

Louis Kang

Neural Circuits and Computations Unit

RIKEN Center for Brain Science

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<https://louiskang.group>

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POSITIONS

Unit Leader (Junior Group 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

VISITING AND ADJUNCT POSITIONS

Adjunct Associate Professor, Graduate School of Informatics 2021–
Kyoto University, Japan

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

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 interested in how hippocampal circuits produce memory and how they are disrupted in neurological diseases.

EDUCATION

MD, Perelman School of Medicine 2017
University of Pennsylvania, Philadelphia, USA

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

–. **Kang L**[†], Toyozumi T. Distinguishing examples while building concepts in hippocampal and

- artificial networks. *bioRxiv* (2023). doi:10.1101/2023.02.21.529365.
- . **Kang L[†]**, Toyozumi T. A Hopfield-like model with complementary encodings of memories. *arXiv* (2023). doi:10.48550/arXiv.2302.04481.
 - 10. Wang R, **Kang L[†]**. Multiple bumps can enhance robustness to noise in continuous attractor networks. *PLOS Comput Biol* 18, e1010547 (2022). doi:10.1371/journal.pcbi.1010547.
 - 9. **Kang L[†]**, Xu B, Morozov D. Evaluating state space discovery by persistent cohomology in the spatial representation system. *Front Comput Neurosci* 15, 616748 (2021). doi:10.3389/fncom.2021.616748.
 - 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
KAKENHI Grant-in-Aid for Early-Career Scientists

2022–2024

Japan Society for the Promotion of Science

Project role: PI

Project title: *The influence of attractor topology on seizure initiation in the hippocampal region (22K15209)***Collaborative Research Travel Grant**

2019–2020

Burroughs Wellcome Fund

Project role: PI

Project title: *Complementary input pathways enhance associative memory in a model of CA3***Travel Award**

2018

Computational Neuroscience Meeting (CNS*2018)

Miller Research Fellowship University of California, Berkeley	2017–2020
Mary Ellis Bell Prize 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.”	2016
Werner Teutsch Memorial Prize 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.”	2012
Medical Scientist Training Program National Institutes of Health (USA), awarded through the University of Pennsylvania	2009–2017
Phi Beta Kappa Harvard University	2009

CONFERENCE PRESENTATIONS [†]talk

Bernstein Conference , Berlin, Germany <i>Multiscale encodings of memories in hippocampal and artificial networks</i>	2022
Computational and Systems Neuroscience (Cosyne) , Lisbon, Portugal <i>Multiscale encodings of memories in hippocampal and artificial networks</i>	2022
Computational and Systems Neuroscience (Cosyne) , Denver, USA <i>Complementary encoding pathways build a memory hierarchy in a model of hippocampus</i>	2020
Society for Neuroscience Meeting , Chicago, USA <i>Replay as wavefronts and theta sequences as bump oscillations in a grid cell attractor network</i>	2019
Bernstein Conference , Berlin, Germany <i>Replay arises naturally as a traveling wavefront in an entorhinal attractor network[†]</i>	2018
Computational Neuroscience Meeting (CNS*2018) , Seattle, USA <i>A geometric attractor mechanism for the self-organization of entorhinal grid modules[†]</i>	2018
Interdisciplinary Navigation Symposium (iNAV) , Mont-Tremblant, Canada <i>A geometric attractor mechanism for the self-organization of entorhinal grid modules[†]</i>	2018
American Physical Society March Meeting , Los Angeles, USA <i>Self-organization of entorhinal grid modules through commensurate lattice relationships[†]</i>	2018
Computational and Systems Neuroscience (Cosyne) , Denver, USA <i>Self-organization of entorhinal grid modules through commensurate lattices</i>	2018
American Physical Society March Meeting , New Orleans, USA <i>Membrane rafts stabilized by chiral liquid crystal correction to bare interfacial tension[†]</i>	2017
Computational and Systems Neuroscience (Cosyne) , Salt Lake City, USA <i>Coupling between attractor networks naturally generates a discrete grid cell hierarchy</i>	2017
Gordon Research Conference & Seminar on Liquid Crystals , Biddeford, USA <i>Roles of entropy and chirality in depletion-induced colloidal membranes[†]</i>	2015

American Chemical Society Colloid & Surface Science Symposium, Philadelphia, USA <i>A theory for depletion-induced colloidal membranes[‡]</i>	2014
American Physical Society March Meeting, Denver, USA <i>A theory for depletion-induced colloidal membranes[‡]</i>	2014
IAS Program on Frontiers of Soft Matter Physics, Hong Kong <i>A theory for depletion-induced colloidal membranes</i>	2014
American Physical Society March Meeting, Baltimore, USA <i>Mitotic wavefronts mediated by mechanical signaling in early Drosophila embryos[‡]</i>	2013

TEACHING

An introduction to computational neuroscience RIKEN Center for Brain Science, Brain Science Training Program Two-hour lecture for graduate students once a year	2022–
An introduction to computational neuroscience Kyoto University, Graduate School of Informatics Three-hour lecture for graduate students once a year	2021–

REFERENCES

Mike DeWeese*Postdoctoral advisor*

University of California, Berkeley

Redwood Center for Theoretical Neuroscience

deweese@berkeley.edu

Tom Lubensky*PhD advisor*

University of Pennsylvania

Department of Physics & Astronomy

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Vijay Balasubramanian*Research mentor*

University of Pennsylvania

Department of Physics & Astronomy

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Taro Toyozumi*Research mentor*

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