CURRICULUM VITAE - SUNGHAN RO

sunghanro@fas.harvard.edu
Department of Physics, Harvard University
Cambridge, Massachusetts 02138, USA

PERSONAL DETAILS

Language *Korean*, Native Speaker
English, Advanced

EDUCATION

Korea Advanced Institute of Science and Technology — Daejeon, Republic of Korea
B.S. Physics — 2008 - 2013

Korea Advanced Institute of Science and Technology — Daejeon, Republic of Korea
Ph.D. Physics (Advisor: Yong Woon Kim) — 2013 - 2019
Integrated master's/doctoral program
Thesis title: A study on the effects of shapes and interactions of objects in the stochastic dynamical systems

HONORS AND AWARDS

Postdoctoral overseas training program — 2019-2020
National Research Foundation of Korea

Young Statistical Physicist Award — 2019
Korean Physical Society

Joong-Hoon Shin Scholarship — 2019
Outstanding dissertation award of KAIST for doctoral graduates of physics and nanoscience

Excellent presentation award — 2018
2018 Korean physical society spring meeting

Global Ph.D. Fellowship — 2013-2017
National Research Foundation of Korea

RESEARCH EXPERIENCE

Harvard University — Cambridge, Massachusetts, USA
Research Scholar — 2024 - Present

MIT — Cambridge, Massachusetts, USA
Postdoctoral associate; Advisor: Julien Tailleur — 2022 - 2024

Technion - Israel Institute of Technology — Haifa, Israel
Postdoctoral fellow; Advisors: Dov Levin, Yariv Kafri, and Guy Bunin — 2019 - 2022

Korea Advanced Institute of Science and Technology — Daejeon, Republic of Korea
Graduate Researcher; Advisor: Yong Woon Kim — 2013 - 2019

Korea Institute of Science and Technology Information — Daejeon, Republic of Korea
Participant; High Energy Physics Team, lead by Kihyeon Cho — 2011

RESEARCH INTERESTS

- Collective phenomena in nonequilibrium systems, such as active matter
- Information-theoretic quantification of order in systems both in- and out-of-equilibrium
- Stochastic systems: Systems governed by Langevin- and Fokker-Planck-type equations, barrier-crossing problem and the first-passage dynamics of random walkers
- Complex biological systems: membraneless organelles formed by phase separation of polymers, emergent interactions between polyelectrolytes mediated by counterions, and nuclear pore complex

PUBLICATION LIST

(* equally contributed)

1. O. Granek, Y. Kafri, M. Kardar, **Sunghan Ro**, J. Tailleur, A. Solon. *Colloquium: Inclusions, Boundaries and Disorder in Scalar Active Matter*. Rev. Mod. Phys. **96**, 031003 (2024).
2. J. H. Han, E. Lake, and **Sunghan Ro**. *Scaling and localization in multipole-conserving diffusion*. Phys. Rev. Lett. 132, 137102 (2024, Editors' Suggestion).
3. N. Rana, R. Chatterjee, **Sunghan Ro**, D. Levine, S. Ramaswamy, and P. Perlekar. *Defect turbulence in a dense suspension of polar, active swimmers*. Phys. Rev. E 109, 024603 (2024).
4. B. Benvegnen, O. Granek, **Sunghan Ro**, R. Yaacoby, H. Chaté, Y. Kafri, D. Mukamel, A. Solon, and J. Tailleur. *Metastability of Discrete-Symmetry Flocks*. Phys. Rev. Lett., 131, 218301 (2023, Editors' Suggestion).
5. **Sunghan Ro**, J. Yi, and Y. W. Kim. *Target searches of interacting Brownian particles*. Phys. Rev. E **107**, 064143 (2023).
6. T. Agranov, Sunghan Ro, Y. Kafri, and V. Lecomte. *Macroscopic fluctuation theory and current fluctuations in active lattice gases*. SciPost Physics 14(3), 045 (2023).
7. **Sunghan Ro***, B. Guo*, A. shih, T V. Phan, R. H. Austin, S. Martiniani, D. Levine, and P. M. Chaikin. *Model-free measurement of local entropy production and extractable work in active matter*. Phys. Rev. Lett., 129, 220601 (2022, Editors' Suggestion).
8. **Sunghan Ro** and Y. W. Kim. *Optimal searcher distribution for parallel random target searches*. Phys. Rev. E 106, 024101 (2022).
9. Y. Ben Dor*, **Sunghan Ro***, Y. Kafri, M. Kardar, J. Tailleur. *Disordered boundaries destroy bulk phase separation in scalar active matter*. Phys. Rev. E **105**, 044603 (2022, Editors' Suggestion).
10. T. Agranov, **Sunghan Ro**, Y. Kafri, and V. Lecomte. *Exact fluctuating hydrodynamics of active lattice gasses – Typical fluctuations*. J. Stat. Mech. 083208 (2021).
11. **Sunghan Ro**, Y. Kafri, M. Kardar, and J. Tailleur. *Disorder-Induced Long-Ranged Correlations in Scalar Active Matter*. Phys. Rev. Lett. **126**, 048003 (2021).
12. M. Cha, **Sunghan Ro**, and Y. W. Kim. *Condensation of Rodlike Counterions on a Charged Cylinder*. J. Korean Phys. Soc. **77**, 811 (2020).
13. Y. Kang, J. Yi, and **Sunghan Ro**. *Entropy production and energy exchange by transferring quantum particles between canonical initial states*. J. Korean Phys. Soc. **76**, 788 (2020).
14. M. Cha*, **Sunghan Ro***, and Y. W. Kim. *Rodlike counterions near charged cylinders: Counterion condensation and intercylinder interaction*. Phys. Rev. Lett. **121**, 058001 (2018).
15. **Sunghan Ro**, A. Gopinathan, and Y. W. Kim. *Interactions between a fluctuating polymer barrier and transport factors together with enzyme action are sufficient for selective and rapid transport through the nuclear pore complex*. Phys. Rev. E **98**, 012403 (2018).

