



W. E. Moerner

Harry S. Mosher Professor and Professor, by courtesy, of Applied Physics
Chemistry

 Curriculum Vitae available Online

CONTACT INFORMATION

• Alternate Contact

Nancy McCarthy - Administrative Assistant

Email nancylm@stanford.edu

Tel 650-736-8120

Bio

BIO

W. E. (William Esco) Moerner, the Harry S. Mosher Professor of Chemistry and Professor by courtesy of Applied Physics, has conducted research in physical chemistry, biophysics, and the optical properties of single molecules, and is actively involved in the development of 2D and 3D super-resolution imaging for cell biology. Imaging studies include protein superstructures in bacteria, structure of proteins in cells, studies of chromatin organization, and dynamics of regulatory proteins in the primary cilium. Using powerful microscopes optimized for tracking of single objects in cells, the motions of proteins, DNA, and RNA are being measured in three dimensions in real time to understand processing and binding interactions. A related research area concerns precise analysis of photodynamics of single trapped biomolecules in solution, with applications to photosynthesis, protein-protein interactions, and transport measurements.

Born on June 24, 1953 at Parks Air Force Base in Pleasanton, California, Professor Moerner was raised in San Antonio, Texas. He attended Washington University as a Langsdorf Engineering Fellow, graduating in 1975 with degrees in Physics and Electrical Engineering (both B.S. with top honors), and Mathematics (A.B. summa cum laude). His doctoral research in physics at Cornell University (M.S. 1978, Ph.D. 1982) employed tunable infrared lasers to explore infrared vibrational modes of impurities in crystals. In 1982, he moved from New York to San Jose, California to join the IBM Research Division developing spectral holeburning for frequency domain optical storage and photorefractivity for dynamic hologram formation. After 13 years at IBM, Dr. Moerner accepted a position as Distinguished Professor of Physical Chemistry at UC San Diego, where he broadened his research to include biological systems and biophysics. Recruited to the Stanford Chemistry Department faculty in 1997, he served as Chair of the department from 2011 to 2014.

Professor Moerner's scientific contributions were recognized with the 2014 Nobel Prize in Chemistry "for the development of super-resolved fluorescence microscopy."

One method to surpass the optical diffraction limit (PALM/STORM) uses single-molecule imaging combined with a control mechanism to keep the concentration of emitting molecules at a very low level, followed by sequential localization to reconstruct the underlying structure. The fundamentals of this idea came from early work in the Moerner lab: optical detection and imaging of single molecules (1989) combined with blinking and switching at low temperature, as well as the discovery of optical control of single copies of green fluorescent protein at room temperature (1997). Among many other honors and awards, Professor Moerner was elected fellow of the American Physical Society, Optical Society of America, American Association for the Advancement of Science, American Academy of Arts and Sciences; and member of the National Academy of Sciences.

Today, the Moerner Laboratory uses laser spectroscopy and microscopy of single molecules to probe biological processes, one molecule at a time. Primary thrusts include development and application of fluorescence microscopy far beyond the optical diffraction limit by PALM/STORM and STED approaches, single-molecule tracking in complex cellular environments, invention and validation of methods for precise and accurate 3D optical microscopy in cells, and trapping of single photosynthetic biomolecules in solution for extended study. Through a variety of collaborations, these approaches are applied to explore protein and oligonucleotide localization patterns in bacteria, measure structures of amyloid aggregates in cells, define the behavior of signaling proteins in the primary cilium, quantify photodynamics for photosynthetic proteins and enzymes, and observe the dynamics of DNA and RNA in cells and viruses.

Please visit the Moerner Lab home page for more information.

ACADEMIC APPOINTMENTS

- Professor, Chemistry
- Professor (By courtesy), Applied Physics
- Member, Bio-X
- Faculty Fellow, Sarafan ChEM-H
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Faculty Fellow, ChEM-H at Stanford, (2014- present)
- Chairman, Department of Chemistry, Stanford University, (2011-2014)
- Member, Advisory Board, Center for Biological Imaging at Stanford, (2010-2015)
- Member, Board of Scientific Counselors, NIBIB, (2010-2014)
- Chair, University Health and Safety Committee, (2008-2010)

