

# Louis Kang

Neural Circuits and Computations Unit

RIKEN Center for Brain Science

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<https://louiskang.group>

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## POSITIONS

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**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

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**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

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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

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**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

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9. **Kang L<sup>†</sup>**, 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<sup>†</sup>**, 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<sup>†</sup>**, 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<sup>†</sup>**, 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<sup>†</sup>**, 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\*<sup>†</sup>, 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\*<sup>†</sup>, **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<sup>†</sup>. 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<sup>†</sup>. Emergence of species in evolutionary “simulated annealing”. *Proc Natl Acad Sci USA* 106, 1869 (2009). doi:10.1073/pnas.0809852106.

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GRANTS, AWARDS, AND HONORS

<b>Collaborative Research Travel Grant</b>	2019–2020
Burroughs Wellcome Fund	
Project role: PI	
Project title: <i>Complementary input pathways enhance associative memory in a model of CA3</i>	
<b>Travel Award</b>	2018
Computational Neuroscience Meeting (CNS*2018)	
<b>Miller Research Fellowship</b>	2017–2020
University of California, Berkeley	
<b>Mary Ellis Bell Prize</b>	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.”	
<b>Werner Teutsch Memorial Prize</b>	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.”	
<b>Medical Scientist Training Program</b>	2009–2017

National Institutes of Health (USA), awarded through the University of Pennsylvania

**Phi Beta Kappa** 2009  
Harvard University

#### CONFERENCE PRESENTATIONS <sup>†</sup>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<sup>†</sup>*
- Computational Neuroscience Meeting (CNS\*2018)**, Seattle, USA 2018  
*A geometric attractor mechanism for the self-organization of entorhinal grid modules<sup>†</sup>*
- Interdisciplinary Navigation Symposium (iNAV)**, Mont-Tremblant, Canada 2018  
*A geometric attractor mechanism for the self-organization of entorhinal grid modules<sup>†</sup>*
- American Physical Society March Meeting**, Los Angeles, USA 2018  
*Self-organization of entorhinal grid modules through commensurate lattice relationships<sup>†</sup>*
- 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<sup>†</sup>*
- 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<sup>†</sup>*
- American Chemical Society Colloid & Surface Science Symposium**, Philadelphia, USA 2014  
*A theory for depletion-induced colloidal membranes<sup>†</sup>*
- American Physical Society March Meeting**, Denver, USA 2014  
*A theory for depletion-induced colloidal membranes<sup>†</sup>*
- 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<sup>†</sup>*

#### EXTERNAL SEMINARS

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- Simons Collaboration for the Global Brain**, online 2020  
West Coast Postdoc/Student Meeting  
*Topological discovery in spatial representation circuits with persistent homology*
- 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

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**An introduction to computational neuroscience** 2021

Kyoto University

Three hours of lectures to Master's students in Informatics

## REFERENCES

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**Mike DeWeese**

*Postdoctoral advisor*

University of California, Berkeley

Redwood Center for Theoretical Neuroscience

deweese@berkeley.edu

**Vijay Balasubramanian**

*Research mentor*

University of Pennsylvania

Department of Physics & Astronomy

vijay@physics.upenn.edu

**Tom Lubensky**

*PhD advisor*

University of Pennsylvania

Department of Physics & Astronomy

tom@physics.upenn.edu

**Taro Toyozumi**

*Research mentor*

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Neural Adaptation and Computation Group

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