

# LUCAS ILLING

Department of Physics and  
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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

## RESEARCH EXPERIENCE

- 2005 – present    **Department of Physics, Duke University, Durham, NC**  
Senior Research Scientist. 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
- 2003 – 2005    **Department of Physics, Duke University, Durham, NC**  
Research Associate. 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
- 2002 – 2003    **Institute for Nonlinear Science, University of California, San Diego, CA**  
Postgraduate Research Scientist. 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    **Department of Physics, University of California, San Diego, CA**  
Research Assistant. 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    **Universität Göttingen, Göttingen, Germany**  
Visiting Scientist. Explored issues regarding the quality of chaos synchronization. Host: Ulrich Parlitz

## TEACHING EXPERIENCE

- Spring 2007    **Department of Physics, Duke University, Durham, NC**  
Instructor. Two recitation sections of *Introductory Mechanics* (Physics 61L, J. Socolar). This core course of the department is part of an introductory course sequences intended principally for students in engineering and the physical sciences. Lectures and recitation sections are taught by faculty.

- Fall 2006 **Department of Physics, Duke University, Durham, NC**  
Instructor. Recitation section of *Introductory Electricity, Magnetism, and Optics* (Physics 62L, A. Goshaw). This core course of the department is part of an introductory course sequences intended principally for students in engineering and the physical sciences. Lectures and recitation sections are taught by faculty.
- Fall 2005 **Department of Physics, Duke University, Durham, NC**  
Guest Lecturer. Lectured on chaos control for the class titled *Nonlinear Dynamics* (Physics 213, A. Lin).
- Fall 2004 **Department of Physics, Duke University, Durham, NC**  
Guest Lecturer. Lectured on delay dynamical systems for the class titled *Nonlinear Dynamics* (Physics 213, A. Lin).
- 2003 – 2004 **Preparing Future Faculty (PFF) program, Duke University, Durham, NC**  
Colloquia at Duke on successful teaching methods. Professional mentoring with Martin Kamela, Assistant Professor of Physics at Elon University, Elon, NC. Included lecturing on *Electromagnetism* at Elon University.
- Fall 2003 **Department of Physics, Duke University, Durham, NC**  
Co-Instructor with Daniel Gauthier. Aided in developing and teaching a seminar class titled *Clocks, Chaos, and Complexity in the Living World* (Physics 49S).
- Spring 2001 **Department of Physics, University of California, San Diego, CA**  
Instruction in Physics Teaching, Physics 500, Practical classroom teaching (several lectures of Physics 100C, *Electromagnetism*) under faculty supervision (Henry D. I. Abarbanel).
- 1998 – 1999 **Department of Physics, University of California, San Diego, CA**  
Teaching Associate, Taught recitation sessions and group discussion sessions for introductory physics courses.

#### UNDERGRADUATE AND \*GRADUATE STUDENTS MENTORED

\*Kristine Callan, Duke University: Experiments and theory on the dynamics of coupled opto-electronic devices with delayed-feedback (2006 - present).

Barry Wright, Duke University: Introduction to dynamical systems and analog circuit design (2005).

Grant A. Degler, Duke University: PIC-controller for chaotic circuits (2005).

Susan Clark, Duke University: Collaborated on ultra-low light level all-optical switching (2004).

#### ACADEMIC FELLOWSHIPS

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

#### SERVICE

Reviewer for *Optics Letters*, *Chaos*, *Physica D*, *IEEE J. Quantum Electron.*, *IEEE Trans. Circuits Syst. I*, *JOSA B*, *Europhysics Letters*, *Math. Comput. Simulations*, NOLTA2005

Organizer, quantum electronics group meeting, Duke University, 2003 - present

Organizer, nonlinear journal club, Institute for Nonlinear Science, UCSD, 1999-2001

#### MEMBERSHIPS

American Physical Society, Optical Society of America, American Association of Physics Teachers

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

- [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**

- [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)

### Submitted Publications and Articles in Preparation

- [3] 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.
- [2] H. Jeong, A. M. C. Dawes, L. Illing, and D. J. Gauthier  
Step-modulated pulse propagation through a narrow single-resonator absorber  
in preparation
- [1] A. M. C. Dawes, L. Illing, S. M. Clark, and D. J. Gauthier  
All-optical switching: the weak controlling the strong  
in preparation

### 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)

### CONFERENCE PRESENTATIONS

- [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)
- [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)