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Education

Ph.D. **University of California, Los Angeles**
 2003–2009 Theoretical Biophysics and Condensed Matter Physics
 Advisors: Robijn F. Bruinsma and Sudip Chakravarty

B.S. **Cornell University**
 1999–2003 Cum laude in Physics and Mathematics

Fellowships and Awards

Simons Investigator \$620,000 fellowship in the Mathematical Modeling of
 Living Systems, Fall 2017–Fall 2022
NIH K25 Fellowship \$630,000 research grant, Fall 2012 – Fall 2017
Graduate Research Mentorship University of California, Los Angeles, 2007–2008
Fellowship
Outstanding TA Award University of California, Los Angeles, Dept. of Physics
 2006, 2007
Vice-Provost’s Recognition Award University of California, Los Angeles, 2006
Edwin F. Pauley Fellowship University of California, Los Angeles, 2003–2007
Physics Bowl National Champion Sponsored by AAPT and Metrologic, 1999

Research Positions

Sept. ’17–present **Assistant Professor**
 CUNY, Graduate Center, Initiative for the Theoretical Sciences
 and Depts. of Biology and Physics
Sept. ’14–Sept. ’17 **Assistant Professor**
 Northwestern University, Department of Physics and Astronomy
Sept. ’15–Aug. ’17 **Visiting Assistant Professor**
 CUNY, Graduate Center, Initiative for the Theoretical Sciences
Sept. ’09–Aug. ’14 **Postdoctoral Research Scholar and Lecturer in Physics (’11–’12)**
 Princeton University, Departments of Physics, Molecular Biology,
 and Lewis–Sigler Institute for Integrative Genomics
 Supervisor: Ned S. Wingreen
Sept. ’04–Aug. ’09 **Graduate Research Fellow**
 University of California, Los Angeles, Dept. of Physics
May–Sept. ’02 **Summer Research Fellow**
 & *May–Aug. ’03* California Institute of Technology, Institute for Quantum Information,
 Supervisors: Barbara Terhal and Dave Bacon
Aug. ’00–Aug. ’02 **Database Developer**
 National Institute of Standards and Technology, Office of ECS&D

Publications (h-index: 20, Google Scholar September, 2018)

- 40. *Mean-field theory of batch normalization*
Mingwei Wei, James Stokes, **David J. Schwab**
in prep, for submission to ICLR 2019
- 39. *Learning to share and hide intentions using information regularization*
DJ Strouse, M Kleiman-Weiner, J Tenenbaum, M Botvinick, **D Schwab**
<http://arxiv.org/abs/1808.02093>
NIPS (2018)
- 38. *A high-bias, low-variance introduction to machine learning for physicists*
P Mehta, M Bukov, CH Wang, A Day, C Richardson, CK Fisher, **DJ Schwab**
<http://arxiv.org/abs/1803.08823>
- 37. *Nonequilibrium cooperative sensing*
Vudtiwat Ngampruetikorn, **David J. Schwab***, Greg J. Stephens*
<http://arxiv.org/abs/1809.04095>
* co-corresponding author
- 36. *The information bottleneck and geometric clustering*
DJ Strouse, **David J. Schwab**
<http://arxiv.org/abs/1712.09657>
Neural Computation (2018)
- 35. *Coordination of size-control, reproduction and memory in freshwater planarians*
Xingbo Yang, Kelson J. Kaj, **David J. Schwab***, and Eva-Maria S. Collins*
Physical Biology 14 (3), 036003 (2017)
* co-corresponding author
- 34. *Associative pattern recognition through macro-molecular self-assembly*
Weishun Zhong, **David J. Schwab**, Arvind Murugan
Journal of Statistical Physics 167 (3-4), 806-826 (2017)
- 33. *Supervised learning with quantum-inspired tensor networks*
Miles Stoudenmire, **David J. Schwab**
<http://arxiv.org/abs/1605.05775>
NIPS (2016)
- 32. *The deterministic information bottleneck*
DJ Strouse, **David J. Schwab**
AISTATS (2016)
Neural Computation (2017)
<http://arxiv.org/abs/1604.00268>
- 31. *A central role for mixed ACh/GABA transmission in direction coding in the retina*
S Sethuramanujam, AJ McLaughlin, G deRosenroll, A Hoggarth, **DJ Schwab**, GB Awatramani
Neuron 90 (6), 1243-1256 (2016)
- 30. *Landauer in the age of synthetic biology: energy consumption and information processing in biochemical networks*
Pankaj Mehta, Alex Lang, **David J. Schwab**
Journal of Statistical Physics, 1-14 (2016)

