Edward S. Boyden, Ph. D.

Y. Eva Tan Professor in Neurotechnology at MIT
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Co-founder, Co-CEO, Mindspan Institute
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Investigator, McGovern Institute
Faculty Member, Yang Tan Collective, MIT
Professor, Departments of Brain and Cognitive Sciences, Media Arts and Sciences, and Biological Engineering, MIT
Co-director, MIT Center for Neurobiological Engineering
Co-director, K. Lisa Yang Center for Bionics, MIT
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Last updated: September 26, 2026

Vision

I am an expert in inventing and applying technologies to enable the systematic mapping, analysis, repair, and simulation of the brain and other complex biological systems. At MIT, I lead the Synthetic Neurobiology Group, which develops ground truth-oriented tools for analyzing and repairing the brain, and applies them systematically to reveal fundamental mechanisms underlying brain functions, as well as to repair the brain. One ultimate goal is to create biologically accurate computer simulations of entire brains.

My MIT group's philosophy is to try to bring the observation and fixing of complex systems, such as the brain, to a "ground truth" level, addressing the fundamental mechanisms of operation of these systems in a scalable and systematic way, all the way down to the fundamental building blocks of life and how they interact.

We are developing tools that enable molecular mapping of cells and tissues with single-molecule precision (expansion microscopy), recording of the high-speed signaling dynamics of brain circuits and other biological systems (voltage indicators and other fluorescent indicators evolved by robotic directed evolution, as well as spatially and temporally multiplexed reporters, and ways of making the living brain more transparent), and control of the activity of brain cells using molecular tools engaged by light (optogenetics) as well as other means (temporal interference).

I am a neuroscientist and physicist, and skilled at many domains of engineering, ranging from nanoengineering to chemistry to genomics to optics to electrical engineering, thanks to my interdisciplinary training in many fields. I lead extremely multidisciplinary teams to tackle these problems, including physicists, chemists, computer scientists, clinicians, and hardware engineers.

At MIT, we apply these tools, in-house, to the analysis of nervous systems such as those of C. elegans and the larval zebrafish, with an eye towards scaling to mouse and human, with the goal of simulating entire brains in a biologically realistic manner. We also work on the fundamental understanding and confrontation of brain aging, as well as neurological and psychiatric conditions. I collaborate with many dozens of labs around the world to bring new technologies to fruition, and to apply these tools to solve basic and applied scientific problems.

Our lab at MIT, and our partners, have distributed our tools to thousands of researchers around the world. My personal dream is to understand the nature of human existence, and to engineer improvements thereupon.

I co-founded in 2026, and am co-CEO of, the Mindspan Institute, a non-profit that is building, scaling up, and applying, technologies for human brain analysis. Long-term, I hope that understanding how the brain generates the mind will help provide a deeper understanding of the human condition, and help humanity achieve a more enlightened state.

Research and work activities

Massachusetts Institute of Technology, Cambridge, MA, professor; Mindspan Institute, Co-founder, Co-CEO (June 2026-present)
Y. Eva Tan Professor in Neurotechnology at MIT
Mindspan Institute, Co-founder, Co-CEO
Full Professor with Tenure, MIT Departments of Brain and Cognitive Sciences, Media Arts and Sciences, and Biological Engineering
Investigator, MIT McGovern Institute
Extramural Member, MIT Koch Institute for Integrative Cancer Research
Leader, Synthetic Neurobiology Group
Co-director, MIT Center for Neurobiological Engineering
Co-director, K. Lisa Yang Center for Bionics, MIT
Faculty Member, Yang Tan Collective, MIT
Inventing, and applying, tools for systematic analysis and engineering of the brain and other biological systems.

Massachusetts Institute of Technology, Cambridge, MA (July 2020-May 2026)
Y. Eva Tan Professor in Neurotechnology at MIT
Howard Hughes Medical Institute, Investigator
Full Professor with Tenure, MIT Departments of Brain and Cognitive Sciences, Media Arts and Sciences, and Biological Engineering
Investigator, MIT McGovern Institute
Extramural Member, MIT Koch Institute for Integrative Cancer Research
Leader, Synthetic Neurobiology Group
Co-director, MIT Center for Neurobiological Engineering
Co-director, K. Lisa Yang Center for Bionics, MIT (2021-on)
Faculty Member, Yang Tan Collective, MIT (2021-on)
Inventing, and applying, tools for systematic analysis and engineering of the brain and other biological systems.

Massachusetts Institute of Technology, Cambridge, MA (July 2019-June 2020)
Y. Eva Tan Professor in Neurotechnology at MIT
Full Professor with Tenure, MIT Media Lab, MIT Departments of Biological Engineering and Brain and Cognitive Sciences
Investigator, MIT McGovern Institute
Extramural Member, MIT Koch Institute for Integrative Cancer Research
Leader, Synthetic Neurobiology Group
Co-director, MIT Center for Neurobiological Engineering
Inventing, and applying, tools for systematic analysis and engineering of the brain and other biological systems.

Massachusetts Institute of Technology, Cambridge, MA (July 2014-Jun 2019)
Y. Eva Tan Professor in Neurotechnology at MIT (2018-on)
Associate Professor with Tenure, MIT Media Lab, MIT Departments of Biological Engineering and Brain and Cognitive Sciences
Investigator, MIT McGovern Institute
Extramural Member, MIT Koch Institute for Integrative Cancer Research (2017-on)
Leader, Synthetic Neurobiology Group
Co-director, MIT Center for Neurobiological Engineering
Inventing, and applying, tools for systematic analysis and engineering of the brain and other biological systems.

