

CURRICULUM VITAE

Mark J. Schnitzer

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Education:

Harvard University, Cambridge, MA	A.B. <i>summa cum laude</i>	1992	Physics
Cambridge University, Cambridge, UK	M.A.	1993	Mathematics
Princeton University, Princeton, NJ	M.A.	1994	Physics
Princeton University, Princeton, NJ	Ph.D.	1999	Physics (Advisor: Steven M. Block)

Research & Professional Positions:

<i>pending</i>	Professor, Dept. Biology & Dept. Applied Physics, Stanford University, Stanford CA.
2010– <i>present</i>	Associate Professor, Dept. of Biology and Dept. of Applied Physics; Faculty Member, Neuroscience Program, Biophysics Program, Stanford University, Stanford, CA.
2009– <i>present</i>	Co-Director, <i>Cracking the Neural Code</i> Program, Stanford University, Stanford, CA.
2008– <i>present</i>	Investigator, Howard Hughes Medical Institute; Stanford University.
2003–2010	Assistant Professor, Dept. of Applied Physics and Dept. of Biology; Stanford University, Stanford, CA.
1999–2003	Member of Technical Staff, Physical Sciences Laboratory, Biological Computation Research Department, Bell Laboratories, Lucent Technologies, Murray Hill, NJ.

Honors & Service:

Scientific Advisory Board, NSF National Center for Brain Mapping, Oct. 2016–*present*.
Editorial Board, *Neuron*, Cell Press, Nov. 2016–*present*
NIH National Institute on Drug Abuse (NIDA), National Advisory Council, *Ad hoc* member, 2014-2017.
NIH BRAIN Initiative Multi-Council Working Group, which oversees the BRAIN Initiative, 2014-2017.
Course Lecturer, FENS Cajal Neuroscience Training Course, “*Interacting with Neural Circuits*”, Lisbon, July 2017.
Co-Organizer, DECODE Summit, *Neural Circuits and Brain Disease*, Palo Alto, Sept. 2016.
Invited Speaker, White House Office of Science & Technology, *BRAIN Initiative Meeting*, Wash. DC, March 2015.
Caltech, Wiersma Visiting Professor, March 16–20, 2015.
Co-Organizer, *Cell Press Symposium*, “*Engineering the Brain*”, Chicago, Oct. 2015.
Issue Editor, *Current Opinion in Neurobiology*, June 2015.
White House BRAIN Conference, Invited Panelist, September 30, 2014.
United States BRAIN Initiative NIH Director’s Advisory Committee, which authored “*BRAIN 2025*”, 2013-2014.
NIH, Parkinson Disease Basic Science Working Group, 2013-14.
Milken Institute Global Conference, Invited Panelist, Los Angeles, CA, April 29, 2014.
NIMH Director’s Innovation Speaker, NIH, Bethesda, MD. March 4, 2014.
14th Distinguished Kavli Lecture, Kavli Inst. for Systems Neuroscience, NTNU, Trondheim, Norway, June 2013.
Top Innovation of 2013, *The Scientist*, to the miniature fluorescence microscope invented in our lab.
Finalist (on behalf of Inscopix, for our lab’s miniature microscope), Israel Brain Prize, Tel Aviv, 2013.
Ellison Senior Scholar Award, Ellison Medical Foundation, 2012.
William Shucart Lecturer, Tufts Neuroscience Institute, Tufts University, 2012.
Symposium Chair, “*Cracking Neural Codes with Photons*”, Society for Neuroscience, 42nd Annual Meeting, 2012.
Course Lecturer, FENS / IBRO Summer Course: “*Imaging Neural Function*”, Lausanne, Switzerland, Sept. 2012.
Course Lecturer, “*Advanced Techniques in Molecular Neuroscience*”, Cold Spring Harbor Laboratory, July 2012.
Course Lecturer, EMBO Practical Course, “*Two-photon imaging of brain circuits*”, Munich, Germany, Sept. 2011.
Allen Distinguished Investigator Award, Paul G. Allen Family Foundation, 2010.
Michael & Kate Bárány Young Investigator Award, Biophysical Society, 2010.
Public presentation, *NIH NIBIB Advisory Council Meeting*, Bethesda, MD, January 22, 2010.
Symposium Chair, “*New Technologies for Probing Brain Disease with Light*”: Soc. for Neuroscience Meeting, 2009.
Symposium Chair, “*Imaging & controlling cellular dynamics using light*”. Biophysical Society Meeting, 2008.
NIH Director’s Pioneer Award, 2007.
W. M. Keck Foundation, Medical Research Program grant, 2007.
Member of the Brilliant Ten, top ten scientists under age 40, Popular Science magazine, 11/2007.

Issue Editor, *Current Opinion in Neurobiology*, *New Technologies*, Dec. 2007.
Best Methods Paper, American Society of Biomechanics, 2007.
Coulter Translational Partner Funding Award, Wallace H. Coulter Foundation, 2006.
Terman Fellow, Stanford University, 2006.
Course Lecturer, EMBO Practical Course, “*Multi-photon imaging of living cells and tissues*”, Munich, Oct. 2006.
Course Lecturer, “*Imaging Structure & Function in the Nervous System*”, Cold Spring Harbor Laboratory, 2006.
Symposium Chair and Organizer, “*Optogenetics: Next-Generation Optical Technologies*”. Soc. for Neuroscience, 2006.
Beckman Interdisciplinary Translational Research Program Award, 2005.
Packard Fellowship in Science & Engineering, David & Lucille Packard Foundation, 2005.
Presidential Early Career Award in Science & Engineering, awarded at White House 6/13/2005.
Alfred P. Sloan Research Fellowship, 2005.
Klingenstein Fellowship in the Neurosciences, 2004.
Young Investigator Award, Beckman Foundation, 2004.
Young Investigator Award, Office of Naval Research, Cognitive & Neural Division, 2004.
Member of TR100, World’s Top 100 Innovators under age 35, Technology Review Magazine, Oct. 2003.
Cutting Edge Basic Research Award (CEBRA), National Institutes of Health, 2003.
Young Investigator Award (with #1 world ranking), Human Frontiers in Science Program, 2002.
McKnight Technological Innovations in Neuroscience Award, 2000.
Burroughs Wellcome Fellowship, Program in Mathematics and Molecular Biology, 1998-1999.
Charlotte Elizabeth Procter Honorific Fellowship, Princeton University, 1997-1998.
American Heart Association Predoctoral Fellow, 1996-1998.
NSF Predoctoral Fellow, 1993-1996.
Winston Churchill Fellowship, Winston Churchill Foundation of the United States, 1992-1993.
Junior *Phi Beta Kappa*, for top 12 Junior men, Harvard University, 1991.
Barry Goldwater Fellowship for Excellence in Science, United States, 1990.
Detur Scholar, Harvard University, 1989.
United States Physics Team, International Physics Olympiad, Bad Ischl, Austria, 1988.

United States Patents & United States Patent Applications: 26 total.

Ghosh, K. Burns, L., El Gamal, A., Schnitzer, MJ, Cocker, E, Ho, TW, (2017). “Microscopy imaging device with advanced imaging properties.” **U.S. Patent Application**. 20170296060.
Zhang, T., Schnitzer, M.J., Lecoq, J.A., Savall, J., Kim, H., Rumyantsev, O. (2017). “Multi-photon microscope having an excitation-beam array.” **U.S. Patent** 9,820,652.
Flusberg, B.A., Cocker, E.D., Jung, J.C., Schnitzer, M.J. (2017). “Live being optical analysis system and approach”. **U.S. Patent** 9,636,020.
Ghosh, K. Burns, L., El Gamal, A., Schnitzer, MJ, Cocker, E, Ho, TW, (2017). “Microscopy imaging device with advanced imaging properties.” **U.S. Patent** 9,629,554.
Marshall, J.D. and Schnitzer, M.J. (2016). “Method and apparatus for optical recording of biological parameters in freely moving animals.” **U.S. Patent Application** 20160135754.
Jung, J.C. & Schnitzer, M.J. (2016). “Optical analysis system and approach therefore”, **U.S. Patent Application** 20160022148.
Ghosh, K. Burns, L., El Gamal, A., Schnitzer, MJ, Cocker, E, Ho, TW, (2016a). “Microscopy imaging device with advanced imaging properties.” **U.S. Patent** 9,474,448.
Rumyantsev, O., Schnitzer, M.J., Lecoq, J.A., Zhang, T., Kim, H., Savall, J. (2016). “Multi-foci laser-scanning microscope and use of same of analyzing samples”. **U.S. Patent** 9,494,777.
Ghosh, K. Burns, L., El Gamal, A., Schnitzer, MJ, Cocker, E, Ho, TW, (2016b). “Microscopy imaging device with advanced imaging properties.” **U.S. Patent** 9,498,135.
Flusberg, B.A., Ko, T., and Schnitzer, M.J. (2016). “Microendoscopy with corrective optics”. **U.S. Patent** 9,411,149.
Kim, H., Savall, J., Lecoq, J.A., Schnitzer, M.J. (2016). “Robotic imaging system”. **U.S. Patent** 9,398,935.
Jung, J.C. & Schnitzer, M.J. (2015). “Optical analysis system and approach therefore”, **U.S. Patent** 9,161,694.
Sanchez, G.N., Delp, S.L., Schnitzer, M.J., Llewellyn, M.E. (2015). “System and method useful for sarcomere imaging via objective-based microscopy”. **U.S. Patent** 8,897,858.
Flusberg, B.A., Cocker, E.D., Jung, J.C., Schnitzer, M.J. (2014). “Live being optical analysis system and approach”. **U.S. Patent** 8,788,021.
Jung, J.C. & Schnitzer, M.J. (2012). “Optical analysis system and approach therefore”, **U.S. Patent** 8,346,346.
Blevins, N., Cheung, E.L.M. Jung, J.C., Monfared, A., and Schnitzer, M.J. (2012). “Cochlear optical analysis system and approach therefor”, **U.S. Patent** 8,099,156.

