

## Sean Quirin, Ph.D.

Curriculum Vitae: updated October 10<sup>th</sup>, 2023

### Education history

2004	BA in Astronomy/Astrophysics, University of Colorado, Boulder
2009	MS in Electrical Engineering, University of Colorado, Boulder
2012	PhD in Electrical Engineering, University of Colorado, Boulder

### Fellowship training

2012-2013	Postdoctoral fellowship, Optical methods in neuroscience, Columbia University (laboratory of Rafael Yuste)
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### Positions

2004-2008	Optical Engineer, InPhase Technologies, Longmont, CO
2010	Research Assistant, École Polytechnique Fédérale de Lausanne, Neuchatel, Switzerland
2013-2015	Computational Imaging Scientist, The MITRE Corporation, McLean, VA
2015-2022	Senior Computation and Optical Engineer, Stanford University, Stanford, CA
2022-2023	Assistant Professor (Research), Department of Psychiatry and Behavioral Sciences, Stanford University, Stanford, CA

### Honors and Awards

2009-2012	National Science Foundation, Computational Optical Sensing and Imaging Integrative Graduate Education and Research Traineeship
2010	University of Colorado Department of Electrical, Computer and Energy Engineering Travel Award
2010	Computational Optical Sensing and Imaging Integrative Graduate Education and Research Traineeship International Research Award
2013	National Eye Institute – Vision Sciences Postdoctoral Training Fellowship (2012)

### Bibliography

#### Peer-reviewed original research (14 total)

\* denotes shared first authorship

1. Grover, G., Quirin, S., Fiedler, C., Piestun, R., Photon-efficient Double Helix Point Spread Function Microscope for 3D Photo-activation Localization Microscopy. *Biomedical Optics Express* 2(11), pp. 3010-3020 (2011) *Role: Contributed optical fabrication methods and assisted writing manuscript.*
2. Quirin, S., Pavani, S. R. P., Piestun, R., Optimal 3D Single-Molecule Localization for Super-Resolution Microscopy with Engineered Point Spread Functions. *Proceedings of the National Academy of Sciences* 109(3), pp. 675-9(2011)

3. Grover, G., DeLuca, K., Quirin, S., DeLuca, J., Piestun, R., Super-resolution photon-efficient imaging by nanometric double-helix point spread function localization of emitters. *Optics Express* 20(24), pp. 26681-26695 (2012) *Role: Contributed optical fabrication methods, image processing algorithms and assisted writing manuscript.*
4. Agrawal, A., Quirin, S., Grover, G., Piestun, R., Limits of 3D Dipole Localization and Orientation Estimation for Single-Molecule Imaging: towards Green's tensor engineering. *Optics Express* 20(24), pp. 26667-26680 (2012) *Role: Contributed to the design and analysis included in manuscript.*
5. Quirin, S., Piestun, R., Depth Estimation and Image Recovery Using Broadband, Incoherent Illumination with Engineered Point Spread Functions [Invited]. *Applied Optics* 52(1), pp. A367-A376 (2013)
6. Gahlmann, A., Ptacin, J., Grover, G., Quirin, S., von Diezmann, A., Lee, M., Backlund, M., Shapiro, L., Piestun, R., Moerner, W. E., Quantitative multicolor subdiffraction imaging of bacterial protein ultrastructures in three dimensions. *NanoLetters* DOI: 10.1021/nl304071h (2013) *Role: Contributed optical fabrication methods.*
7. Quirin, S., Peterka, D. S., Yuste, R., Instantaneous three-dimensional sensing using Spatial Light Modulator illumination with Extended Depth of Field imaging. *Optics Express* 21(13), pp. 16007-16021 (2013)
8. Quirin, S., Jackson, J., Peterka, D. S., Yuste, R., Simultaneous imaging of neural activity in three dimensions. *Frontiers in Neural Circuits* 8(29), (2014)
9. Quirin, S., Vladimirov, N., Yang, C-T., Peterka, D. S., Yuste, R., Ahrens, M. B., Calcium imaging of neural circuits with extended depth-of-field light-sheet microscopy. *Optics Letters* 41(5), pp. 855-858 (2016)
10. Jennings, J., Kim, C., Marshel, J., Raffiee, M., Ye, L., Quirin, S., Pak, S., Ramakrishnan, C., Deisseroth, K., Interacting neural ensembles in orbitofrontal cortex for social and feeding behavior. *Nature* 565(7741), pp. 645-649 (2019) *Role: Contributed optical methods and experimental controls to the manuscript.*
11. Inoue, M., Takeuchi, A., Manita, S., Horigane, S., Sakamoto, M., Kawakami, R., Yamaguchi, K., Omoto, K., Yokoyama, H., Kim, R., Yokoyama, T., Takemoto-Kimura, S., Abe, M., Okamura, M., Kondo, Y., Quirin, S., Ramakrishnan, C., Imamura, T., Sakimura, K., Nemoto, T., Kano, M., Fujii, H., Deisseroth, K., Kitamura, K., Bito, H., Rational engineering of XCaMPs, a multicolor suite for in vivo imaging of complex brain circuit dynamics. *Cell* 177(5), pp. 1346-1360.e24 (2019). *Role: Contributed optical methods to the manuscript.*
12. Marshel, J.\* , Kim, Y-S.\* , Machado, T.\* , Quirin, S.\* , Kadmon, J., Benson, B., Raja, C., Chibukhchyan, A., Ramakrishnan, C., Inoue, M., Shane, J., McKnight, D., Yoshizawa, S., Kato, H., Ganguli, S., Deisseroth, K., Layer-specific neural ensembles contributing to ignition and plasticity of perception, *Science* 365(6453), pp. eaaw5202 (2019)
13. Trautmann, E. M., O'Shea D. J., Sun, X., Marshel, J. H., Crow, A., Hsueh, B., Vesuna, S., Cofer, L., Bohner, G., Allen, W., Kauvar, I., Quirin, S., MacDougall, M., Chen, Y., Whitmire, M. P., Ramakrishnan, C., Sahini, M., Seidemann, E., Ryu, S., Deisseroth, K., Shenoy, K. V, Dendritic calcium signals in rhesus macaque motor cortex drive an optical brain-computer interface, *Nature Communications* 12(1), pp. 3689 (2021). *Role: Contributed optical method validation.*
14. Kishi, K., Kim, Y. S., Fukuda, M., Inoue, M., Kusakizako, T., Wang, P., Ramakrishnan, C., Byrne, E., Thadhani, E., Paggi, J., Matsui, T., Yamashita, K., Nagata, T., Konno, M., Quirin, S., Lo, M., Benster, T., Uemura, T., Liu, K., Shibata, M., Nomura, N., Iwata, S., Nureki, O., Dror, R., Inoue, K., Deisseroth, K.,