16. **Sunghan Ro** and Y. W. Kim. *Parallel random target searches in a confined space.* Phys. Rev. E **96**, 012143 (2017).

17. **Sunghan Ro**, J. Yi, and Y. W. Kim. *Chiral separation by flows: The role of flow symmetry and dimensionality.* Sci. Rep. **6**, 35144 (2016).

18. **Sunghan Ro**, J. Yi, and Y. W. Kim. *Analysis of diffusion trajectories of anisotropic objects.* J. Chem. Phys. **142**, 214302 (2015).

TEACHING EXPERIENCE

Harvard University — Cambridge, Massachusetts USA
Lecturer; Physics 262/Applied Physics 284: Statistical Mechanics — Fall 2024

MIT — Cambridge, Massachusetts USA
Teaching Assistant; IAP 8.08/8.S421: Statistical Mechanics 2 — Winter 2024

Korea Advanced Institute of Science and Technology — Daejeon, Republic of Korea
Teaching Assistant; Special Topics in Physics (Theoretical Biophysics) — Fall 2014

Korea Advanced Institute of Science and Technology — Daejeon, Republic of Korea
Teaching Assistant; Introduction to Nanobiology — Spring 2014

MENTORING

Final project mentor of Statistical Physics of Fields by Mehran Kardar — Spring 2023
MIT — Cambridge, Massachusetts, USA

Amer Al-Hiyasat — with Julien Tailleur, 2022 - Present
MIT — Cambridge, Massachusetts, USA

Jessica Metzger — with Julien Tailleur, 2022 - Present
MIT — Cambridge, Massachusetts, USA

PRESENTATIONS

1. *Multipole-conserving diffusion.* Soft Condensed Matter Seminar Series, Harvard University, (September, 2024).

2. (invited) *Far-reaching impact of boundaries and disorder on scalar active matter.* 2024 CECAM workshop, Active Matter: Interfaces and Boundaries, Beijing (April, 2024).

3. *Metastability of Discrete-Symmetry Flocks.* 2024 APS March Meeting, Minneapolis (March, 2024).

4. *Target searches by Brownian particles.* Table talk at Grater Boston Area Statistical Mechanics Meeting, MIT (Oct, 2023).

5. *The far-reaching impact of disorder on bulk behavior of scalar active matter.* Oral presentation in Statphys28, Japan (Aug, 2023).

6. *Metastability of discrete-symmetry flocks.* Poster presentation in Perspectives on Non-Equilibrium Statistical Mechanics: The 45th anniversary Symposium of Yamada Science Foundation. Yukawa Institute for Theoretical Physics, Kyoto University (Aug, 2023).