- Llewellyn, M.E., Barretto, R.J., Delp, S.L., & Schnitzer, M.J. (2011). "Method & system of using intrinsic-based photosensing with high-speed line scanning for characterization of biological thick tissue including muscle". **U.S. Patent** 8,068,899.
- Schnitzer, M.J. (2008). "Multi-photon endoscopy", **U.S. Patent** 7,336,988.
- Anderson, E.P., Cocker, E.D., Flusberg, B.A., Jung, J.C. and Schnitzer, M.J. (2006). "Micro-optical analysis system and approach therefor", **U.S. Patent** 7,307,774.
- Schnitzer, M.J. (2006), "Multi-photon endoscopic imaging system", **U.S. Patent** 7,091,500.
- Fee, M. & Schnitzer, M.J. (2006). "Acousto-optic monitoring and imaging in a depth sensitive manner." **U.S. Patent** 7,023,558.
- Reed, W.A. and Schnitzer, M.J. (2005) "Fiber devices using GRIN fiber lenses". **U.S. Patent** 6,839,483.
- Reed, W.A. and Schnitzer, M.J. (2004) "Method of fabricating a GRIN fiber". **U.S. Patent** 6,802,190.
- Reed, W.A. and Schnitzer, M.J. (2004) "Grin-fiber lens based optical endoscopes". **U.S. Patent** 6,760,112.
- Schnitzer, M.J. (2003). "Graded-index lens microscopes", **U.S. Patent** 6,643,071.
- Reed, W.A. and Schnitzer, M.J. (2003) "GRIN fiber lenses." **U.S. Patent** 6,542,665.

Peer Reviewed Publications:

———— *Papers currently under review* ————

- Zhang, T., Hernandez, O., Chrapkiewicz, R., Wagner, M.J., Zhang, Y., Wu, C-H., Li, J.Z., Shai, A., Inoue, M. Gong, Y., Zeng, H., Bito, H., and Schnitzer, M.J. "Ultrafast two-photon microscopy for high-speed brain imaging in awake mice". *Under peer review*, **Nature Methods**.
- Wang, T., Ouzounov, D.G., Horton, N.G., Zhang, B., Wu, C.-H., Zhang, Y., Schnitzer, M.J., Xu, C. "Three-photon imaging of structure and neural activities through intact mouse skull". *Under peer review*, **Nature Methods**.
- Corder, G., Ahanonu, B., Grewe, B.F., Schnitzer, M.J.[†], Scherrer, G.[†] "An amygdalar neural ensemble encoding the unpleasantness of painful experiences". *Under peer review*, **Science**. ([†]Corresponding Author).
- Kannan, M., Vasan, G., Huang, C., Haziza, S., Li, J.Z., Schnitzer, M.J., Pieribone, V.A. "Fast, multimodal, neuronal voltage imaging using a red fluorescent indicator". *Under peer review*, **Nature Methods**.
- Kondo, T., Saito, R., Otaka, M., Yoshino-Saito, K., Mizukami, H., Yamanaka, A., Yamamori, T., Schnitzer, M.J., Tanaka, K.F., Ushiba, J., Okano, H. "Calcium transient dynamics of neural ensembles in the primary motor cortex of naturally behaving monkeys." *Submitted for publication*.
- Williams, A.H., Kim, T.H., Wang, F., Vyas, S., Ryu, S.I., Shenoy, K.V., Schnitzer, M.J., Kolda, T.G., Ganguli, S. "Unsupervised discovery of demixed, low-dimensional neural dynamics across multiple timescales through tensor components analysis". *Under review*, **Neuron**, BioRxiv: <https://doi.org/10.1101/211128>.
- Chavarha, M., Villette, V., Dimov, I., Pradhan, L., Chamberland, S., Shi, D., Evans, S.W., Bradley, J., Mathieu, B., Schnitzer, M.J., Bi, G., Toth, K., Dieudonne, S., Lin, M.Z., "Random-access multi-photon imaging of an improved voltage indicator reveals oscillatory and spiking activity patterns in the awake brain", *Under review*, **Nature**.
- Attardo, A. Lu, J., Kawashima, T., Okuno, H., Fitzgerald, J.E., Bito, H. and Schnitzer, M.J. "Long-term consolidation of ensemble neural plasticity patterns in hippocampal area CA1". *peer review*, **Neuron**.
- Chen, X., Sanchez, G.N., Schnitzer, M.J. and Delp, S.L. "Early detection of altered muscular contractile dynamics in a mouse model of amyotrophic lateral sclerosis". *peer review*, **Neuron**.
- Rumyantsev, O.I., Lecoq, J.A., Savall, J.C., Zeng, H., Ganguli, S. & Schnitzer, M.J. "Fundamental limits of information encoding by sensory cortical neural ensembles". *Under peer review*, **Nature**.
- Wagner, M.J., Savall, J., Li, J.Z., & Schnitzer, M.J., "A neural circuit state change underlying the preparation of skilled movements." *In peer review*, **Cell**.

———— *Papers in press or published* ————

- Parker, J.G., Marshall, J.D., Ahanonu, B., Wu, Y-W., Kim, T.H., Grewe, B.F, Zhang, Y., Li, J.Z., Ding, J.B., Ehlers, M.D. & Schnitzer, M.J. (2018) "Diametric neural ensemble dynamics in parkinsonian and dyskinetic states". *In press*, **Nature**.

- Huang, C., Maxey, J.R., Sinha, S., Savall, J.C., Gong, Y. and Schnitzer, M.J. (2018). "Long-term optical brain imaging in live adult fruit flies". **Nature Communications**. 9:872.
- Remedios, R., Kennedy, A., Zelikowsky, M, Grewe, B.F., Schnitzer, M.J., Anderson, D.J (2017). Social behaviour shapes hypothalamic neural ensemble representations of conspecific sex. **Nature**. 550:388-392.
- Li, Y., Mathis, A., Grewe, B.F., Osterhout, J.A., Ahanonu, B, Schnitzer, M.J., Murthy, V.N., Dulac, C. (2017). Neuronal representation of social information in the medial amygdala of awake behaving mice. **Cell**. 171:1176-1190.e17.
- Inan, H., Erdogdu, M.A., Schnitzer, M.J. (2017). "Robust Estimation of Neural Signals in Calcium Imaging." **Advances in Neural Information Processing Systems**, 30 (NIPS 2017).
- Grewe, B.F., Gründemann, J., Kitch, L.J., Lecoq, J.A., Parker, J.G., Marshall, J.D., Larkin, M.C., Jercog, P., Grenier, F., Li, J.Z., Lüthi, A. and Schnitzer, M.J. (2017). "Neural ensemble dynamics underlying a long-term associative memory", **Nature**. 543:670–675 (*Article*).
- Wagner, M.J., Kim, T.K., Schnitzer, M.J., Luo, L. (2017). "Cerebellar granule cells encode the expectation of reward", **Nature**. 544:96–100.
- Marshall, J.D., Parker, J.G., Gong Y., Li, J.Z., St-Pierre, F., Lin, M.Z., Schnitzer, M.J. (2016). "Cell-type specific optical recording of membrane potential dynamics in freely moving behaving mice". **Cell**, 167:1650-62.
- Xu, C., Krabbe, S., Gründemann, J., Botta, P., Fadok, J.P., Osakada, F., Saur, D., Grewe, B.F., Schnitzer, M.J., Callaway, E.M., Lüthi, A. (2016). "Distinct hippocampal pathways mediate dissociable roles of context in memory retrieval". **Cell**, 167:1–12.
- Kim, T.H., Zhang, Y., Lecoq, J., Jung, J.C., Li, J., Zeng, H., Niell, C.M. and Schnitzer, M.J. (2016). "Long-term optical access to an estimated million neurons in the live mouse cortex". **Cell Reports**, 17:3385–3394.
- Chen, X., Sanchez, G.N., Schnitzer, M.J., Delp, S.L. (2016). "Changes in sarcomere lengths of the human vastus lateralis muscle with knee flexion measured using in vivo microendoscopy". **J. Biomech**. 49:2989-2994.
- Lin, M.Z. and Schnitzer, M.J. (2016). "Genetically encoded indicators of neuronal activity". **Nature Neurosci**. 19:1142-1153.
- Sanchez, G.N., Sinha, S., Liske, H., Chen, X., Nguyen, V., Delp, S.L., Schnitzer, M.J. (2015). "In vivo imaging of human sarcomere twitch dynamics in individual motor units". **Neuron**. 88:1109–1120.
- Gong, Y., Huang C., Li J.Z., Grewe B.F., Zhang, Y., Eismann S., Schnitzer, M.J. (2015). "High-speed recording of neural spikes in awake mice and flies with a fluorescent voltage sensor". **Science**. 350:1361-1366.
- Kitamura, T., Sun, C., Martin, J., Kitch, L.J., Schnitzer, M.J., Tonegawa, S. (2015). "Entorhinal cortical ocean cells encode specific contexts and drive context-specific fear memory". **Neuron**. 87(6):1317-31.
- Attardo, A., Fitzgerald, J.E., Schnitzer, M.J. (2015). "Impermanence of dendritic spines in live adult CA1 hippocampus". **Nature**. 523:592-6.
- Sun, C., Kitamura T., Yamamoto J., Martin J., Pignatelli M., Kitch L.J., Schnitzer M.J., Tonegawa S. (2015). "Distinct speed dependence of entorhinal island and ocean cells, including respective grid cells". **PNAS**. 112(30): 9466-71.
- Savall, J., Ho, E.T., Huang, C., Maxey, J.R., Schnitzer, M.J. (2015). "Dexterous robotic manipulation of alert adult *Drosophila* for high-content experimentation". **Nature Methods**. 12:657-60. (*covered in N.Y. Times*).
- Barretto, R.P., Gillis-Smith, S., Chandrashekar, J., Yarmolinsky, D.A., Schnitzer, M.J., Ryba, N.J., Zuker, C.S. (2015). "The neural representation of taste quality at the periphery". **Nature**. 517(7543):373-6.
- Hamel E.J., Grewe B.F., Parker J.G., Schnitzer M.J. (2015). "Cellular level brain imaging in behaving mammals: An engineering approach". **Neuron**. 86(1):140-159.

