

# Carolina Tropini, Ph.D.

Microbiology and Immunology, Stanford University.  
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## Education

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### **Stanford University**

*Ph.D. Biophysics. GPA: 3.9/4*

Doctoral dissertation: On growth and form: a bacterial perspective.

Committee: Prof. KC Huang (Advisor), Prof. Daniel Fisher, Prof. Julie Theriot, Prof. Stephen Quake.

**Stanford, CA, USA**

2008–2014

### **University of British Columbia (UBC)**

*B.Sc., Honors Biophysics. GPA: 3.8/4.0, Science One Program*

**Vancouver, BC, Canada**

2003–2008

## Research Experience

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### ○ **Sonnenburg Lab, Microbiology and Immunology Department, Stanford University. (2014 - )**

Created a framework to investigate the effects of physical perturbations on the gut microbiota. Currently investigating osmotic diarrhea using a combination of omics, imaging, mathematical modeling and microfluidic technologies, mouse and in vitro models. Demonstrated diarrhea causes lasting changes to the gut microbiota and selects microbial taxa based on their metabolic capabilities and osmotic tolerance.

### ○ **Marine Biological Laboratory Physiology Course, Jonathon Howard Group, Woods Hole. (2011)**

Developed a novel assay to investigate stochastic transition between microtubule shrinking and growing phases. The project led to the shortest time to publication project to come out of the Physiology course.

### ○ **Huang Lab, Bioengineering Department, Stanford University. (2010 - 2014)**

Investigated how shape is determined in Gram-negative bacteria. Used genetic and biophysical approaches to modify cell wall building blocks and forces; observed with microscopy how bacterial shape and cellular mechanical properties are affected.

Investigated the establishment and function of protein localization in bacteria using a combination of mathematical modeling and time-lapse microscopy. Demonstrated that localized protein activity can give rise to gradients of cellular components that are robust to cell shape changes and cellular regulation.

### ○ **Hansen Lab, UBC Proteomics, UBC. (2006 - 2008)**

Applied microfabrication and soft lithography techniques to develop, construct, and test a microfluidic device capable of a million parallel digital PCR reactions in picoliter reactors for non-invasive detection of fetal Down syndrome.

### ○ **Stanford Genome Technology Center, Stanford University. (May - August 2006)**

Provided instruction to the Ronaghi group on organic nanopore analysis. Designed and performed synthetic nanopore experiments for detection and real-time analysis of proteins and DNA methylation.

### ○ **Applied Biophysics Lab, UBC, Prof. Andre Marziali. (2005 - 2006)**

Developed a technology for parallel measurements of DNA hybridization using a lipid membrane with multiple nanopores, as a precursor for a synthetic DNA sequencer. Reduced the time required to obtain data by more than 100-fold to current gold standard. This work was the first to demonstrate multi-nanopore force spectroscopy measurements that could be used for single nucleotide polymorphism detection.

## Selected Awards and Scholarships

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James S. McDonnell Foundation Postdoctoral Fellowship Award - \$200,000	2014–2017
Microscopy image winner: 2017 cover <i>Nature Reviews Gastroenterology &amp; Hepatology</i> journal	2016
Outstanding paper award: Center for Individualizing Medicine - Mayo Clinic	2016
Bruce and Elizabeth Dunlevie Bio-X Stanford Interdisciplinary Graduate Fellowship	2011–2014
Stanford Biosciences Office of Graduate Education Travel Grant	2013
Stanford Graduate Fellowship	2008–2011
Marine Biological Laboratory Physiology Summer Course Award	2011
Stanford Bio-X Student Travel Fellowship Award	2009–2011, 2013
FEBS-EMBO Lecture Course Travel Award	2009
UBC Science Service Award, for contributions as the UBC Biophysics Student Society president and for starting a research seminar series for undergraduates (AIS)	2008
Arthur Crooker Prize – best experimental physics student	2008
Thomas and Evelyn Hebb Memorial Scholarship - academic excellence in physics	2007
Wesbrook Scholarship	2007
Trek Excellence Scholarship – top 5% of faculty of Science	2007
Charles and Jane Banks Scholarship	2007
UBC Science Scholar for outstanding academic achievement	2006–2008
NSERC summer undergraduate scholarship research award	2007
UBC Dean of Science Scholarship	2006–2007
UBC Dean's Honor List: Faculty of Science	2003–2008
British Columbia Government Scholarship	2004
Larry Roberts Science One Memorial Scholarship	2004

## Publications and Patents

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### Publications.....