Massachusetts Institute of Technology, Cambridge, MA (Jan 2011-Jun 2014)
Associate Professor, MIT Media Lab (Benesse Career Development Professor 2011-2013, AT&T Career Development Professor, 2013-2014), MIT Departments of Biological Engineering and Brain and Cognitive Sciences
Investigator, MIT McGovern Institute
Leader, Synthetic Neurobiology Group
Co-director, MIT Center for Neurobiological Engineering (2013-on)
Inventing tools for systematic analysis and engineering of the brain.

Massachusetts Institute of Technology, Cambridge, MA (Jan 2007-Jan 2011)
Assistant Professor, MIT Media Lab (Benesse Career Development Professor), MIT Department of Biological Engineering (2007-on), MIT Department of Brain and Cognitive Sciences (2008-on)
Investigator, MIT McGovern Institute (2010-on)
Leader, Synthetic Neurobiology Group
Inventing tools for systematic analysis and engineering of the brain.

Massachusetts Institute of Technology, Cambridge, MA (Nov 2006-Jan 2007)
Visiting Scientist, MIT Media Lab; Leader, Neuroengineering and Neuromedia Group
Inventing tools for systematic analysis and engineering of the brain.

Stanford University, Stanford, CA (Oct 2005-Oct 2006)
Helen Hay Whitney postdoctoral fellow, Depts. of Bioengineering, Applied Physics, Biological Sciences, with Drs. Mark Schnitzer and Karl Deisseroth
Inventing optical methods for accelerating neuroscience progress.

Stanford University, Stanford, CA (Sep 1999-Oct 2005)
Hertz predoctoral fellow, NIH NRSA predoctoral fellow, Program in Neurosciences, Depts. of Molecular and Cellular Physiology and Neurobiology, with Drs. Jennifer Raymond and Richard Tsien.
Studied how neural circuits selectively engage plasticity to store specific memories.
Co-developed optogenetics (an independent side collaboration, done in parallel to PhD work).

Bell Labs, Lucent Technologies, Murray Hill, NJ (1998-99)
Research assistant, with Drs. Sebastian Seung and Michale Fee.
Created an elementary phase-resetting model of birdsong stochasticity.
Helped implement active electrode stabilizer for neural recordings in awake animals.

Massachusetts Institute of Technology, MIT Media Lab, Cambridge, MA (1998-99)
Graduate research, with Dr. Neil Gershenfeld.
Design and fabrication of prototype nuclear magnetic resonance (NMR) quantum computer.

Engineered control software for the MIT ORCA-1 autonomous submarine.
Designed hardware for a MEMS accelerometer using electron-tunneling.

Massachusetts Institute of Technology, MIT Media Lab, Cambridge, MA (1996-98)
Research assistant, with Dr. Neil Gershenfeld.
Programmed machine-learning tools for reconstructing dynamics of a digital violin.
Created 3D, non-contact interactive design program based on electric field imaging of hands.

Activision, Inc., Santa Monica, CA (1997)
Research programmer
Designed real-time, physics-based animation engine for video games.

University of North Texas Chemistry Department, Denton, TX (1994-95)
Research assistant, with Dr. Paul Braterman
Research on the origins of life; synthesized and analyzed layered double hydroxides with intercalated anions.

Education

Stanford University, Stanford, CA (1999-2005)
GPA: 4.1/4.0
PhD, Neurosciences
Thesis title: Task-specific neural mechanisms of memory encoding
Advisors: Drs. Jennifer Raymond and Richard Tsien.

Massachusetts Institute of Technology, Cambridge, MA (1995-99)
GPA: 5.0/5.0
M.Eng., Electrical Engineering and Computer Science
B.S., Electrical Engineering and Computer Science
B.S., Physics
Thesis title: Quantum Computation: Theory and Implementation
Advisor: Dr. Neil Gershenfeld

Texas Academy of Mathematics and Science, University of North Texas, Denton, TX (1993-95)
GPA: 4.0/4.0

Major awards and honors

International prizes and awards:
2020, Wilhelm Exner Medal
2019, Lennart Nilsson Award
2019, Croonian Medal
2019, Warren Alpert Foundation Prize
2019, Rumford Prize
2018, Canada Gairdner International Award
2016, Breakthrough Prize in Life Sciences
2015, BBVA Foundation Frontiers of Knowledge Award
2015, Carnegie Prize in Mind and Brain Sciences
2013, Jacob Heskel Gabbay Award

2013, Grete Lundbeck European Brain Research Prize ("The Brain Prize")
2011, Perl/UNC Neuroscience Prize

Honorary memberships:
2019, National Academy of Sciences, elected member
2017, American Institute for Medical and Biological Engineering (AIMBE) College of Fellows, elected member
2017, National Academy of Inventors, elected member
2017, American Academy of Arts and Sciences, elected member

Honorary grant awards and positions:
2020, Howard Hughes Medical Institute, Investigator
2017, 2013, 2012, NIH Director's Transformative Research Award
2016, Howard Hughes Medical Institute Simons Faculty Scholar
2013, NIH Director's Pioneer Award
2011, New York Stem Cell Foundation-Robertson Investigator Award
2011, NSF CAREER Award
2011, A F Harvey Prize
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
2007, Wallace H. Coulter Foundation Early Career Translational Research Award in Biomedical Engineering