- Lecoq J., Savall J, Vucinic D, Grewe BF, Kim H, Li JZ, Kitch LJ, Schnitzer M.J. (2014). "Visualizing mammalian brain area interactions by dual-axis two-photon calcium imaging". **Nature Neurosci.** 17(12):1825-9.
- Gong, Y., Wagner, M.J., Li, J.Z., Schnitzer, M.J. (2014). "Imaging neural spiking in brain tissue using FRET-opsin protein voltage sensors". **Nature Communications.** 5:3674.
- St-Pierre, F., Marshall J.D., Yang Y., Gong Y., Schnitzer, M.J., Lin M.Z. (2014). "High-fidelity optical reporting of neuronal electrical activity with an ultrafast fluorescent voltage sensor". **Nature Neurosci.** 17:884-9.
- Wetmore, D.Z., Jirenhed D.A., Rasmussen A., Johansson F., Schnitzer M.J., Hesslow G. (2014). "Bidirectional plasticity of Purkinje cells matches temporal features of learning". **J. Neurosci.** 34(5):1731-1737.
- Sinha, S., Liang, L., Ho. E.T., Urbanek, K.E., Luo, L., Baer, T.M. and Schnitzer, M.J. (2013). "High-speed laser microsurgery of alert fruit flies for fluorescence imaging of neural activity". **PNAS.** 110(46):18374-9.
- Cromie, M.J., Sanchez, G.N., Schnitzer, M.J., Delp, S.L. (2013). "Sarcomere lengths in human extensor carpi radialis brevis measured by microendoscopy". **Muscle & Nerve.** 48(2):286-92.
- Freifeld, L., Clark, D.A., Schnitzer, M.J., Horowitz, M.A., Clandinin, T.R. (2013). "GABAergic lateral interactions tune the early stages of visual processing in Drosophila." **Neuron.** 78(6):1075-89.
- Gong, Y., Li, J.Z., and Schnitzer M.J. (2013). "Enhanced archaerhodopsin fluorescent protein voltage indicators". **PLoS ONE.** 8(6):e66959.
- Marshall, J. D. and Schnitzer, M.J. (2013). "Optical strategies for sensing neuronal voltage using quantum dots and other semiconductor nanocrystals". **ACS Nano.** 7(5):4601-9.
- Ziv, Y., Burns, L.D., Cocker, E.D., Hamel, E.O., Ghosh, K.K., Gamal, A.E., and Schnitzer, M.J. (2013). "Long-term dynamics of CA1 hippocampal place codes". **Nature Neuroscience.** 16(3): 264-6.
- Wilt, B.A., Fitzgerald, J.E. and Schnitzer, M.J. (2013). "Photon shot noise limits on optical detection of neuronal spikes and estimation of spike timing". **Biophysical Journal.** 104:51-62.
- Prakash, R., Yizhar, O., Grewe, B., Ramakrishnan C., Wang, N., Goshen, I., Packer, A.M., Peterka, D.S., Yuste, R., Schnitzer, M.J., Deisseroth, K. (2012). "Two-photon optogenetic toolbox for fast inhibition, excitation and bistable modulation". **Nature Methods.** 9(12):1171-9.
- Mukamel, E.A. and Schnitzer M.J. (2012). "Unified resolution bounds for conventional and stochastic localization fluorescence microscopy". **Physical Review Letters.** 109, 168102.
- Fitzgerald, J.E., Lu, J., and Schnitzer M.J. (2012). "Estimation theoretic measure of resolution for stochastic localization microscopy". **Physical Review Letters.** 109, 048102.
- Lam, A.J., St-Pierre, F., Gong, Y., Marshall, J.D., Cranfill, P.J., Baird, M.A., McKeown, M.R., Wiedenmann, J., Davidson, M.W., Schnitzer, M.J., Tsien, R.Y., Lin, M.Z. (2012). "Improving FRET dynamic range with bright green and red fluorescent proteins". **Nature Methods.** 9(10):1005-12.
- Ghosh, K.K., Burns, L.D., Cocker, E.D., Nimmerjahn, A., Ziv, Y., Gamal, A.E., and Schnitzer, M.J. (2011). "Miniaturized integration of a fluorescence microscope". **Nature Methods.** 8(10):871-8.
- Clark, D.A., Bursztyn, L., Horowitz M.A., Schnitzer, M.J., Clandinin, T.R. (2011). "Defining the computational structure of the motion detector in Drosophila". **Neuron.** 70(6):1165-77.
- Fitzgerald, J.E., Katsov, A.Y., Clandinin, T.R., Schnitzer, M.J. (2011). "Symmetries in stimulus statistics shape the form of visual motion estimators". **PNAS.** 108(31):12909-14.
- Barretto, R.P., Ko, T.H., Jung J.C., Wang, T.J., Capps G, Waters AC, Ziv Y, Attardo A, Recht L, Schnitzer MJ. (2011). "Time-lapse imaging of disease progression in deep brain areas using fluorescence microendoscopy". **Nature Medicine.** 17(2):223-8. (Cover Article).
- Barretto, R.P.J., Messerschmidt, B., Schnitzer, M.J. (2009). "In vivo fluorescence imaging with high-resolution microlenses". **Nature Methods.** 6(7):511-2.

- Piyawattanametha, W., Cocker, E.D., Burns L.D., Barretto R.P., Jung J.C., Ra H., Solgaard O., Schnitzer M.J. (2009). "In vivo brain imaging using a portable 2.9 g two-photon microscope based on a microelectromechanical systems scanning mirror". **Optics Letters**. 34(15):2309-11.
- Mukamel, E.A., Nimmerjahn, A., Schnitzer, M.J. (2009). "Automated analysis of cellular signals from large-scale calcium imaging data". **Neuron**. 63(6):747-60.
- Wilt, B.A., Burns, L.D., Ho, E.T.W., Ghosh, K.K., Mukamel, E.A., and Schnitzer, M.J. (2009). "Advances in light microscopy for neuroscience". **Annual Review of Neuroscience**. 32:435-506.
- Nimmerjahn, A., Mukamel, E.A., Schnitzer M.J. (2009). "Motor behavior activates Bergmann glial networks". **Neuron**. 62(3):400-12.
- Flusberg, B.A, Nimmerjahn, A., Cocker, E.D., Mukamel, E.A., Barretto, R.P.J., Ko, T.H., Burns, L.D., Jung, J.C., and Schnitzer, M.J. (2008). "High-speed, miniaturized fluorescence microscopy in freely moving mice". **Nature Methods**. 5:935-8. *See also accompanying News and Views in the same issue.*
- Llewellyn, M.E., Barretto, R.P.J., Delp, S.L. & Schnitzer, M.J. (2008). "Minimally invasive high-speed imaging of sarcomere contractile dynamics in mice and humans". **Nature**. 454: 784-8.
- Wetmore, D.Z., Mukamel, E.A., and Schnitzer, M.J. (2008). "Lock-and-key mechanisms of memory recall based on rebound conductances". **J. Neurophysiol**. 100: 2328-2347.
- Deisseroth, K., Feng, G., Majewska, A.K., Miesenbock. G., Ting, A., Schnitzer, M.J. (2006). "Next-generation optical technologies for illuminating genetically targeted brain circuits." **J. Neurosci**. 26:10380-6.
- Piyawattanametha, W., Barretto, R.P.J., Ko, T., Flusberg B.A., Cocker, E.D. Ra, H., Lee, D., Solgaard, O., and Schnitzer, M.J. (2006). "Fast-scanning two-photon fluorescence imaging based on a microelectromechanical systems (MEMS) two-dimensional scanning mirror". **Optics Letters**. 31:2018-20.
- Monfared, A., Blevins, N.H., Cheung, E.L.M., Jung, J.C., Popelka, G.R., and Schnitzer, M.J. (2006). "In vivo imaging of mammalian cochlear blood flow using fluorescence microendoscopy". **Otology & Neurotology**. 27:144-52.
- Flusberg, B.A., Cocker, E.D., Piyawattanametha, W., Jung, J.C., Cheung, E.L.M. and Schnitzer, M.J. (2005). "Fiber-optic fluorescence imaging". **Nature Methods**. 2: 941-950.
- Flusberg, B.A., Jung, J.C., Cocker, E.D., Anderson, E.P, and Schnitzer, M.J. (2005). "In vivo brain imaging using a portable 3.9 gram two-photon fluorescence microendoscope". **Optics Letters**. 30: 2272-2274.
- Shaevitz, J.W., Block, S.M. and Schnitzer, M.J. (2005). "Statistical kinetics of macromolecular dynamics." **Biophysical Journal**. 89: 2277-2285.
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- Jung, J.C., and Schnitzer, M.J. (2003). "Multiphoton endoscopy". **Optics Letters**. 28: 902-905.
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- Reed, W.A., Yan, M.F. and Schnitzer, M.J. (2002). "Gradient-index fiber-optic microprobes for minimally invasive in vivo low coherence interferometry". **Optics Letters**. 27: 1794-1796.
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- Visscher, K*, Schnitzer, M.J*, and Block, S.M. (1999). "Single kinesin molecules studied with a molecular force clamp." **Nature**. 400: 184-189. *Authors contributed equally.
- Wang, M.D., Schnitzer, M.J., Yin, H., Landick, R., Gelles, J., and Block, S.M. (1998). "Force and velocity

measured for single molecules of RNA polymerase." **Science**. 282: 902-907.

