

# Bo Sun

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## Education & Career

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2019- present, Department of Physics, Oregon State University

Associate Professor

2013 – 2019, Department of Physics, Oregon State University

Assistant Professor

2011 – 2013, Princeton University.

Postdoc Associate, Advisor: Howard Stone, Department of Aerospace & Mechanical Engineering

Robert Austin, Department of Physics

2009 - 2010, Department of Physics, New York University.

Ph.D. Thesis: Non-conservative Optical Forces and Brownian Vortexes

Thesis advisor: David G. Grier

2006 - 2009, Department of Physics, New York University.

M.A. Thesis: Theory of Holographic Optical Tweezers

2003 – 2006, Institute of Theoretical Physics, Chinese Academy of Science.

Research Area: String Theory

1999 – 2003, Department of Physics, Tsinghua University, Beijing, China

B.S. Thesis: Curved Space-time Quantum Field Theory and Black Hole Thermodynamics

## Honors:

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2019 CAREER award, the National Science Foundation

2019 Richard T. Jones award, the Medical Research Foundation of Oregon

2014 Scialog Fellow for Scialog: Molecules Come to Life, (Research Corporation for Science Advancement and Gordon and Betty Moore Foundation)

2010 Chinese Government Award for Self-Financing Students Abroad

2007 -- 2010 Kessler Fellowship, New York University

2006 – 2007 MacCracken Fellowship, New York University

2005 Liu Yong Ling Scholarship, Chinese Academy of Science

2004 ITP Excellence Performance Scholarship, Chinese Academy of Science  
2003 Ye Qi Sun Scholarship, Tsinghua University  
2003 Excellence in Undergraduate Study, Tsinghua University  
2000 Yang Zhen Bang Scholarship, Tsinghua University  
1999-2002 University Fellowship, Tsinghua University

### Professional Activity:

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- NSF reviewer (approximately 2 panels each year plus ad hoc reviewing)
- Executive Editor, Cancer Convergence, 2016-present
- Guest Editor, Physical Biology, 2016-2017
- Regular Referee for Science, Proceedings of National Academy of Sciences, Cell Systems, Optical Express, Applied Optics, Optics Letters, Biomedical Optics, PLoS Computational Biology, PLoS ONE

### Grant:

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- NSF, “CAREER: Understand the dynamic endothelium shear sensing through communication and multiplexing”, 09/01/2019-08/31/2024, \$740,378
- (Recommended as alternative) DOD, Decoding the mechanoregulation of breast tumor organoid invasion -- one cell at a time, lead PI, 09/01/2020-08/31/2023, (Sun amount) \$528,020
- College of Science, Oregon State University, SciRIS-ii, “Understanding the migrational phenotype plasticity of metastatic tumor cells”, single PI, 02/15/2019 – 02/14/2020, \$10,000
- Medical Research Foundation of Oregon, “Decode collective endothelium shear stress sensing” single PI, 02/15/2018 - 08/14/2019, \$40,000
- Gordon and Betty Moore Foundation, “Following the Leaders: Forecasting collective cancer dynamics”, 08/01/2017 to 07/31/2018, 3 PIs each awarded \$56,250.
- OSU small grant, “Lighting up the human endothelium”, single PI, 05/01/2017 – 04/30/2018, \$7000
- NSF, “Decoding Complexed Cellular Information Flow through Multiplexed Chemosensing”, single PI, PHY-1400968, 09/01/2014 to 08/31/2018, \$361,331
- Soeldner Campbell Fund, “Biological Motion through the Lenses”, Co-PI, 07/01/2014 – 06/30/2015, \$4000

