

# LUCAS ILLING

Department of Physics  
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## EDUCATION

- 1999 – 2002    **University of California, San Diego, CA**  
Ph.D. in Physics  
Advisor: Prof. H. D. I. Abarbanel  
Thesis: Chaos Synchronization and Communications in Semiconductor Lasers
- 1997 – 1999    **University of California, San Diego, CA**  
M.Sc. in Physics
- 1994 – 1997    **Humboldt Universität, Berlin, Germany**  
Vordiplom in Physics

## PROFESSIONAL EXPERIENCE

- 2007 – present    **Assistant Professor of Physics, Department of Physics, Reed College, Portland, OR**
- 2005 – 2007    **Senior Research Scientist, Department of Physics, Duke University, Durham, NC**  
Experiments and theory of laser-pumped atomic vapors for all-optical switching. Theory and experiments on the dynamics of nonlinear RF-circuits and opto-electronic devices with delayed feedback. Calcium imaging in songbird brain-slices (in collaboration with Prof. Richard Mooney). Assist in managing the quantum electronics research group. Mentor: Daniel Gauthier  
Instructor. Recitation sections of *Introductory Mechanics* (Physics 61L, J. Socolar) and *Introductory Electricity, Magnetism, and Optics* (Physics 62L, A. Goshaw).
- 2003 – 2005    **Research Associate, Department of Physics, Duke University, Durham, NC**  
Experiment demonstrating an all-optical switch consisting of laser-pumped atomic vapor. Theory and experiments on the dynamics and control of nonlinear electronic and opto-electronic systems. Designed and build low-speed as well as RF-analog nonlinear circuits. Numerically modeled opto-electronic device and performed a bifurcation analysis for delay-systems with band-limited feedback. Mentor: Daniel Gauthier  
Co-Instructor with Daniel Gauthier. Aided in developing and teaching a seminar class titled *Clocks, Chaos, and Complexity in the Living World* (Physics 49S).
- 2002 – 2003    **Postgraduate Research Scientist, Institute for Nonlinear Science, University of California, San Diego, CA**  
Developed parameter-estimation methods for reduced models of physical and biological systems. Conducted theoretical research on performance enhancements for high bit-rate communication with semiconductor lasers. Mentor: Henry D. I. Abarbanel
- 1999 – 2002    **Research Assistant, Department of Physics, University of California, San Diego, CA**  
Theory and experiments on chaos synchronization and communication using chaos. Simulated chaotic lasers dynamics, build low speed analog-circuits with delayed feedback as well as electronics for a free-space laser chaos communication experiment. Advisor: Henry D. I. Abarbanel
- 2000    **Visiting Scientist, Universität Göttingen, Göttingen, Germany**  
Explored issues regarding the quality of chaos synchronization. Host: Ulrich Parlitz