Schnitzer, M.J. and Block, S.M. (1997). "Kinesin hydrolyses one ATP per 8-nm step." **Nature**. 388: 386-390.

Schnitzer, M.J. and Block, S.M. (1995). "Statistical kinetics of processive enzymes." **Cold Spring Harbor Symp. Quant. Biol.** 60: 793-802.

Schnitzer, M.J. (1993). "Theory of continuum random walks and application to chemotaxis." **Phys. Rev. E**. 48: 2553-2568.

Schnitzer, M.J., Block, S.M, Berg, H.C., and Purcell, E.M. (1990). "Strategies for chemotaxis." **Symp. Soc. Gen. Microbiol.** 46: 15-33.

Wen, X., Schnitzer M.J., and Meyer R.B. (1990). "An automated light scattering system scanning in two spherical dimensions." **Rev. Sci. Instrum.** 61: 2069-2072.

Reviews, Perspectives, and Other Publications:

Lin, M.Z. and Schnitzer, M.J. (2016). "Genetically encoded indicators of neuronal activity". **Nature Neurosci.** 19:1142-1153.

Jercog, P., Rogerson, T., Schnitzer, M.J. (2016). "Large-scale fluorescence calcium-imaging methods for studies of long-term memory in behaving mammals". **Cold Spring Harb. Perspect. Biol.** 8:a021824.

Battaglia, F.P., Schnitzer, M.J. (2015). "Large-scale recording technology: Scaling up neuroscience". **Current Opinion in Neurobiology.** 32:iv-vi.

Hamel E.J., Grewe B.F., Parker J.G., Schnitzer M.J. (2015). "Cellular Level Brain Imaging in Behaving Mammals: An Engineering Approach". **Neuron**. 86(1):140-159.

Jorgenson, L.A. et al. (2015). "The BRAIN Initiative: developing technology to catalyse neuroscience discovery". **Philos. Trans. R. Soc B.** 370:20140164.

Adamantidis A., et al. (2015). "Optogenetics: 10 years after ChR2 in neurons-views from the community". **Nature Neurosci.** 18(9):1202-12.

Deisseroth, K. and Schnitzer, M.J. (2013). "Engineering approaches to illuminating brain structure and dynamics". **Neuron**. 80:568-77.

Alivisatos A.P., et al. (2013) "Nanotools for neuroscience and brain activity mapping". **ACS Nano**, 7:1850–66.

Barretto R.P.J. and Schnitzer M.J. (2012). "In vivo microendoscopy of the hippocampus". **Cold Spring Harb. Protoc.** 2012(10).

Barretto R.P.J. and Schnitzer M.J. (2012). "In vivo optical microendoscopy for imaging cells lying deep within live tissue". **Cold Spring Harb. Protoc.** 2012(10).

Lecoq J. and Schnitzer M.J. (2011). "An infrared fluorescent protein for deeper imaging". **Nature Biotech.** 29(8):715-6.

Schnitzer, M.J. (2010). "Journal Club. A neurobiologist learns about algorithms for motor learning." **Nature**. 463(7279):273.

Barretto, R.P.J. and Schnitzer, M.J. (2011). "In vivo optical microendoscopy for imaging cells lying deep within live tissue", in **Cold Spring Harbor Imaging Manual**, Cold Spring Harbor Press, Cold Spring Harbor NY (Editor: Rafael Yuste).

Nimmerjahn, A. and Schnitzer, M.J. (2011). "Imaging cerebellar Bergmann glia in awake behaving animals by two-photon microscopy". **Cold Spring Harbor Imaging Manual**, Cold Spring Harbor Press, Cold Spring Harbor NY (Editor: Rafael Yuste).

Miyawaki, A. and Schnitzer, M.J. (2007). "New technologies for neuroscience", **Current Opinion in Neurobiology**. 17:565-6.

Mukamel, E.A. and Schnitzer, M.J. (2005). "Retinal coding of visual scenes – repetitive and redundant too?". **Neuron**. 46: 357-359.

Mehta, A.D., Jung, J.C., Flusberg, B.A. and Schnitzer, M.J. (2004). "Fiber optic *in vivo* imaging in the mammalian nervous system". **Current Opinion in Neurobiology**. 14: 617-28.

Schnitzer, M.J. (2002). "Biological computation: Amazing algorithms." **Nature**. 416: 683.

Schnitzer, M.J. (2001). "Molecular motors: Doing a rotary two-step." **Nature**. 410: 878-881.

To view (90) news stories about our work, please visit our lab website <http://pyramidal.stanford.edu>.

Invited Conference Symposia: 149, at conferences on neuroscience, optics, imaging, biophysics, biology.

1. Schnitzer, M.J., Visscher, K., and Block, S.M. (1998). "Kinetic analysis of movement by single kinesin motors." *COE International conference: Molecular mechanisms of intracellular transports*. Yokohama, Japan.
2. Invited Presenter. "New fiber-optic tools for brain imaging." *Technology Workshop Presentation, McKnight Conference on Neuroscience*. Aspen, CO, June 2002.
3. Schnitzer, M.J. and Jung, J.C. (2003). "Non-linear optical endoscopy". *Photonics West, Commercial and Biomedical Applications of Ultrafast Lasers V, SPIE*, San Jose, CA.
4. Jung J.C., Mehta A.D., Schnitzer M.J. (2003). "Multiphoton endoscopy: Optical design and application to *in vivo* imaging of mammalian hippocampal neurons", Peer-reviewed post-deadline paper, *Conference on Lasers and Electro-Optics*, Baltimore, Maryland.
5. Invited Speaker. "Fiber- and micro-optic approaches to *in vivo* brain imaging." *McKnight Conference on Neuroscience*. Aspen, CO, June 2003.
6. Invited Speaker. "*In vivo* mammalian brain imaging using microendoscopy", Center for Neural Science at New York University, *7th Biennial Symposium. Imaging the Brain: Neurons, Networks and Behavior* (2003).
7. Invited Speaker "*In vivo* mammalian brain imaging using one- and two-photon fluorescence microendoscopy". *Stanford Photonics Research Center Annual Meeting*. Stanford, CA, Sept. 2003. Invited Speaker, *Functional Imaging in Living Systems*, A Workshop at the Howard Hughes Medical Institute Conference Center, Chevy Chase, MD., June 14, 2004. Invited Speaker. "Fluorescence microendoscopy: A new tool for *in vivo* brain imaging". *Moving and Sensing: From Molecules to Cells. A Symposium in Honor of Howard Berg*. Oct. 3, 2004, Harvard University, Cambridge MA.
10. Invited Speaker. "Next-generation *in vivo* two-photon imaging: frontiers in microscopy and endoscopy". *Optical Society of America Annual Meeting*. Oct. 13, 2004, Rochester, NY.
11. Invited Speaker. "*In vivo* mammalian brain imaging using one- and two-photon fluorescence microendoscopy". *Society for Neuroscience Annual Meeting, NIDA Sponsored Symposium on Frontiers in Addiction Research*. Oct. 22, 2004, San Diego, CA.
12. Invited Speaker. "Microendoscopy: A new tool for cellular level imaging in the live mammalian brain". *IEEE Asilomar Conference on Signals, Systems, and Computers*. Nov. 9, 2004, Asilomar, CA.
13. "Micro-motor based two-photon fluorescence microendoscopy". *Photonics West, Biomedical Optics*. Jan. 23, 2005. San Jose, CA. Peer-reviewed paper and presentation.
14. Invited Speaker. "*In vivo* brain imaging using one- and two-photon fluorescence microendoscopy". *Biophysical Society Annual Meeting, Fluorescence Sub-group Symposium*. Feb. 12, 2005, Long Beach, CA.
15. Invited Speaker. Flusberg, B.A., Jung, J.C., Cocker, E.D, Wang, T.J, Anderson, E.P, & Schnitzer, M.J. "Fiber optic two-photon fluorescence microendoscopy: Towards chronic and portable brain imaging in mice." *Cold Spring Harbor Laboratory Imaging Neurons & Neural Activity Meeting*. Cold Spring Harbor, NY. March 11, 2005.