HONORS AND AWARDS

- Nobel Prize in Chemistry, Nobel Foundation (2014)
- Wu Zheng Kai Chemistry Prize, Fudan University (2018)
- Distinguished Eagle Scout Award, Boy Scouts of America (2017)
- INSPIRE Award for Excellence, San Antonio Independent School District (2016)
- Julio Palmaz Award for Innovation in Healthcare and Biosciences, BioMed SA (2015)
- Peter Debye Award in Physical Chemistry, American Chemical Society (2013)
- Irving Langmuir Prize in Chemical Physics, American Physical Society (2009)
- Wolf Prize in Chemistry, Wolf Foundation of Israel (2008)
- Member, National Academy of Sciences (2007)
- Earle K. Plyler Prize in Molecular Spectroscopy, American Physical Society (2001)
- Fellow, Optical Society of America (1992)
- Fellow, American Physical Society (1992)
- National Winner, Roger I. Wilkinson Outstanding Young Electrical Engineer Award, Eta Kappa Nu (1985)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Trustee, Society for Science and the Public (2018 - present)
- Member, Scientific Advisory Board, Welch Foundation (2017 - present)

- Member, International Advisory Board, Angewandte Chemie (2017 - present)
- Member, Advisory Board, Institute of Atomic and Molecular Sciences, Academia Sinica, Taiwan (2003 - present)
- Member, Corporation Visiting Committee, Department of Chemistry, Massachusetts Institute of Technology (2013 - 2017)
- Editorial Advisory Board Member, Journal of Physical Chemistry (2013 - 2015)
- Member, Board of Scientific Counselors, National Institute of Biomedical Imaging and Bioengineering (2010 - 2014)
- Member, DOE Workshop on Single-Molecule Research in the New Millennium (2005 - 2005)
- Advisory Editor, Single Molecules (2000 - 2002)
- Member, NIH-NIGMS Workshop on Single Molecule Detection and Manipulation (2000 - 2000)
- Member, FAMOS Update Panel, National Research Council (1999 - 2002)
- Member, NIH Bioengineering Symposium Panel on Imaging at the Molecular and Cellular Levels (1998 - 1998)

PROFESSIONAL EDUCATION

- Ph.D., Cornell University , Physics (1982)
- M.S., Cornell University , Physics (1978)
- B. S., Washington University , Physics (1975)
- B. S., Washington University , Electrical Engineering (1975)
- A. B., Washington University , Mathematics (1975)

COMMUNITY AND INTERNATIONAL WORK

- Amateur Radio Emergency Service

LINKS

- Moerner Lab: <http://web.stanford.edu/group/moerner>
- More information about Prof. Moerner: <http://web.stanford.edu/group/moerner/WEM.html>

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Most biophysical or chemical experiments in condensed matter measure the average behavior of a huge number, N , of molecules, where N may range from millions to billions to Avogadro's Number. At the same time, most theoretical models are intended to describe the behavior of a single molecule interacting with its surroundings, and averaging over the number of molecules N is normally required to compute an observable. Using precision laser spectroscopic techniques, we have been detecting and probing the detailed properties of individual impurity molecules hidden deep inside a cell, in a protein, or even in a liquid, i.e., the ultimate limit of $N=1$. This was first done in the Moerner Lab in 1989, and has since expanded dramatically to include many groups around the world. A key reason for doing this is to explore heterogeneity that is normally obscured by ensemble averaging.

Studying one individual molecule in a solid means we are working with an extremely small number of moles of material. You might be aware that the international standards organization, IUPAC, has defined several new prefixes: zepto- for $1E-21$, and yocto- for $1E-24$. Thus 1 molecule is equivalent to 1.66 yoctomoles. But we think this is unwieldy. Thus we define a new prefix guaca- so that (with apologies to Prof. Avogadro)

1 guacamole = $1 / (\text{Avocado's Number})$ of moles.

More seriously, it is worth recalling that each molecule we are probing is only 1 or 2 nanometers in size. This means that when we use a laser to select one probe molecule, we can sense details of the immediate local environment of a truly nanoscopic probe.

To achieve this extreme reduction of the concentration and reach the single-molecule level, we use either (a) extremely low concentrations and diffraction-limited confocal, TIRF, or far-field microscopy, or (b) near field optical excitation to pump sample volumes much smaller than the diffraction limit, or (c) superresolution imaging by single-molecule active control. By studying a large number of individual molecules one at a time, we are able not only to observe how the usual ensemble average behavior is formed, but also to see unexpected, surprising behavior normally hidden by the usual ensemble averaging.