- [1] The Tabula Muris Consortium. Tabula Muris: Transcriptomic characterization of 20 organs and tissues from *Mus Musculus* at single cell resolution. *In Revision, Nature*, January 2018.
- [2] **Carolina Tropini**, Eli L Moss, Bryan D Merrill, Katharine M Ng, Steven K Higginbottom, Ellen Casavant, Carlos Gonzales, Brayon Fremin, Joshua E Elias, Huang Kerwyn C Bhatt, Ami S, and Justin L Sonnenburg. Transient osmotic perturbation causes long-term alteration to the gut microbiota. *Accepted, Cell*, March 2018.
- [3] Brad A Krajina, **Carolina Tropini**, Audrey Zhu, Philip DiGiacomo, Justin L Sonnenburg, Sarah C Heilshorn, and Andrew J Spakowitz. Dynamic light scattering microrheology reveals multi-scale viscoelasticity of polymer gels and precious biological materials. *ACS Central Science*, 10.1021/acscentsci.7b00449, December 2017.
- [4] Handuo Shi, Alexander Colavin, Desmond A Moore, Marty Bigos, Harold P Erickson, **Carolina Tropini\*\***, Russell D Monds\*\*, and Kerwyn C Huang\*\*. Deep phenotypic mapping of bacterial

cytoskeletal mutants reveals physiological robustness to cell size. *Current Biology*.  
\*\* *Corresponding authors*, 27:3419–3429, November 2017.

- [5] **Carolina Tropini\***, Kristen Earle\*, Kerwyn C Huang, and Justin L Sonnenburg. The Gut Microbiome: Connecting Spatial Organization to Function. *Cell Host and Microbe*, 21:433–442, April 2017.
- [6] Tristan Ursell\*, Timothy K Lee\*, Daisuke Shiomi, Handuo Shi, **Carolina Tropini**, Russell D Monds, Alexander Colavin, Gabriel Billings, Iina Bhaya-Grossman, Michael Broxton, Bevan E Huang, Hironori Niki, and Kerwyn C Huang. Rapid, precise quantification of bacterial cellular dimensions across a genomic-scale knockout library. *BMC Biology*, 15(17), February 2017.
- [7] Samantha M Desmarais, **Carolina Tropini**, Amanda Miguel, Felipe Cava, Russell D Monds, Miguel A de Pedro, and Kerwyn C Huang. High-throughput, Highly Sensitive Analyses of Bacterial Morphogenesis Using Ultra Performance Liquid Chromatography. *Journal of Biological Chemistry*, 290(52):31090–31100, December 2015.
- [8] Dylan Dodd, **Carolina Tropini**, and J L Sonnenburg. Your gut microbiome, deconstructed. *Nature Biotechnology*, 33(12):1238–1240, December 2015.
- [9] **Carolina Tropini**, Timothy K Lee, Jen Hsin, Samantha M Desmarais, Tristan Ursell, Russell D Monds, and Kerwyn C Huang. Principles of bacterial cell-size determination revealed by cell-wall synthesis perturbations. *Cell Reports*, 9(4):1520–1527, November 2014.
- [10] Timothy K Lee, **Carolina Tropini**, Jen Hsin, Samantha M Desmarais, Tristan S Ursell, Enhao Gong, Zemer Gitai, Russell D Monds, and Kerwyn C Huang. A dynamically assembled cell wall synthesis machinery buffers cell growth. *Proceedings of the National Academy of Sciences*, 111(12):4554–4559, March 2014.
- [11] **Carolina Tropini**, Naveed Rabbani, and Kerwyn C Huang. Physical constraints on the establishment of intracellular spatial gradients in bacteria. *BMC Biophysics*, 5(1):17, August 2012.
- [12] **Carolina Tropini** and Kerwyn C Huang. Interplay between the localization and kinetics of phosphorylation in flagellar pole development of the bacterium *Caulobacter crescentus*. *PLoS Computational Biology*, 8(8):e1002602, August 2012.
- [13] Hannah H Tuson, George K Auer, Lars D Renner, Mariko Hasebe, **Carolina Tropini**, Max Salick, Wendy C Crone, Ajay Gopinathan, Kerwyn C Huang, and Douglas B Weibel. Measuring the stiffness of bacterial cells from growth rates in hydrogels of tunable elasticity. *Molecular Microbiology*, 84(5):874–891, June 2012.
- [14] **Carolina Tropini\***, Elizabeth A Roth\*, Marija Zanic, Melissa K Gardner, and Jonathon Howard. Islands containing slowly hydrolyzable GTP analogs promote microtubule rescues. *PLoS ONE*, 7(1):e30103–, January 2012.
- [15] Kevin A Heyries, **Carolina Tropini**, Michael Vaninsberghe, Callum Doolin, Oleh I Petriv, Anupam Singhal, Kaston Leung, Curtis B Hughesman, and Carl L Hansen. Megapixel digital PCR. *Nature Methods*, 8(8):649–651, July 2011.
- [16] Y Erin Chen\*, **Carolina Tropini\***, Kristina Jonas, Christos G Tsokos, Kerwyn C Huang, and Michael T Laub. Spatial gradient of protein phosphorylation underlies replicative asymmetry in a bacterium. *Proceedings of the National Academy of Sciences*, 108(3):1052–1057, January 2011.