16. Invited Speaker. "In vivo brain imaging using one- and two-photon fluorescence microendoscopy". *American Physical Society, March Meeting*. March 20, 2005, Los Angeles, CA.
17. Invited Speaker. "Biophysical approaches to the study of mammalian learning and memory". *Symposium on fields, strings, and life*. March 26, 2005, Brandeis University, Waltham, MA.
18. Keynote Speaker. "In vivo fluorescence microendoscopy: The nervous system as frontier". *NSF Center for Biophotonics Science & Technology, Annual Retreat*, Squaw Valley, July 12, 2005.
19. Keynote Speaker. "Biophysical approaches to the study of mammalian learning and memory". *Eran Karmon Memorial Lecture, Biophysics Annual Retreat*, UC Berkeley, Sept. 10, 2005.
20. Invited Speaker. "Fluorescence microendoscopy as a new modality for in vivo brain imaging". *Stanford Photonics Research Center Annual Meeting*, Stanford, CA., Sept. 20, 2005.
21. Invited Speaker. "Next generation in vivo fluorescence imaging: One- and two-photon fluorescence microendoscopy". *Imaging in 2020*. A Conference on Molecular Imaging sponsored by the NIH. Jackson Hole, WY., Sept. 25, 2005.
22. Invited Speaker. "In vivo brain imaging using one- and two-photon fluorescence microendoscopy". *11th Micro-Optics conference (MOC '05)*. Sponsored by the Japanese Society of Applied Physics, Nov. 2, 2005. Tokyo, Japan.
23. D. Z. Wetmore, E. A. Mukamel, M. J. Schnitzer (2005), "A theory of cerebellum-dependent motor learning and timing based on rebound conductances in deep cerebellar nuclei neurons", *Advances in Computational Motor Control IV, Symposium at the Society for Neuroscience Conference*, Washington, D.C., Nov. 11, 2005. (Talk delivered by my two graduate students).
24. Invited Speaker. "In vivo brain imaging using one- and two-photon fluorescence microendoscopy." International Brain Mapping & Intraoperative Surgical Planning Society Symposium. Los Angeles, CA. Nov. 19, 2005.
25. Invited Speaker. "Microendoscopy: A new brain imaging modality", *Defense Sciences Research Council Meeting*, Stanford, CA. Feb. 11, 2006.
26. Invited Speaker. "Fluorescence microendoscopy: A new brain imaging modality" *Winter Conference on Neural Plasticity, 18th Annual Meeting*. Feb. 20, 2006. Barbados.
27. Invited Speaker. "Laser-scanning computed tomography", Group Leaders Meeting, Janelia Farm Research Center, Howard Hughes Medical Institute, Ashburn VA, March 14, 2006.
28. Invited Speaker. "One- and two-photon fluorescence microendoscopy for in vivo mammalian brain imaging", Invited Speaker. *The 5th Picower-RIKEN Neuroscience Symposium, New Frontiers in Brain Science: from molecules to mind*. Massachusetts Institute of Technology, Cambridge, MA. March 27, 2006.
29. Invited Speaker. "In Vivo Brain Imaging Using One- and Two-Photon Fluorescence Microendoscopy", Invited Speaker. Lester-Wolfe Workshop on Femtosecond Microscopy and Microscopy, A Joint Symposium between the MIT Spectroscopy Lab and the Massachusetts General Hospital, Massachusetts General Hospital, April 18, 2006.
30. "Fiber optic fluorescence imaging" *Cold Spring Harbor Course on Imaging Structure & Function in the Nervous System*, Cold Spring Harbor, NY, August 4, 2006.
31. Invited Speaker. "Fluorescence microendoscopy as a new modality for in vivo brain imaging". *Fifth Annual Meeting, Society for Molecular Imaging*. Kona, Hawaii, Sept. 2, 2006.
32. Piyawattanametha, W., Barretto, R.P.J., Ko, T., Flusberg B.A., Cocker, E.D. Ra, H., Lee, D., Solgaard, O., and Schnitzer, M.J (2006). "Two-photon fluorescence microscopy and microendoscopy based on a two-dimensional microelectromechanical systems (MEMS) scanning mirror". *Stanford Photonics Research Center Annual Meeting*, Stanford CA, Sept. 19, 2006. (Talk delivered by postdoc Dr. Wibool Piyawattanametha).
33. Invited Speaker. "Fluorescence microendoscopy: A new modality for in vivo brain imaging". *New imaging tools, micro- and nanofabrication technologies and computational modeling for neuroscience and neurodegenerative disease research*. A Society for Neuroscience 2006 Satellite Symposium. Atlanta, GA. Oct 13, 2006.
34. Symposium Speaker. "Fluorescence Microendoscopy: A New Modality for Chronic and Portable In Vivo Brain Imaging with Cellular Resolution". *Opto-Genetics: Next-Generation Optical Technologies for Illuminating Genetically Targeted Brain Circuits*. Mini-Symposium, Soc. for Neuroscience 36th Annual Meeting, Atlanta, GA, Oct 15, 2006.
35. Invited Speaker. "Fiber optic fluorescence imaging", *Multi-photon imaging of living cells and tissues, European Molecular Biology Organization*. Munich, Germany. Oct. 25, 2006.
36. Invited Speaker. "Fiber optic fluorescence imaging". *Small Animal Imaging Workshop, Molecular Imaging Program*, Stanford School of Medicine, Stanford, CA. Nov 15, 2006.
37. Invited speaker. "Fluorescence microendoscopy as a new modality for in vivo brain imaging", *4th Annual Advanced Optical Methods Workshop*. Molecular Imaging Center, U.C. Berkeley, Berkeley, CA. Jan. 17, 2007.

38. Invited Speaker. "Biophysical approaches to the study of cerebellar motor learning" *Winter Conference on Neural Plasticity, 19th Annual Meeting*. Moorea, French Polynesia, Feb. 13, 2007.
39. Invited Speaker. *Seeing is Believing: The Future of Molecular and Biomolecular Imaging*, Inauguration of the French Family Science Center, Duke University, Sponsored by the Center for Molecular and Biomolecular Imaging and the Office of the Provost, Duke University. March 13, 2007.
40. "High-speed cellular level brain imaging in freely moving mice using fluorescence microendoscopy", *Imaging Neurons & Neural Activity: New Methods, New Results*, Cold Spring Harbor Laboratory, NY, March 23, 2007.
41. Keynote Speaker. *UCLA Neurobiology Retreat*. April 21, 2007.
42. Invited speaker. "Biophysical approaches to the study of mammalian learning and memory". *In vivo Two-Photon Imaging of Brain Function*, International Brain Research Organization. World Congress of Neuroscience, Melbourne, Australia. July 14, 2007.
43. Invited Speaker. "Optical Brain Imaging and Neuronal Mapping in Small Animals". *Special Joint Symposium, Frontiers in Optics/Stanford Photonics Research Center*, San Jose, CA. Sept. 17, 2007.
44. Invited Speaker. "Two-Photon Fluorescence and Second-Harmonic Generation Microendoscopy for Minimally Invasive in vivo Imaging at the Cellular Scale", *Frontiers in Optics 2007, the 91st Optical Society of America Annual Meeting*, San Jose, CA, Sept. 18, 2007.
45. Invited Speaker. "Chronic and portable in vivo brain imaging at the cellular scale using fluorescence microendoscopy" *Enabling Technologies for Alzheimer Disease Research: 7th Bar Harbor Workshop*, ME, Aug. 10, 2007.
46. Invited Speaker. "Chronic and portable brain imaging in awake behaving mammalian subjects". *Lasker Regenerative Medicine Collaborative*, Palo Alto, CA, Nov. 17, 2007.
47. Invited Speaker, "Chronic and portable microscopy in freely moving mice." *At the Limits: Optical Methods for Single Molecules, Cells, and Organisms*, Symposium at the American Society for Cell Biology Annual Meeting, Washington D.C. Dec. 1, 2007.
48. Symposium Speaker. "High-speed imaging of cellular dynamics in freely moving mice using portable fluorescence microscopy". *Imaging and Controlling Cellular Dynamics In vivo Using Light*. Joint Meeting of the Biophysical Society, 52nd Annual Meeting, and the 16th International Biophysics Congress, Feb. 4, 2008, Long Beach, CA.
49. Invited Speaker, "Chronic and Portable Fluorescence Microscopy in Freely Moving Mice", *NIH Cutting-Edge Seminar Series Mini-Symposium*, Bethesda, MD, March 20, 2008.
50. Invited Speaker. "Chronic and Portable Fluorescence Microscopy in Freely Moving Mice", *FASEB/American Association of Anatomists Annual Meeting*, San Diego, CA., April 5, 2008.
51. Invited Speaker, "*In vivo* cellular level imaging using nonlinear optical microendoscopy". *Ultrafast Optics, Optoelectronics & Applications*; Conference on Lasers and Electro-optics (CLEO), May 4-9, 2008 in San Jose, CA.
52. Invited Speaker. "Of mice and microscopes: Watching the brain dynamics of motor control at the cellular scale in behaving animals", *Japanese Neuroscience Society Annual Meeting*, Tokyo, Japan. July 9, 2008.
53. Invited Speaker, "Fluorescence microendoscopy as a new modality for *in vivo* brain imaging", *Emerging high-resolution in vivo technologies*, 6th FENS Forum of European Neuroscience, Geneva, Switzerland, July 12, 2008.
54. Invited Speaker. "Innovations in Brain Imaging: From Miniaturized to Massively Parallel Instrumentation". *New Directions in Bio-Imaging Research, a Max Planck Society Symposium*, Palm Beach, FL. Aug. 14, 2008.
55. Invited Speaker, *NIH Director's Pioneer Award Symposium*, Sept. 22, 2008 in Bethesda, MD.
56. Invited Speaker, *NIH Blueprint Workshop on Non-invasive Brain Imaging*. Sept. 23, 2008. Bethesda, MD.
57. Invited Speaker, *University of Bordeaux-Laval University Joint Symposium on New Frontiers in Neurophotonics*, October 20, 2008 in Bordeaux, France.
58. Invited Speaker, *Unraveling Behavioral Function and Dysfunction with In vivo Cellular Imaging and Manipulation Strategies, A Satellite Symposium of the Society for Neuroscience Annual Meeting*, Wash. D.C., Nov. 13, 2008.
59. Invited Speaker, *Society for Neuroscience Annual Meeting, NIDA Sponsored Symposium on Frontiers in Addiction Research*, Washington, D.C., Nov. 14, 2008.
60. Invited Speaker, *Nanotechnology as an Enabler for Neuroscience, Neuroengineering, and Neural Prostheses*. Stanford University Center for Integrated Systems, Dec. 12, Stanford CA 94305.
61. Invited Speaker, *Physics of Living Matter 3, Inauguration of the Physics of Medicine*, Cambridge University, Cambridge UK, Dec 16, 2008.