The phenomena under study include protein localization pattern in bacteria, chaperonin proteins, and new fluorophores for active-control superresolution imaging. By dispersing the emitted light, even the vibrational mode spectrum of a single molecule may be measured! By measuring correlations in the emitted photon stream, fast dynamics including environmental fluctuations, or the purely quantum-mechanical behavior termed photon antibunching may be probed. In biomolecules, we observe fascinating differences in behavior due to conformational states, local environments, or enzymatic cycle, all of which are obscured in large N experiments.

Importantly, a single molecule can be viewed as a probe of its immediate local nanoenvironment on the scale on the order of the molecular size (~1 nm). Because single molecules are nanoscale emitters, when active control is used to turn molecules on and off, it is possible to build up a super-resolution image of the sample, far beyond the optical diffraction limit, typically on the 40 nm scale. Several advanced optical techniques for obtaining three-dimensional information from single-molecule photoswitching are underdevelopment, and we apply these methods to imaging a variety of cellular structures in bacteria and in mammalian cells and to tracking of RNA in living yeast.

Teaching

COURSES

2021-22

- Advanced Physical Chemistry - Single Molecules and Light: CHEM 275 (Spr)

2020-21

- Advanced Physical Chemistry - Single Molecules and Light: CHEM 275 (Spr)

2019-20

- Advanced Physical Chemistry - Single Molecules and Light: CHEM 275 (Spr)

2018-19

- Advanced Physical Chemistry - Single Molecules and Light: CHEM 275 (Spr)
- Chemical Principles Accelerated: CHEM 31X (Aut)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Adam Bowman, John Breen, Jacob Kirsh, Ching-Ting Tsai

Postdoctoral Faculty Sponsor

Leonid Andronov, Andrew Barentine, William Carpenter, Pierre Jouchet

Doctoral Dissertation Advisor (AC)

Ashwin Balaji, Abhijit Lavania, Davis Perez, Anish Roy, Annina Sartor

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biophysics (Phd Program)

Publications

PUBLICATIONS

- **Ratiometric Sensing of Redox Environments Inside Individual Carboxysomes Trapped in Solution.** *The journal of physical chemistry letters*
Carpenter, W. B., Lavania, A. A., Borden, J. S., Oltrogge, L. M., Perez, D., Dahlberg, P. D., Savage, D. F., Moerner, W. E.
2022: 4455-4462
- **Fast and parallel nanoscale 3D tracking of heterogeneous mammalian chromatin dynamics.** *Molecular biology of the cell*
Gustavsson, A., Ghosh, R. P., Petrov, P. N., Liphardt, J. T., Moerner, W. E.
2022: mbcE21100514
- **A bottom-up perspective on photodynamics and photoprotection in light-harvesting complexes using anti-Brownian trapping.** *The Journal of chemical physics*
Squires, A. H., Wang, Q., Dahlberg, P. D., Moerner, W. E.
2022; 156 (7): 070901
- **Multi-color super-resolution imaging to study human coronavirus RNA during cellular infection.** *bioRxiv : the preprint server for biology*
Wang, J., Han, M., Roy, A. R., Wang, H., Mockl, L., Zeng, L., Moerner, W. E., Qi, L. S.
2022
- **Multi-color super-resolution imaging to study human coronavirus RNA during cellular infection.** *Cell reports methods*
Wang, J., Han, M., Roy, A. R., Wang, H., Möckl, L., Zeng, L., Moerner, W. E., Qi, L. S.
2022: 100170
- **A localized adaptor protein performs distinct functions at the Caulobacter cell poles.** *Proceedings of the National Academy of Sciences of the United States of America*
Wang, J., Moerner, W. E., Shapiro, L.
2021; 118 (13)
- **Cryogenic Super-Resolution Fluorescence and Electron Microscopy Correlated at the Nanoscale.** *Annual review of physical chemistry*
Dahlberg, P. D., Moerner, W. E.
2021
- **Exploring Cell Surface-Nanopillar Interactions with 3D Super-Resolution Microscopy.** *ACS nano*
Roy, A. R., Zhang, W., Jahed, Z., Tsai, C. T., Cui, B., Moerner, W. E.
2021
- **Super-resolution Microscopy with Single Molecules in Biology and Beyond-Essentials, Current Trends, and Future Challenges.** *Journal of the American Chemical Society*
Mockl, L., Moerner, W. E.
2020
- **Cryogenic single-molecule fluorescence annotations for electron tomography reveal in situ organization of key proteins in Caulobacter.** *Proceedings of the National Academy of Sciences of the United States of America*
Dahlberg, P. D., Saurabh, S., Sartor, A. M., Wang, J., Mitchell, P. G., Chiu, W., Shapiro, L., Moerner, W. E.
2020
- **Deep learning in single-molecule microscopy: fundamentals, caveats, and recent developments [Invited].** *Biomedical optics express*
Mockl, L., Roy, A. R., Moerner, W. E.
2020; 11 (3): 1633-61
- **Selective sequestration of signalling proteins in a membraneless organelle reinforces the spatial regulation of asymmetry in Caulobacter crescentus.** *Nature microbiology*
Lasker, K., von Diezmann, L., Zhou, X., Ahrens, D. G., Mann, T. H., Moerner, W. E., Shapiro, L.
2020

