

# **Xue Han, Ph.D.**

Postdoctoral Fellow

MIT McGovern Institute and MIT Media Lab  
Massachusetts Institute of Technology

*Address* MIT 46-6165, 77 Massachusetts Ave., Cambridge, MA 02139

*Email* xuehan1 (at) gmail.com

*Web* <http://www.xuehan.org>

- Objective** Discover design principles for novel neural modulation therapies.
- Education** **Ph. D. (2004)** Physiology, University of Wisconsin – Madison  
**B. S. (2000)** Biophysics and Physiology, Beijing University, Beijing, China
- Fellowships and Awards** NIMH K99 pathway to independence award, 2009-present  
Helen Hay Whitney Postdoctoral Fellowship, 2006-2009  
MIT McGovern Institute Neurotechnology Award, 2007-2008  
UW-Madison Jerzy Rose Neuroscience Thesis Award, 2005  
UW-Madison Vilas Travel Award, 2002  
UW-Madison Cremer Fellowship, 2000-2001
- Research Experience** **2009-present**  
Postdoctoral Fellow with Drs Robert Desimone and Edward Boyden  
MIT McGovern Institute and MIT Media Lab, MIT, Cambridge, MA
- 2007-2009**  
Helen Hay Whitney Fellow with Drs Edward Boyden, Robert Desimone and Tirin Moore  
Department of Biological Engineering, McGovern Institute and Media lab, MIT, Cambridge, MA  
Neurobiology Department, Stanford University, Palo Alto, CA
- 2006-2007**  
Research Affiliate with Synthetic Neurobiology Group  
Department of Biological Engineering and MIT media lab, MIT, Cambridge, MA
- 2005-2007**  
Helen Hay Whitney Fellow with Drs. Richard Tsien and Tirin Moore  
Department of Molecular and Cellular Physiology, and Department of Neurobiology, Stanford University, Stanford, CA
- 2005**  
Postdoctoral Fellow with Dr. Meyer Jackson  
Department of Physiology, University of Wisconsin – Madison, Madison, WI
- 2000-2004**  
Graduate Student with Dr. Meyer Jackson

Department of Physiology, University of Wisconsin – Madison, Madison, WI

**1999- 2000**

Undergraduate Research Associate with Dr. Ying-Chuan Tian

Laboratory of Plant Biotechnology, Institute of Microbiology, Chinese Academy of Sciences, Beijing, China

**Publications  
(Journal  
Papers)**

1. **Xue Han**, Chih-Tien Wang, Jihong Bai, Edwin R. Chapman and Meyer B. Jackson, “Transmembrane segments of syntaxin line the fusion pore of Ca<sup>2+</sup>-triggered exocytosis,” *Science* 304 (5668): 289-92 (2004)
2. **Xue Han** and Meyer B. Jackson, “Electrostatic interactions between the syntaxin membrane anchor and neurotransmitter passing through the fusion pore,” *Biophys J.* 88 (3): L20-2 (2005)
3. **Xue Han** and Meyer B. Jackson, “Structural Transitions in the Synaptic SNARE Complex during Calcium Triggered Exocytosis,” *J Cell Biol.* 172(2): 281-93 (2006)
4. **Xue Han** and Edward S. Boyden, “Multiple-Color Optical Activation, Silencing, and Desynchronization of Neural Activity, with Single-Spike Temporal Resolution,” *PLoS ONE*, 2(3):e299. (2007)
5. Bernstein J.G.\*, **Han X.**\*, Henninger M.A., Koa E.Y., Qian X., Franzesi G.T., McConnell J.P., Stern P., Desimone R., and Boyden E.S., "Prosthetic Systems for Therapeutic Optical Activation and Silencing of Genetically-Targeted Neurons," *Optical Interactions with Tissue and Cells XVIII, Proceedings of the SPIE.* (2008). \* Equal contributions
6. **Xue Han**, Xiaofeng Qian, Jacob G. Bernstein, Hui-hui Zhou, Giovanni Talei Franzesi, Patrick Stern, Roderick T. Bronson, Ann M. Graybiel, Robert Desimone and Edward S. Boyden, “Millisecond-Timescale Optical Control of Neural Dynamics in the Nonhuman Primate Brain,” *Neuron* 62(2):191-8 (2009)
7. **Xue Han**, Sherry X. Xian, and Tirin Moore, “Dynamic sensitivity of area V4 neurons during saccade preparation”, *PNAS* 106(31):13046-51 (2009)
8. **Xue Han**, Xiaofeng Qian, Patrick Stern, Amy Chuong and Edward S. Boyden, “Informational lesions: optical perturbation of spike timing and neural synchrony via microbial opsin gene fusions”, *Front. Mol. Neurosci* 2, 12, (2009)
9. Chow, B. Y.\*, **Han, X.**\*, Dobry, A. S., Qian, X., Chuong, A. S., Li, M., Henninger, M. A., Belfort, G. M., Lin, Y., Monahan, P. E., Boyden, E. S. High-performance genetically targetable optical neural silencing by light-driven proton pumps, *Nature* 463:98-102. (2010) (\* equal contributions)