Institutional, societal, and journalistic recognitions:
2023, Eric R. Kandel Award, Columbia University
2018, Charles C. Shepard Award, Laboratory Science, Centers for Disease Control
2018, Larry J. Anderson Award for Outstanding Public Health Service, Centers for Disease Control, National Center for Immunization and Respiratory Diseases
2017, Drexel Prize in Biotechnology
2017, The Scientist: Top Technical Advances in 2017 (robotic image-guided patch clamping)
2017, Nature Methods Method to Watch (Expansion Microscopy)
2016, TED Summit, Invited Speaker
2016, Boston Globe, 2016 Game Changers
2013, 10 Life Science Superstars 40 and Under, Genetic Engineering & Biotechnology News
2013, World Economic Forum, Young Scientist
2012, Wired, "Smart List 2012: 50 People Who Will Change the World"
2011, TED, Invited Speaker
2010, Nature Methods Method of the Year (Optogenetics)
2007, Society for Neuroscience, Research Award for Innovation in Neuroscience (RAIN)
1998, International Autonomous Underwater Vehicle Competition, 1st place

Junior investigator prizes and awards:
2018, Blavatnik National Award for Young Scientists, Life Sciences, Finalist
2015, Society for Neuroscience Young Investigator Award
2014, Academy of Achievement, Delegate
2014, Schuetze Award in Neuroscience
2010, Eppendorf and Science Prize for Neurobiology, Finalist
2006, Technology Review TR35, World's Top 35 Innovators under Age 35
2006, Fannie and John Hertz Foundation, Top Ph.D. Thesis Prize

2005, Helen Hay Whitney Fellowship
2004, Dan David Prize Scholarship (Future Dimension, Brain Sciences)
1999, Fannie and John Hertz Fellowship

Named lectureships and keynotes (full list of lectures at end)
2026, Methods and Applications in Fluorescence, Copenhagen, Denmark, Keynote
2026, 26th International Meeting of the European Light Microscopy Initiative, Keynote
2026, International Anesthesia Research Society Annual Meeting, Montreal, Canada, Presidential Lecture.
2025, Academy of Consultation-liaison Psychiatry Annual Conference, San Antonio, TX, plenary speaker.
2025, Joint Tumor Section Symposium Congress of Neurological Surgeons, Los Angeles, CA, keynote.
2025, Presidential Lecture, Göttingen Expansion Forum 2025.
2025, Volker Henn Lecture, ETH Zurich.
2025, Wired Health, Boston, MA, keynote.
2025, Kyoichi Tanaka Lecture, Proteins and Peptides Conference, Geneva, Switzerland.
2025, Mass Eye and Ear Research Day, keynote.
2025, Texas Academy of Math and Science, commencement address
2025, Imagine Solutions, Naples, Florida.
2024, Plenary Lecture, Microscopy & Microanalysis, Cleveland, OH.
2024, Featured Speaker, American Society for Stereotactic and Functional Neurosurgery Biennial Meeting, Nashville, TN.
2024, Merson Lecture, Queensland Brain Institute.
2023, Woods Lecture, Butler University.
2023, Eric R. Kandel Lecture, Columbia University.
2023, Exner Lecture, Vienna, Austria.
2023, Association of Biomolecular Resource Facilities Annual Meeting, Boston, MA, Keynote
2023, Patricia Levy Zusman International Workshop on Neuroregeneration, Department of Neurosurgery and the Center for Neuroregeneration, Houston Methodist, Keynote
2022, Boston University Biomedical Engineering Graduate Student Research Symposium, Keynote
2022, 3rd Optogenetic Technologies and Applications Conference (AiChE), Heidelberg, Germany, Keynote.
2022, Sundaram Lecture, Massachusetts General Hospital
2022, Tools for Seeing and Controlling Biological Systems, Workshop for Interaction and Scientific Collaboration, U Albany, SUNY, Keynote
2022, Brenda Milner Lecture Series, University of Lethbridge, Keynote
2022, Bioengineering Solutions for Biology and Medicine, Keynote
2022, Cell Biology of the Neuron Gordon Research Conference, Keynote
2022, 21st International European Light Microscopy Initiative Meeting, Keynote.
2022, Restoring and Extending the Human Brain, Rice University, Keynote
2022, MatchPoints Conference, Aarhus University, Keynote.
2022, Latta Lecture, University of Nebraska Medical Center
2022, Waterloo Nanotechnology Conference, Keynote.
2021, Neurotechnologies: Current Developments, Applications and Ethical Issues, King's College London, Keynote.
2021, Peter and Eva Safar Lecture, Department of Critical Care Medicine, U Pittsburgh.
2021, Bassoe Lecture, American Neuropsychiatric Association.
2021, Croonian Lecture.
2021, Israel Society for Neuroscience, virtual forum, keynote.

