Edward S. Boyden, Plenary Speaker

Leader, Synthetic Neurobiology Group

Associate Professor and AT&T Chair, MIT Media Lab and McGovern Institute, Departments of Biological Engineering and Brain and Cognitive Sciences

Co-Director, MIT Center for Neurobiological Engineering

New York Stem Cell Foundation-Robertson Investigator and

Paul Allen Distinguished Investigator

Presentation Title: **Tools for Mapping Brain Computations**

Dr. Ed Boyden is an expert in inventing new tools for neuroscience for understanding and controlling neural circuits, to reveal their underlying mechanisms and to reveal principles of treating neural disorders. He is a neuroscientist, but also skilled at many domains of engineering, ranging from nanoengineering to chemistry, genomics, optics and electrical engineering. He works with multidisciplinary teams including physicists, chemists, computer scientists, clinicians, and hardware engineers, and collaborates with labs around the world to bring new technologies to bear upon the study of the brain. His lab at MIT, and their partners, have shared the tools they have developed with 1000 research groups from around the world.

Major International Awards and Recognitions

2013, Jacob Heskel Gabbay Award
2013, Grete Lundbeck European Brain Research Prize (“The Brain Prize”)
2011, Perl/UNC Neuroscience Prize
2011, A F Harvey Prize
2010, Nature Methods Method of the Year
2007, Society for Neuroscience, Research Award for Innovation in Neuroscience (RAIN)
2006, Technology Review TR35, World’s Top 35 Innovators under Age 35

Honorary Grant Awards

2013, NIH Director's Pioneer Award
2013, NIH Director’s Transformative Research Award
2012, NIH Director’s Transformative Research Award
2011, New York Stem Cell Foundation-Robertson Investigator Award
2011, NSF CAREER Award
2010, Paul Allen Distinguished Investigator Award in Neuroscience

2008, NARSAD Young Investigator Award
2008, Alfred P. Sloan Research Fellowship
2007, NIH Director's New Innovator Award
2005, McKnight Technological Innovations in Neuroscience Award, Investigator
2005, Helen Hay Whitney Fellowship
1999, Fannie and John Hertz Fellowship

Other Honors

2013, World Economic Forum, Young Scientist
2012, Wired, "Smart List 2012: 50 People Who Will Change the World"
2008, Discover Magazine, 20 Best Scientists Under Age 40
2006, Fannie and John Hertz Foundation, Top Ph.D. Thesis Prize
2004, Dan David Prize Scholarship (Future Dimension, Brain Sciences)
1998, International Autonomous Underwater Vehicle Competition, 1st place

Selected Peer-reviewed papers

1. Boyden, E. S., Zhang, F., Bamberg, E., Nagel, G., Deisseroth, K. (2005) Millisecond-timescale, genetically-targeted optical control of neural activity, Nature Neuroscience 8(9):1263-1268. PMCID: N/A (pre-2008)

2. Han, X. and Boyden, E. S. (2007) Multiple-color optical activation, silencing, and desynchronization of neural activity, with single-spike temporal resolution, PLoS ONE 2(3): p. e299. PMCID: PMC1808431

3. Han, X., Qian, X., Bernstein, J.G., Zhou, H.-H., Talei Franzesi, G., Stern, P., Bronson, R.T., Graybiel, A.M., Desimone, R., and Boyden, E.S. (2009) Millisecond-Timescale Optical Control of Neural Dynamics in the Nonhuman Primate Brain, Neuron 62(2): 191-198. PMCID: PMC2830644

4. 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. (2010) High-performance genetically targetable optical neural silencing by light-driven proton pumps, Nature 463:98-102. PMCID: PMC2939492

5. Desai M., Kahn I., Knoblich U., Bernstein J., Atallah H., Yang A., Kopell, N., Buckner R.L., Graybiel A. M., Moore C. I., and Boyden E. S. (2011) Mapping Brain Networks in Awake Mice Using Combined Optical Neural Control and fMRI, Journal of Neurophysiology 105(3):1393-405. PMCID: PMC3074423

6. Wentz, C. T., Bernstein, J. G., Monahan, P., Guerra, A., Rodriguez, A., Boyden, E. S. (2011) A Wirelessly Powered and Controlled Device for Optical Neural Control of Freely-Behaving Animals, Journal of Neural Engineering 8(4):046021. PMCID: PMC3151576

7. Joo, J., Chow, B. Y., Prakash, M., Boyden, E. S., Jacobson, J. M. (2011) Face-selective electrostatic control of hydrothermal zinc oxide nanowire synthesis, Nature Materials 10(8):596-601. PMCID: PMC3572365

8. Chow, B. Y. and Boyden, E. S. (2011) Synthetic Physiology, Science 332(6037):1508-1509. PMCID: PMC3553595

9. Han, X.*, Chow, B. Y.*, Zhou, H., Klapoetke, N. C., Chuong, A., Rajimehr, R., Yang, A., Baratta, M. V., Winkle, J., Desimone, R., Boyden, E. S. (2011) A high-light sensitivity optical neural silencer: development and application to optogenetic control of non-human primate cortex, Frontiers in Systems Neuroscience 5:18. (* co-first authors) PMCID: PMC3082132

10. Kleinlogel, S., Terpitz, U., Legrum, B., Gokbuget, D., Boyden, E. S., Bamann, C., Wood, P. G., Bamberg, E. (2011) A gene-fusion strategy for stoichiometric and co-localized expression of light-gated membrane proteins, Nature Methods 8(12):1083-1088. PMCID: N/A (no NIH funding)

11. Madisen, L., Mao, T., Koch, H., Zhuo, J.-m., Berenyi, A., Fujisawa, S., Hsu, Y.-W., Garcia, A. J., Gu, X., Zanella, S., Kidney, J., Gu, H., Mao, Y., Hooks, B. M., Boyden, E. S., Buzsáki, G., Ramirez, J. M., Jones, A. R., Svoboda, K., Han, X., Turner, E. E., Zeng, H. (2012) A toolbox of Cre-dependent optogenetic transgenic mice for light-induced activation and silencing, Nature Neuroscience 15(5):793-802. PMCID: PMC3337962

12. Lee, S.-H., Kwan, A. C., Zhang, S., Phoumthipphavong, V., Flannery, J. G., Masmanidis, S. C., Taniguchi, H., Huang, Z. J., Boyden, E. S., Deisseroth, K., Dan, Y. (2012) Activation of specific interneurons improves V1 feature selectivity and visual perception, Nature 488(7411):379-8. PMCID: PMC3422431

13. Kodandaramaiah, S., Talei Franzesi, G., Chow, B., Boyden, E. S.*, Forest, C.* (2012) Automated whole-cell patch clamp electrophysiology of neurons in vivo, Nature Methods 9:585–587. (* co-correspond. authors) PMCID: PMC3427788

14. Zorzos, A. N., Scholvin, J., Boyden, E. S.*, Fonstad, C. G. (2012) Three-dimensional multiwaveguide probe array for light delivery to distributed brain circuits, Optics Letters 37(23):4841-4843. (* corresponding author) PMCID: PMC3572236

15. Gurkan, U. A., Fan, Y., Xu, F., Erkmen, B., Urkac, E. S., Parlakgul, G., Bernstein, J., Xing, W.*, Boyden, E. S.*, Demirci, U.* (2012) Simple precision creation of digitally specified, spatially heterogeneous, engineered tissue architectures, Advanced Materials 25(8):1192-1198. (* co-corr. authors) PMCID: in progress (Wiley-Blackwell is a “Method B” submitter to PMC).