- 29. *I Presynaptic inhibition in the striatum of the basal ganglia improves pattern classification and promotes superior goal selection*
David J. Schwab, James Houk
Frontiers in Systems Neuroscience, 9, 152 (2015)
- 28. *Multiscale modeling of oscillations and spiral waves in Dictyostelium populations*
Javad Noorbakhsh, **David J. Schwab**, Allyson Sgro, Thomas Gregor, Pankaj Mehta
Phys. Rev. E 91, 062711 (2015)
- 27. *Specific wiring of distinct amacrine cells in the directionally selective circuit of the mouse retina permits independent coding of direction and size*
A Hoggarth, K Ronellenfitch, S Trenholm, A McLaughlin, R Vasandani, **D Schwab**, KL Briggman, GB Awatramani
Neuron 86 (1), 276-291 (2015)
- 26. *From intracellular signaling to population oscillations: bridging size and time scales in collective behavior*
A Sgro, **DJ Schwab**, J Noorbakhsh, T Mestler, P Mehta, T Gregor
Molecular Systems Biology 11: 799 (2015)
- 25. *Constant growth rate can be supported by decreasing energy flux and increasing aerobic glycolysis*
Nikolai Slavov, Bogdan Budnik, **David Schwab**, Edoardo Airoldi, Alexander van Oudenaarden
Cell Reports, Volume 7, Issue 3, 705-714 (2014)
Highlighted by: Cell Press.
- 24. *Quantifying the role of population subdivision in evolution on rugged fitness landscapes*
Anne-Florence Bitbol, **David J. Schwab**
PLoS Computational Biology **10** (8), e1003778 (2014)
- 23. *Zipf's law and criticality in multivariate data without fine-tuning*
David J. Schwab, Ilya Nemenman, Pankaj Mehta
Phys. Rev. Lett. **113**, 068102 (2014)
Highlighted by: eScience Commons and Science Daily.
- 22. *Nonlinear dendritic integration of electrical and chemical synaptic inputs drives fine-scale correlations*
S Trenholm, AJ McLaughlin, **DJ Schwab**, MH Turner, RG Smith, F Rieke, G Awatramani
Nature Neuroscience **17** (12), 1759-1766 (2014)
- 21. *A binary Hopfield network with $1/\log(n)$ info. rate and applications to grid cell decoding*
Ila Fiete, **David J. Schwab**, Ngoc M Tran
<http://arxiv.org/abs/1407.6029> (2014)
- 20. *An exact mapping between the variational renormalization group and deep learning*
Pankaj Mehta, **David J. Schwab**
<http://arxiv.org/abs/1410.3831> (2014)
Highlighted by: Quanta and Wired magazines.
- 19. *Dynamic tuning of electrical and chemical synaptic transmission in a network of motion coding retinal neurons*
Stuart Trenholm, Amanda McLaughlin, **David J. Schwab**, and Gautam Awatramani
The Journal of Neuroscience, **11**, 33(37): 14927-14938 (2013)

