Asher Preska Steinberg

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Education

California Institute of Technology, Pasadena, CA
Ph.D. in Chemistry — Apr 2019
Thesis advisor: Rustem F. Ismagilov
Thesis committee: Zhen-Gang Wang (chair), David A. Tirrell, Julie A. Kornfield
Thesis: *How polymers shape the physicochemical environment of the gut*
Thesis awarded Herbert Newby McCoy Award by the Division of Chemistry & Chemical Engineering at Caltech

Brandeis University, Waltham, MA
B.A. in Chemistry with highest honors — May 2013
B.A. in Physics
summa cum laude
Thesis advisor: Milos Dolnik
Thesis: *Growth dynamics of Turing patterns in the photosensitive CDIMA reaction*

Honors, Awards, & Fellowships

2020-present Life Sciences Research Foundation Postdoctoral Fellowship (Simons Foundation Awardee)
2019 Herbert Newby McCoy Award at Caltech (In recognition of the most outstanding achievements in research by a graduate student in the CCE Division)
2018-2019 Caldwell CEMI Graduate Fellowship at Caltech
2013-2018 National Science Foundation Graduate Research Fellowship
2013 Molly W. and Charles K. Schiff Memorial Award at Brandeis University
2012 Columbia University Energy Frontiers Research Center RPU
2012 Phi Beta Kappa, Mu Chapter (Inducted as Junior)
2011 NYU Summer MRSEC REU Fellowship
2010 Winner of Chemical Rubber Company Press Chemistry Achievement Award at Brandeis University
2009-2013 Brandeis Dean's List

Research Experience

Kussell Group **June 2019-present**
New York University **New York, NY**
Advisor: Dr. Edo Kussell
-Investigating the role of homologous recombination in microbial genome evolution using population genetics and computational biology.

Ismagilov Group **Nov 2013-April 2019**
California Institute of Technology **Pasadena, CA**
Advisor: Dr. Rustem F. Ismagilov
-Ph.D. thesis: How polymers shape the physicochemical environment of the gut
-Studied how dietary and host-secreted polymers shape the physicochemical environment of the gut using tools from polymer physics
-Trained users on gel permeation chromatography (GPC) instrument, taught users how to analyze GPC data, and maintained the instrument
-Trained users with basic mouse work, assisted with animal husbandry of mouse colonies, and assisted with writing IACUC protocols
-Assisted with training users on and maintenance of epifluorescence microscopes
-Served as secondary chemical safety officer
-Managed group responsibilities for instrument maintenance and trainings
-Contributed to idea generation, writing, and proof-reading for 2018 Jacobs Institute for Molecular Engineering for Medicine grant (awarded)
-Led writing, developed ideas, contributed data, and coordinated with other labs for 2018 Caltech CEMI pilot grant (awarded)
-Led writing for Ismagilov group, coordinated with other labs, developed ideas, and contributed data for DARPA MURI-ONR grant (awarded)
-Contributed to writing and ideas development for DARPA BRICS grant (awarded)
-Contributed to writing and ideas development for DARPA BRICS Abstract 2014 (invited to apply)

Epstein Group **Mar-May 2010, Sept 2011-May 2013**
Brandeis University **Waltham, MA**
Advisor: Dr. Milos Dolnik
-Received highest honors for senior thesis, *Growth dynamics of Turing patterns in the photosensitive CDIMA reaction*
-Studied wavenumber locking of Turing patterns with spatial periodic forcing

Brus Group **May-Aug 2012**
Columbia University **New York, NY**
Advisor: Dr. Louis Brus
-Participated in Columbia University EFRC Research Program for Undergraduates
-Examined the photo-oxidation of citrate by silver nanoparticles in a photo-electrochemical cell
-Goal was to elucidate the relation between photoresponse and surface plasmon resonance of particles

Center for Soft Matter Research **Jun-Aug 2011**
New York University **New York, NY**
Advisor: Dr. Paul Chaikin
-Participated in NYU MRSEC 2011 Research Experience for Undergraduates program
-Studied non-equilibrium properties of active suspensions of artificial light-activated microswimmers
-Goal was to help build a framework for understanding the physics of active matter