[17] Matthew Wiggin, **Carolina Tropini**, Vincent Tabard-Cossa, Nahid N Jetha, and Andre Marziali. Nonexponential kinetics of DNA escape from alpha-hemolysin nanopores. *Biophysical Journal*, 95(11):5317–5323, December 2008.

[18] **Carolina Tropini** and Andre Marziali. Multi-nanopore force spectroscopy for DNA analysis. *Biophysical Journal*, 92(5):1632–1637, March 2007.

\* **Co-authors.**

#### Intellectual Property.....

Carl Hansen and **Carolina Tropini**. “Microfluidic device and method of using same.” PCT/CA2008/001985. November 2008.

Andre Marziali, David Broemeling, Joel Pel, Jason D Thompson, Jaryn Perkins, Thomas Willis, Herbert Heyneker, Darren Gray and **Carolina Tropini**. “Systems and methods for enhanced Scoda.” PCT/CA2009/001648. November 2009.

### Presentations

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#### Invited Talks.....

26. “Mechanical Forces and Constraints Shape the Gut Microbiota.” School of Biomedical Engineering. University of British Columbia, BC, Canada. April 2018.
25. “Mechanical perturbations to the gut microbiota.” Department of Physics. University of Alberta, AB, Canada. March 2018.
24. “Defining microbiota and host resilience to physical perturbations: a multi-scale approach.” Department of Microbiology and Immunology. University of British Columbia, BC, Canada. February 2018.
23. “Defining microbiota and host resilience to physical perturbations: a multi-scale approach.” Department of Bioengineering. University of California Berkeley, CA, USA. February 2018.
22. “Defining microbiota and host resilience to physical perturbations: a multi-scale approach.” Department of Bioengineering. University of California Los Angeles, CA, USA. February 2018.
21. “Microbiota and host resilience to physical perturbations.” Department of Biology. University of Oregon, OR, USA. January 2018.
20. “Going with the flow: a multi-scale approach to the gut microbiota during osmotic disturbance.” Institute of Bioengineering. EPFL, Lausanne, Switzerland. April 2017.
19. “Going with the flow: a multi-scale approach to the gut microbiota during osmotic disturbance.” Biological Engineering Department. MIT, Boston, MA, USA. March 2017.

