

# Joel Zylberberg

University of Colorado School of Medicine  
Department of Physiology and Biophysics  
P18-7118, RC-1 North  
Aurora, CO 80045

Web: [www.jzlab.org](http://www.jzlab.org)

## Education

**University of California**, Berkeley, California

Ph.D. (2012), M.A. (2010), Physics

**Advisor:** Mike DeWeese

**Dissertation:** *From scenes to spikes: understanding vision from the outside in*

**Simon Fraser University**, Burnaby, British Columbia

B.Sc. (2008), Physics (with First Class Honors)

## Academic and Research Positions

**Assistant Professor**, Department of Physiology and Biophysics, University of Colorado School of Medicine, Aurora, Colorado (2015 -)

Member of the Computational Bioscience Program, Medical Scientist Training Program, and Center for Neuroscience

**Affiliate Professor**, Department of Applied Mathematics, University of Colorado, Boulder, Colorado (2016 -)

**Azrieli Global Scholar**, Learning in Machines and Brains Program, Canadian Institute for Advanced Research, Toronto, Ontario (2016 -)

**Acting Assistant Professor**, Department of Applied Mathematics, University of Washington, Seattle, Washington (2012 - 2015)

## Honors & Awards Received

### *Major Awards*

**Sloan Research Fellowship** (2017)

**Google Faculty Research Award** (2017)

**Canadian Institute for Advanced Research (CIFAR) Azrieli Global Scholar Award** (2016)

**Howard Hughes Medical Institute (HHMI) International Student Research Fellowship** (2011)

**Natural Sciences and Engineering Research Council of Canada (NSERC) PGS-D Doctoral Scholarship** (2011; declined in order to take HHMI Fellowship)

**Fulbright Science and Technology Ph.D. Fellowship** (2008)

**NSERC Julie Payette Research Scholarship** (2008)

**NSERC Andre Hamer Prize** (2008; I declined this prize in order to pursue my studies abroad)

*Smaller awards (subset)*

CNS Conference Travel Grant (2013, 2015)

CoSyNe Conference Travel Grant (2011, 2013)

Travel grant to attend Okinawa Computational Neuroscience Course (2012)

"Outstanding Graduate Student Instructor" award from UC Berkeley (2011)

**Publications**

J. Zylberberg and B. Strowbridge (2017). Mechanisms of persistent activity in cortical circuits: possible neural substrates for working memory. *Annual Review of Neuroscience* (in press).

J. Zylberberg, A. Pouget, P.E. Latham, and E. Shea-Brown (2017). Robust information propagation through noisy neural circuits. *PLoS Computational Biology* 13: e1005497.

J. Zylberberg\*, J. Cafaro\*, M. Turner\*, E. Shea-Brown, and F. Rieke (2016). Direction-selective circuits shape noise to ensure a precise population code. *Neuron* 89: 369-383. (\* denotes equal contribution)

J. Zylberberg, R. Hyde, and B.W. Strowbridge (2016). Dynamics of robust pattern separability in the hippocampal dentate gyrus. *Hippocampus* 26: 623-632.

J. Zylberberg and E. Shea-Brown (2015). Input nonlinearities can shape beyond-pairwise correlations and improve information transmission by neural populations. *Physical Review E* 92: 062707.

N.A. Cayco Gajic, J. Zylberberg, and E. Shea-Brown (2015). Triplet correlations among similarly tuned cells impact population coding. *Frontiers in Computational Neuroscience* 9: 57.

Y. Hu, J. Zylberberg, and E. Shea-Brown (2014). The sign rule and beyond: Boundary effects, flexibility, and noise correlations in neural population codes. *PLoS Computational Biology* 10: e1003469.

J. Zylberberg and M.R. DeWeese (2013). Sparse coding models can exhibit decreasing sparseness while learning sparse codes for natural images. *PLoS Computational Biology* 9: e1003182.

P. King, J. Zylberberg, and M.R. DeWeese (2013). Inhibitory interneurons decorrelate excitatory cells to drive sparse code formation in a spiking model of V1. *Journal of Neuroscience* 33: 5475-5485.