2020, Neuronexus Neurotechnologies Symposium, keynote.
2020, Keynote, Optogenetics and Optical Manipulation 2020, SPIE Photonics West, San Francisco, CA.
2020, Keynote, 18th International Symposium on Neural Regeneration, Asilomar, California.
2019, Gurley Lecture, UC Santa Barbara.
2019, Optogenetic Technologies and Applications, AIChE / Society for Biological Engineering, Boston MA, keynote
2019, Fredric S. Fay Memorial Lecture, U Mass Medical
2019, Britton Chance Lecture for Advances in Basic Imaging Research, World Molecular Imaging Congress, Montreal, Canada.
2019, Keynote, OptoDBS, Geneva.
2019, Beatrice and Jacob H. Conn Lectureship in Regenerative Medicine, Johns Hopkins University.
2018, Presidential Distinguished Lecturer, 57th Annual Meeting, American College of Neuropsychopharmacology, Hollywood, Florida.
2018, Keynote, 4th Science for Life Conference, Utrecht Life Sciences.
2018, Expansion Microscopy, Keynote, Labeling and Nanoscopy, Heidelberg, Germany.
2018, Gairdner Lecture, U Alberta, Edmonton, Canada.
2018, Gairdner Lecture, U Calgary, Calgary, Canada.
2018, Gairdner Lecture, U Toronto, Toronto, Canada.
2018, Keynote Fireside Chat, Synbiobeta 2018, San Francisco, CA.
2018, Keynote, Gather Festival, Stockholm, Sweden.
2018, International Conference on Pattern Recognition and Artificial Intelligence, Montreal, Canada, keynote
2018, Imaging: Innovations to Enhance Aging Research, Geroscience Interest Group, NIH, keynote
2018, Optogenetics and Optical Manipulation, SPIE Photonics West, San Francisco, CA, Keynote.
2017, Single Cell Analyses, Cold Spring Harbor Laboratory, Keynote, Cold Spring Harbor, NY.
2017, Nanotechnology in Medicine Network, Keynote, University of Manchester
2017, Roger Tsien Keynote Lecture, 32nd Congress of the International Society for Advancement of Cytometry
2017, Breakthroughs in Biology (Hadad) lecture, Haverford College
2017, Boston Photonics Centennial, keynote
2017, Foundations of Nanoscience, keynote
2016, Karen L. Wrenn Lectureship, Duke University
2016, Optogenetics Day, Keynote, Neurex, Strasbourg, France
2016, Litwack Lecture, North Carolina State University
2016, Schueler Lecture, Tulane University
2016, Hello Tomorrow Global Summit, Keynote, Paris, France
2016, National Society for Histotechnology Annual Symposium, Keynote Lecture
2015, Keynote, Gulf Coast Cluster for Neuroengineering 5th Annual Symposium, Houston, TX.
2015, NIH Director's Lecture, NIH
2015, Milton Gordon Lecturer, University of Washington
2015, Crill Lecturer, University of Washington
2015, SPIE Optogenetics Conference, Keynote
2014, "Talking Science" Lecture, Munich, Germany
2014, Gordon Conference, Membrane Transport Proteins, Keynote
2014, Special Lecturer, 9th FENS Forum of Neuroscience
2014, Featured Plenary Speaker, Canadian Neuroscience Meeting
2014, Carl P. Duncan Lecturer, Northwestern University

2014, Edward Llewellyn-Thomas Lecturer, University of Toronto
2014, Theodore Koppanyi Lecturer, Georgetown University
2014, Director's Special Colloquium, Argonne National Laboratory
2014, Brain Prize Talk, XXVIII Sandbjerg Symposium, Danish Society for Neuroscience
2013, Herman P. Schwan Lecturer, University of Pennsylvania
2013, Marine Biology Laboratory, Friday Evening Lecturer
2013, Leica Scientific Forum Lecturer
2013, Georgia Tech/Emory University "Young Innovator In Biomedical Engineering"
2013, Brain Prize Meeting, Keynote Address
2013, Neuroscience Day Lecturer, University of New Mexico
2013, Society for Neuroscience, Symposium Speaker
2012, Bagrit Lecturer, Imperial College London
2012, 2013, 2016, World Economic Forum, Davos, Switzerland, Invited Speaker
2012, The Brain: An Owner's Guide Lecture, UT Dallas Center for Brainhealth
2011, Sackler Lecturer, Leiden University Medical Center
2011, SPIE "Hot Topics" Opening Session, Plenary Lecturer
2011, Mahoney Institute of Neurological Sciences Retreat, University of Pennsylvania, Keynote
2011, Honors Colloquium, University of Rhode Island
2011, 4th Conference on Artificial General Intelligence, Keynote Address
2011, Taiwan Neuroscience Society Meeting, Keynote Address
2011, Issekutz Memorial Lecturer, Dalhousie University
2010, Spivack Distinguished Lecturer, Boston University
2008, NIMH Annual Retreat, Keynote Lecture

Other training

Cold Spring Harbor Laboratories, Cold Spring Harbor, NY (2001)
Biology of Memory: From Molecules to Behavior, Summer Course
Directors: Drs. Kelsey Martin, Jack Byrne, Howard Eichenbaum, Larry Squire

Marine Biological Laboratory, Woods Hole, MA (2000)
Neural Systems and Behavior, Summer Course
Directors: Drs. Catherine Carr and Rick Levine

Classes Taught

Applications of Neuroengineering, MAS.882/9.433, MIT (Spring 2008, Spring 2009)
Project-focused course in which students take top-down approach to developing technologies that address critical clinical and basic-science problems of human brain function. Focus is on application of engineering principles to development of systematically powerful tools. Problem domains include neurological/psychiatric disorders, consciousness, and human cognitive augmentation. Students work in teams to apply cross-disciplinary (e.g., molecular, physical, nanotechnological) building blocks to design new tools for the analysis and engineering of the brain.

Bioinstrumentation Project Lab, 20.345, MIT (Spring 2011, Spring 2012, Spring 2013, Spring 2014, Spring 2015, Spring 2016, Spring 2018)
In-depth examination of instrumentation design, principles and techniques for studying biological systems, from single molecules to entire organisms. Lectures cover optics, advanced microscopy techniques, electronics for biological measurement, magnetic resonance imaging,

computed tomography, MEMs, microfluidic devices, and limits of detection. Students select two lab exercises during the first half of the semester and complete a final design project in the second half. Lab emphasizes design process and skillful realization of a robust system. (Taught in collaboration with M. F. Yanik, S. Nagle, P. So, S. Wasserman, M. Jonas, E. Frank, and others.)