62. Invited Speaker, *Photons and Neurons, SPIE Symposium on Biomedical Optics, Photonics West*. San Jose, CA, Jan. 25, 2009.
63. Plenary Session Speaker, *Optical Society of America Leadership Meeting*. Washington, D.C. Feb. 6, 2009.
64. Invited Speaker, *International Solid State Circuits Conference, Medical Image Sensor Forum*, San Francisco, CA. Feb. 8, 2009.
65. Plenary Session Speaker, *Society of Biological Psychiatry, 64th Annual Meeting*, Vancouver, Canada. May 14, 2009.
66. Invited Speaker, *Nobel Mini-Symposium, High-resolution in vivo imaging of cell biology*, Karolinska Institute, Stockholm, Sweden. May 16, 2009, *cancelled due to illness*.
67. Invited Speaker, *Gordon Conference on Neural Circuits & Plasticity*, June 7-12, 2009.
68. Invited Speaker, *IEEE/LEOS International Conference on Optical MEMS and Nanophotonics*, Aug. 17-20, 2009 Clearwater, FL.
69. Invited Speaker, *Second International Congress of the Society for Research on the Cerebellum*. Oct. 16, 2009. Chicago, IL.
70. Symposium Speaker. *New Technologies for Probing Brain Disease with Light: From Super-resolution and In vivo Imaging to Optical Control of Circuits*. Symposium, Society for Neuroscience 39th Annual Meeting, Chicago, IL, Oct 17, 2009.
71. Invited Speaker. *Fluorescent Proteins and Biological Sensors II*. Nov. 3, 2009, HHMI Janelia Farm Research Campus, Ashburn, VA.
72. Invited Public Presenter. *National Advisory Council for Biomedical Imaging and Bioengineering*. National Institute of Biomedical Imaging and Bioengineering. Bethesda, MD. Jan. 22, 2010.
73. Invited Speaker, *SPIE Photonics West*. San Francisco, CA. Jan 25, 2010.
74. *Award Symposium*. "Of Mice, Men, and Microscopes: Watching Cells at Work in Awake Behaving Mice and Humans". Biophysical Society, 54th Annual Meeting. Feb 23, 2010 in San Francisco, CA.
75. Invited Speaker. Institute of Molecular Pathology Symposium: *Seeing more: Emerging Technologies in Microscopy*, 27-29 May 2010, Vienna, Austria.
76. Invited Speaker. *Cerebellar Nuclei – Ins and Outs*. Satellite Symposium of the 7th Biennial Federation European Neuroscience Society (FENS) meeting.) July 2, 2010 in Amsterdam, Netherlands. (*cancelled due to illness*).
77. Invited Speaker. *Jacques Monod Conference on Imaging brain circuits in health and disease*. June 30-July 4, 2010, Roscoff, France. (*cancelled due to illness*).
78. Invited Speaker. *Commonalities in neurodegenerative diseases: proteins, pathologies, and protective strategies*. August 5, 2010, Bar Harbor, ME.
79. Invited Speaker. *Defense Sciences Research Council - New Tools for Neuroscience Workshop*. Nov 4, 2010. Arlington, VA.
80. Invited Participant. *National Academies Keck Futures Initiative – Imaging Science*. Nov. 16-18, Irvine, CA.
81. Invited Speaker. *The 16th Takeda Science Foundation Symposium on Bioscience*, December 1, 2010 Tokyo, Japan.
82. Speaker. *HHMI Science Meeting: "Neurons, Systems, and Neural Disease"*, Dec. 7, 2010, Janelia Farm Research Campus, Ashburn, VA.
83. Symposium Speaker. *Association for Research in Otolaryngology*, Mid-Winter meeting, Feb. 20, 2011. Baltimore MD.
84. Invited Speaker. *EMBO/EMBL Symposium Seeing is Believing Imaging the Processes of Life*. March 19, 2011, in Heidelberg, Germany.
85. Invited Speaker. *Janelia Conference: Multiphoton Imaging: The Next 6x10²³ Femtoseconds*, to April 3 - 6, 2011. Ashburn, VA.
86. Invited Speaker. *Cold Spring Harbor Asia Conference on New Advances in Optical Imaging of Live Cells and Organisms*, May 9-13, 2011, in Suzhou, China.
87. Speaker. *HHMI Science Meeting*. June 5-8, 2011, Ashburn, VA.
88. Symposium Speaker. *Paul G. Allen Foundation - Allen Distinguished Investigator Symposium*, June 14, 2011, Seattle, WA.
89. Invited Participant. *Allen Institute for Brain Science - Meeting the Decoding Challenge of the Brain*. June 15-16, 2011, Seattle, WA.
90. Invited Speaker. *EMBO Practical Course "Two-photon imaging of brain circuits"*. September, 3-10, 2011 in Munich, Germany.

91. Invited Speaker, *Defense Sciences Research Council*, "New tools for neuroscience". Nov. 3-4 in Arlington VA.
92. Plenary Speaker. *Association of American Medical Colleges (AAMC) Annual Meeting*. Nov. 7, 2011, Denver CO.
93. Invited Speaker. *2012 RIKEN Brain Science Institute Seminar Series*, June 14, 2012 in Saitama, Japan.
94. Invited Speaker. *Optical Society of America*, "Imaging Systems and Applications", June 25-27, 2012, Monterey, CA.
95. Invited Speaker. *Cold Spring Harbor Laboratory Course: "Advanced Techniques in Molecular Neuroscience"*. Cold Spring Harbor, New York. (2 presentations). July 10-11, 2012.
96. Invited Speaker. *Federation of European Neuroscience / International Brain Research Organization, Summer Course: "Imaging Neural Function"*, Sept. 4, 2012, Lausanne, Switzerland.
97. William Shucart Lecturer, *Tufts Neuroscience Symposium*, Tufts University, Oct. 4, 2012, Boston, MA.
98. Symposium Speaker. *Society for Neuroscience, Annual Meeting: "Cracking Neural Codes with Photons: Optogenetics as an Integral Tool for Systems"*, Oct. 15, 2012, New Orleans, LA.
99. Invited Speaker. *Cold Spring Harbor Asia Conference: Neural Circuit Basis of Behavior and its Disorders*. Nov. 7, 2012. Suzhou, China.
100. Invited Speaker, *8th Kavli Futures Symposium: Tool Development for the Brain Activity Map*. Arlington, VA. Dec 1, 2012.
101. Invited Speaker, *QB3/UCSF Course in Biological Light Microscopy*, UCSF Nikon Imaging Center, UCSF, San Francisco, CA. March, 2013.
102. Invited Speaker, *iBio Microscopy*, *iBiology.org*. May 2013.
103. 14th Distinguished Kavli Lecture, Kavli Inst. for Systems Neuroscience, NTNU, Trondheim, Norway, June 14, 2013.
104. Invited Speaker, NIH BRAIN Advisory Committee Working Group, Rockefeller Univ., New York, NY. June 26, 2013.
105. Invited Speaker, *Sloan-Swartz Annual Meeting on Computational Neuroscience*, Brandeis University, Boston, MA, July 27, 2013.
106. Invited Speaker, Second Biennial Symposium on *Emerging Genetics & Neurobiology of Severe Mental Illness*, Stanley Center, Broad Institute, Harvard/MIT, Cambridge, MA, September 10th, 2013.
107. Invited Speaker, *International Symposium on Optogenetics*, Keio University, Tokyo, Japan, Sept. 27, 2013
108. Invited Speaker, "*Illuminating brain function: new tools and new applications*". Korea Institute of Science and Technology (KIST), Seoul, Korea, Oct. 1, 2013.
109. Finalist Presentation, Israel Brain Prize, *Israel Brain Technologies*, Tel Aviv, Israel, Oct. 14, 2013.
110. Invited Speaker, Tau Consortium Futures Meeting, UCSF, San Francisco, CA, Feb. 21, 2014.
111. NIMH Director's Innovation Speaker Series, NIH, Bethesda, MD. March 4, 2014.
112. Panelist, Milken Global Conference, *Unlocking the Mysteries of the Brain*, Los Angeles, CA, April 29, 2014.
113. Invited Speaker, *Bioimaging — a paradigm shift for the life sciences*, 37th Naito Conference, Hokkaido, Japan, July 16, 2014.
114. Invited Speaker, *Quantifying structure in large neural datasets*, The Grossman Center for the Statistics of Mind, Columbia University, New York City, NY, Sept. 22-23, 2014.
115. Invited Panelist, White House BRAIN Conference, Washington DC, Sept. 30, 2014.
116. Invited Speaker, *Fluorescent Proteins and Biological Sensors IV*, HHMI Janelia Farm, Ashburn VA, Oct. 1, 2014.
117. Invited Speaker, *Champalimaud Neuroscience Program*, Lisbon, Portugal, Oct. 16, 2014.
118. Invited Speaker, *Frontiers in Addition Research*, NIDA Mini-Convention, Bethesda MD, Nov. 14, 2014.
119. Invited Speaker. *Meet the Expert*, Society for Neuroscience Annual Meeting, Washington DC, Nov. 15, 2014.
120. Invited Speaker, *Kavli Foundation/U.S. Dept. of Energy BRAIN Workshop*, Washington, D.C. Jan. 22, 2015.
121. Invited Speaker, White House Office of Science & Technology, *BRAIN Initiative Program Officers Meeting*, Eisenhower Executive Office Building, Washington, D.C., March 27, 2015.
122. Speaker, *HHMI Science Meeting*, September 10, 2015.
123. Plenary Lecture, Argentine Society for Research in Neuroscience, Sept. 29, 2015.
124. Invited Speaker, *Cell Press Symposium: Engineering the Brain*, Chicago, IL, Oct. 16, 2015 (Early morning).
125. Invited Panelist, *Dept. of Energy and NIH Joint BRAIN Workshop*, Argonne National Laboratory, Oct. 16 (AM) 2015.
126. Invited Panelist, *Is it time for a national BRAIN observatory? Kavli Foundation/Dept. of Energy*, Argonne National Laboratory, October 16th (PM), 2015.