18. "Microbiota and host resilience to osmotic diarrhea." School of Animal & Comparative Biomedical Sciences Seminar. University of Arizona, Tucson, AZ, USA. January 2017.
17. "Going with the flow: the response of the gut microbiota to osmotic diarrhea." Mayo Clinic Individualizing Medicine Conference. Rochester, MN, USA. October 2016.
16. "Microbiota-mucus interaction during physical perturbations." FASEB - Microbial Glycobiology. West Palm Beach, FL, USA. June 2016.
15. "Real time dynamics of microbiota using microfluidics." Wellcome Trust and NIH/DHS Workshop – Unlocking the microbiome. London, UK. September 2015.
14. "Gut microbiota dynamics during physical perturbations." META Center Symposium, University of Oregon, OR, USA. July 2015.
13. "Building cell shape: lessons from *E. coli*." Microbiology and Immunology Seminar, Stanford University, Stanford, CA, USA. April 2014.
12. "On growth and form – a bacterial perspective." Immunology and Microbiology Department Seminar, UBC, Vancouver, BC, Canada. October 2013.
11. "Building cell shape", Bio-X Fellows Symposium, Stanford University, Stanford, CA, USA. June 2013.
10. "On growth and form – a bacterial perspective." Biophysics Seminar, Simon Fraser University, Vancouver, BC, Canada. May 2013.
9. "From cell wall structure to morphogenesis" American Society for Microbiology Meeting, Denver, CO, USA. Young Investigator Presentation, May 2013.
8. "Spatial gradient of protein phosphorylation underlies replicative asymmetry in *Caulobacter crescentus*" American Society for Microbiology Meeting, New Orleans, LA, USA. May 2011.
7. "Modeling and engineering intracellular organization." Biophysics Seminar, UBC, Vancouver, BC, Canada. May 2010.
6. "The Beginning of the Ends: Localization of Lipids to Bacterial Poles." EMBO biomembranes conference, Cargese, Corsica, France. June 2008.
5. "MegaPixel Digital PCR for Non-Invasive Detection of Fetal Down's Syndrome." IDSSG Conference, Vancouver, BC, Canada. May 2008.
4. Valedictorian graduation speech. UBC, Vancouver, BC, Canada. May 2008.
3. "Mega-Pixel Digital PCR" Fluidigm (Company presentation), CA, USA. September 2007.

2. "Detection of Epigenetic Sequence and Base Mutations Using Organic Nanopores", Hangzhou Genomic Conference, Hangzhou, China. October 2006.
1. "Escape Kinetics of DNA through an alpha-hemolysin nanopore", Biophysics Seminar, UBC, Vancouver, BC, Canada. December 2005.

### Other Talks.....

- "A gut feeling." Stanford Postdoc Symposium. Stanford, CA, USA. October 2017.
- "Transient osmotic perturbation causes long-term alteration to the gut microbiota." Stanford Advanced Seminar in Microbial Molecular Biology. Stanford, CA, USA. October 2017.
- "Physical perturbations to the gut microbiota." JSMF-SFI Postdocs in Complexity Conference II. Santa Fe Institute, NM, USA. July 2017.
- "Osmotic perturbations to the gut microbiota." Shriram Friday Seminar. Stanford, CA, USA. November 2016.
- "Going with the flow: the response of the gut microbiota to osmotic diarrhea." Microbiology and Immunology Seminar. Stanford, CA, USA. October 2016.
- "Talk nerdy to me: integrating microbiology with the physical sciences." NCASM, Pleasanton, CA, USA. March 2015.
- "General principles of bacterial mechanics and cell-size determination revealed by cell wall synthesis perturbations." 2014 Mechanobiology Symposium, Stanford University, Stanford, CA, USA. November 2015.
- "Control of cell width in bacteria." Bioengineering retreat, Santa Cruz, CA, USA, October 2011.
- "Spatial gradient of protein phosphorylation underlies replicative asymmetry in a bacterium." Microbiology Research Series, Stanford University, Stanford, CA, USA. March 2011.
- "The role of spatial asymmetries in the development of the bacterium *Caulobacter crescentus*." American Physical Society Meeting, Portland, OR, USA. March 2010.
- "Tradeoff between localization and expression levels in flagellar pole development of the bacterium *Caulobacter crescentus*." Molecular Biophysics Seminar, Stanford University, Stanford, CA, USA. November 2009.
- "Mega-Pixel Digital PCR with Application to Non-invasive Detection of Fetal Down Syndrome" Thesis Defense, UBC, Vancouver, BC, Canada, April 2008.
- "Mega-Pixel Digital PCR with Application to Non-invasive Detection of Fetal Down Syndrome" MURC Conference, UBC, Vancouver, BC, Canada, March 2008.
- "Electronic Detection of Functional Biomolecules", Frontiers in Biophysics Conference, Loon Lake, BC, Canada. October 2006.
- "DNA, nanopores and the art of genome sequencing", MURC Conference, UBC, Vancouver, BC, Canada. March 2006.