- 18. *Spatial lag normalization in the retina*
Stuart Trenholm, **David J. Schwab**, Vijay Balasubramanian, Gautam Awatramani
Nature Neuroscience **16**, 154-156 (2013)
Recommended by Faculty of 1000.
- 17. *Kuramoto model with coupling through an external medium*
David J. Schwab, Gabriel Plunk, Pankaj Mehta
Chaos **22**, 043139 (2012)
- 16. *Energetic costs of cellular computation*
Pankaj Mehta, **David J. Schwab**
Proceedings of the National Academy of Sciences **109**, 41 (2012)
Highlighted by: MIT Technology Review and Genome Web.
- 15. *Dynamical quorum-sensing and synchronization of nonlinear oscillators coupled through an external medium*
David J. Schwab, Ania Baetica, Pankaj Mehta
Physica D **241**, (21) 1782-1788 (2012)
- 14. *Alpha-ketoglutarate coordinates carbon and nitrogen utilization via enzyme I inhibition*
Christopher D. Doucette, **David J. Schwab**, Ned S. Wingreen, Joshua D. Rabinowitz
Nature Chemical Biology **7**, 894-901 (2011)
- 13. *Stat. mech. of transcription-factor binding site discovery using hidden Markov models*
Pankaj Mehta, **David Schwab**, Anirvan M. Sengupta
Journal of Statistical Physics **142**, 1187-1205 (2011)
- 12. *Rhythmogenic neuronal networks, pacemakers, and k-cores*
David J. Schwab, Robijn F. Bruinsma, Alex J. Levine
Physical Review E **82**, 051911 (2010)
- 11. *A computational model for the robustness of transmembrane proteins*
Karim Wahba, **David J. Schwab**, Robijn Bruinsma
Biophysical Journal **99**, 2217-2224 (2010)
- 10. *Glassy states in fermionic systems with strong disorder and interactions*
David J. Schwab, Sudip Chakravarty
Physical Review B **79**, 125102 (2009)
- 9. *Flory theory of the folding of designed RNA molecules*
David J. Schwab, Robijn Bruinsma
J. Phys. Chem. B **113**, 3880-3893 (2009)
- 8. *How many species have mass M ?*
Aaron Clauset, **David J. Schwab**, Sidney Redner
American Naturalist **173**, 256-263 (2009)
- 7. *Endogenous versus exogenous origins of diseases*
D. Sornette, V.I. Yukalov, E.P. Yukalova, J.Y. Henry, **D.J. Schwab**, J.P. Cobb
Journal of Biological Systems **17**, 225-267 (2009)
- 6. *Nucleosome switches*
David J. Schwab, Robijn Bruinsma, Joseph Rudnick, Jonathan Widom
Physical Review Letters **100**, 228105 (2008)

- 5. *Rounding by disorder of 1st-order quantum phase transitions: emergence of quantum critical points*
Pallab Goswami, **David J. Schwab**, Sudip Chakravarty
Physical Review Letters **100**, 015703 (2008)
- 4. *Local hidden variable theories for quantum states*
Barbara M. Terhal, Andrew C. Doherty, **David Schwab**
Physical Review Letters **90**, 157903 (2003)
- 3. *Photoionization of CO₂ (ARPES)*
A.C. Parr, J.B. West, M.R.F. King, K. Ueda, P.M. Dehmer, J.L. Dehmer, **D.J. Schwab**, A.M. Sansonetti, K. Olsen, R.A. Dragoset
<http://www.nist.gov/pml/data/co2/index.cfm>
- 2. *X-ray transition energies*
R.D. Deslattes, E.G. Kessler Jr, P. Indelicato, L. de Billy, E. Lindroth, J. Anton, J.S. Coursey, **D.J. Schwab**, J. Chang, R. Sukumar, K. Olsen, and R.A. Dragoset
<http://www.nist.gov/pml/data/xraytrans/index.cfm>
- 1. *Atomic weights and isotopic compositions*
Jack Coursey, **David J. Schwab**, Robert A. Dragoset
<http://www.nist.gov/pml/data/comp.cfm>

Other Activities

<i>Jan. - April 2018</i>	Visiting Professor Simons Institute for Computation, UC Berkeley
<i>Sept. 2017- present</i>	Academic Editor PLoS One and PNAS
<i>August 2015-2018</i>	q-bio Conference Program Committee Chair-line
<i>Sept. 2014-present</i>	q-bio Conference Member of organizing committee
<i>May, Nov. 2015</i>	Chicagoland Quantitative Biology meeting Co-founded and organized new biannual meeting
<i>Jan.-Feb. 2014</i>	KITP, Santa Barbara, CA Participated in program on neurophysics of space, time, and learning
<i>Summer '11, '12, '15</i>	Aspen Center for Physics, Aspen, CO Participated in programs at the interface between Biology and Physics as well as a working group on statistical inference
<i>Summer 2012</i>	UCLA IPAM Summer School, Los Angeles, CA 4-week program on machine learning with focus on deep learning
<i>Sept. 2007</i>	Biophysics Bootcamp, Pasadena, CA Experimental bootcamp organized by Rob Phillips' group at Caltech
<i>July 2007</i>	Boulder School in Condensed Matter Physics, Boulder, CO 4-week summer school with focus on Biophysics