**Talks and  
Conference  
Abstracts**

1. Xue Han and Meyer B. Jackson, “Transmembrane segments of syntaxin are the molecular components of the fusion pore of Ca<sup>2+</sup>-triggered exocytosis,” poster presentation at Society for Neuroscience (SFN), New Orleans, LA (2003).
2. Xue Han and Meyer B. Jackson, “Syntaxin regulates fusion pore dynamics during Ca<sup>2+</sup>-

- triggered exocytosis,” poster presentation at Gordon Research Conference, Meriden, NH (2004).
3. Xue Han and Meyer B. Jackson, “Electrostatic interactions between syntaxin transmembrane segment and neurotransmitter escaping through fusion pores,” poster presentation at Society for Neuroscience (SFN), San Deigo, CA (2004).
  4. Xue Han and Meyer B. Jackson, “SNARE Complex Core Mutations Alter the Kinetics of Secretion and Fusion Pores,” poster presentation at Society for Neuroscience (SFN), Washington DC (2005).
  5. Xue Han and Edward S. Boyden, “Two-Color, Bi-Directional Optical Voltage Control of Genetically-Targeted Neurons,” spotlight talk at Computational and Systems Neuroscience (CoSyNe), Salt Lake City, UT (2007).
  6. Xue Han, Sherry Xian and Tirin Moore, “Changes in Contrast Sensitivity of Area V4 Neurons during Saccadic Eye Movements,” talk at European Conference on Visual Perception (ECVP), Arezzo, Italy (2007).
  7. R. D. Groth, M. Lindskog, T. C. Thiagarajan, X. Han, R. W. Tsien, “ $\beta$ CaMKII triggers coordinated pre- and postsynaptic adaptations to inactivity in hippocampal neurons”, poster presentation SFN, Washington DC (2008).
  8. M. A. Henninger, J. Bernstein, E. Ko, A. Strelzoff, S. C. Y. Chan, V. Gidwaney, E. Stickgold, A. M. Tentori, J. McConnell, A. Rodriguez, P. Monahan, G. Talei Franzesi, X. Han, X. Qian, E. S. Boyden, “A scalable toolbox for systematic, cell-specific optical control of entire 3-D neural circuits in the intact mammalian brain” poster presentation SFN, Washington DC (2008).
  9. X. Han, X. Qian, J. Bernsterin. H. Zhou, A. Graybiel, R. Desimone, E.S. Boyden, “Millisecond-timescale optical control of specific genetically-targeted neurons and neural circuits in primate cerebral cortex”, poster presentation SFN, Washington DC (2008).
  10. X. Han, S. Xian and T. Moore, “Neuronal mechanisms of saccadic suppression in ventral visual cortex” poster presentation at SFN, Washington DC (2008).
  11. X. Han, X. Qian, G.T. Franzesi, P. Stern, and E.S. Boyden, “Molecular toolboxes for quantitatively precise, genetically-targeted optical control of normal and pathological neural network dynamics” poster presentation at SFN, Washington DC (2008).
  12. X. Han, X. Qian, J. Bernstein, H. Zhou, A. Graybiel, R. Desimone, E. S. Boyden, “Safety and efficacy of genetically-targeted optical neuromodulation in non-human primates.” Optical Interactions with Tissue and Cells XVIII, Proceedings of the SPIE (2009).
  13. Giovanni Talei Franzesi, Xiaofeng Qian, Mingjie Li, Xue Han, Christoph Borgers, Nancy Kopell, Fiona Le Beau, Miles Whittington, Edward Boyden, "Probing mechanisms of gamma rhythmogenesis with cell type-specific optical neural control", poster presentation at CoSyNe, Salt Lake City, UT (2009).
  14. Brian Chow, Xue Han, Xiaofeng Qian, Edward Boyden, "High-performance halorhodopsin

variants for improved genetically-targetable optical neural silencing", poster presentation at CoSyNe, Salt Lake City, UT (2009).

15. X. Han, X. Qian, J. Bernstein, H. Zhou, A. Graybiel, R. Desimone, E. S. Boyden, "Safety and efficacy of genetically-targeted optical neuromodulation in non-human primates." Neural Control of Movement (2009).

16. G. TALEI FRANZESI, C. BORGERS, X. QIAN, M. LI, X. HAN, N. KOPELL, F. LEBEAU, M. WHITTINGTON, E. S. BOYDEN, "Dynamical properties of gamma-frequency cell assemblies in the hippocampus probed with optical neural control and computational modeling." poster presentation SFN, Chicago (2009).