- **Novel fibrillar structure in the inversin compartment of primary cilia revealed by 3D single-molecule super-resolution microscopy.** *Molecular biology of the cell*
Bennett, H. W., Gustavsson, A., Bayas, C. A., Petrov, P. N., Mooney, N., Moerner, W. E., Jackson, P. K.
2020: mbcE19090499
- **Quantitative super-resolution microscopy of the mammalian glycocalyx**
Mockl, L., Pedram, K., Roy, A., Krishnan, V., Gustavsson, A., Dorigo, O., Bertozzi, C., Moerner, W.
AMER CHEMICAL SOC.2019
- **Interferometric Scattering Enables Fluorescence-Free Electrokinetic Trapping of Single Nanoparticles in Free Solution.** *Nano letters*
Squires, A. H., Lavania, A. A., Dahlberg, P. D., Moerner, W. E.
2019
- **Motional dynamics of single Patched1 molecules in cilia are controlled by Hedgehog and cholesterol** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Weiss, L. E., Milenkovic, L., Yoon, J., Stearns, T., Moerner, W. E.
2019; 116 (12): 5550-5557
- **Single-molecule trapping and spectroscopy reveals photophysical heterogeneity of phycobilisomes quenched by Orange Carotenoid Protein.** *Nature communications*
Squires, A. H., Dahlberg, P. D., Liu, H., Magdaong, N. C., Blankenship, R. E., Moerner, W. E.
2019; 10 (1): 1172
- **Single-molecule trapping and spectroscopy reveals photophysical heterogeneity of phycobilisomes quenched by Orange Carotenoid Protein** *NATURE COMMUNICATIONS*
Squires, A. H., Dahlberg, P. D., Liu, H., Magdaong, N. M., Blankenship, R. E., Moerner, W. E.
2019; 10
- **Motional dynamics of single Patched1 molecules in cilia are controlled by Hedgehog and cholesterol.** *Proceedings of the National Academy of Sciences of the United States of America*
Weiss, L. E., Milenkovic, L., Yoon, J., Stearns, T., Moerner, W. E.
2019
- **Revealing Nanoscale Morphology of the Primary Cilium Using Super-Resolution Fluorescence Microscopy** *BIOPHYSICAL JOURNAL*
Yoon, J., Comerci, C. J., Weiss, L. E., Milenkovic, L., Stearns, T., Moerner, W. E.
2019; 116 (2): 319-329
- **Quantitative Super-Resolution Microscopy of the Mammalian Glycocalyx.** *Developmental cell*
Möckl, L. n., Pedram, K. n., Roy, A. R., Krishnan, V. n., Gustavsson, A. K., Dorigo, O. n., Bertozzi, C. R., Moerner, W. E.
2019
- **Accurate and rapid background estimation in single-molecule localization microscopy using the deep neural network BGnet.** *Proceedings of the National Academy of Sciences of the United States of America*
Möckl, L. n., Roy, A. R., Petrov, P. N., Moerner, W. E.
2019
- **Topologically-guided continuous protein crystallization controls bacterial surface layer self-assembly.** *Nature communications*
Comerci, C. J., Herrmann, J. n., Yoon, J. n., Jabbarpour, F. n., Zhou, X. n., Nomellini, J. F., Smit, J. n., Shapiro, L. n., Wakatsuki, S. n., Moerner, W. E.
2019; 10 (1): 2731
- **Revealing Nanoscale Morphology of the Primary Cilium Using Super-Resolution Fluorescence Microscopy.** *Biophysical journal*
Yoon, J., Comerci, C. J., Weiss, L. E., Milenkovic, L., Stearns, T., Moerner, W. E.
2018
- **Identification of PAmKate as a Red Photoactivatable Fluorescent Protein for Cryogenic Super-Resolution Imaging.** *Journal of the American Chemical Society*
Dahlberg, P. D., Sartor, A. M., Wang, J., Saurabh, S., Shapiro, L., Moerner, W. E.
2018; 140 (39): 12310-13
- **Identification of PAmKate as a Red Photoactivatable Fluorescent Protein for Cryogenic Super-Resolution Imaging** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*