J. Zylberberg, D. Pfau, and M.R. DeWeese (2012). Dead leaves and the dirty ground: low-level image statistics in transmissive and occlusive imaging environments. *Physical Review E* 86: 066112.

J. Zylberberg, J. Murphy, and M.R. DeWeese (2011). A Sparse Coding Model with Synaptically Local Plasticity and Spiking Neurons Can Account for the Diverse Shapes of V1 Simple Cell Receptive Fields. *PLoS Computational Biology* 7: e1002250.

J. Zylberberg and M.R. DeWeese (2011). How should prey animals respond to uncertain threats? *Frontiers in Computational Neuroscience* 5: 20.

G. Zhao, L. Pogosian, A. Silvestri, and J. Zylberberg (2009). Cosmological Tests of General Relativity with Future Tomographic Surveys. *Physical Review Letters* 103: 241301.

G. Zhao, L. Pogosian, A. Silvestri, and J. Zylberberg (2009). Searching for modified growth patterns with tomographic surveys. *Physical Review D* 79: 083513.

C. Vockenhuber *et al.* (2008). Improvements of the DRAGON recoil separator at ISAC. *Nuclear Instruments and Methods in Physics Research B* 266: 4167-4170.

J. Zylberberg *et al.* (2007). Charge-state distributions after radiative capture of helium nuclei by a carbon beam. *Nuclear Instruments and Methods in Physics Research B* 254: 17-24.

J. Zylberberg, A.A. Belik, E. Takayama-Muromachi, and Z.-G. Ye (2007). Bismuth Aluminate: A New High- $T_C$  Lead-Free Piezo-/ferroelectric. *Chemistry of Materials* 19: 6385-6390.

J. Bechhoefer, Y. Deng, J. Zylberberg, C. Lei, and Z.-G. Ye (2007). Temperature dependence of the capacitance of a ferroelectric material. *American Journal of Physics* 75: 1046-1053.

J. Zylberberg and Z.-G. Ye (2006). Improved dielectric properties of bismuth-doped LaAlO<sub>3</sub>. *Journal of Applied Physics* 100: 086102.

## Preprints & Submitted Manuscripts

J. Zylberberg. Untuned but not irrelevant: a role for untuned neurons in sensory information coding. Under review at *Nature Neuroscience*, and available at bioRxiv via doi: 10.1101/134379.

## Research Funding

**A.P. Sloan Foundation, Sloan Research Fellowship in Neuroscience** (2017–2019). Role: P.I. (\$60,000)

**Google Inc., Google Faculty Research Award in Computational Neuroscience** (2017–2018). Role: P.I. (\$40,377)

**Canadian Institute for Advanced Research (CIFAR), Azrieli Global Scholar Award for Learning in Machines and Brains** (2016–2018). Role: P.I. (\$100,000 CAD ≈ \$77,000 USD)

**University of Colorado, New Faculty Start-Up Funding** (2015–2018). Role: P.I.

## Invited Talks & Seminars (subset)

**Information Theory Tutorial, International Conference on Mathematical Neuroscience**, Boulder, Colorado (Upcoming: June 2017)

**Neuroscience Seminar, National Institutes of Health**, Bethesda, Maryland (Upcoming: May 2017)

**Neuroscience Seminar, Institut d'Investigacions Biomediques August Pi Sunyer**, Barcelona, Spain (Dec. 2016)

**Dynamics and Complex Systems Seminar, University of Colorado**, Boulder, Colorado (Sept. 2016)

**Rocky Mountain Regional Neuroscience Group Annual Conference**, Aurora, Colorado (May 2016)

**Workshop on Connecting network architecture and network computation, Banff International Research Station**, Banff, Alberta (Dec. 2015)

**Methods of Information Theory Workshop, Computational Neuroscience Society Conference**, Prague, Czech Republic (Jul. 2015)

