

PETAR N. PETROV

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EDUCATION

Stanford University

August 2020

Ph.D. in Physical Chemistry

Thesis: “*Improving the Precision and Accuracy of Three-Dimensional Single-Molecule Localization Microscopy*”

Advisor: Prof. W. E. Moerner

GPA 4.03/4

University of California, Berkeley

December 2013

B.S. in Chemistry with high honors

GPA 3.92/4

RESEARCH EXPERIENCE

Prof. Holger Müller Group, University of California, Berkeley

September 2020 - Present

Postdoctoral Scholar, Department of Physics

Berkeley, CA

- Developing theory and simulation of laser-based phase plates for cryo-electron microscopy
- Designing and operating high-power optical cavities
- Developing hardware and software for acquisition and analysis of laser phase contrast cryo-electron microscopy data
- Performing phase contrast cryo-electron microscopy experiments

Prof. W. E. Moerner Group, Stanford University

June 2014 - August 2020

Graduate Researcher, Department of Chemistry

Stanford, CA

- Performed single-molecule tracking and super-resolution imaging experiments
- Designed and built specialized microscopes
- Developed image processing algorithms and software
- Wrote simulations of imaging systems and of particle dynamics
- Created experimental protocols for single-molecule sample preparation

Prof. Peidong Yang Group, University of California, Berkeley

January 2012 - January 2014

Undergraduate Researcher, Department of Chemistry

Berkeley, CA

- Performed synthesis and characterization (structural, optical) of GaN, ZnO, and CdS nanowires
- Designed and built a chemical vapor transport furnace system for synthesis of nanowires
- Developed simulations of nanowire waveguides

Berkeley Center for Green Chemistry

June 2011 - August 2011

Research Intern

Berkeley, CA

- Designed a ZnO nanoparticle-based dye-sensitized solar cell and developed it into an experiment which was implemented in the advanced general chemistry laboratory course at UC Berkeley

Department of Chemistry, University of Central Oklahoma

September 2007 - May 2010

Lab Assistant

Edmond, OK

- Developed small-scale acid- and base-catalyzed biodiesel syntheses
- Designed purification protocols and validated with GC/MS and gel point testing

RESEARCH INTERESTS

Novel methods in optical & electron microscopy & spectroscopy; theory & experiment in optical metrology; optical resonators; spatio-temporal dynamics of molecules; signal & image processing algorithms

PUBLICATIONS

Peer-Reviewed:

