

Louis Kang

Neural Circuits and Computations Unit

RIKEN Center for Brain Science

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POSITIONS

Unit Leader, Neural Circuits and Computations Unit 2020–
RIKEN Center for Brain Science, Wako, Japan

Miller Postdoctoral Fellow 2017–2020
University of California, Berkeley, USA
Host departments: Physics and Helen Wills Neuroscience Institute
Host faculty: Mike DeWeese

RESEARCH STATEMENT

Human cognition ultimately emerges from sophisticated computations performed by networks of neurons. I use and develop theoretical tools to investigate how our brains make sense of and respond to our dynamic environments. In particular, I am pursuing a unified understanding for how the hippocampus and entorhinal cortex allow us to form memories and navigate through space.

EDUCATION

MD, Perelman School of Medicine 2017
University of Pennsylvania, Philadelphia, USA
Research elective with Vijay Balasubramanian in theoretical neuroscience

PhD, Department of Physics & Astronomy 2015
University of Pennsylvania, Philadelphia, USA
Thesis advisor: Tom Lubensky
Thesis title: *Chirality and its spontaneous symmetry breaking in two liquid crystal systems*

AB in Chemistry and Physics and Mathematics *summa cum laude* 2009
Harvard University, Cambridge, USA

PUBLICATIONS

*equal contribution †corresponding author

8. **Kang L[†]**, DeWeese MR. Replay as wavefronts and theta sequences as bump oscillations in a grid cell attractor network. *eLife* 8, e46351 (2019). doi:10.7554/eLife.46351.
7. **Kang L[†]**, Balasubramanian V. A geometric attractor mechanism for self-organization of entorhinal grid modules. *eLife* 8, e46687 (2019). doi:10.7554/eLife.46687.
6. **Kang L[†]**, Lubensky TC. Chiral twist drives raft formation and organization in membranes composed of rod-like particles. *Proc Natl Acad Sci USA* 114, E19 (2017). doi:10.1073/pnas.1613732114.

5. **Kang L**[†], Gibaud T, Dogic Z, Lubensky TC. Entropic forces stabilize diverse emergent structures in colloidal membranes. *Soft Matter* 12, 386 (2016). doi:10.1039/C5SM02038G.
4. Davidson ZS*, **Kang L***, Jeong J*[†], Still T, Collings PJ, Lubensky TC, Yodh AG. Chiral structures and defects of lyotropic chromonic liquid crystals induced by saddle-splay elasticity. *Phys Rev E* 91, 050501 (2015). doi:10.1103/PhysRevE.91.050501.
3. Jeong J*[†], **Kang L***, Davidson ZS, Collings PJ, Lubensky TC, Yodh AG. Chiral structures from achiral liquid crystals in cylindrical capillaries. *Proc Natl Acad Sci USA* 112, E1837 (2015). doi:10.1073/pnas.1423220112.
2. Idema T, Dubuis JO, **Kang L**, Manning ML, Nelson PC, Lubensky TC, Liu AJ[†]. The syncytial *Drosophila* embryo as a mechanically excitable medium. *PLOS ONE* 8, e77216 (2013). doi:10.1371/journal.pone.0077216.
1. Heo M, **Kang L**, Shakhnovich EI[†]. Emergence of species in evolutionary “simulated annealing”. *Proc Natl Acad Sci USA* 106, 1869 (2009). doi:10.1073/pnas.0809852106.

 GRANTS, AWARDS, AND HONORS

Collaborative Research Travel Grant	2019–2020
Burroughs Wellcome Fund	
Project role: PI	
Project title: <i>Complementary input pathways enhance associative memory in a model of CA3</i>	
Travel Award	2018
Computational Neuroscience Meeting (CNS*2018)	
Miller Research Fellowship	2017–2020
University of California, Berkeley	
Mary Ellis Bell Prize	2016
University of Pennsylvania, Perelman School of Medicine	
“This prize is given to a student in the School of Medicine who is engaged in noteworthy research in any field related to medicine.”	
Werner Teutsch Memorial Prize	2012
University of Pennsylvania, Department of Physics & Astronomy	
“Awarded annually to the graduate student who, by his or her performance in the first year courses, shows the most promise for outstanding achievement in research.”	
Medical Scientist Training Program	2009–2017
National Institutes of Health (USA), awarded through the University of Pennsylvania	
Phi Beta Kappa	2009
Harvard University	