### Posters.....

- C. Tropini**, B. K. Kajina, A. J. Spakowitz, K. C. Huang, J. L. Sonnenburg. "Mechanical perturbations to the gut microbiota". Biophysical Society Conference, San Francisco, CA, USA. February 2018.

- C. Tropini**, B. D. Merrill, E. L. Moss, K. M. Ng, E. P. Casavant, J. E. Elias, A. S. Bhatt, K. C. Huang, J. L. Sonnenburg. "Transient osmotic perturbation causes long-term alteration to the gut microbiota". Keystone Symposium, Banff, AB, Canada. March 2018.
- C. Tropini** and K.C. Huang. "Spatial Gradients in Bacteria". American Society for Cell Biology Annual Meeting, San Francisco, CA, USA. December 2012.
- C. Tropini**, T. K. Lee, R. Monds and K.C. Huang. "Mechanisms For Cell Width Control In Gram-negative Bacteria." American Society of Microbiology General Meeting, San Francisco, CA, USA. June 2012.
- C. Tropini** and K.C. Huang. "Modeling the effects of changes in protein localization and abundance on development in the bacterium *Caulobacter crescentus*." Conference on Prokaryotic Cell Biology and Development, Montreal, Quebec, Canada. May 2012.
- C. Tropini**, A. Stewart, D. Swem, M. Hidestrand, S. Sinha, Z. Gitai and K.C. Huang, "Exploring mechanisms for cell width control in Gram-negative bacteria with PALM and digital PCR." Single Molecules Meet Systems Biology Conference, Janelia Farm Research Campus, Ashburn, VA, USA. October 2011.
- C. Tropini**, Y. E. Chen, K. Jonas, C. G. Tsokos, M. T. Laub, K. C. Huang, "Spatial gradient of protein phosphorylation underlies replicative asymmetry in a bacterium." BioX Symposium, Stanford, CA, USA. March 2011 and September 2011.
- C. Tropini**, S. Sciochetti, A. Newton, KC Huang. "Tradeoff between localization and expression levels in flagellar pole development of the bacterium *Caulobacter crescentus*." Physics2Life conference, Weizmann Institute, Rehovot, Israel. May 2010.
- C. Tropini**, S. Sciochetti, A. Newton, KC Huang. "Tradeoff between localization and expression levels in flagellar pole development of the bacterium *Caulobacter crescentus*." Biophysical Society Conference, San Francisco, CA, USA. February 2010.
- C. Tropini**, KC Huang. "The Beginning of the Ends: Localization of Lipids to Bacterial Poles." EMBO biomembranes conference, Cargese, Corsica, France. Poster selected for oral presentation. June 2008.
- C. Tropini**, J. Dueber, D. Endy. "State Output for Genetic Memory: Early Insights and Foundations." SynBerc Conference, Berkeley, CA, USA. February 2009.
- C. Tropini**, C. Hansen. "MegaPixel Digital PCR for Non-Invasive Detection of Fetal Down's Syndrome." ISPD Conference, Vancouver, BC, Canada. June 2008.
- C. Tropini**, M. Wiggin, V. Tabard-Cossa, A. Atalasz, M. Ronaghi and A. Marziali. "Detection of Epigenetic sequence mutation with organic nanopores." Biophysical Society Meeting, Baltimore, MD, USA. March 2007.
- C. Tropini**, M. Wiggin, D. Trivedi and A. Marziali. "Anomalous Kinetics of DNA interaction with an organic nanopore." AGBT Conference, Marco Island, FL, USA. February 2006.
- M. Wiggin, **C. Tropini**, D. Trivedi, N. Jetha, D. Broemeling, and A. Marziali, "Kinetic Studies of DNA Escape from Nanopores." NHGRI grantee meeting, Marco Island, FL, USA. Feb 2006.