**PUBLICATIONS****Peer-Reviewed Publications**

- [13] K. E. Callan, L. Illing, Z. Gao, D. J. Gauthier, and E. Schöll  
Broadband Chaos Generated by an Optoelectronic Oscillator  
*Physical Review Letters*, vol. 104, 113901 (2010)
- [12] L. Illing  
Digital communication using chaos and nonlinear dynamics  
*Nonlinear Analysis: Theory, Methods & Applications*, vol. 71, e2958 (2009)
- [11] A. M. C. Dawes, L. Illing, S. M. Clark, and D. J. Gauthier  
All-optical Switching with Transverse Optical Patterns  
*Physical Review A*, vol. 77, 013833 (2008)
- [10] L. Illing and D. J. Gauthier  
Ultra-high-frequency chaos in a time-delay electronic device with band-limited feedback  
*Chaos*, vol. 16, 033119 (2006)
- [9] L. Illing and D. J. Gauthier  
Hopf bifurcations in time-delay systems with band-limited feedback  
*Physica D*, vol. 210, 180 (2005)
- [8] A. M. C. Dawes, L. Illing, S. M. Clark, and D. J. Gauthier  
All-optical switching in rubidium vapor  
*Science*, vol. 308, 672 (2005)
- [7] J. N. Blakely, L. Illing, and D. J. Gauthier  
Controlling Fast Chaos in Delay Dynamical Systems  
*Physical Review Letters*, vol. 92, 193901 (2004)
- [6] L. Illing and M. Kennel  
Shaping Current Waveforms for Direct Modulation of Semiconductor Lasers  
*IEEE Journal of Quantum Electronics*, vol. 40, 445 (2004)
- [5] J. N. Blakely, L. Illing, and D. J. Gauthier  
High speed chaos in an optical feedback system with flexible timescales  
*IEEE Journal of Quantum Electronics*, vol. 40, 299 (2004)
- [4] N. F. Rulkov, M. A. Vorontsov, and L. Illing  
Chaotic Free-Space Laser Communication over a Turbulent Channel  
*Physical Review Letters*, vol. 89, 277905 (2002)
- [3] L. Illing, J. Bröcker, L. Kocarev, U. Parlitz, and H. D. I. Abarbanel  
When are synchronization errors small ?  
*Physical Review E*, vol. 66, 036229 (2002)
- [2] H. D. I. Abarbanel, M. Kennel, L. Illing, S. Tang, H. F. Chen and J. M. Liu  
Synchronization and Communication Using Semiconductor Lasers With Optoelectronic Feedback  
*IEEE Journal of Quantum Electronics*, vol. 37, 1301 (2001)
- [1] C. Lewis, H. D. I. Abarbanel, M. Kennel, M. Buhl, L. Illing  
Synchronization of chaotic oscillations in doped fiber ring lasers  
*Physical Review E*, vol. 63, 016215 (2000)

**Published Book Chapters and General Audience Publications**

- [4] L. Illing, D. J. Gauthier, and J. N. Blakely  
Controlling fast chaos in opto-electronic delay dynamical systems  
an invited chapter to appear in *Handbook of Chaos Control, 2nd. Ed.*, E. Schöll and H. G. Schuster, Eds.,  
(WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, 2008), pp. 407-425.
- [3] L. Illing, D. J. Gauthier, and R. Roy  
Controlling Optical Chaos, Spatio-temporal Dynamics, and Patterns  
an invited chapter in *Advances in Atomic, Molecular and Optical Physics*, vol. 54, P. R. Berman, E. Arimondo,  
and C. Lin, Eds. (Academic Press, 2006)
- [2] N. F. Rulkov, A. R. Volkovskii, M. M. Sushchik, L. S. Tsimring, and L. Illing  
Digital Communication Using Self-Synchronizing Chaotic Pulse Position Modulation  
an invited chapter in *Digital Communications Using Chaos and Nonlinear Dynamics*  
L. E. Larson, J. M. Liu, and L. S. Tsimring, Eds. (Springer, 2006)
- [1] A. M. C. Dawes, L. Illing, S. M. Clark, and D. J. Gauthier  
All-optical switch controls strong beams with weak ones  
*Optics & Photonics News*, vol. 16, no. 12, 34 (2005)