Biological Instrumentation and Measurement, 20.309, MIT (Spring 2009, Spring 2010, Spring 2014, Spring 2015, Spring 2016, Spring 2017, Spring 2018, Spring 2019, Spring 2020, Spring 2021, Spring 2022, Spring 2023, Spring 2024, Spring 2025)
Sensing and measurement aimed at quantitative molecular/cell/tissue analysis in terms of genetic, biochemical, and biophysical properties. Methods include light and fluorescence microscopies, and electro-mechanical probes (atomic force microscopy, optical traps, MEMS devices). Application of statistics, probability, signal and noise analysis, and Fourier techniques to experimental data. Enrollment limited; preference to Course 20 undergraduates. (Taught in collaboration with M. F. Yanik, S. Nagle, P. So, S. Wasserman, M. Jonas, E. Frank, A. Hansen, and others, over the years.)

Neurotechnology Ventures, MAS.883/9.455/20.454/15.128 (MAS.961/9.912J/HST.588 in Spring 2007; MAS.883/9.455/20.454/15.128/HST.588 Fall 2008-Fall 2009), MIT (Spring 2007, Fall 2008, Fall 2009, Fall 2010, Fall 2011, Fall 2012, Fall 2013, Fall 2014)
A special seminar focused on the challenges of envisioning, planning and building startups; commercializing innovations from neuroscience; and the blossoming domain of neuroengineering. (Taught in collaboration with J. Bonsen and R. Ellis-Behnke.)

Principles of Neuroengineering, MAS.881/9.422/20.352 (starting Fall 2017)/20.452, MIT (Fall 2007, Fall 2008, Fall 2009, Fall 2010, Fall 2011, Fall 2012, Fall 2013, Fall 2014, Fall 2015, Fall 2017, Fall 2018, Fall 2019, Fall 2020, Fall 2021, Fall 2022, Fall 2024, Fall 2025, Fall 2026)
Covers principles underlying current and future technologies for brain analysis and engineering, for neurology, psychiatry, and neuroscience. Focuses on using biophysical, biochemical, and anatomical models to understand technology design constraints governing ability to observe and alter brain function. Topics include functional magnetic resonance imaging, electromagnetic recording/stimulation, neuropharmacology, optical cellular imaging, and gene/stem-cell therapy. Design projects by student teams.

Revolutionary Ventures, MAS.883/9.455/20.454/15.128, MIT (Fall 2015, Fall 2017, Fall 2018, Fall 2019, Fall 2020, Fall 2021, Fall 2022, Fall 2024, Fall 2025, Fall 2026)
Seminar on envisioning and building ideas and organizations to accelerate engineering revolutions. Focuses on emerging technology domains, such as neurotechnology, imaging, cryotechnology, gerontechnology, and bio-and-nano fabrication. Draws on historical examples as well as live case studies of existing or emerging organizations, including labs, institutes, startups, and companies. Goals range from accelerating basic science to developing transformative products or therapeutics. Each class is devoted to a specific area, often with invited speakers, exploring issues from the deeply technical through the strategic. Individually or in small groups, students prototype new ventures aimed at inventing and deploying revolutionary technologies. (Taught in collaboration with, over the years, J. Bonsen, J. Weis, D. Dudley, J. Jacobson, and A. Marblestone.)

Social and professional activities

Advisory roles

2025-on, Thalion Initiative, advisor
2023-on, E11 Bio, advisor
2022-on, NeuroTools Scientific Steering Committee, University of North Carolina
2018, NINDS P30-funded cellular imaging core at Harvard Medical School/Boston Children's Hospital, External Committee Member
2018-on, Brainmind, Core Advisor
2014, The Brain Challenge, Advisor
2013, University of Pennsylvania Gene Therapy Center, steering committee
2012, confidential foundation, advisory committee
2012, Tufts Center for Neuroscience Research, Science Advisor
2011, Faculty of 1000 (F1000), Member
2010-present, Technology Review TR35 Young Innovators Under 35, Judge
2010, Cognitive Rhythms Collaborative (Boston-wide network working on brain dynamics), executive committee
2010, Aspen Brain Forum, Scientific Advisory Board
2009, Lifeboat Foundation, Advisory Board
2007-present, Fannie and John Hertz Foundation, Fellowship Interviewer

Invited workshops, panels, and events

2026, Protocol Labs Connectomics Workshop, Montauk, NY, invited participant and session chair
2026, Neuroscience of Vitality and Aging Conference, Harvard Rubenstein Treehouse, invited panelist
2026, Higgs Community Summit, Renaissance Philanthropy, panelist
2025, Biotech + Healthcare Innovation Summit, Harvard, panelist
2025, Longwood Healthcare Leaders MIT CEO Meeting, panelist, "Ensuring Global Access"
2025, Unicorn Summit, panelist, "Inside the Human Horizon: Nano, Brain, and the Science of Vitality"
2025, Imagination in Action: Pioneering the New Era with AI, MIT, panelist, "AI Use Case: Deep Dive Into Healthcare"
2024, BrainMind Salon: The Future of Neuromodulation, participant
2024, Ideas Matter Writing Fellowship, conversation with participants
2023, Neurotechnology and its Societal and Ethical Implications Workshop, Casina Pio IV, Pontifical Academy of Sciences, Vatican City, invited participant.
2023, virtual panel, Neuro Talks, Texas Academy of Math and Science, Denton, TX.
2023, Neurotech Panel, Vision Weekend US 2023, Foresight Institute.
2023, BrainMind Summit, UCSF Mission Bay, panel chair
2023, Tau Consortium Investigators' Meeting TCIM 2023, Boston, MA, invited panelist.
2023, virtual fireside chat, Plexus Conference, Croatia
2022, High Throughput Imaging Characterization of Brain Cell Types and Connectivity, NIH BRAIN/BICAN Imaging Workshop, Panelist.
2021, Sparks! Serendipity Forum, CERN, invited participant.
2021, Dan Lewis Foundation Summit Meeting on Brain Regeneration Research.
2021, "A society and lifestyle in which human beings can be free from the limitation of body, brain, space, and time," Moonshot International Symposium, Japan Science and Technology Agency, invited panelist.
2020, Department of Energy Roundtable, Bioimaging Capabilities to Enable Mapping of the Neural Connections in a Complex Brain, invited participant
2020, SynBioBeta, Synthetic biology and the brain, invited panelist
2019, Convergence Forum, Chatham, MA, invited panelist