**Computational Neuroscience Seminar, University of Washington**, Seattle, Washington (Jun. 2015)

**Neuroscience Seminar, Stanford University**, Stanford, California (Mar. 2015)

**Brain and Cognitive Sciences Seminar, Massachusetts Institute of Technology**, Cambridge, Massachusetts (Feb. 2015)

**Systems Biology Seminar, University of Texas Southwestern Medical Center**, Dallas, Texas (Jan. 2015)

**Mathematics and Neuroscience Seminar, University of Texas**, Austin, Texas (Jan. 2015)

**Communications, Networks, and Systems Seminar, University of Southern California**, Los Angeles, California (Jan. 2015)

**Mathematics Seminar, Monash University**, Melbourne, Australia (Nov. 2014)

**Workshop on Biological and Bio-Inspired Information Theory, Banff International Research Station**, Banff, Alberta (Oct. 2014)

**Biophysics Seminar, Simon Fraser University**, Burnaby, British Columbia (Sept. 2014)

**eScience Institute Seminar, University of Washington**, Seattle, Washington (Feb. 2014)

**Seminar on Computational Neuroscience, Ecole Polytechnique Federale de Lausanne (EPFL)**, Lausanne, Switzerland (Oct. 2013)

**Computational Neuroscience Seminar, University of Washington**, Seattle, Washington (Feb. 2012)

## Contributed Talks (subset)

**Computational Neuroscience Society (CNS) Conference**, Prague, Czech Republic. *Limited-Range correlations, when modulated by firing rate, can substantially improve neural population coding* (Jul. 2015)

**Computational Neuroscience Society (CNS) Conference** (40-minute "featured oral presentation" at main meeting), Paris, France. *Consistency requirements determine optimal noise correlations in neural populations* (Jul. 2013)

**American Physical Society (APS) March Meeting**, Baltimore, Maryland. *Add HOC?: dendritic nonlinearities shape higher-than-pairwise correlations and improve coding in noisy (spiking) neural populations* (Mar. 2013)

**Computational and Systems Neuroscience (CoSyNe) Conference** (main meeting), Salt Lake City, Utah. *Consequences of learning a sparse code for natural images with spiking neurons and synaptically local plasticity rules* (Feb. 2011)

**Canadian Society for Chemistry (CSC) Conference**, Winnipeg, Manitoba. *BiAlO<sub>3</sub>: a high-T<sub>C</sub> ferroelectric and a performance enhancing additive to dielectric LaAlO<sub>3</sub>* (May 2007)

**Winter Nuclear and Particle Physics Conference (WNPPC)**, Banff, Alberta. *Recoil charge-state distributions in <sup>12</sup>C( $\alpha, \gamma$ )<sup>16</sup>O at DRAGON*. (Feb. 2007)

## Research Advising

### *Post-doctoral fellows*

Will Kindel, University of Colorado School of Medicine (2016- ; using machine learning methods to interrogate the sensory systems)

### *Doctoral Students*

Callie Federer, University of Colorado School of Medicine (2016- ; self-organizing memory networks)

Shelly Jones, University of Colorado School of Medicine (2016- ; role of gap junctions in the olfactory system)

Elijah Christensen, University of Colorado School of Medicine (2017- ; machine learning models of the visual system)

### *Master's Students*

Gaurav Chanda, University of Washington (2014-2015; smoothness priors to improve nonlinear dimensionality reduction)

## Undergraduate Students

Chelsey Wildenborg, University of Colorado School of Medicine (2016; encoding multiple stimulus features in neural population activities)

Jacob Jaminet, University of Colorado School of Medicine (2016; encoding multiple stimulus features in neural population activities)

Nile Graddis, University of Washington (2014-2015; representation of time in the hippocampus)

Jason Murphy, Berkeley City College and UC Berkeley Helen Wills Neuroscience Institute (2010-2011; fitting model V1 receptive fields with Gabor functions)

Marvin Thielk, UC Berkeley (2011; creating minimum-wiring configurations for network models with known inter-neuronal connectivity)

## Teaching Experience

### Undergraduate

**Instructor**, University of Washington, Applied Mathematics 402 *Introduction to dynamical systems and chaos* (Winter 2013, Winter 2014, Winter 2015)

**Guest lecturer**, University of Washington, Mathematics 498 *Undergraduate Mathematical Sciences Seminar* (Winter 2014)