Kato, H. E., Structural basis for channel conduction in the pump-like channelrhodopsin ChRmine. Cell (2022) doi: <https://doi.org/10.1016/j.cell.2022.01.007>. Role: *Contributed optical method development and control experiments*.

15. Fan, L., Kim, D. K., Jennings, J. H., Tian, H., Wang, P., Ramakrishnan, C., Randles, S., Sun, Y., Thadhani, E., Kim Y. S., Quirin, S., Giocomo, L., Cohen, A. E., Deisseroth, K., All-optical physiology resolves a synaptic basis for behavioral timescale plasticity. Cell (2023) Role: *Contributed optical method development and software*.

## Presentations

1. T. Trentler, B. Ihas, M. Cole, F. Askham, M. Schnoes, S. Quirin, D. Michaels, J. Carter, W. Wilson, A. Hill, C. Stanhope, L. Dhar, (2004) **Blue-sensitive rewriteable holographic media**, presented at OSA topical meeting: Optical Data Storage
2. P. Wang, B. Ihas, M. Schnoes, S. Quirin, D. Beal, S. Setthachayanon, T. Trentler, M. Cole, F. Askham, D. Michaels, S. Miller, A. Hill, W. Wilson, L. Dhar, (2004) **Photopolymer media for holographic storage at 405 nm**, presented at OSA topical meeting: Optical Data Storage
3. Quirin, S., Pavani, S. R. P., Piestun, R. (2008, November). **Broadband Three Dimensional Passive Imaging System**. Poster session at Colorado Photonics Industry Association Conference, Boulder, CO.
4. Quirin, S., Pavani, S. R. P., Piestun, R. (2009, May). **3D Imaging using Computational Optics**. Poster session at NSF-IGERT Principal Investigators Meeting, Alexandria, VA.
5. Quirin, S., Pavani, S. R. P., Pavani, R. (2009, October). **Broadband three-dimensional imaging using a double-helix point spread function**. Presentation at OSA Topical Meeting: Computational Optical Sensing and Imaging, San Jose, CA.
6. Quirin, S., Pavani, S. R. P., Piestun, R. (2010, March). **3D Imaging using double-helix point spread functions**. Poster session at IEEE International Conference on Computational Photography, Boston, MA.
7. Quirin, S., Pavani, S. R. P., Piestun, R. (2010, April). **Pattern matching estimator for precise 3D particle localization with engineered point spread functions**. Presentation at OSA Topical Meeting: Digital Holography, Miami, FL.
8. Sharma, G., Pavani, S. R. P., Quirin, S., Piestun, R. (2010, May). **Double-Helix Microscopy for Wide-Field 3-D Single-Molecule Fluorescence Imaging**. Presentation at Conference on Lasers and Electro Optics (CLEO), San Jose, CA.
9. Quirin, S., Piestun, R. (2010, June). **3D Imaging using Helical Point Spread Functions**. *Invited Talk* presented at Optical Society of America Topical Meeting: Imaging Systems, Tuscan, AZ.
10. Quirin, S., Pavani, S. R. P., Grover, G., Piestun, R. (2010, October). **Optimal 3D Single-molecule Localization for Double-Helix Super-resolution Microscopy**. Presentation at European Optical Society Annual Meeting, Paris, France.
11. Preza, C., Ghosh, S., Grover, G., Quirin, S., Piestun, R. (2011, April). **Extraction of Depth Information in the Presence of Spherical Aberration using Double-Helix Point Spread Function Coding in 3D Fluorescence Microscopy Imaging**. Presentation at Focus On Microscopy (FOM2011), Konstanz, Germany.
12. Quirin, S., Grover, G., Fiedler, C., Piestun, R. (2011, April). **Double-Helix PSF Microscopy with a Phase Mask for Efficient Photon Collection**. Presentation at OSA Topical Meeting: Novel Techniques in Microscopy, Monterey, CA.

