

# PETAR N. PETROV

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1806 Wanut St. #1, Berkeley, CA 94709, USA

## EDUCATION

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### Stanford University

August 2020

Ph.D. in Physical Chemistry

Advisor: Prof. W. E. Moerner

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

GPA 4.03/4

### University of California, Berkeley

December 2013

B.S. in Chemistry with high honors

GPA 3.92/4

## LABORATORY EXPERIENCE

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### 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

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

## PUBLICATIONS

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### 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

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

## AWARDS & HONORS

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- 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

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### Invited Talks:

- [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:

- [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

<b>Stanford Splash</b>	2018 - 2019
· Instructor, “A single molecule: the smallest thing you can see” (Fall 2018, Spring 2019, Fall 2019)	
<b>Stanford University</b>	2014 - 2016
· 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)	
<b>University of California, Berkeley</b>	2011
· Co-Facilitator, Chemistry Undergraduate Internships & Research (Chem 98/198, Fall 2011)	

## MENTORSHIP & OUTREACH

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- The Compass Project at Berkeley** 2022
- Provided bi-weekly one-on-one mentorship of undergraduate physics student Shawn Li.
- Be A Scientist (Bay Area Scientists In Schools)** 2021
- Led groups of 7<sup>th</sup> grade students at Martin Luther King Jr. Middle School in developing, conducting, and presenting science experiments in their classroom.
- Stanford Splash** 2018-2019
- Designed and taught short courses on single-molecule microscopy for groups of ~20 high school students.
- Stanford Science Penpals** 2017
- Corresponded by mail with high school students from low-income backgrounds about science, college, and graduate school.
- Inspiring Future Scientists Through Shadowing** 2017
- Mentored high school student Stephen Gross in building a white light interferometer.
- Stanford Summer Undergraduate Research Fellowship** 2016
- Trained and mentored undergraduate student Stella Schindler in an independent research project on adaptive optics.

## SERVICE

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

## REFERENCES

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- Prof. W. E. Moerner**, Stanford University *Graduate Advisor*
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  - Tel: +1 (650) 723-1727
  - E-mail: [wmoerner@stanford.edu](mailto:wmoerner@stanford.edu)
- Prof. Robert M. Glaeser**, University of California, Berkeley *Collaborator*
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