- Dahlberg, P. D., Sartor, A. M., Wang, J., Saurabh, S., Shapiro, L., Moerner, W. E.
2018; 140 (39): 12310-12313
- **Resolving Mixtures in Solution by Single-Molecule Rotational Diffusivity** *NANO LETTERS*
Yang, H., Moerner, W. E.
2018; 18 (8): 5279-5287
 - **Resolving Mixtures in Solution by Single-Molecule Rotational Diffusivity.** *Nano letters*
Yang, H., Moerner, W. E.
2018
 - **Light sheet approaches for improved precision in 3D localization-based super-resolution imaging in mammalian cells [Invited]** *OPTICS EXPRESS*
Gustavsson, A., Petrov, P. N., Moerner, W. E.
2018; 26 (10): 13122-47
 - **Spatial organization and dynamics of RNase E and ribosomes in *Caulobacter crescentus*** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Bayas, C. A., Wang, J., Lee, M. K., Schrader, J. M., Shapiro, L., Moerner, W. E.
2018; 115 (16): E3712-E3721
 - **Single-molecule diffusometry reveals the nucleotide-dependent oligomerization pathways of *Nicotiana tabacum* Rubisco activase** *JOURNAL OF CHEMICAL PHYSICS*
Wang, Q., Serban, A. J., Wachter, R. M., Moerner, W. E.
2018; 148 (12): 123319
 - **3D single-molecule super-resolution microscopy with a tilted light sheet** *NATURE COMMUNICATIONS*
Gustavsson, A., Petrov, P. N., Lee, M. Y., Shechtman, Y., Moerner, W. E.
2018; 9: 123
 - **Single-Molecule Imaging of Wnt3A Protein Diffusion on Living Cell Membranes** *BIOPHYSICAL JOURNAL*
Lippert, A., Janeczek, A. A., Furstenberg, A., Ponjavic, A., Moerner, W. E., Nusse, R., Helms, J. A., Evans, N. D., Lee, S. F.
2017; 113 (12): 2762-67
 - **Observation of live chromatin dynamics in cells via 3D localization microscopy using Tetrapod point spread functions** *BIOMEDICAL OPTICS EXPRESS*
Shechtman, Y., Gustavsson, A. N., Petrov, P. N., Dultz, E., Lee, M. Y., Weis, K., Moerner, W. E.
2017; 8 (12): 5735-48
 - **Three-Dimensional Localization of Single Molecules for Super-Resolution Imaging and Single-Particle Tracking.** *Chemical reviews*
von Diezmann, A., Shechtman, Y., Moerner, W. E.
2017
 - **Super-Resolution Microscopy and Single-Protein Tracking in Live Bacteria Using a Genetically Encoded, Photostable Fluoromodule.** *Current protocols in cell biology*
Saurabh, S. n., Perez, A. M., Comerci, C. J., Shapiro, L. n., Moerner, W. E.
2017; 75: 4.32.1-4.32.22
 - **Super-resolution Imaging of Live Bacteria Cells Using a Genetically Directed, Highly Photostable Fluoromodule.** *Journal of the American Chemical Society*
Saurabh, S., Perez, A. M., Comerci, C. J., Shapiro, L., Moerner, W. E.
2016; 138 (33): 10398-10401
 - **Removing orientation-induced localization biases in single-molecule microscopy using a broadband metasurface mask** *NATURE PHOTONICS*
Backlund, M. P., Arbabi, A., Petrov, P. N., Arbabi, E., Saurabh, S., Faraon, A., Moerner, W. E.
2016; 10 (7): 459-?
 - **Removing Orientation-Induced Localization Biases in Single-Molecule Microscopy Using a Broadband Metasurface Mask.** *Nature photonics*
Backlund, M. P., Arbabi, A., Petrov, P. N., Arbabi, E., Saurabh, S., Faraon, A., Moerner, W. E.
2016; 10: 459-462
 - **Enhanced DNA imaging using super-resolution microscopy and simultaneous single-molecule orientation measurements.** *Optica*
Backer, A. S., Lee, M. Y., Moerner, W. E.
2016; 3 (6): 3-6