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Mentoring & Teaching Experience

Ismagilov Group **Oct 2017-Mar 2018**
California Institute of Technology **Pasadena, CA**
Graduate Rotation Students mentored
- Fall term 2018: Robert Grayson (Chemical Engineering)
- Winter term 2018: Michael Porter (Chemical Engineering)
- Fall term 2017: Thomas Naragon (Chemistry)

Supplemental Instruction Leader **Sept 2010-May 2013**
Brandeis University Chemistry Department **Waltham, MA**
-Led review sessions, proctored quizzes, attended classes, and answered questions students had about course material for the General Chemistry course

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Publications

10. A. Preska Steinberg, O.K. Silander, E. Kussell. "Correlated substitutions reveal SARS-like coronaviruses recombine frequently with a diverse set of structured gene pools". *In review*.
9. A. Preska Steinberg, M. Lin, E. Kussell. "Core genes can have higher recombination rates than accessory genes within global microbial populations". *eLife* **2022,** *11:e78533*.
8. M. K. Porter, A. Preska Steinberg, R. F. Ismagilov. "Interplay of motility and polymer-driven depletion forces in the initial stages of bacterial aggregation". *Soft Matter* **2019,** *15*, 7071-7079.
7. A. Preska Steinberg, Z. G. Wang, R. F. Ismagilov. "Food polyelectrolytes compress the colonic mucus hydrogel by a Donnan mechanism". *Biomacromolecules* **2019,** *20* (7), 2675-2683.
6. A. Preska Steinberg, S. S. Datta, T. Naragon, J. C. Rolando, S. R. Bogatyrev, R. F. Ismagilov. "High-molecular-weight polymers from dietary fiber drive aggregation of particulates in the murine small intestine". *eLife* **2019,** *8:e40387*.
5. S. S. Datta, A. Preska Steinberg, R. F. Ismagilov. "Polymers in the gut compress the colonic mucus hydrogel". *Proc Natl Acad Sci USA* **2016,** *113* (26), 7041-7046.
4. L. Haim, A. Hagberg, R. Nagao, A. Preska Steinberg, M. Dolnik, I. R. Epstein, E. Meron. "Fronts and patterns in a spatially forced CDIMA reaction". *Phys Chem Chem Phys* **2014,** *16* (47), 26137-26143.

3. A. Preska Steinberg, I. R. Epstein, M. Dolnik. "Target Turing Patterns and Growth Dynamics in the Chlorine Dioxide-Iodine-Malonic Acid reaction". *J Phys Chem A* **2014,** *118* (13), 2393-2400.
2. E. S. Thrall, A. Preska Steinberg, X. Wu, L. E. Brus. "The Role of Photon Energy and Semiconductor Substrate in the Plasmon-Mediated Photooxidation of Citrate by Silver Nanoparticles". *J Phys Chem C* **2013,** *117* (49), 26238-26247.
1. J. Palacci, S. Sacanna, A. Preska Steinberg, D. J. Pine, P. M. Chaikin. "Living Crystals of Light-Activated Colloidal Surfers". *Science* **2013,** *339* (6122), 936-940.