- [14] J. J. Axelrod, **P. N. Petrov**, J. T. Zhang, J. Remis, B. Buijsse, R. M. Glaeser, H. Müller, “Overcoming resolution loss due to thermal magnetic field fluctuations from phase plates in transmission electron microscopy,” *Ultramicroscopy* **249**, 113730 (2023) [[doi](#)]
- [13] A.-K. Gustavsson, R. P. Ghosh, **P. N. Petrov**, J. T. Liphardt, W. E. Moerner, “Fast and parallel nanoscale three-dimensional tracking of heterogeneous mammalian chromatin dynamics,” *Mol. Biol. Cell* **33**(6), 1-11 (2022) [[doi](#)]
· **Selected as a Highlight from MBoC**
- [12] **P. N. Petrov**, H. Müller, R. M. Glaeser, “Perspective: Emerging strategies for determining atomic-resolution structures of macromolecular complexes within cells,” *J. Struct. Biol.* **214**(1), 107827 (2022) [[doi](#)]
- [11] C. Turnbaugh, J. J. Axelrod, S. L. Campbell, J. Y. Dioquino, **P. N. Petrov**, J. Remis, O. Schwartz, Z. Yu, Y. Cheng, R. M. Glaeser, H. Müller, “High-power near-concentric Fabry-Perot cavity for phase contrast electron microscopy,” *Rev. Sci. Instrum.* **92**, 053005 (2021) [[doi](#)]
· **Selected as Editor’s pick**
- [10] **P. N. Petrov**, W. E. Moerner, “Addressing systematic errors in axial distance measurements in single-emitter localization microscopy,” *Opt. Express* **28**(13), 18616-18632 (2020) [[doi](#)]
- [9] H. W. Bennett, A.-K. Gustavsson, C. A. Bayas, **P. N. Petrov**, N. Mooney, W. E. Moerner, P. K. Jackson, “Novel fibrillar structure in the inversin compartment of primary cilia revealed by 3D single-molecule super-resolution microscopy,” *Mol. Biol. Cell* **31**(7), 619-639 (2020) [[doi](#)]
· **Selected as a Highlight from MBoC**
- [8] L. Möckl, A. R. Roy, **P. N. Petrov**, W. E. Moerner, “BGnet: Accurate and rapid background estimation in single-molecule localization microscopy with deep neural nets,” *Proc. Natl. Acad. Sci. U.S.A.* **117**(1), 60-67 (2020) [[doi](#)]
- [7] L. Möckl, **P. N. Petrov**, W. E. Moerner, “Accurate phase retrieval of complex 3D point spread functions with deep residual neural networks,” *Appl. Phys. Lett.* **115**, 251106 (2019) [[doi](#)]
· **Selected as Editor’s pick**
- [6] A.-K. Gustavsson, **P. N. Petrov**, W. E. Moerner, “Light sheet approaches for improved precision in 3D localization-based super-resolution imaging in mammalian cells,” *Opt. Express* **26**(10), 13122-13147 (2018) [[doi](#)]
- [5] A.-K. Gustavsson, **P. N. Petrov**, M. Y. Lee, Y. Shechtman, W. E. Moerner, “3D single-molecule super-resolution microscopy with a tilted light sheet,” *Nat. Commun.* **9**, 123 (2018) [[doi](#)]
· Featured in Research Highlights, Methods in Brief, *Nat. Methods* **15**(3), 163 (2018) [[doi](#)]
· Featured in Stanford News, 22 February, 2018 [[url](#)]
- [4] Y. Shechtman, A.-K. Gustavsson, **P. N. Petrov**, E. Dultz, M. Y. Lee, K. Weis, W. E. Moerner, “Observation of live chromatin dynamics in cells via 3D localization microscopy using Tetrapod point spread functions,” *Biomed. Opt. Express* **8**(12), 5735-5748 (2017) [[doi](#)]
- [3] **P. N. Petrov**, Y. Shechtman, W. E. Moerner, “Measurement-based estimation of global pupil functions in 3D localization microscopy,” *Opt. Express* **25**(7), 7945-7959 (2017) [[doi](#)]
- [2] M. P. Backlund, A. Arbabi, **P. N. Petrov**, E. Arbabi, A. Faraon, W. E. Moerner, “Removing orientation-induced localization biases in single-molecule microscopy using a broadband metasurface mask,” *Nat. Photonics* **10**(7), 459-462 (2016) [[doi](#)]
- [1] A. Fu, H. Gao, **P. N. Petrov**, P. Yang, “Widely Tuneable Distributed Bragg Reflectors Integrated into Nanowire Waveguides,” *Nano Lett.* **15**(10), 6909-6913 (2015) [[doi](#)]

Conference Proceedings:

- [2] J. J. Axelrod, J. Dioquino, **P. N. Petrov**, J. Remis, S. Sandhaus, J. H. Silber, J. Whinnery, R. M. Glaeser, H. Müller, “Laser Phase Plate: Advancing Beyond Proof-of-Concept,” *Microsc. Microanal.* **28**(S1), 1186-1187 (2022) [doi]
- [1] A.-K. Gustavsson, **P. N. Petrov**, M. Y. Lee, Y. Shechtman, W. E. Moerner, “Tilted light sheet microscopy with 3D point spread functions for single-molecule super-resolution imaging in mammalian cells,” *Proc. SPIE Int. Soc. Opt. Eng.* **10500**, 105000M (2018) [doi]

SOFTWARE

- [1] [Easy Pupil Finder](#), **P. N. Petrov** & W. E. Moerner, SourceForge (2017).