- **Delayed emergence of subdiffraction-sized mutant huntingtin fibrils following inclusion body formation.** *Quarterly reviews of biophysics*
Sahl, S. J., Lau, L., Vonk, W. I., Weiss, L. E., Frydman, J., Moerner, W. E.
2016; 49
- **Nobel Lecture: Single-molecule spectroscopy, imaging, and photocontrol: Foundations for super-resolution microscopy** *REVIEWS OF MODERN PHYSICS*
Moerner, W.
2015; 87 (4)
- **Single-molecule imaging of Hedgehog pathway protein Smoothed in primary cilia reveals binding events regulated by Patched1.** *Proceedings of the National Academy of Sciences of the United States of America*
Milenkovic, L., Weiss, L. E., Yoon, J., Roth, T. L., Su, Y. S., Sahl, S. J., Scott, M. P., Moerner, W. E.
2015; 112 (27): 8320-8325
- **Chromosomal locus tracking with proper accounting of static and dynamic errors** *PHYSICAL REVIEW E*
Backlund, M. P., Joyner, R., Moerner, W. E.
2015; 91 (6)
- **Precise Three-Dimensional Scan-Free Multiple-Particle Tracking over Large Axial Ranges with Tetrapod Point Spread Functions.** *Nano letters*
Shechtman, Y., Weiss, L. E., Backer, A. S., Sahl, S. J., Moerner, W. E.
2015; 15 (6): 4194-4199
- **Chromosomal locus tracking with proper accounting of static and dynamic errors.** *Physical review. E, Statistical, nonlinear, and soft matter physics*
Backlund, M. P., Joyner, R., Moerner, W. E.
2015; 91 (6): 062716-?
- **Single-Molecule Identification of Quenched and Unquenched States of LHCII.** *journal of physical chemistry letters*
Schlau-Cohen, G. S., Yang, H., Krüger, T. P., Xu, P., Gwizdala, M., van Grondelle, R., Croce, R., Moerner, W. E.
2015; 6 (5): 860-867
- **Single-molecule spectroscopy and imaging over the decades** *FARADAY DISCUSSIONS*
Moerner, W. E., Shechtman, Y., Wang, Q.
2015; 184: 9-36
- **Single-Molecule Photocontrol and Nanoscopy** *FAR-FIELD OPTICAL NANOSCOPY*
Lew, M. D., Lee, S. F., Thompson, M. A., Lee, H. D., Moerner, W. E., Tinnefeld, P., Eggeling, C., Hell, S. W.
2015; 14: 87-110
- **Single-Molecule Spectroscopy, Imaging, and Photocontrol: Foundations for Super-Resolution Microscopy (Nobel Lecture).** *Angewandte Chemie (International ed. in English)*
Moerner, W. E.
2015; 54 (28): 8067-93
- **Super-resolution fluorescence of huntingtin reveals growth of globular species into short fibers and coexistence of distinct aggregates.** *ACS chemical biology*
Duijn, W. C., Jiang, Y., Shen, K., Frydman, J., Moerner, W. E.
2014; 9 (12): 2767-2778
- **Correlations of three-dimensional motion of chromosomal loci in yeast revealed by the double-helix point spread function microscope.** *Molecular biology of the cell*
Backlund, M. P., Joyner, R., Weis, K., Moerner, W. E.
2014; 25 (22): 3619-3629
- **Small-molecule labeling of live cell surfaces for three-dimensional super-resolution microscopy.** *Journal of the American Chemical Society*
Lee, M. K., Rai, P., Williams, J., Twieg, R. J., Moerner, W. E.
2014; 136 (40): 14003-14006
- **Optimal point spread function design for 3D imaging.** *Physical review letters*
Shechtman, Y., Sahl, S. J., Backer, A. S., Moerner, W. E.
2014; 113 (13): 133902-?