 VISITING POSITION

Visiting Scientist	Summer 2019
RIKEN Center for Brain Science, Wako, Japan	
Host faculty: Taro Toyozumi	

CONFERENCE PRESENTATIONS †talk

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- Computational and Systems Neuroscience (Cosyne)**, Denver, USA 2020
Complementary encoding pathways build a memory hierarchy in a model of hippocampus
- Society for Neuroscience Meeting**, Chicago, USA 2019
Replay as wavefronts and theta sequences as bump oscillations in a grid cell attractor network
- Bernstein Conference**, Berlin, Germany 2018
Replay arises naturally as a traveling wavefront in an entorhinal attractor network[†]
- Computational Neuroscience Meeting (CNS*2018)**, Seattle, USA 2018
A geometric attractor mechanism for the self-organization of entorhinal grid modules[†]
- Interdisciplinary Navigation Symposium (iNAV)**, Mont-Tremblant, Canada 2018
A geometric attractor mechanism for the self-organization of entorhinal grid modules[†]
- American Physical Society March Meeting**, Los Angeles, USA 2018
Self-organization of entorhinal grid modules through commensurate lattice relationships[†]
- Computational and Systems Neuroscience (Cosyne)**, Denver, USA 2018
Self-organization of entorhinal grid modules through commensurate lattices
- American Physical Society March Meeting**, New Orleans, USA 2017
Membrane rafts stabilized by chiral liquid crystal correction to bare interfacial tension[†]
- Computational and Systems Neuroscience (Cosyne)**, Salt Lake City, USA 2017
Coupling between attractor networks naturally generates a discrete grid cell hierarchy
- Gordon Research Conference & Seminar on Liquid Crystals**, Biddeford, USA 2015
Roles of entropy and chirality in depletion-induced colloidal membranes[†]
- American Chemical Society Colloid & Surface Science Symposium**, Philadelphia, USA 2014
A theory for depletion-induced colloidal membranes[†]
- American Physical Society March Meeting**, Denver, USA 2014
A theory for depletion-induced colloidal membranes[†]
- IAS Program on Frontiers of Soft Matter Physics**, Hong Kong 2014
A theory for depletion-induced colloidal membranes
- American Physical Society March Meeting**, Baltimore, USA 2013
Mitotic wavefronts mediated by mechanical signaling in early Drosophila embryos[†]

EXTERNAL SEMINARS

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- University of Tokyo**, Japan 2019
Yuji Ikegaya Group
Replay as wavefronts and theta sequences as bump oscillations in a grid cell attractor network
- Ludwig-Maximilians-Universität München**, Germany 2018
Bernstein Center for Computational Neuroscience Munich
Modules (and phase precession and replay) in continuous attractor models of grid cells
- University College London**, UK 2018
Institute for Behavioural Neuroscience

Replay arises naturally as a traveling wavefront in an entorhinal attractor network

École Normale Supérieure, Paris, France 2017

Group for Neural Theory

Self-organization of entorhinal grid modules through commensurate lattice relationships

Institut Curie, Paris, France 2017

Pierre Sens Group

Chiral twist drives raft formation and organization in membranes composed of rod-like particles

University College London, UK 2016

Gatsby Computational Neuroscience Unit

Coupling between attractor networks naturally generates a discrete grid cell hierarchy

University of California, Los Angeles, USA 2016

Center for Biological Physics

Chiral twist drives raft formation and organization in membranes composed of rod-like particles

TEACHING

Teaching Assistant 2011–2015

University of Pennsylvania

Modern physics, wave phenomena, electromagnetism, physics laboratory

Teaching Fellow 2006–2007

Harvard University

Organic chemistry, linear algebra

CLINICAL SERVICE

Medical Volunteer 2018–present

Project Homeless Connect

Providing medical care at homeless services events in San Francisco

Medical Student Volunteer 2010–2013

United Community Clinics

Provided medical care at a free health clinic in Philadelphia

REFERENCES

Mike DeWeese

Postdoctoral advisor

University of California, Berkeley

Redwood Center for Theoretical Neuroscience

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Tom Lubensky

PhD advisor

University of Pennsylvania

Department of Physics & Astronomy

tom@physics.upenn.edu

Vijay Balasubramanian

Research mentor

University of Pennsylvania

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Taro Toyozumi

Research mentor

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Neural Adaptation and Computation Group

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