13. Grover, G., Quirin, S., Piestun, R. (2011, May). **Double-Helix 3D Photo-activation Localization Microscopy with a Phase Mask for Efficient Photon Collection**. Presentation at Conference on Lasers and Electro Optics (CLEO), Baltimore, MD.
14. Quirin, S., Piestun, R. (2011, April). **Novel helical point spread functions for 3D imaging**. *Invited paper* presented at SPIE Defence, Security + Sensing in Orlando, FL
15. Agrawal, A., Quirin, S., Grover, G., Piestun, R. (2011, July). **Limits of 3D dipole localization and orientation estimation with application to single-molecule imaging**. Presentation at OSA Topical Meeting: Computational Optical Sensing and Imaging, Toronto, CN
16. Quirin, S., Grover, G., Piestun, R. (2011, July). **Phase mask fabrication for pupil encoding in computational optical imaging**. Presentation at OSA Topical Meeting: Computational Optical Sensing and Imaging, Toronto, CN
17. Grover, G., Quirin, S., DeLuca, K., DeLuca, J., Piestun, R., (2012, April) **3D Nano-Photography with Single-Molecule Sensitivity**. Presentation at International Conference on Computational Photography 2012, Seattle, WA
18. Grover, G., DeLuca, K., Quirin, S., DeLuca, J., Piestun, R., (2012, April) **3D Super-resolution Imaging of Microtubules with a Double-Helix Point Spread Function Microscope**. Presentation at OSA Topical Meeting: Biomedical Optics, Miami, FL
19. Grover, G., DeLuca, K., Quirin, S., DeLuca, J., Piestun, R., (2012, July) **Design of Double-helix Point Spread Functions for 3D Super-resolution Imaging**. Presentation at OSA Topical Meeting: Computational Optical Sensing and Imaging, Monterey, CA
20. Quirin, S., Piestun, R., (2012, July) **Precision Limits of Wavefront Sensing with Microlens Arrays**. Presentation at OSA Topical Meeting: Computational Optical Sensing and Imaging, Monterey, CA
21. Quirin, S., Peterka, D. S., Yuste, R., (2013, November) **Spatial light modulation microscopy with wavefront coding for two-photon 3D imaging of neural activity**. Presentation at Janelia Farms Conference: Shaping the Waves, Ashburn, VA
22. Marshel, J. H., Quirin, S., Sylwestrak, E., Chibukhchyan, A., Kim, Y-S., Crow, A., Ramakrishnan, C., Deisseroth, K. **Wide field-of-view 3D all-optical neurophysiology with millisecond-resolution *in vivo***. (2017, November) Society for Neuroscience 2017, Washington D. C.

## Editorial Service

2011-present	Ad hoc reviewer for <i>Applied Optics</i>
2013-present	Ad hoc reviewer for <i>Optics Letters</i>

## Patents

1. Stoeckel, N., Bruder, F., Askham, F., Cole, M., Dhar, L., Michaels, M., Miller, S., Quirin, S., Setthachayanon S., Trentler; T., Trujillo-Lemon, M., **“Advantageous recording media for holographic applications”**, US Patent #8,053,147
2. Piestun, R., Quirin, S., **“Method And Systems For Three Dimensional Optical Imaging, Sensing, Particle Localization and Manipulation”**, US Patent #9,560,338
3. Piestun, R., Agrawal, A., Quirin, S., Barsic, A., Grover, G., **“Imaging or measurement methods and systems”**, US Patent #10,955,331

4. Yuste, R., Quirin, S., Peterka, D. S., “**System, Method, and Computer-Accessible Medium For Depth of Field Imaging for Instantaneous and Targeted Three-Dimensional Sensing Utilizing a Spatial Light Modulator Microscope**”, US Patent Provisional #61/756803
5. Deisseroth, K., Quirin, S., “**Modular, electro-optical device for increasing the imaging field-of-view using time-sequential capture**”, US Patent Provisional #62/478981