127. Symposium Speaker, *Society for Neuroscience Annual Meeting*, “Hidden Variables of Behavior: Neuronal Parameters Underlying Brain States”, Chicago, IL. Oct. 18, 2015.
128. Invited Speaker, *Hippocampal-Entorhinal Complexities: Maps, Cell Types and Mechanisms*, HHMI Janelia Conference, Nov. 8–11, 2015.
129. Invited Speaker, *MIT Center for Brains Minds and Machines*, Cambridge MA, Nov. 13, 2015.
130. Invited Speaker, *EMBO Conference on Imaging the Brain*, Nencki Institute in Warsaw, Poland, May 18-20, 2016.
131. Invited Speaker, 2016 Keystone Symposia, *Brain 2016*, May 15-20, 2016, Alpbach, Austria.
132. Invited Speaker, Jacques-Monod conference on “Optical imaging of brain connectivity: from synapses to networks in action”, June 15, 2016 in Roscoff, Brittany.
133. Symposium Speaker, *Federation of European Neuroscience Societies, Forum of Neuroscience 2016*, July 6, 2016, Copenhagen, Denmark.
134. Invited Speaker, Gordon Research Conference, “Optogenetic approaches to understanding neural circuits and behavior”, July 20, 2016, Newry, ME.
135. Symposium Speaker, *Stanford Neurosciences Institute, 2016 Symposium*, Oct. 13, 2016, Stanford CA.
136. Invited Speaker, HHMI Meeting on Fluorescent Proteins & Biological Sensors V, Janelia Farm Research Campus, Nov. 9, 2016. Ashburn VA.
137. Invited Panelist, 2016 BRAIN Initiative Investigators Meeting, “Exciting new technologies from BRAIN”, moderated by Dr. Joe Palca of National Public Radio, and Dr. Joshua Gordon, NIMH Director, Dec. 13, 2016.
138. Symposium Speaker, 2017 Suddath Symposium: “Neuromodulation & Synaptic Control: Modern Tools & Applications”, Feb. 21, 2017, Georgia Tech., Atlanta, GA,
139. Keynote Speaker, Muscular Dystrophy Assoc. 2017 Scientific Conference, Mar. 19, 2017, Wash. DC.
140. Symposium Speaker, German Neuroscience Society Meeting, Mar. 24, 2017, Gottingen, Germany.
141. Invited Speaker, Optical Soc. America Meeting, “Optics and the Brain, 2017”, April 2-5, San Diego, CA.
142. Invited Speaker, BRAIN Prize Meeting / Federation of European Neuroscience Societies, “Learning, Memory & Synaptic Plasticity”, April 23–26, 2017. Copenhagen, Denmark.
143. Invited Speaker, Klingenstein-Simons Meeting, *May 10, 2017*, New York, NY.
144. Invited Speaker, 12th Uehara International Symposium, ‘*Make Life Visible*’, June 12–14, 2017, Tokyo.
145. Course Lecturer, FENS Cajal Neuroscience Training Course, “*Interacting with neural circuits*”, Portugal, July 2017.
146. Symposium Speaker, Japan Neuroscience Society Meeting, *July. 20–23*, Nakase, Japan.
147. Keynote Speaker, Gordon Research Seminar on Amygdala Function in Emotion, Cognition & Disease, Aug. 6, 2017. Stonehill, MA.
148. Speaker, Gordon Research Conference on Amygdala Function in Emotion, Cognition & Disease, Aug. 7, 2017. Stonehill, MA.
149. Invited Speaker, Kavli Foundation Salon, Aug. 19, 20, 2017, Budapest, Hungary.

Honors received by my lab’s graduate students and postdoctoral fellows:

- Eran A. Mukamel, 2002 NSF Graduate Fellowship.
- Amit Mehta, 2003 Life Sciences Research Foundation Fellow
- Benjamin A. Flusberg, 2004 NSF Graduate Fellowship.
- Daniel Z. Wetmore, 2004 NSF Graduate Fellowship.
- Eunice Cheung, 2005 Dean's Fellowship, Stanford University School of Medicine.
- Robert P.J. Barretto, 2005 NSF Graduate Fellowship Honorable Mention.
- Axel Nimmerjahn, 2006 Feodor Lynen Humboldt Society Postdoctoral Fellowship.
- Axel Nimmerjahn, 2006 Du Bois-Reymond Prize in Physiology.
- Axel Nimmerjahn, 2006 Otto Hahn Medal of the Max Planck Society.
- Laurie Burns, 2007 Stanford Graduate Fellowship.
- Michael Molineux, 2007 Alberta Heritage Foundation for Medical Research, Fellowship.
- Eran Mukamel, 2008 Sloan-Swartz Postdoctoral Fellow, Harvard University.

Laurie Burns, 2008 NSF Graduate Fellowship.
James Fitzgerald, 2008 NSF Graduate Fellowship.
Brian Wilt, 2008 Stanford Bio-X Graduate Fellowship.
Gabriel Sanchez, 2008 Stanford Graduate Fellowship (Co-Advised with Scott Delp).
Melinda Cromie, 2008 Stanford Graduate Interdisciplinary Fellowship (Co-Advised by Scott Delp).
Yaniv Ziv, 2008 Rothschild Postdoctoral Fellowship.
Yaniv Ziv, 2008 Machiah Postdoctoral Fellowship.
Zuzanna Pikowska, 2009 Marie Curie Postdoctoral Fellowship.
Georg Dietzl, 2009 Austrian Academy of Science Postdoctoral Fellowship.
Dan-Anders Jirenhed, 2009 Swedish Research Council Postdoctoral Fellowship.
Elizabeth Otto, 2009 Stanford Graduate Fellowship.
Shelley Batts, 2010 Ruth L. Kirschstein NIH NRSA fellowship.
Jesse Marshall, 2010 Stanford Graduate Fellowship.
Lacey Kitch, 2010 Stanford Graduate Fellowship.
Benjamin Grewe, 2011 Swiss National Science Foundation Fellowship.
Jeff Chi-Tat Law, 2011 Croucher Fellowship.
Jerome Lecoq, 2011 Institut de France Prix AXA-Académie des Sciences.
Tony Hyun Kim, Stanford Graduate Fellowship, 2011.
Oleg Rumyantsev, Stanford Graduate Fellowship, 2012.
Lacey Kitch, Simons Graduate Fellowship, 2012.
Lacey Kitch, NSF Graduate Research Fellowship, 2012.
Lacey Kitch, Stanford Graduate Fellowship, 2012.
Seung Je Woo, Samsung Fellowship, 2012.
Biafra Ahanonu, NSF Graduate Research Fellowship, 2013.
Jerome Lecoq, Postdoctoral Fellowship, Stanford Institute for Neuro-Innovation and Translational
Neurosciences (SINTN) and Department of Ophthalmology, 2013.
Margaret F. Carr, Helen Hay Whitney Postdoctoral Research Fellowship, 2013.
Amy Christensen, Texas Instruments Stanford Graduate Fellowship, 2013.
Tugce Tasci, Simons Graduate Fellowship, 2014.
Pablo Jercog, Marie Curie Fellow, 2014.
Biafra Ahanonu, HHMI Gilliam Fellowship, 2015.
Albert Tsao, Helen Hay Whitney Postdoctoral Fellowship, 2015.
Jesse Marshall, Helen Hay Whitney Postdoctoral Fellowship, 2016.
Jones Parker, NIH K01 Research Career Development Award, 2017.

Former Postdocs and Ph.D. Students who are now Principal Investigators:

Wibool Piyawattanametha, Associate Professor, King Mongkut's Institute of Technology, Bangkok, Thailand.
Edward Boyden, Professor, Massachusetts Institute of Technology, Cambridge, MA.
Axel Nimmerjahn, Assistant Professor, Salk Institute, San Diego, CA.
Eran Mukamel, Assistant Professor, University of California at San Diego (UCSD), San Diego, CA.
Alessio Attardo, Junior Group Leader, Max Planck Institute for Psychiatry, Munich, Germany.
Yaniv Ziv, Assistant Professor (Senior Scientist), Weizmann Institute of Science, Rehovot, Israel.

Dan-Anders Jirenhed, Assistant Researcher, Lund University, Lund, Sweden.