2018, Gordon Research Conference, Optogenetic Approaches to Understanding Neural Circuits and Behavior, Newry, ME, discussion leader
2018, Tapping, Zapping, Hacking and Mapping the Nervous System through pioneering Bioelectronic Nerve Implants and Neural AI to Stop Chronic Disease, BIO International Convention, invited panelist
2018, Cyborgs, Futurists, & Transhumanism: A Conversation, Institute for Cross-Disciplinary Engagement at Dartmouth College/Museum of Science, Boston, MA, invited panelist
2018, Pilot Projects for a Human Cell Atlas, Chan Zuckerberg Initiative Science investigator meeting, invited participant
2017, UT Dallas BrainHealth 2027 Collaborators Conference, Center for BrainHealth/Brain Performance Institute, invited participant
2017, Forbes 30 Under 30 Summit, invited panelist.
2017, Organ Banking Summit, Harvard University, invited panelist
2017, NIH Workshop, Cutting Edge Science Meeting to End the Opioid Crisis, Understanding the Neurobiological Mechanisms of Pain, National Institutes of Health, Bethesda, MD, invited participant.
2017, Renaissance Weekend, Park City, Utah, invited participant.
2017, Curiosity Camp, Boulder Creek, CA, invited participant and session chair
2017, Things that Will Blow your Mind panel, Milken Global Conference, Los Angeles, CA.
2017, Panel, AI Frontiers - Straight from the Labs, MIT Club of Northern California Spotlight Conference, Redwood City, CA.
2017, Human Cell Atlas Meeting, Chan Zuckerberg Science, Stanford, CA, invited participant
2016, Breakthrough Prize Panel, Theory of Everything, Berkeley, CA
2016, Enhancing Humans: How Far Can We Go?, Panel, Hello Tomorrow Global Summit, Paris, France
2016, “Convergence: The Future of Health,” MIT Washington Office, Science Advisor
2016, Reddit AskScience “Ask Me Anything”
2016, NIMH Convergent Neuroscience Virtual Workshop
2015, Breakthrough Prize Panel, Why is the Universe Understandable?, Berkeley, CA
2015, Kavli Futures Symposium, Is it time for national BRAIN observatories?, Argonne National Laboratory
2015, Epilepsy Innovation Meeting, Epilepsy Foundation, Cambridge MA
2015, Kavli Workshop on Cortical Computation, Cambridge MA
2015, NIH Workshop on Defining Cellular Phenotypes, invited participant
2015, Dialog Retreat, invited participant
2015, Neural Engineering and Systems Design BootCamp, DARPA, invited participant
2014, Simons Foundation Autism Research Initiative, Circuit Dynamics Workshop
2014, Jackson Hole Science Media Awards, Panelist, Idea Salon: The Brain
2014, Allen Institute for Brain Science, Human Cell Types Advisory Council Meeting
2014, 9th FENS Forum on Neuroscience, Big Questions in Neuroscience, invited panelist
2014, NSF Panel, Surprising Reasons Why We Need Biodiversity, invited panelist
2013, 1st International Workshop on Mammalian Synthetic Biology, discussion leader
2013, NSF Workshop on Mapping and Engineering the Brain, Arlington, VA, invited participant
2013, NIH Advisory Committee to the Director, Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Working Group Meeting, Invited Participant
2013, Physical and Mathematical Principles of Brain Structure and Function, Workshop Sponsored by NSF & Kavli Foundation
2012, 8th Kavli Futures Symposium: Tool Development for the Brain Activity Map, invited participant
2012, Dahlem Conference, Optogenetics, Invited Participant
2012, ’13, ’16, World Economic Forum, Davos, Switzerland, Discussion Leader

2011, Milken Institute, Accelerating Innovation in the Bioscience Revolution, Invited Participant and Panelist
2011, Allen Institute for Brain Science, Neural Coding Meeting, Invited Participant
2011, Arnold and Mabel Beckman Initiative for Macular Research, National Academies of Sciences, Arnold and Mabel Beckman Center, Irvine, CA, invited participant
2010, Science Magazine, advisory workshop
2010, XPrize Workshop, “Brain-Computer Interfaces: Igniting a Revolution”, featured advisor
2010, European Commission, Medical Devices Expert Group, invited panelist
2008, National Academies Keck Futures Initiative 2008: Complex Systems, Arnold and Mabel Beckman Center, Irvine, CA, invited participant
2008, NIH Blueprint for Neuroscience Research, Pain Grand Challenges/Transformative R01 Workshop, invited participant
2007, NIH Blueprint for Neuroscience Research, Neuroplasticity Workshop, invited participant
2006, ’07, ’10, ’12, ’15, ’18, ’25, Science Foo (SciFoo) camp, Nature / Google / O’Reilly, invited participant
2006, United Kingdom Office of Horizon Scanning, Institute for the Future, Palo Alto, CA, invited workshop participant