## Publication: (as independent PI)

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- [1]. Modeling cell migration regulated by cell-ECM micromechanical coupling, Yu Zheng, Hanqing Nan, Qihui Fan, Xiaochen Wang, Liyu Liu, Ruchuan Liu, Fangfu Ye, Bo Sun, Yang Jiao, *Physical Review E*, 2019, 100, 043303
- [2]. Absorbing-active transition in multi-cellular system regulated by dynamic force network, Hanqing Nan, Yu Zheng, Shaohua Chen, Christopher Eddy, Jianxiang Tian, Wenxiang Xu, Bo Sun\*, Yang Jiao\*, *Soft Matter*, 2019, 15, 6938--6945
- [3]. Novel inverse finite-element formulation for reconstruction of relative local stiffness in heterogeneous extra-cellular matrix and traction forces on active cells, Chen, Shaohua; Xu, Wenxiang; Kim, Jihan; Nan, Hanqing; Zheng, Yu; Sun, Bo\*; Jiao, Yang\*, *Physical Biology*, 16, 036002 (2019).
- [4]. Stress-induced plasticity of dynamic collagen networks, Jihan Kim, Jingchen Feng, Christopher A.R. Jones, Xiaoming Mao, Leonard M. Sander, Herbert Levine\*, Bo Sun\*, *Nature Communications*, 8, 842 (2017)
- [5]. Probing the cooperative force generations in collective cancer invasion, Amani A. Alobaidi, Yaopengxiao Xu, Shaohua Chen, Yang Jiao, Bo Sun, *Physical Biology*, 14 (4), 045005 (2017)
- [6]. Probing Three-dimensional Collective Cancer Invasion with DIGME, Amani A. Alobaidi, Bo Sun, *Cancer Convergence*, 1 (1) (2017)
- [7]. Dynamic Sampling and Information Encoding in Biochemical Networks, Garrett Potter, Tommy A. Byrd, Andrew J. Mugler, Bo Sun, *Biophysical Journal*, 112(4), (2017)
- [8]. Heterogeneous Force Network in 3D Cellularized Collagen Networks, Long Liang, Christopher Allen Rucksack Jones, Shaohua Chen, Bo Sun and Yang Jiao, *Physical Biology*, 13, 066001 (2016)
- [9]. Three-dimensional reflectance traction microscopy, Jihan Kim, Nicholas Groves, Christopher Jones, Bo Sun, *PLoS ONE* 11(6): e0156797 (2016)
- [10]. Communication shapes sensory response in multicellular networks, Garrett Potter, Tommy A. Byrd, Andrew J. Mugler\*, Bo Sun\*, *Proceedings of the National Academy of Science*, 113(37), 10334 (2016)
- [11]. The micromechanics of cellularized biopolymer networks, Christopher Allen Rucksack Jones, Matthew Cibula, Jingchen Feng, Emma A. Krnacik, David H. McIntyre, Herbert

Levine\*, Bo Sun\*, *Proceedings of the National Academy of Science*, 112 (37), E5117–E5122 (2015)

- [12]. Mechanics regulates ATP-stimulated collective calcium response in fibroblast cells, Josephine Lembong, Benedikt Sabass, Bo Sun, Matthew E. Rogers, Howard A. Stone, *Journal of Royal Society Interface* (12), 20150140 (2015)
- [13]. Collagen network and the mechanical microenvironment of cancer cells, B. Sun, *Acta Physica Sinica*, 64, 058201 (2015)
- [14]. The spatial-temporal characteristics of type I collagen-based extracellular matrix, Christopher Allen Rucksack Jones, Long Liang, Daniel Lin, Yang Jiao\* and Bo Sun\*, *Soft Matter*, 10 (44), 8855 - 8863 (2014)

### Manuscripts under review

1. Collective force generation regulate collective cancer invasion, Jihan Kim, Yu Zheng, Amani A. Alobaidi, Hanqing Nan, Jianxiang Tian, Yang Jiao\*, Bo Sun\*, (<https://arxiv.org/abs/1903.03290>)
2. The morphodynamics of 3D migrating cancer cells, Christopher Eddy, Xinyao Wang, Fuxin Li, and Bo Sun, (<https://arxiv.org/abs/1807.10822>)

### Publication: (before establishing independent research lab)

- The network characteristics of collective chemosensing, B. Sun, G. Duclos and H. A. Stone, *Phys. Rev. Lett*, 110, 158103 (2013)
- Minimization of thermodynamic costs in cancer cell invasion, L. Liu\*, G. Duclos\*, B. Sun\*, J. Lee, A. Wu, Y. Kam, E. D. Sontag, H. A. Stone, J. C. Sturm, R. A. Gatenby and R. H. Austin, *Proceedings of the National Academy of Science* 110(5), 1686-1691 (2013).
- Spatial-temporal dynamics of collective chemosensing, B. Sun, J. Lembong, V. Normand, M. Rogers and H. A. Stone, *Proceedings of the National Academy of Sciences* 109 (20), 7759-7764 (2012).
  - ※ Highlighted from the cover of PNAS.
  - ※ Also commented in the same issue of PNAS.