**Proceedings**

- [6] L. Illing, J. N. Blakely, and D. Gauthier  
Time delay systems with band-limited feedback  
*Proceedings of the Fifth EUROMECH Nonlinear Dynamics Conference (ENOC-2005)*; D. H. Van Campen, M.  
D. Lazurko, W. P. J. M. Van der Oever; Eds., ISBN 90-386-2667-3, 1115 (2005)
- [5] A. M. C. Dawes, S. M. Clark, L. Illing, and D. J. Gauthier  
Observation of ultra-low-light-level all-optical switching  
*Advanced Optical and Quantum Memories and Computing II*; H. J. Coufal, Z. U. Hasan, and A. E. Craig; Eds.,  
Proc. SPIE 5735, 60 (2005)
- [4] I. Tokuda, U. Parlitz, L. Illing, M. Kennel, and H. D. I. Abarbanel  
Parameter Estimation of Neuron Models  
*AIP Conference Proceedings of the 7th Experimental Chaos Conference*, no. 676, 251 (2003)
- [3] L. Illing, N. F. Rulkov, and M. A. Vorontsov  
Chaotic Optical Communication over Turbulent Channel  
*AIP Conference Proceedings of the 7th Experimental Chaos Conference*, no. 676, 307 (2003)
- [2] N. F. Rulkov, L. Illing and M. A. Vorontsov  
Chaos-based communication over turbulent channel  
*Proceedings of the IASTED International Conference. Communications, Internet, and Information Technology*,  
326 (2002)
- [1] S. Tang, L. Illing, J. M. Liu, H. D. I. Abarbanel, M. Kennel  
Communication using Synchronization of Chaos in Semiconductor Lasers with optoelectronic feedback  
*AIP Conference Proceedings of the 6th Experimental Chaos Conference*, no. 622, 224 (2002)

**TEACHING AT REED COLLEGE**

Phys 100	General Physics I
Phys 323	Optics
Phys 331	Advanced Laboratory I
Phys 332	Advanced Laboratory II

**UNDERGRADUATE AND \*GRADUATE STUDENTS MENTORED***At Reed College:*

Chris Panda, summer research: Chaos and Synchrony in a system of three opto-electronic delay system (2010).  
 Alison Saunders, summer research: Reed College Science Research Fellowship: The dynamics of the Malkus water wheel (2010).  
 Greg Hoth, thesis: The Dynamics of Delay Coupled Optoelectronic Devices (2009 - 2010)  
 Sam Spencer, thesis: Active Modelocking an Open-Cavity Helium-Neon Laser (2009 - 2010)  
 M. Jemielita, summer research: Bifurcations and modeling of a pulsed opto-electronic delay system (2009).  
 Greg Hoth, summer research: Dynamics of cross-coupled opto-electronic delay systems (2009).  
 Adarsh Pyarelal, summer research: Chaotic dynamics and bifurcations of the Malkus Water Wheel (2009).  
 Rachel Fordyce, thesis: Chaotic Waterwheel (2008 - 2009).  
 Cody Myers, thesis: Monochromatic Plane Waves in a Corrugated Tube System (2008 - 2009).  
 Matthew Jemielita, summer research: Bifurcations of a pulsed opto-electronic delay system (2008).  
 Christopher May, summer research: Chaos synchronization of mutually coupled opto-electronic devices (2008).  
 Seth Terashima, summer research: Chaos and bifurcations in the electronic "Rulkov" circuit (2008).  
 Drew Atwater, thesis: Thermoacoustic engines (2007 - 2008).  
 Christopher May, thesis: Chaos synchronization and communication (2007 - 2008).  
 Erin McCowen, thesis: Bioconvection in *Bacillus subtilis* (2007 - 2008).

*At Duke University:*

\*Kristine Callan: Experiments and theory on the dynamics of coupled opto-electronic devices with delayed-feedback (2006 - 2007).  
 Barry Wright, summer research: Introduction to dynamical systems and circuit design (2005).  
 Grant A. Degler, summer research: PIC-controller for chaotic circuits (2005).  
 Susan Clark, honor thesis: Collaborated on ultra-low light level all-optical switching (2004).

**ACADEMIC FELLOWSHIPS**

Fulbright Fellowship (awarded but declined), Fulbright Commission (1997)

**SERVICE**

Administration Committee, Reed College, 2008 - present

Web Policy Committee, Reed College, 2008 - present

Search Committee for Chemistry position, Spring 2007 and for Physics position, Fall 2009.