Teaching

<i>Fall '18</i>	Professor, Nonlinear Dynamics and Chaos, CUNY Taught graduate course in nonlinear dynamics and applications.
<i>Summer '18</i>	Professor, CPBF summer school for advanced undergraduates Lectured on statistical physics.
<i>Spring '15</i>	Professor, Nonlinear Dynamics and Chaos, Northwestern Taught undergraduate/graduate course in nonlinear dynamics.
<i>Fall '14, '15, '16</i>	Professor, Methods of Theoretical Physics, Northwestern Taught graduate course in mathematical techniques for physicists.
<i>Nov. '14</i>	Physics and Astronomy New Faculty Workshop, UMD Teaching expertise workshop sponsored by the AAPT, APS, and AAS.
<i>Summer '12</i>	Instructor, Princeton Computational Neuroscience Course Taught the computational section of a summer school for graduate students with quantitative backgrounds transitioning into neuroscience.
<i>Sept. '11–May '12</i>	Precept instructor, Princeton Integrated Science Course Taught freshman following the quantitative sciences track intended to provide a broad introduction to the natural sciences.
<i>Sept. '10–June '14</i>	Organizer, Princeton Biophysics Journal Club Organized weekly discussions and presentations of current literature.
<i>Oct. '09–June '14</i>	Student research supervision, Princeton University Co-supervised three undergraduate student theses, one resulting in a journal publication.
<i>Sept. '03–Jun. '09</i>	Teaching assistant, University of California, Los Angeles Taught numerous Physics courses, including lectures and labs, for Physics, Engineering, and Biology majors.

Invited Talks

- 2018 UC, Davis, Depts. of Computer Science, Physics, and Neurobiology
 Institut Scientifiques de Cargèse, School on machine learning
 Max Planck Institute, Dresden, Quantum machine learning conference
 Max Planck Institute, Gottingen, Comp. neuro. conference
 Columbia University, Theoretical neuroscience seminar
 CUNY, Advanced Science Research Center
 UCLA, Neurophysics conference
 Princeton, Biophysics seminar
 SAIER Sao Paulo, School on theoretical physics
 Champalimaud Center for the Unknown, School on behavior
 HKUST, Conference on mathematics of deep learning
- 2017 Wash. U, Department of Physics
 APS March Meeting, Invited talk
 Simons Center for Computational Biology
 Institut Scientifiques de Cargèse, School on biophysics
 CUNY, ITS Symposium on recent developments in condensed matter
 U. Mass. Amherst, Workshop: work from noise
- 2016 UC, Davis, Department of Physics
 Perimeter Institute, Quantum machine learning conference
 IST, Austria, Info., prob., and inference in systems biology
 Caltech, Phillips group, 4 lectures
 University of Chicago, Department of Statistics
 IUPUI, Department of Physics
- 2015 ICAM Conference, University of Michigan
 Perimeter Institute, Waterloo, ON
 University of Texas, Austin, Center for Learning and Memory
 University of Chicago, Departments of Neurobiology and Statistics
 University of California, San Diego, Department of Physics
 University of Rochester, Department of Physics
 Northwestern University, Institute on Complex Systems
 Northwestern University, CIERA Interdisciplinary Seminar
 ICAM Annual Conference, Argonne National Lab
 Runde, Conference on inference in complex systems
- 2014 European Conference of mathematical and theoretical biology
 Infometrics Conference, American University
 Northwestern University, Department of Physics and Astronomy
 Emory University, Department of Physics
 Purdue University, Department of Physics
 University of Michigan, Department of Biophysics and CSCS
- 2013 University of Chicago, Institute for Genomics and Systems Biology
 University of California, Irvine, Department of Physics
 APS March Meeting, Invited talk

Current Support

- Sponsor: NSF
Award number: 7E126-00-01
Amount awarded: \$2,100,000 (Schwab portion)
Dates: 09/01/17 - 08/31/22
Role: co-PI
Title: PFC: Center for the Physics of Biological Function
- Sponsor: Simons Foundation
Award number: N/A
Amount awarded: \$620,000
Dates: 09/01/17 - 08/31/22
Role: PI
Title: Disentangling collective neural activity with hidden variables
- Sponsor: NIH
Award number: R01 EB026943-01
Amount awarded: \$450,000 (Schwab portion, approx)
Dates: 09/01/18 - 08/31/21
Role: co-PI
Title: Coarse graining approaches to networks, learning, and behavior

Past Support

- Sponsor: NIH
Award number: GM098875-05
Amount awarded: \$630,000
Dates: 09/01/12 - 05/31/17
Role: PI
Title: Excitability in *Dictyostelium* development
- Sponsor: Chicago Biomedical Consortium
Award number:
Amount awarded: \$200,000
Dates: 02/01/16 - 01/31/18
Role: co-PI
Title: Reading the cortical code for natural motion