- Simultaneous imaging of multiple focal planes for three-dimensional microscopy using ultra-high-speed adaptive optics, M. Duocastella, B. Sun, C.B. Arnold, *Journal of Biomedical Optics*, 17, 050505 (2012)
- Probing the invasiveness of prostate cancer cells in a 3D microfabricated landscape, L. Liu, B. Sun, J. Pedersen, Koh-Meng, R. H. Getzenberg, H. A. Stone, and R. H. Austin, *Proceedings of the National Academy of Sciences* 108 (17) , 6853-6856 (2011).
  - ※ Highlighted from the cover of PNAS.
- A minimal model for Brownian vortexes, B. Sun, D. G. Grier and A. Y. Grosberg, *Physical Review E* **82**, 021123 (2010)
- Flow visualization and flow cytometry with holographic video microscopy, F. C. Cheong, B. Sun, R. Dreyfus, Amato-Grill, K. Xiao, L. Dixon and D. G. Grier, *Optics Express* 17, 13071-13079 (2009).
  - ※ Selected for inaugural issue of the OSA's Spotlight on Optics.
  - ※ Reprinted in *Virtual Journal of Biomedical Optics*.
- Brownian Vortexes, B. Sun, J. Lin, E. Darby, A. Y. Grosberg and D. G. Grier, *Physical Review E*, 80, 010401(R) (2009),
  - ※ Highlighted in Nature News & Views, *Nature* 461, 1226 (2009).
  - ※ Reprinted in *Virtual Journal of Biological Physics Research*
  - ※ Selected for Kaleidoscope image by *Physical Review E*
- Comment: The effect of Mie resonances on trapping in optical tweezers, B. Sun and D. G. Grier, *Optics Express* 17, 2657-2660 (2009)
  - ※ Reprinted in *Virtual Journal of Biomedical Optics*.
- Theory of holographic optical trapping, B. Sun, Y. Roichman and D. G. Grier, *Optics Express* 16, 15765-15776 (2008)
  - ※ Reprinted in *Virtual Journal of Biomedical Optics*.
- Influence of non-conservative optical forces on the dynamics of optically trapped colloidal spheres: The fountain of probability, Y. Roichman, B. Sun, A. Stolarski and D. G. Grier, *Physical Review Letters*, 101, 0128301(2008)
  - ※ Reprinted in *Virtual Journal of Biological Physics Research*
- Optical forces arising from phase gradients, Y. Roichman, B. Sun, Y. Roichman, J. Amato-Grill and D. G. Grier, *Physical Review Letters*, 100, 013602 (2008)
  - ※ Reviewed in Nature Physics Research Highlights, *Nature Physics* 4, 87 (2008)
  - ※ Reprinted in *Virtual Journal of Biological Physics Research*

- Note on DBI Dynamics of Dbrane Near NS5-Branes. Bin Chen, Bo Sun Phys. Rev. D, 72, 046005 (2005).
- Dbrane Near NS5-Branes: With Electromagnetic Field. Bin Chen, Miao Li, Bo Sun, JHEP, 0412, 057 (2004).

## Books:

Non-conservative Optical Force and Brownian Vortexes, Bo Sun and David Grier, VDM Verlag Dr. Müller (September 12, 2011)

## Conference Proceedings:

- Flow Visualization and Flow Cytometry with Holographic Video Microscopy, F. C. Cheong, B. Sun, R. Dreyfus, Amato-Grill, K. Xiao, L. Dixon and D. G. Grier, *SPIE Proceedings*, 7619 (2010)
- Non-conservative Forces in Optical Tweezers and Brownian Vortexes, B. Sun, A. Y. Grosberg and D. G. Grier, *SPIE Proceedings*, 7613 (2010)
- Optical Forces arising From Phase Gradients D. G. Grier, B. Sun, F. C. Cheong, Y. Roichman, S. H. Lee, Y. Roichman, J. Amato-Grill *SPIE Proceedings*, 7227 (2009)

## Presentations & Seminars:

- ASCB | EMBO (2019), “Machine-assisted quantification of cell phenotype and phenodynamics”, contributed talk
- APS NW annual meeting (2019), “Decoding the body language of 3D migrating cells”, invited talk
- Sichuan University (2018), “Revisiting mechanical reciprocity in tumor-ECM systems”, invited seminar at Department of Physics, invited seminar
- Banff International Research Station (2018), “Multicellular dynamics by not-so-similar cells”, invited seminar

- University of California San Diego (2018), “The mechanoplasticity of extracellular matrix”, invited seminar at Department of Mechanical & Aerospace Engineering
- Rice University (2017), “Information encoding during collective chemosensing”, invited seminar at Center of Theoretical Biophysics, invited seminar
- Aspen Center for Physics (2017), “The Extracellular Matrix Mechanics”, invited seminar
- University of Oregon (2016), “Communication shapes sensory responses”, invited seminar at Department of Physics, invited seminar
- Annual Biophysical Society Meeting (2016), “The Micromechanics of Cellularized Extracellular Matrix”, contributed talk.
- Portland State University (2016), “Information encoding of collective chemosensing”, Department of Physics, invited seminar
- Purdue University (2015), “Information encoding of collective chemosensing”, invited seminar
- Scialog: from molecules to cells (2015), “Sensation and Response: from subcellular to multicellular signal integration”, invited.
- Oregon State University (2015), “The microstructure and micromechanics of collagen-based extracellular matrix (Department of Mathematics, invited seminar)
- Biophysical Society Meeting (2014), “The collective information encoding of collective chemosensing”
- Oregon State University (2013), “Driving the self-organization of cellular system: The Physics of mechano-chemical signaling”
- Willamette University (2013), “On the self-organization in collective chemosensing”, invited seminar
- Institute of Physics, Chinese Academy of Sciences (2013), “On the self-organization in collective chemosensing” , invited seminar
- Beijing Computational Science Research Center (2013), “On the self-organization in collective chemosensing”, invited seminar