Reviewer for *Optics Letters*, *Physical Review E*, *Chaos*, *Physica D*, *IEEE J. Quantum Electron.*, *IEEE Trans. Circuits Syst. I*, *JOSA B*, *Europhysics Letters*, *The European Physical Journal D*, *Math. Comput. Simulations*, *Optical Engineering*, NOLTA2005

SPARK lecture at Lincoln High School, March 19, 2009

**MEMBERSHIPS**

American Physical Society, Optical Society of America, American Association of Physics Teachers, Society for Industrial and Applied Mathematics

**CONFERENCE PRESENTATIONS**

- [32] 11th Experimental Chaos Conference, Lille, France, June 1-4, 2010 (poster)
- [31] Seminar, Physics Department, Willamette University, March 12, 2010 (invited talk)
- [30] Oregon Center for Optics, Fall retreat, September 17, 2009 (invited talk)
- [29] Colloquium, Mathematics Department, Pacific University, April 9, 2009 (invited talk)
- [28] Colloquium, Physics Department, Linfield College, March 12, 2009 (invited talk)
- [27] Colloquium, Oregon Center for Optics and Department of Physics, University of Oregon, December 4, 2008 (invited talk)
- [26] Colloquium, Physics Department, Lewis & Clark College, November 10, 2008 (invited talk)
- [24] Fifth World Congress of Nonlinear Analysts (WCNA 2008), Orlando, FL, July 2-9, 2008 (invited talk)
- [23] 10th Experimental Chaos Conference, Catania, Italy, June 3-6, 2008 (invited talk)
- [22] 10th Annual Meeting of the Northwest Section of APS, Portland, OR, May 16-17, 2008 (poster)
- [21] Colloquium, Physics Department, Queens College, CUNY, February 26, 2007 (invited talk)
- [20] Lecture Series, Department of Physics and Astronomy, Oberlin College, February 22, 2007 (invited talk)
- [19] Seminar, Department of Physics, Reed College, February 5, 2007 (invited talk)
- [18] Symposium on Photonics at the Frontiers of Science and Technology, Duke University, September 28-29, 2006 (poster)
- [17] Dynamics Days 2006, Bethesda, MD, January 4-7, 2006 (poster)
- [16] Fifth EUROMECH Nonlinear Dynamics Conference (ENOC - 2005), Eindhoven, Netherlands, August 7-12, 2005 (talk)
- [15] SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May 22-26, 2005 (talk)
- [14] Workshop on Global Perspectives in Frontiers of Photonics Computational Imaging, Biophotonics and Nanophotonics, Duke University, May 18-20, 2005 (poster)
- [13] CNCS Seminar Series, Durham, NC, February 15, 2005 (invited talk)
- [12] Dynamics Days 2005, Long Beach, CA, January 7-10, 2005 (talk)
- [11] 8th Experimental Chaos Conference, Florence, Italy, June 14-17, 2004 (poster)
- [10] Understanding Complex Systems Symposium, University of Illinois at Urbana-Champaign, May 17-20, 2004 (talk)
- [9] Third Physical Institute, University of Göttingen, Germany, Seminar, March 1, 2004 (invited talk)
- [8] Workshop on Multivariate Time Series Analysis, Internationales Wissenschaftsforum (IWH), Heidelberg, Germany, February 25-28, 2004 (invited talk)
- [7] Dynamics Days 2004, Chapel Hill, NC, January 2-5, 2004 (poster)
- [6] Gordon Research Conference, Nonlinear Science, Tilton, NH, August 3-8, 2003 (talk)
- [5] 7th Experimental Chaos Conference, San Diego, CA, USA, August 25-29, 2002 (talk)
- [4] Dynamics Days 2002, Baltimore, MD, USA, January 4-7, 2002 (poster)

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- [3] 6th Experimental Chaos Conference, University of Potsdam, Potsdam, Germany, July 22-26, 2001 (talk)
  - [2] Gordon Research Conference, Nonlinear Science, Mt. Holyoke College, MA, June 17-22, 2001 (poster)
  - [1] Symposium on Synchronization of Chaotic Systems, Abdus Salam International Centre for Theoretical Physics, Miramare, Trieste, Italy, July 3 - 5, 2000 (poster)