Teaching outside of MIT

2026 Summer School in Neurovascular Imaging Across Scales in Animals and Humans, Boston University, lecturer
2026, Neurobiology Course, Marine Biology Lab, Woods Hole, MA, Monday night lecturer
2024, Neurotechnology: Science, Medicine, Marketplace and Ethics Summer School, UIMP, Santander, Spain, lecturer
2024, C. elegans: from genome editing to imaging, EMBO Practical Course, Virtual Speaker
2022, ’23, ’24, ’25, High Throughput Neuroanatomy Course, Cold Spring Harbor, lecturer
2022, CAJAL Course on Interacting with Neural Circuits, Lisbon, Portugal, faculty
2019, Norwegian Research School of Neuroscience Summer School in Neuroscience, Molecular Genetic Tools for the Study of Neural Circuits, Tromso, Norway, lecturer
2019, Prospects in Theoretical Physics, "Great Problems in Biology for Physicists," Institute for Advanced Study, lecturer
2019, CAJAL Course on Interacting with Neural Circuits, Lisbon, Portugal, lecturer
2019, Novel Technologies for the Study of Cognitive Function, Neuroscience School of Advanced Studies, Venice, Italy, lecturer
2018, Society for Neuroscience Short Course, "Functional, Structural, and Molecular Imaging, and Big Data Analysis," lecturer
2017, Frontiers in Imaging Lecture, Analytical & Quantitative Light Microscopy Course, Marine Biology Laboratory, Woods Hole, MA
2016, ’17, ’19, ’23, ’24, ’25, Research Update in Neuroscience for Neurosurgeons (RUNN) Course, Marine Biology Laboratory, Woods Hole, MA
2015, Frontiers in Neurophotonics Summer School, Quebec City, Canada
2013, Society for Neuroscience Short Course, "The Science of Large Data Sets: Spikes, Fields, and Voxels," lecturer
2013, Cold Spring Harbor Ion Channels and Synaptic Transmission Course, Visiting Faculty
2012, Marine Biology Laboratory, Neurobiology Course, Visiting Faculty
2011, FENS-IBRO-SFN Summer School, Causal Neuroscience, Bertinoro, Italy, Faculty
2011, ’13, Marine Biology Laboratory, Neural Systems and Behavior Course, Visiting Faculty
2009, Society for Neuroscience Short Course, “Rhythms of the Neocortex: Where Do They Come From and What Are They Good For?”, lecturer

Conference organizing

2026, Connectomics Workshop, Protocol Labs, Montauk, NY, organizing committee.
2020-21, Learning Meaningful Representations of Life (LMRL) Workshop, NeurIPS, organizer
2018, Society for Neuroscience Short Course, "Functional, Structural, and Molecular Imaging, and Big Data Analysis," co-organizer
2018, Reconfiguring the Landscape for the Alzheimer's Challenge Workshop, Wequassett Resort, Harwich, MA, steering committee
2018, The Blood-Brain Barrier: An Obstacle to Effective Therapies, Brigham Neurosurgery / MIT / Sontag Foundation Conference, MIT, Cambridge, MA, co-organizer
2017, Kavli Futures Symposium on Next-Gen, Open-Source Neurotechnology Dissemination, Los Angeles, CA, co-organizer
2017, UCSB/MIT Alzheimer's Conference, Steering Committee
2017, 17th Congress of the European Light Microscopy Initiative, scientific advisory board
2016, Expansion Microscopy Workshop, Janelia Research Campus, co-organizer
2016, Optogenetics in Neuroscience, Symposium Chair, Biophysical Society 60th Annual Meeting, Los Angeles, CA.
2015, NYSCF Immunoengineering Workshop, Co-Chair
2014, IEEE EMBS BRAIN Grand Challenges Conference, International Program Committee
2014-2017, Minnesota Neuromodulation Symposium, Program Committee
2013, Cognitive Rhythms Collaborative "Rhythmic Dynamics and Cognition" Conference, Organizing Committee
2013, "Optogenetics and optical control of biological processes", Symposium co-chair, CLEO conference, San Jose, CA
2013, European Conferences on Biomedical Optics (ECBO), Neurophotonics program committee
2012, SPIE BiOS 2012 Meeting, Neurons and Photons Conference, San Jose, CA, Program Committee
2010, Computational and Systems Neuroscience (CoSyNe) Meeting, reviewer
2010, Society for Neuroscience Meeting, Mini-Symposium Co-Chair, Towards the Second Generation of Optogenetic Tools, San Diego, CA
2010-2015, Society for Neuroscience, Newsworthy Items Reviewer
2010, Program Committee, First Augmented Human International Conference, '10, Megeve, France.
2009, SPIE BiOS 2009 Meeting, Neurons and Photons Conference, San Jose, CA, Program Committee
2008, Computational and Systems Neuroscience (CoSyNe) Meeting, Workshop Organizer, How to solve systems neuroscience problems with molecular tools, Snow Bird, Utah
2007, BodyNets 2007 Conference, Florence, Italy, Technical Program Committee member

Editing and writing

2020-present, Molecular Frontiers, editorial board
2019-present, IEEE Open Access Journal of Engineering in Medicine and Biology (OJEMB), Advisory Board
2016-present, Network Neuroscience, Editorial Board
2014-present, Neural Computation, Editorial Board
2014-present, Bioelectronic Medicines, Editorial Board
2013-2018, Journal of Neural Engineering, Editorial Board
2012-2013, Optogenetics, Editorial Board
2012, Neural Systems & Circuits, Editorial Board
2012, Progress In Brain Research, invited co-editor of vol. 196, "Optogenetics"
2011, The Scientist, invited writer (cover story, July 2011 issue)
2011, Dana Foundation, invited writer ("Cerebrum" magazine, November/December 2011)

2010, SPIE Newsroom, invited writer
2000, NINDS Conference on Computational and Theoretical Neuroscience: From Synapse to Circuitry, writer