AWARDS & HONORS

- **Ruth L. Kirschstein Postdoctoral Fellowship** (F32 GM149186) – NIH/National Institute of General Medical Sciences 2022-2023
- **Stanford Interdisciplinary Graduate Fellowship** (Anonymous Donor) – Stanford University 2017-2020
- Bio-X Travel Award – Stanford University 2017-2019 (three times)
- Poster Award, Bio-X Interdisciplinary Initiatives Seed Grants Program Symposium – Stanford University 2018
- Second Best Poster – Stanford University Photonics Retreat 2017-2018 (twice)
- Best Poster – Stanford University Photonics Retreat 2016
- **Glenn T. Seaborg Award for Outstanding Undergraduate Research in Chemistry** – UC Berkeley 2014
- **Melvin J. Heger-Horst Fellowship** – College of Chemistry, UC Berkeley 2011-2014 (three times)
- Undergraduate Research Stipend – College of Chemistry, UC Berkeley Summer 2013
- Dean’s List – College of Chemistry, UC Berkeley Fall 2011, Spring 2013, Fall 2013

TALKS AND POSTER PRESENTATIONS

Invited Talks:

- [8] “Toward cryo-electron tomography with a laser phase plate,” Three Dimensional Electron Microscopy Gordon Research Seminar, Newry, ME, June 2023
- [7] “Cryo-electron microscopy with a laser phase plate,” Rosalind Franklin Institute, Didcot, United Kingdom, April 2023
- [6] “Cryo-electron microscopy with a laser phase plate,” Laboratory of Molecular Biology, Cambridge, United Kingdom, April 2023
- [5] “Laser phase-contrast cryo-EM and associated computational opportunities,” One World Cryo-EM Seminar Series (virtual), March 2023
- [4] “Laser phase-contrast transmission electron microscopy and associated computational opportunities,” Institute for Pure and Applied Mathematics, Los Angeles, CA, November 2022
- [3] “Phase-engineered microscopy: from super-resolution to cryo-EM,” University of Vienna, Vienna, Austria, September 2022
- [2] “Improving biological microscopy by engineering phase: from super-resolution to cryo-EM,” Max Planck Institute for the Science of Light, Erlangen, Germany, September 2022
- [1] “Improving biological microscopy by engineering phase: from super-resolution to cryo-EM,” Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany, September 2022

Other Talks:

- [5] “Measurement of the depth-dependence of point spread functions near the glass-water interface in high-numerical aperture microscopy,” Quantitative BioImaging, Oxford, United Kingdom, January 2020.
- [4] “A tilted light sheet for single-molecule super-resolution imaging in thick cells,” Quantitative BioImaging, Rennes, France, January 2019.
- [3] “Modeling engineered point spread functions for 3D single-molecule localization microscopy,” Quantitative BioImaging, Göttingen, Germany, January 2018.
- [2] “Measurement-based estimation of global pupil functions in 3D localization microscopy,” Stanford University Single-Molecule Seminar Series, Stanford, CA, February 2017.
- [1] “Maximum likelihood estimation of pupil functions in 3D single-molecule localization microscopy,” SPIE BiOS (Single Molecule Spectroscopy and Superresolution Imaging Conference), San Francisco, CA, January 2017. [\[doi\]](#)

Poster Presentations:

- [12] “Cryo-electron microscopy with a laser phase plate,” eBEAM School on Nano-Optics with Free Electrons, Porquerolles, France, September 2022
- [11] “Addressing systematic errors in axial distance measurements in high-numerical aperture microscopy of single molecules,” Stanford Bio-X Interdisciplinary Initiatives Seed Grants Symposium, Stanford, CA, February 2020
- [10] “Development and application of a light sheet microscope for 3D single-particle tracking of chromatin loci in thick, live mammalian cells,” Stanford Bio-X Fellowship Symposium, Stanford, CA, October 2019
- [9] “Modeling engineered point spread functions for 3D single-molecule localization microscopy,” Stanford University Photonics Retreat, Marshall, CA, April 2019
- [8] “Development and application of a light sheet microscope for 3D single-particle tracking of chromatin loci in thick, live mammalian cells,” Stanford Bio-X Interdisciplinary Initiatives Seed Grants Symposium, Stanford, CA, February 2019
 - **Received Poster Award**
- [7] “Modeling engineered point spread functions for 3D single-molecule localization microscopy,” Stanford Bio-X Symposium, Stanford, CA, August 2018
- [6] “Modeling engineered point spread functions for 3D single-molecule localization microscopy,” Stanford University Photonics Retreat, Pacific Grove, CA, April 2018
 - **Awarded Second Best Poster**
- [5] “Development and application of a light sheet microscope for 3D single-particle tracking of chromatin loci in thick, live mammalian cells,” Stanford Bio-X Fellowship Symposium, Stanford, CA, October 2017
- [4] “3D single-molecule super-resolution microscopy with a tilted light sheet,” NIH Common Fund 4D Nucleome 2017 Annual Meeting, Bethesda, MD, September 2017
- [3] “3D single-molecule super-resolution microscopy with a tilted light sheet,” Stanford University Photonics Retreat, Pacific Grove, CA, April 2017.
 - **Awarded Second Best Poster**
- [2] “Removing orientation-induced localization biases in single molecule microscopy using a broadband metasurface mask,” Stanford University Photonics Retreat, Marshall, CA, April 2016
 - **Awarded Best Poster**
- [1] “Next-Generation Photonic Mirrors in a Nanowire,” UC Berkeley Saegebarth Undergraduate Research Fair, Berkeley, CA, April 2013