Eric Tatt Wei Ho, Senior Lecturer, Universiti Teknologi Petronas, Seri Iskandar, Malaysia.

Jerome Lecoq, Senior Scientific Manager, Allen Institute for Brain Science, Seattle, WA.

Pablo Jercog, Junior Group Leader, Marie Curie Fellow, IDIBAPS, University of Barcelona, Barcelona, Spain.

Yiyang Gong, Assistant Professor, Duke University, Durham, NC.

James Fitzgerald, Group Leader, HHMI Janelia Farm Research Campus, Ashburn, VA (*to start* in 2018).

Benjamin F. Grewe, Assistant Professor, Institute of Neuroinformatics, ETH Zürich, Zürich, Switzerland.

Research Support:

NSF Instrumentation Development 4/2004-3/2007

Title: "High-resolution cellular imaging in freely moving animals using fiber-optic multiphoton fluorescence endoscopy".

Young Investigator Award, Office of Naval Research 6/2004-5/2009

Title: "In vivo micro-optical imaging of neuronal dynamics".

NIDA R21 07/31/2005-07/31/2006

Title: "Chronic Brain Imaging Using Fluorescence Endoscopy".

NIDCD R21 12/05-11/07.

Title: "Cognitive processing of temporal information in the cerebellum".

NIH R01 Neurotechnology Program Announcement. 1/2005-12/2009

Title: "Microscopy with micro-optics in deep tissue *in vivo*".

Beckman Foundation, Young Investigator Award 9/1/2004-8/31/2007

Title: "Cellular Imaging in Freely Moving Animals Using Fiber-Optic Multiphoton Fluorescence Endoscopy".

P51 NCI (PI: Gambhir) (2006)

Title: "*In vivo* imaging of brain tumor cellular dynamics using fluorescence microendoscopy

Beckman Translational Research Program 11/15/2005-11/14/2008

Title: "Minimally Invasive Cellular Level Imaging in the Inner Ear for Diagnosis Intervention using Fluorescence Microendoscopy".

Coulter Foundation (PI: Boahen) 4/1/2006-3/31/2007

Title: "Minimally invasive cellular level imaging in the inner ear for intervention and diagnosis using fluorescence microendoscopy".

Klingenstein Fellowship in Neuroscience 7/1/2004-6/30/2007

Title: "In Vivo Imaging of Neuronal Calcium Dynamics Underlying Cerebellar-Dependent Classical Conditioning".

Mauna Kea Technologies 3/1/2006-2/28/2007

Title: "Multi-Modality Microendoscopy".

Packard Foundation Science and Technology Fellowship 11/1/2005-10/31/2005

Title: "Fiber-optic Imaging and Comparative Neurocomputing Studies of Cerebellar Circuits".

Sloan Foundation Fellowship 9/16/2005-9/15/2007

Title: "In vivo imaging of neuronal dynamics underlying cerebellar-dependent learning and memory".

Lawrence Livermore National Laboratory 2007

Title: "Miniaturized integration of a fluorescence microscope".

Bio-X IIP Award 2007

Title: "How are synapses eliminated to generate a functional neural circuit?"

NSF Center for Biophotonics 2007-2008.

Title: "Multi-modal microendoscopy".

Stanford Medical Free Electron Laser Program (PI: Schwettman) 2008.

Title: "Cochlear microendoscopy".

Anonymous Foundation 08/01/2007 – 08/31/2010

Title: “Massively Parallel Brain Imaging”.

NIH NDC for the Optical Control of Biological Function (PI: Isacoff) 09/2009 – 8/2010

Title: “Combined *in vivo* photonic imaging and control in deep mammalian tissues using minimally invasive microendoscopy”.

NIH Director’s Pioneer Award 09/30/2007 – 07/31/2012

Title: “Massively Parallel Brain Imaging”.

W.M. Keck Foundation 01/2008–12/2012

Title: “Massively Parallel Brain Imaging”.

Howard Hughes Medical Institute, 9/2008–2013 (up for review/renewal consideration in 2013).

Title: Discretionary Research Funds.

Stanford Medical Free Electron Laser Program (PI: Contag) 2011.

Title: “Cochlear microendoscopy”.

NSF Biophotonics (5/2010 – 5/2013)

Title: “Chip-scale ultrashort pulsed lasers for two-photon fluorescence imaging and sensing”.

NIH NDC for the Optical Control of Biological Function (PI: Isacoff) 09/2010 – 8/2012

Title: “*In vivo* brain imaging studies of visual discrimination”.

Bill & Melinda Gates Foundation (6/2010 – 6/2011)

Title: “Mass-producible, miniaturized fluorescence microscopes for low-cost diagnosis of tuberculosis”.

NIBIB R21

Title: “Microscopy in the cochlea”. 12/2010 – 11/2012

Center for Biomedical Imaging at Stanford

Title: “Integrated fluorescence microscopes based on CMOS image sensors for teaching digital imaging in the microscopy courses at Stanford University”

Paul G. Allen Foundation (11/2010 – 11/2012)

Title: “Massively parallel brain imaging in mouse models of human brain disease”.

DARPA (subcontract from HRL) (2/2011 – 8/2012)

Title: “SyNapse Phase 2”

NSF DBI (2/2011–2/2014)

Title “Integrated, miniaturized fluorescence microscopes for biology research and general science education”.

Center for Biomedical Imaging at Stanford (2011).

Title: “Integrated fluorescence microscopes based on CMOS image sensors for teaching digital imaging in the microscopy courses at Stanford University”.

National Academy Keck Futures Initiative (2011).

Title: “A technology platform for high-resolution biomedical imaging in live animals using genetically targeted nanoparticles.”

NIA R21 (9/2011–9/2013).

Title: “Hippocampal neurodifferentiation studied in young and aged animals by *in vivo* microendoscopy”.

NIMH R21 (9/2011–9/2013)

Title: “Hippocampal dendritic spines tracked across learning and memory processing using *in vivo* microendoscopy”.

Stanford Bio-X IIP Award (PI: Lin) (2011–2012).

Title: “Rationally engineered sensors of millisecond neuronal activity”.

Stanford Bio-X Neuroventures (2/2012–2/2014).

Title: “Bridging the gap from cells to cognition: Photoacoustic imaging of mesoscopic brain activity”.

Ellison Foundation, Senior Scholar Award. (12/2012–11/2016).

Title: “Visualizing forgetful neurons: A first study on the long-term stability and instability of cellular representations of spatial memory in aged brains.”

NIMH R21 (1/2013–12/2014).

Title: “Long-term kinetics of CA1 hippocampal place codes.”

HHMI Instrumentation Fabrication Project (8/2012-8/2014).

Title: "Next-generation instrumentation for two-photon optical imaging of neural dynamics in awake behaving mice and rats"

HHMI Investigator status renewed through 2018.

DARPA (10/2013–9/2015) PI: Childrens' Hospital of Philadelphia.

Title: "Identifying the neural substrates regulating emotional arousal: Towards a Path to Stress Resistance."

NIMH R01 (1/2013-12/2017).

Title: "Imaging astrocytic calcium dynamics in freely behaving mice."

DARPA (1/2014-6/2015). PI: Schnitzer

Title: "Imaging the dynamics of 10,000-50,000 neurons in the brains of awake behaving mammals".

NIMH EUREKA R01 (9/2013–7/2017). PI: Schnitzer.

Title: "Octopus microscopy for imaging multiple brain areas concurrently."

NIH BRAIN U01 (11/2014–10/2017). Co-PDs: M.J. Schnitzer and M.Z. Lin.

Title: "Protein voltage sensors: kilohertz imaging of neural dynamics in behaving animals."

European Research Commission (2/2015–7/2016). PI: Universite de Lausanne.

Title: "The language of astrocytes: Multilevel analysis to understand astrocyte communication and its role in memory-related brain operations and in cognitive behavior".

Tau Consortium (1/2015–12/2015). PI: Schnitzer. Title: "Ensemble neural codes underlying prefrontal cortical and hippocampal function and dysfunction in normal and tauopathy model mice."

DARPA (4/2016–10/2017). PI: Schnitzer. Title: "Basic principles of optical read-write manipulations of sensory cortex and perception".

NIH R24 (09/15/2016 - 05/31/2020). PI: Schnitzer. Title: "Large-scale dual-color two-photon calcium imaging in awake behaving animals".

DARPA (12/2016–12/2018). PI: Sahel. Title: "Visual restoration: Cortical prosthesis and optogenetic therapy".

NIH 1R21NS104833-01 (09/01/2017-08/31/2019) PI: Schnitzer. Title "Ensemble neural dynamics in the medial prefrontal cortex underlying cognitive flexibility and reinforcement learning".

NSF DBI-1707261 (12/01/2017-11/30/2019). PI: Deisseroth. Title: "NeuroNex Technology Hub: Integrated Circuit Cracking (ICC) with Linked Tools for Diverse Systems Linking tools and communities to crack neural circuits".

DARPA HR0011-16-2-0017 (10/15/2017 – 10/14/2018). PI: Schnitzer. Title: "Basic principles of optical read-write manipulations of sensory cortex and perception".

DARPA HR0011-17-C-0038 (02/07/2017-09/30/2020) PI: Moore. Title: "Visual restoration: Cortical prosthesis and optogenetic therapy".

NIH 1U19NS104590-01 (09/01/2017-08/31/2022). PI: Soltesz. Title: "Towards a Complete Description of the Circuitry Underlying Sharp Wave-Mediated Memory Replay"

DARPA (9/1/2017 - 2/28/2019) Title: "Monitoring the activity of 1 million neurons in awake behaving mammals".