Talks and Presentations

- July 2022: "Core genes can have higher recombination rates than accessory genes within global microbial populations". GRC on Microbial Stress Response, Mt. Holyoke College, South Hadley, MA. (Poster)
- April 2022: "Correlated substitutions reveal SARS-like coronaviruses recombine frequently with a diverse set of structured gene pools". Life Sciences Research Foundation Annual Meeting, Philadelphia, PA. (Poster)
- March 2022: "Core genes can have higher recombination rates than accessory genes within global microbial populations". American Physical Society March Meeting. (Virtual Talk)
- Nov 2021: "Understanding recombination across the pangenome in global microbial populations". Postdoc Seminar Series, New York University, Biology Department, New York, NY. (Talk)
- May 2021: "Understanding microbial recombination from the genome to population-scale". Life Sciences Research Foundation Annual Meeting, Virtual meeting. (Poster)
- June 2019: "How polymers shape the physicochemical environment of the gut". McCoy Award Symposium, Caltech, Chemistry and Chemical Chemical Engineering, Pasadena, CA. (Talk)
- June 2019: "The physics of the gut: How polymers shape a microbial home". GRC on Molecular Mechanisms in Evolution, Stonehill College, Easton, MA. (Poster)
- Sept 2018: "High-molecular-weight polymers from dietary fiber drive aggregation of particulates in the murine small intestine". Caltech CCE Seminar Day, Caltech, Chemistry and Chemical Engineering, Pasadena, CA. (Talk)
- Sept 2018: "High-molecular-weight polymers from dietary fiber drive aggregation of particulates in the murine small intestine". Frontiers in Soft Matter and Macromolecular Networks, University of San Diego, San Diego, CA. (Talk)
- July 2018: "Polymers compress the colonic mucus hydrogel". Mechanobiology Symposium: The Mechanome in Action, UC Irvine, Irvine, CA. (Talk & Poster)
- Nov 2017: "Polymers in the gut compress the colonic mucus hydrogel". Caltech CCE Seminar Day, Caltech, Chemistry and Chemical Engineering, Pasadena, CA. (Poster)

- Sept 2017: “Polymers compress colonic mucus hydrogel in vitro and in vivo”. Frontiers in Soft Matter and Macromolecular Networks, University of San Diego, San Diego, CA. (Talk)
- Mar 2017: “Physics of the gut: How polymers dynamically structure the gut environment”. American Physical Society March Meeting, New Orleans, LA. (Talk)
- Mar 2017: “Polymers in the gut compress the colonic mucus hydrogel”. Center for the Chemistry of Cellular Signaling Seminar, Caltech, Pasadena, CA. (Talk)

Patent Applications

1. Polymeric compositions and related systems and methods for regulating biological hydrogels
   US Patent Application 15/399,711 (filed: 1/5/17)
   Inventors: R. F. Ismagilov, S. S. Datta, A. Preska Steinberg, S. R. Bogatyrev

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Relevant Skills

Laboratory skills (as demonstrated in “Publications” above):

-*Ex vivo* and *in vivo* mouse experiments (Publications #5-7)
-Confocal microscopy (Publications #5-7)
-Gel permeation chromatography (Publications #5-7)
-Western blot (Publication #6)
-Dynamic light scattering (Publication #5)
-Zeta potential measurements (Publication #6)
-Basic mouse husbandry (Publications #5-7)

Analytical/computational skills (as demonstrated in “Publications” above):

-Polymer physics (e.g., numerical calculations using Flory-Huggins solution theory and Donnan partitioning in Publication #7, using depletion model in Publication #6 & 8, using Flory-Huggins model in Publication #5)
-Image analysis (e.g., quantification of colloidal suspension structure in Publication #6 and mucus thickness and permeability measurements in Publication #5 & 7)
-Population genetics (e.g., coalescent model with recombination in Publication #9)
-Bioinformatics (e.g., contributed to pipeline for inferring recombination from large-scale sequencing data and developed sequence clustering pipeline in Publication #9)
-Experience with Linux-based high-performance computing environments (e.g., recombination analysis in Publication #9)

Programming: Python, Go, Java (basic knowledge), Shell scripting

Applications: ImageJ, Mathematica (basic knowledge)

Outreach & Additional Activities

-Volunteer, Physics demos for Caltech educational outreach event, 626 Night Market, Arcadia, CA (Sept 2018).

-**Volunteer,** Chemistry experiment demos, March for Science – Pasadena, Pasadena Memorial Park, Pasadena, CA (Mar 2017).
-**Volunteer,** Judge for Caltech Summer Undergraduate Research Fellowship Seminar Day, Caltech, Pasadena, CA (Oct 2016).
-**Caltech Jazz Band,** Perform for various Caltech fundraising and outreach events, Pasadena, CA (2013-2019).