17. B. Y. CHOW, X. HAN, X. QIAN, M. LI, A. S. CHUONG, P. E. MONAHAN, A. S. DOBRY, E. S. BOYDEN, "High-efficacy, temporally-precise, in vivo neural silencing via light-driven proton pumping." poster presentation SFN, Chicago (2009).

18. B. Y. CHOW, X. HAN, X. QIAN, M. LI, A. S. CHUONG, P. E. MONAHAN, A. S. DOBRY, E. S. BOYDEN, "Multiple-color optical silencing of distinct neural populations using novel classes of light-driven ion pumps." poster presentation SFN, Chicago (2009).

19. A. N. ZORZOS, A. DIETRICH, G. TALEI FRANZESI, B. CHOW, X. HAN, C. G. FONSTAD, E. S. BOYDEN, "Light-proof neural recording electrodes." poster presentation SFN, Chicago (2009).

20. M. M. MCCARTHY, X. HAN, E. BOYDEN, N. KOPELL, "Striatum as a possible source of exaggerated beta oscillations in Parkinson's disease: Insights from computational models." poster presentation SFN, Chicago (2009).

**Conference  
Papers and  
Abstracts  
(peer  
reviewed)**

1. Xue Han and Edward S. Boyden, "Two-Color, Bi-Directional Optical Voltage Control of Genetically-Targeted Neurons," spotlight talk at Computational and Systems Neuroscience (CoSyNe), Salt Lake City, UT (2007).

2. Xue Han, Sherry Xian and Tirin Moore, "Changes in Contrast Sensitivity of Area V4 Neurons during Saccadic Eye Movements," Perception, 36 ECVF Abstract Supplement (2007).

3. Bernstein J.G.\*, Han X.\*, Henninger M.A., Koa E.Y., Qian X., Franzesi G.T., McConnell J.P., Stern P., Desimone R., and Boyden E.S., "Prosthetic Systems for Therapeutic Optical Activation and Silencing of Genetically-Targeted Neurons," Optical Interactions with Tissue and Cells XVIII, Proceedings of the SPIE (2008). \* Equal contributions

**Theses**

**Xue Han (2004)**, "Molecular composition and regulation of the fusion pore of calcium triggered exocytosis," Ph.D. Thesis in Physiology, University of Wisconsin, Madison, WI.

**Xue Han (2000)**, "Construction of plant expression vectors with anti-insect genes and their expression in rice," Bachelor Thesis in Physiology and Biophysics, Beijing University, Beijing, China.

**Patents**

1. "Genetically-Targetable Optical Inactivation of Excitable Cells," two pending applications.

2. "Methods and Compositions of Optical Neural Control in Primate Brain" pending application

**Teaching  
Experience**

Medical Physiology 335, 2001, Medical School, UW – Madison, Teaching Assistant

**Social  
Activities**

Society for the Neural Control of Movement (2009 – present)

SPIE (2008 – present)

Society for Neuroscience (2000 – present)

Expanding Your Horizons, Health & Medicine Section, UW-Madison (2004)

UW Graduate Women in Sciences (2000 – 2004)

Madison Hooper Sailing Club (2001 – 2005)

**Invited Talks**

Han, X. (2005), “Molecular composition and regulation of the fusion pore of Ca<sup>2+</sup> triggered exocytosis,” invited talk, department of molecular and cellular biology, Berkeley University, Berkeley, CA.

Han, X. (2005), “Molecular composition and regulation of the fusion pore of Ca<sup>2+</sup> triggered exocytosis,” invited talk, department of molecular and cellular physiology, Stanford University, Stanford, CA.

Han, X. (2008), “Novel approaches to the analysis of cognitive circuits,” invited talk, Center for Brain Science, Harvard University, Cambridge, MA.

Han, X. (2008), “New approaches to analyze neural circuit and to treat neurological diseases,” invited talk, Research forum at Novartis, Cambridge, MA.

Han, X. (2008), “Novel approaches to analyze neural circuits,” invited talk, MIT McGovern Institute 2008 Retreat, Newport, RI.

Han, X. (2008), “Neural circuit analysis of attention at millisecond time scale,” invited talk, HHWF 2008 Retreat, Dedham, MA.

Han, X (2009), “Safety and efficacy of genetically-targeted optical neuromodulation in non-human primates.” invited talk at SPIE 2009, San Jose, CA.

Han, X (2009), “Dynamic neural response upon optical modulation of primate cortical excitatory neurons”, invited talk, NYU, New York, NY.

Han, X (2009), “Developing novel cell-type specific optical neural control prosthetics”, invited talk, BU, Boston, MA.

Han, X (2009), “Developing novel cell-type specific optical neural control prosthetics”, invited talk, BU medical campus, Boston, MA.