**Graduate Student Instructor**, UC Berkeley, Physics C10 *Physics for future presidents* (Spring 2011); UC Berkeley, Physics 7B *Physics for Scientists and Engineers* (Fall 2010)

### Graduate School

**Instructor**, University of Washington, Applied Mathematics 502 *Introduction to dynamical systems and chaos* (Winter 2013, Winter 2014, Winter 2015)

**Co-Instructor**, University of Colorado Denver, Electrical Engineering 5375 *Engineering/Quantitative Neuroscience* (Fall 2016)

**Guest Lecturer**, University of Colorado Denver, Neuroscience 7501 *Introduction to Neuroscience* (Fall 2016); University of Colorado Denver, Computational Bioscience 7711 *Methods and Tools in Biomedical Informatics* (Fall 2016); University of Colorado Denver, Neuroscience 7657 *MatLab for Neuroscientists* (Summer 2016); University of Colorado Denver, Neuroscience 7610 *Fundamentals of Neurobiology* (Winter 2016); University of Colorado Denver, Computational Bioscience 7712 *Research Methods in Biomedical Informatics* (Winter 2016, Winter 2017); University of Washington, Computer Science and Engineering 590 *Special topics – Molecular and Neural Computation* (Winter 2014); University of Washington, Applied Mathematics 500J *Special Topics in Applied Mathematics* (Spring 2013)

### Medical School

**Lecturer**, University of Colorado School of Medicine, *Molecules to Medicine* (Fall 2016)

## Extra-Curricular Teaching Experience

**Co-director** of the *Colorado Biomedical Informatics Summer Training Program* (2016 - ). This is an 8-week summer program, including coursework and research experience, that introduces minority undergraduates to computational biology. The program is funded by a NIH T15 grant.

**Workshop designer and instructor**, University of Washington STEM Bridge research experience for incoming undergraduates: sensory neural coding in the cockroach and mouse (2013).

**Teaching assistant and workshop designer**, University of Calgary, *Shad Valley program* (2004, 2005, 2008). This is a month-long summer program that introduces gifted high school students to advanced topics in science, engineering, and entrepreneurship.

## Professional Service

**Session Chair** at the Computational and Systems Neuroscience Conference (CoSyNe) (2017)

**New Faculty Search Committee Member**, Dept. of Physiology and Biophysics, University of Colorado School of Medicine (2016 - 2017 )

**Program Committee Member**, Computational and Systems Neuroscience Conference (CoSyNe) (2016 - )

**Program Committee Member**, International Conference on Mathematical Neuroscience (ICMNS) (2016 - )

**Faculty Senator**, University of Colorado School of Medicine (2016 - )

**Organizer** of the Quantitative Systems Neuroscience Journal Club at the University of Colorado Medical School (2015 - )

**Co-organizer** of the Boeing Distinguished Speaker Series in Applied Mathematics at the University of Washington (2012 - 2015)

**Referee** for *eLife*; *Nature Neuroscience*; *Journal of Neuroscience*; *Nature Communications*; *PLoS Computational Biology*; *Vision Research*; *Journal of Neurophysiology*; *Neural Computation*; *Biological Cybernetics*; *IEEE Transactions on Molecular, Biological, and Multi-Scale Communications*; *Hearing Research*; *Frontiers in Computational Neuroscience*; *International Journal of Neural Systems*; *Journal of Zoology*; *CoSyNe conference*

**Co-chair of the organizing committee** for the 2007 Canadian Undergraduate Physics Conference (2007)

## Community Service

**Postdoc Travel Awards Reviewer**, University of Colorado Anschutz Medical Campus (2017 - )

**Science Fair Judge**, Laurelhurst Elementary School (2014)

**Celebr8 Project Mentor**, San Francisco Day School (2014)

**Community Advisor**, Simon Fraser University (2004-2005)

**Founder and Director**, *Computer Literacy Education Outreach* (CLEO) program of SFU Engineers Without Borders (2004-2006)

## Professional Affiliations

Member, Organization for Computational Neurosciences

Member, Society for Neuroscience

Member, American Physical Society