TEACHING EXPERIENCE

Stanford Splash

2018 - 2019

- Instructor, “A single molecule: the smallest thing you can see” (Fall 2018, Spring 2019, Fall 2019)

Stanford University	2014 - 2016
<ul style="list-style-type: none"> · Head Teaching Assistant, Chemical Principles Accelerated (Chem 31X, Fall 2016) · Teaching Assistant, Chemical Principles Accelerated (Chem 31X, Fall 2015) · Teaching Assistant, Physical Chemistry Laboratory (Chem 176, Winter 2015) · Teaching Assistant, Chemical Principles Accelerated (Chem 31X, Fall 2014) 	

University of California, Berkeley	2011
<ul style="list-style-type: none"> · Co-Facilitator, Chemistry Undergraduate Internships & Research (Chem 98/198, Fall 2011) 	

MENTORSHIP & OUTREACH

The Compass Project at Berkeley	2022
<ul style="list-style-type: none"> · Provided bi-weekly one-on-one mentorship of undergraduate physics student Shawn Li. 	

Be A Scientist (Bay Area Scientists In Schools)	2021
<ul style="list-style-type: none"> · Led groups of 7th grade students at Martin Luther King Jr. Middle School in developing, conducting, and presenting science experiments in their classroom. 	

Stanford Splash	2018-2019
<ul style="list-style-type: none"> · Designed and taught short courses on single-molecule microscopy for groups of ~20 high school students. 	

Stanford Science Penpals	2017
<ul style="list-style-type: none"> · Corresponded by mail with high school students from low-income backgrounds about science, college, and graduate school. 	

Inspiring Future Scientists Through Shadowing	2017
<ul style="list-style-type: none"> · Mentored high school student Stephen Gross in building a white light interferometer. 	

Stanford Summer Undergraduate Research Fellowship	2016
<ul style="list-style-type: none"> · Trained and mentored undergraduate student Stella Schindler in an independent research project on adaptive optics. 	

SERVICE

Optica Publishing Group	2018-present
<i>Reviewer: Optics Express, Biomedical Optics Express, Optics Letters</i>	
Berkeley Undergraduate Chemical Society	2011-2014
<i>Co-Founder, Webmaster</i>	
Berkeley Chemical Review	2012
<i>Editor</i>	

REFERENCES

Prof. Holger Müller , University of California, Berkeley	<i>Postdoctoral Advisor</i>
<ul style="list-style-type: none"> · Address: 301C Physics South, Berkeley, CA 94720, USA · Tel: +1(510)664-4298 · E-mail: hm@berkeley.edu 	
Prof. W. E. Moerner , Stanford University	<i>Graduate Advisor</i>
<ul style="list-style-type: none"> · Address: 333 Campus Drive, Stanford, CA 94305, USA · Tel: +1(650)723-1727 · E-mail: wmoerner@stanford.edu 	
Prof. Robert M. Glaeser , University of California, Berkeley	<i>Collaborator</i>
<ul style="list-style-type: none"> · Address: 363B Donner Hall, Berkeley, CA 94720, USA · Tel: +1(510)642-2905 · E-mail: rmglaeser@lbl.gov 	