- Michigan Technology University (2012), “The emergent cellular dynamics – from one to many”
- Miami University (2012), “The emergent cellular dynamics – from one to many”
- Rowan University(2012), “The collective dynamics of mammalian cell systems”
- Annual Meeting for Physical Sciences and Oncology Centers 2011, “Evolutionary Game Theory of a 3-D Cancer Model”
- SPIE Photonic West 2010, “Non-conservative Forces in Optical Tweezers and Brownian Vortexes”
- Frontiers of Optics (2009), “Brownian Vortexes Induced by Optical Tweezers”
- March Meeting of American Physical Society (2009), “Complex Stochastic Behavior Induced by Optical Tweezers.”
- Conference on Advances in Microfluidics and Nanofluidics 2009, *invited talk*, “Complex Stochastic Behavior Induced by Optical Tweezers.”
- March Meeting of American Physical Society (2008), “Non-conservative Optical Forces: The Fountain of Probability.”
- Frontiers of Optics (2008), “Vectorial Theory of Holographic Optical Trapping.”

### Patents: (before OSU)

- System for applying optical forces from phase gradients, United States Patent 8174742

### Patents: (based on work at OSU)

- Engineering Tumor Organoids for Cancer Drug Testing, Provisional patent application filed and available for exclusive license

### Mentee Awards:

- Kailie Franco, Summer Undergraduate Research Experience (SURE), Oregon State University, 2019, \$5000



- Ryan Wong, Undergraduate Research, Scholarship, and the Arts (URSA Engage), Oregon State University, 2019, \$1000
- AnneMarie Hasbrook, Undergraduate Research, Scholarship, and the Arts (URSA Engage), Oregon State University, 2019, \$1000
- Eleanora Kemp, Undergraduate Research, Scholarship, and the Arts (URSA Engage), Oregon State University, 2019, \$1000
- Hunter Nelson, Undergraduate Research, Scholarship, and the Arts (URSA Engage), Oregon State University, 2019, \$1000
- Ryan Wong, DeLoach Work Scholarship, Oregon State University, 2019, \$1000
- Victoria Bennette, STEM leader, Oregon State University, 2019, \$2500
- Jihan Kim, Graduate Research Award, Department of Physics, Oregon State University, 2018, \$500
- Madison Gryba, Undergraduate Research, Scholarship, and the Arts (URSA Engage), Oregon State University, 2018, \$1000
- Katelyn Chase, Undergraduate Research, Innovation, Scholarship & Creativity (URISC), Oregon State University, 2017, \$2000
- Theresa Dihl, Summer Undergraduate Research Experience (SURE), Oregon State University, 2015, \$5000
- Yu-Tin Hsiao, DeLoach Work Scholarship, Oregon State University, 2016, \$1000
- Katelyn Chase, Summer Undergraduate Research Experience (SURE), Oregon State University, 2015, \$5000
- Swechya Banskota, runner-up for Joe Hendricks Honors College Scholarship for Academic Excellence, 2016
- Yu-Tin Hsiao, Undergraduate Research, Scholarship, and the Arts, Oregon State University, 2016, \$1200
- Yu-Tin Hsiao, Summer Undergraduate Research Experience (SURE), Oregon State University, 2015, \$6000
- Swechya Banskota, DeLoach Work Scholarship, Oregon State University, 2015, \$1500
- Daniel Lin, Undergraduate Research Award, American Physical Society, 2015
- Yu-Tin Hsiao, Undergraduate Research, Scholarship, and the Arts, Oregon State University, 2015, \$1000
- Cameron Thayer-Freeman, Summer Undergraduate Research Experience (SURE), Oregon State University, 2014, \$5000
- Chris Jones, Peter Fontana Graduate Teaching Award, Oregon State University, 2014, \$500
- Teresa Lawson, Undergraduate Research, Innovation, Scholarship & Creativity (URISC), Oregon State University, 2013, \$1000
- Daniel Lin, International Cultural Service Scholarship, Oregon State University, 2013, full tuition

## Professional Affiliations:

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- American Physical Society, from 2008
- Biophysical Society, from 2010

## Major Research Areas:

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- Collective Chemosensing by Mammalian Cells
- Force Generation During Wound Healing and Cancer Invasion
- Social Behavior and Self-organization of Multicellular Systems
- Optical Manipulations Using Holographic Optical Tweezers