7. *The far-reaching impact of disorder on bulk behavior of scalar active matter.* Oral presentation in Frontiers in nonequilibrium physics: active matter, topology and beyond. Yukawa Institute for Theoretical Physics, Kyoto University (Aug, 2023)
8. *Metastability of discrete-symmetry flocks.* Seminar in PLS Short Talks, MIT (June, 2023).
9. (invited) *Fate of scalar active matter in the presence of disorder.* Colloquium in Seoul National University-Center for Theoretical Physics (March, 2023).
10. (invited) *Fate of motility-induced phase separation in disordered boundaries.* Seminar in CMT Kid's seminar, Harvard University (Feb, 2023).
11. (invited) *Fate of motility-induced phase separation in disordered boundaries.* Oral presentation in The 3rd workshop on stochasticity and fluctuations in small systems, APCTP (Nov, 2022).
12. *Macroscopic phase of active matter depends on the boundary conditions.* Table talk at Grater Boston Area Statistical Mechanics Meeting, UMass-Amherst (Oct, 2022).
13. *Fate of motility-induced phase separation in quenched disorder.* Seminar in PLS Short Talks, MIT (Sep, 2022).
14. (invited) *Target search by many random walkers.* Seminar in center for soft matter research, New York University (2022).
15. (invited) *Long-ranged effects of disorder on active systems.* Seminar in Korea Institute for Advanced Study (2021).
16. *Disorder-induced long-ranged correlations in scalar active matter.* Oral presentation in 2021 Korean Physical Society spring meeting, South Korea (2021).
17. *The impact of quenched disorder on scalar active matter.* Oral presentation in Israel Physical Society conference 2021, Israel (2021).
18. (invited) *The impact of quenched disorder on scalar active matter.* Oral presentation in Statistical Mechanics Day XII, Weizmann Institute of Science (2020).
19. (invited) *Role of order statistics and interactions in the first-passage dynamics.* Oral presentation in Korea Institute for Advanced Study (2019).
20. (invited) **Sunghan Ro** and Y. W. Kim. (title translated from Korean) *The role of shapes in interactions of objects in the stochastic dynamical systems.* Oral presentation in 2019 KPS Spring Meeting, South Korea (2019).
21. **Sunghan Ro** and Y. W. Kim. *Parallel random target searching by multiple searchers in a confined space.* Short talk presentation in 120th Statistical Mechanics Conference, New Jersey (2018).
22. **Sunghan Ro** and Y. W. Kim. *Target searches by multiple random walkers in a confined space.* Poster presentation in APCTP-KIAS Workshop on "Motors and Engines", South Korea (2018).
23. **Sunghan Ro** and Y. W. Kim. *Parallel random target searches in a confined space.* Oral presentation in 2018 KPS Spring Meeting, South Korea (2018).
24. **Sunghan Ro**, J. Yi, and Y. W. Kim. *Analysis of diffusion trajectories of anisotropic objects.* Poster presentation in 2016 Korea Global Ph.D. Fellows Annual Conference: Beyond Disciplinary Boundaries, South Korea (2016).
25. **Sunghan Ro**, J. Yi, and Y. W. Kim. *Analysis of diffusion trajectories of anisotropic objects.* Oral presentation in 2016 KPS Fall Meeting, South Korea (2016).
26. **Sunghan Ro**, J. Yi, and Y. W. Kim. *Chiral separation by creeping flows.* Poster presentation in The 26th IUPAP International conference on Statistical Physics, France (2016).

27. **Sunghan Ro**, J. Yi, and Y. W. Kim. *The role of flow symmetry and singularity in chiral separation*. Oral presentation in 2016 KPS Spring Meeting, South Korea (2016).

28. **Sunghan Ro** and Y. W. Kim. *Separation of chiral objects using optimal flow patterns*, Poster presentation in The Search for a New Methodology in Academic Research, South Korea (2014).

29. **Sunghan Ro** and Y. W. Kim. *Separation of chiral objects using optimal flow patterns*, Poster presentation in Surmounting the Insurmountable, South Korea (2014).

30. **Sunghan Ro** and Y. W. Kim. *Separation of microscopic chiral objects*, Oral presentation in Workshop on Statistical Physics of Complex Systems, South Korea (2014).

31. **Sunghan Ro** and Y. W. Kim. *Separation of Chiral objects in flow*, Poster presentation in The 25th IUPAP International conference on Statistical Physics, South Korea (2013).