## Teaching Training and Experience

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- **Coordinator and Head Instructor of Stanford MATLAB User Group** **Stanford, CA, USA**  
*Founded, coordinated, and taught classes for the Stanford MATLAB user group.* 2017-2018
- **Guest Lecturer for MI 221/BIOE 221G/GENE208** **Stanford, CA, USA**  
*Gut Microbiota in Health and Disease: technology and approaches.* 2017
- **Teaching Workshop** **Stanford, CA, USA**  
*Attended 2-day workshop for Postdocs based on 7-component educational framework.* 2017
- **Instructor for "Scientific Animations for Your Presentations."** **Stanford, CA, USA**  
*Designed course materials and lectured course of 30+ students.* 2016
- **Guest Lecturer for MI 215** **Stanford, CA, USA**  
*Principles of biological technologies - microfluidics in microbiology.* 2015,2016
- **Teaching Assistant (TA) for BIOS 213** **Stanford, CA, USA**  
*Scientific illustration and animation. Instructed class on 3D animation.* 2015
- **Physiology Course TA: Rob Phillips group** **MBL, Woods Hole, MA, USA**  
*Computational and Experimental Instructor for biology students.* 2013
- **Physiology Course TA: KC Huang group** **MBL, Woods Hole, MA, USA**  
*Computational Biophysics Instructor for biology students.* 2012
- **TA for BIOE 41** **Stanford, CA, USA**  
*Physical biology of the cell. Development of class material, teaching, grading.* 2010
- **SPLASH Instructor** **Stanford, CA, USA**  
*High school Instructor. Designed and presented course on molecular motors.* 2009
- **EPATT Tutor** **Stanford, CA, USA**  
*High school Tutor for underprivileged students.* 2008–2009

## Academic Service

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- **Stanford Microbiome Summit Organizer** **Stanford, CA, USA**  
*Co-Organizer of Stanford Microbiome Conference with more than 300 registrants.* 2017
- **BMECS Conference Organizer** **Stanford, CA, USA**  
*Fund-raised and coordinated publicity for bio-mechanical engineering conference.* 2011
- **Biophysics Student Society President** **UBC, Vancouver, BC, Canada**  
*Organizer and Creator of "Adventures in Science" seminar series.* 2007–2008  
*Coordinator of UBC biophysics events and student society.*
- **Welcome Women to Physics Event Coordinator** **UBC, Vancouver, BC, Canada**  
*Organizer for the outreach event towards women in physics* 2007–2008  
*Group leader, laboratory tour guide.*
- **Physics and Astronomy Outreach Event Volunteer** **UBC, Vancouver, BC, Canada**  
*Volunteer laboratory tour guide for high school recruitment yearly event.* 2007



## References

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- Dr. Justin Sonnenburg, Postdoctoral Advisor.  
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- Dr. KC Huang, Ph.D. Advisor.  
Associate Professor of Bioengineering and of Microbiology and Immunology, Stanford University.  
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- Dr. Daniel Fisher, Mentor and Ph.D. Committee Member.  
Professor of Applied Physics and, by courtesy, of Biology and Bioengineering, Stanford University.  
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- Dr. Rob Phillips, Mentor and Director of MBL Physiology Course.  
Professor of Biophysics and Biology, California Institute of Technology  
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159 Broad; 1200 California Boulevard, Pasadena, CA 91125
- Prof. Kevin Foster.  
Professor of Evolutionary Biology and Fellow of Magdalen College.  
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