- **Extending single-molecule microscopy using optical fourier processing.** *journal of physical chemistry. B*
Backer, A. S., Moerner, W. E.
2014; 118 (28): 8313-8329
- **Bacterial scaffold directs pole-specific centromere segregation** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Ptacin, J. L., Gahlmann, A., Bowman, G. R., Perez, A. M., von Diezmann, A. R., Eckart, M. R., Moerner, W. E., Shapiro, L.
2014; 111 (19): E2046-E2055
- **Single-molecule motions enable direct visualization of biomolecular interactions in solution** *NATURE METHODS*
Wang, Q., Moerner, W. E.
2014; 11 (5): 555-558
- **The role of molecular dipole orientation in single-molecule fluorescence microscopy and implications for super-resolution imaging.** *Chemphyschem*
Backlund, M. P., Lew, M. D., Backer, A. S., Sahl, S. J., Moerner, W. E.
2014; 15 (4): 587-599
- **Single-molecule spectroscopy of photosynthetic proteins in solution: exploration of structure-function relationships** *CHEMICAL SCIENCE*
Schlau-Cohen, G. S., Bockenbauer, S., Wang, Q., Moerner, W. E.
2014; 5 (8): 2933-2939
- **Exploring bacterial cell biology with single-molecule tracking and super-resolution imaging** *NATURE REVIEWS MICROBIOLOGY*
Gahlmann, A., Moerner, W. E.
2014; 12 (1): 9-22
- **Super-resolution fluorescence imaging with single molecules.** *Current opinion in structural biology*
Sahl, S. J., Moerner, W.
2013; 23 (5): 778-787
- **Rotational mobility of single molecules affects localization accuracy in super-resolution fluorescence microscopy.** *Nano letters*
Lew, M. D., Backlund, M. P., Moerner, W. E.
2013; 13 (9): 3967-3972
- **Single-molecule spectroscopy reveals photosynthetic LH2 complexes switch between emissive states** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Schlau-Cohen, G. S., Wang, Q., Southall, J., Cogdell, R. J., Moerner, W. E.
2013; 110 (27): 10899-10903
- **Lifetime and Spectrally Resolved Characterization of the Photodynamics of Single Fluorophores in Solution Using the Anti-Brownian Electrokinetic Trap** *JOURNAL OF PHYSICAL CHEMISTRY B*
Wang, Q., Moerner, W. E.
2013; 117 (16): 4641-4648
- **Quantitative Multicolor Subdiffraction Imaging of Bacterial Protein Ultrastructures in Three Dimensions** *NANO LETTERS*
Gahlmann, A., Ptacin, J. L., Grover, G., Quirin, S., von Diezmann, A. R., Lee, M. K., Backlund, M. P., Shapiro, L., Piestun, R., Moerner, W. E.
2013; 13 (3): 987-993
- **Enzymatic activation of nitro-aryl fluorogens in live bacterial cells for enzymatic turnover-activated localization microscopy** *CHEMICAL SCIENCE*
Lee, M. K., Williams, J., Twieg, R. J., Rao, J., Moerner, W. E.
2013; 4 (1): 220-225
- **Cellular Inclusion Bodies of Mutant Huntingtin Exon 1 Obscure Small Fibrillar Aggregate Species** *SCIENTIFIC REPORTS*
Sahl, S. J., Weiss, L. E., Duim, W. C., Frydman, J., Moerner, W. E.
2012; 2
- **Simultaneous, accurate measurement of the 3D position and orientation of single molecules** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Backlund, M. P., Lew, M. D., Backer, A. S., Sahl, S. J., Grover, G., Agrawal, A., Piestun, R., Moerner, W. E.
2012; 109 (47): 19087-19092

- **Fluorescence correlation spectroscopy at high concentrations using gold bowtie nanoantennas** *CHEMICAL PHYSICS*
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- What Can You Do With Single Molecules? (student talk 2017) - Physics/Astronomy Colloquium, University of New Mexico
- Kavli Symposium APS March Meeting 2015: Light & Single-Molecule Spectroscopy, Imaging, & Photocontrol - Foundations for Super-Resolution Microscopy - American Physical Society March Meeting (3/1/2015)
- AAAS Science technology webinar 2013: Fluorescent Probes and Digital Imaging - AAAS Science (June 12, 2013)
- Moerner Presentations - full list - Various locations
- SPIE interview 2012: Super-Resolution and the Double-Helix Point Spread Function - SPIE (June 4, 2012)