Yuansheng Cao

CONTACT INFORMATION

University of California, San Diego
9500 Gilman Drive, La Jolla, CA 92093

Email: caoys1988@gmail.com

EDUCATION

Peking University, China 2011- 2016

Ph.D., Biophysics and Condensed Matter Physics, 2016
- Thesis title: Nonequilibrium thermodynamics in biological networks
- Mentor: Yuhai Tu, Hongli Wang and Qi Ouyang

Peking University, China 2007–2011

B.A., Physics, 2011

RESEARCH EXPERIENCE

Postdoctoral Scholar, University of California, San Diego November 2016 – Present

Postdoctoral Associate at Department of Physics working with **Wouter-Jan Rappel** (UCSD)
- Mechanochemical coupling determines the plasticity of cell migration.
- Mechanical instability induced pattern formation in bacterial biofilm.
- Computational models of three-dimensional cell migration using phase-field method.
- Border cells path selection in fruit fly embryo.

Graduate Student at Peking University, China 2011 – 2016

Graduate student mentored by **Yuhai Tu** (IBM Watson), **Qi Ouyang** (PKU)
- Trade-offs between accuracy, sensitivity and energy dissipation in biochemical oscillators.
- Energy dissipation and optimal design principles of synchronization in coupled oscillators.
- Modeling kinetics and thermodynamics of cyanobacterial circadian clock (the Kai system).
- Information-driven Maxwell's Demon with enzyme kinetics

Visiting Scholar, IBM Watson March 2015 – August 2015

Short term visiting scholar
- Nonequlibrium thermodynamics of biochemical oscillations.
- Efficiency and power of bacterial flagellar motor

Undergraduate research, Peking University 2008 – 2011

Modeling cell cycle in fission yeast. Advisor: Fangting Li (PKU)

TEACHING AND MENTORING

Teaching assistant of thermodynamics, PKU	2012
Mentored graduate and undergraduate students (Dongliang Zhang, Chenyi Fei), PKU	2015–present
Collaborated with graduate student (Liyang Xiong), UCSD	2017–present

HONORS AND AWARDS

The Best Doctoral Dissertation of Peking University	2016
National Scholarship	2015
Special Scholarship for Graduates, Peking University	2014

PUBLICATIONS

(*co-first authors, **primary author, •papers of particular relevance)

1. •**Y. Cao***, E. Ghabache*, W.-J. Rappel, *Plasticity of cell migration resulting from mechanochemical coupling*, eLife 2019;8:e48478 (2019)
2. •D. Zhang*, **Y. Cao***, Q. Ouyang, Y. Tu, *The energy cost and optimal design for synchronization of coupled molecular oscillators*, Nature Physics (2019)
3. **Y. Cao***, E. Ghabache*, Y. Miao, C. Niman, H. Hakozaki, S. L. Reck-Peterson, P. N. Devreotes, W.-J. Rappel, *A minimal computational model for three dimensional cell migration*, accepted at J. R. Soc. Interface (2019)
4. •L. Xiong, **Y. Cao**, R. Cooper, W.-J. Rappel, J. Hasty, L. Tsimring, *Flower-like patterns in multi-species bacterial colonies*, accepted at eLife (2019), preprint: bioRxiv/10.1101/550996

5. W. Dai, X. Guo, J. Mondo, H. Burrous, S. Streichan, J. Campanale, **Y. Cao**, W.-J. Rappel, N. Gov, D. Montell, *Orthogonal physical and chemical cues steer migrating border cells in vivo*, under review
6. **Y. Cao***, R. Karmakar*, E Ghabache, E. Gutierrez, Y. Zhao, A. Groisman, H. Levine, B. Camley, W.-J. Rappel, *Cell motility dependence on adhesive wetting*, Soft Matter 15, 2043-2050 (2019)
7. •C. Fei*, **Y. Cao***, Q. Ouyang, Y. Tu, *Design principles for enhancing phase sensitivity and suppressing phase fluctuations simultaneously in biochemical oscillatory systems*, Nature Communications 9, 1434 (2018)
8. Y. Tu, **Y. Cao**, *Design principles and optimal performance for molecular motors under realistic constraints*, Phys. Rev. E 97, 022403 (2018)
9. •**Y. Cao****, H. Wang, Q. Ouyang, Y. Tu, *The free-energy cost of accurate biochemical oscillations*, Nature Physics 11, 772 (2015)
10. **Y. Cao***, Z. Gong*, HT Quan, *Thermodynamics of information processing based on enzyme kinetics: An exactly solvable model of an information pump*, Phys. Rev. E 91, 062117 (2015)
11. H. Zhang, Y. Sheng, Q. Wu, A. Liu, Y. Lu, Z. Yin, **Y. Cao**, W. Zeng, Q. Ouyang, *Rational design of a biosensor circuit with semi-log dose-response function in Escherichia coli*, Quantitative Biology 1, 209–220 (2013)

TALKS AND POSTERS

1. Seminar on Mathematics for Complex Biological Systems, *Nonequilibrium Thermodynamics of Biochemical Clocks: From Single to Synchronized Oscillators*, UCSD, March 2019
2. APS March Meeting, *Modeling cell motility dependence on substrate adhesion using phase field method*, Los Angeles, March 2018
3. Emergence in Chemical Systems 4.0, *The free energy cost of accurate biochemical oscillations*, Anchorage, August, 2015