S.R. McKay. A Detailed Look at the Entropy and Excess Entropy in a Transition in which Order Arises from Quenched Disorder. March Meeting of the American Physical Society, Indianapolis, 2002.

D.A. Kenneway, S.R. McKay, and D.P. Feldman. The Entropy and Excess Entropy of the Two-Dimensional Ising Spin Glass. March Meeting of the American Physical Society, Indianapolis, 2002.

D.P. Feldman. Transient Information and the Entropy Convergence Hierarchy. Meeting of the New England Section of the American Physical Society. Colby College, 11 November, 1999.

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## Teaching-Related Presentations

The Physics and Mathematics of Sustainable Energy. Workshop for K-8 science and math teachers. Mount Desert Island. June 26–29, 2011.

Numbers not Adjectives: Helping Students Understand Energy. Education for Energy Literacy Panel, Association for Environmental Studies and Science Annual Meeting and Conference, 24 June 2011. (With Anna E. Demeo.)

A Workshop on Fractals for High School Math and Science Teachers. Southern Aroostook Math Science Partnership (SAMS), Houlton, ME. 10 December 2009.

Preparing for and Applying for Teaching Positions at Liberal Arts Colleges. Presentation for Physics Graduate Students at the University of California, Davis. 27 January 2006.

The Politics of Science Education. Invited Panelist, Constitutional Convention of the Labor Party, Pittsburgh, PA, 13 November 1998.

Gender Equity in the Classroom. Physics Department Teaching Assistant Training Workshop, September, 1996.

No Connection between Studying and Grades? Contributed Poster, American Association of Physics Teachers January 1996 Meeting, Reno, NV.

Suggestions for the Incorporation of Chaos and Fractals into the High School Science and Math Curriculum. Invited Presentation, Chattanooga Area Science Teachers Workshop, Spring 1993.

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## College, Professional, and Community Service

### College of the Atlantic

- Chair, Search Committee for Faculty Member in Computer Science, 11/16–2/17.
- Admission Committee, 1/04–4/11, 9/12–Present.
- Website Redesign Team, 6/14–Present.
- PR Manager Search Committee, 5/14.
- Faculty Personnel Committee, 8/09–7/11.
- Chair, Search Committee for Visiting Faculty in Physics and Mathematics, 3/11–5/11.
- Interim Chair, Academic Affairs Committee, 1/11–3/11.
- Chair, Search Committee for Visiting Faculty in Earth Science and Geology, 2/10–4/10.
- Search Committee for Faculty Member in Anthropology, 10/08–12/08.
- Chair, Search Committee for Wiggins Chair in Governance and Polity, 10/07–2/08.

- Academic Affairs Committee, 9/98–6/01, 9/02–4/08.
- Chair, Academic Affairs Committee, 4/03–6/07.
- Chair, Faculty Meeting, 8/04–12/04.
- Search Committee for Admission Counselors, 5/06–6/06
- Budget Working Group, 1/05–11/05.
- Sexual Assault Advisor, 8/05–Present.
- Search Committee for Admission Counselor, 5/05.
- Chair, Search Committee for Registrar, 1/04–4/04.
- Building Committee, 1/04–5/04.
- Faculty Meeting Moderator, 9/01–6/02.
- Steering Committee, 4/02–7/02.
- Website Advisory Committee, 1/00–10/00.
- Chair, Technology Planning Committee, 11/98–11/99.
- Search Committee for Faculty Member in Education, 1/00–3/00.
- Search Committee for Educational Studies Director, 1/99–3/99.

### Santa Fe Institute

- Search Committee, Head of Education, 2016.
- Search Committee, Vice-president for Education, 2015.

### Academic and Professional

- Referee for: *Advances in Complex Systems*, *Australian Journal of Chemistry*, Chapman & Hall/CRC Publishers, *Chaos*, *Complexity*, *Computational Statistics*, *Entropy*, *European Journal of Physics B*, *Information Processing Letters*, *IEEE Transactions on Magnetics*, J. Wiley & Sons, *Journal of Physics A: Mathematical and Theoretical*, *Journal of Artificial Societies and Social Simulation*, *Journal of Statistical Physics*, *Journal of Systems Science and Complexity*, *Neurocomputing*, Oxford University Press, *PeerJ Computer Science*, *Physica A*, *Physical Review E*, *Physical Review Letters*, *Proceedings of the Royal Society A*, *Structure and Dynamics: eJournal of Anthropological and Related Sciences*, The University of Chicago Press, World Scientific.
- Grant reviewer for: The National Science Foundation, The Environmental Protection Agency, The Maine Space Grant Consortium, U.S. Army Research Office
- Scientific Committee, International Conference on Economic Science with Heterogeneous Interacting Agents 2009 (ESHIA/WEHIA 2009). Beijing, China, June 18–20, 2009.
- Reviewer of applications, Santa Fe Institute Complex Systems Summer School, 2005–2010.
- Reviewer of applications, Santa Fe Institute Postdoctoral Fellow applications, 2007.
- External reviewer of BA and BS programs of the Department of Physics and Astronomy, the University of Maine, November, 2003.
- External reader for: Ph.D theses, Department of Physics and Astronomy, University of Maine (Spring 2000 and Summer 2010); Ph.D. thesis, School of Information Technologies, University of Sydney, AU. (Spring 2010).

## Community

- Interim board member, Mount Desert Island Cooperative. 11/05 - 12/06.

## Other

- Co-Mentor, Minority Undergraduate Research Participation in the Physical Sciences Program. University of California, Davis, 8/97–6/98.
- Co-Founder of the Students-Only Seminar Series. University of California, Davis, Department of Physics 9/95.
- Sexual Harassment Advisor. Carleton College, 11/89–6/91.

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## Media Appearances

- Interviewed about chaos textbook on The Pulse Morning Show, WZON, 620 AM, Bangor, Maine. October 8, 2012.

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## Professional Affiliations

- American Association of Physics Teachers
- American Physical Society (APS)
- APS Forum on Education
- APS Topical Group on Nonlinear and Statistical Physics
- Mathematical Association of America

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## Miscellaneous

- Occasional wikipedia contributor, frequent twitterer @DavidFeldman
- Foreign Travel: Antarctica, Argentina, Austria, Belgium, Canada, Chile, China, Denmark, Egypt, Germany, Great Britain, France, Holland, Hungary, Mexico, Poland, Rwanda, Spain, Sweden, Switzerland, Tanzania, The Philippines
- Other interests: ultimate frisbee (playing), ice hockey (watching), cooking (vegetarian), gardening (vegetables), brewing beer (mostly IPAs)

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## References

- Available upon request.