Other events
2014, White House, BRAIN Initiative Conference, Invited Participant
2013, White House/Pres. Obama BRAIN Initiative Launch, Invited Participant

Reviewing
2026, NIH Director's New Innovator Award, mail reviewer
2023, '24, '25, '26, Pershing Square Foundation MIND Prize Science Advisory Board
2022, '24, HHMI Freeman Hrabowski Scholars Competition
2022, NIH ZRG1 BST-J 70 R, RFA-RM-21-017: NIH Director's Transformative Research Awards (TRA), mail reviewer
2017, Open Philanthropy
2017, NIH New Innovator Award, Final Review Committee
2016-on, Breakthrough Prize in Life Sciences, Selection Committee
2016, Special Emphasis Panel ZRG1 IFCN-J(02)
2016, 2016/05 ZRG1 MOSS-C (56) R RFA RM13-007: New Innovator Award
2015, NIH 2016/01 BVS - Biology of the Visual System Study Section
2015, NIH 2015/10 NSD-C, Neurological Sciences and Disorders C
2015, NIH 2015/05 ZRG1 MOSS-C (56) R - RFA RM13-007: New Innovator Award
2014, IEEE EMBS BRAIN Young Investigator Competition, Judge
2014, NEI 2015/01 ZEY1 VSN (03) 2 - NEI K Training Grant Applications
2014, NIH 2014/05 ZRG1 ETTN-H (53) R - Center for Scientific Review Special Emphasis Panel
2013, 2014/01 RRDS R Rehabilitation Research and Development SPiRE Review Group, US Veterans Administration
2012, Knut and Alice Wallenberg Foundation
2012, National Institutes of Health Study Section ZRG1 ETTN-H (50) R
2012, National Institutes of Health Study Section, ZRG1 BCMB-A (51) R, Transformative R01 Reviewing
2012, 2013, confidential evaluator, two awarding foundations
2011, CIMIT
2011, Michael J. Fox Foundation
2010-2014, National Institutes of Health Molecular Neurogenetics (MNG), Study Section Member
2010, Vienna Science and Technology Fund
2010, European Commission
2010, U. S. Veterans Administration
2010, 2012, 2014, Human Frontiers Science Program
2010, Israeli Science Foundation
2010 February, 2010 June, National Institutes of Health Study Section, Molecular Neurogenetics
2010, Duke Institute for Brain Sciences
2009, Wellcome Trust
2009, NIH Challenge Grants
2008, Alberta Ingenuity Fund (Ingenuity Centres Program)
2008, National Institutes of Health Study Section ZRG1 MDCN-B(90), Tools to Investigate Neural Circuit Development
2007, National Institutes of Health Study Section ZRG1 MDCN-P(02), Neurodegeneration and Disease Mechanisms

2006-present, National Science Foundation

Reviewer for journals:
ACS Nano
ACS Omega
ACS Synthetic Biology
Advanced Science
Angewandte Chemie
Biophysical Journal
Biophysical Reports
Cell
Cell Reports
Cell Research
Chemical Communications
Current Biology
Current Opinion in Structural Biology
Drug Discovery Today
eLife
Frontiers Journals
IEEE Journals
Journal of Microscopy
Journal of Neural Engineering
Journal of Neurophysiology
Journal of Neuroscience
Journal of Neuroscience Methods
Journal of Selected Topics in Quantum Electronics
Lasers in Surgery and Medicine
mBio
Methods
Nature
Nature Biomedical Engineering
Nature Biotechnology
Nature Cell Biology
Nature Chemical Biology
Nature Chemistry
Nature Methods
Nature Nanotechnology
Nature Neuroscience
Nature Protocols
Neuron
Neurophotonics
npj Biofilms and Microbiomes
PLoS ONE
PLoS Biology
Proceedings of the National Academy of Sciences
Science
Science Advances
Science Translational Medicine
Scientific Reports

Memberships

2000-present, Society for Neuroscience, member

MIT

2026-on, Institute for Medical Engineering and Science, affiliate member
2025, MIT CEO Advisory Board meeting, presenter
2023, MIT Tech Reunion presenter, in the Brain and Cognitive Sciences department.
2022, Advances in the quest to understand intelligence, MIT Quest for Intelligence, presenter
2022, MIT CEO Advisory Board meeting , presenter
2020, MIT Climate Grand Challenge workshop, presenter and participant
2020-on, K. Lisa Yang and Hock E. Tan Center for Molecular Therapeutics in Neuroscience, founding member
2020, MIT Tech Day, featured speaker
2019-on, MIT Alana Down Syndrome Center, core collaborator
2018, Visit to MIT by Prime Minister of Canada, presenter
2018, Koch Institute Summer Student Seminar Series, lecturer
2018, MIT Media Lab Disobedience Prize, jury
2018, MIT Media Lab Adventurous Scientist Fellowship, jury
2017-on, Institute for Soldier Nanotechnologies, member
2017, Pinpointing the Cure of all Brain Disease, The MIT Connection lecturer, New York City, NY.
2017, MIT Cog Lunch, speaker
2017, Ragon Institute, Global Health Innovation Partnership Annual Meeting, lecturer and participant
2016, MIT Research and Development Conference, lecturer
2016, MIT President's Convocation for Incoming Freshmen, speaker
2016, MIT Freshman Pre-Orientation Program, Discover Brain and Cognitive Sciences, Lecturer
2016, MIT PRIMES (Program for Research in Mathematics, Engineering and Science for High School Students) program, faculty mentor
2016, MIT Media Lab Artificial Intelligence and Governance Meeting, Participant
2016, MIT Sidney Pacific Presidential Fellows Distinguished Lecture Series, "Reverse Engineering, and Repairing, the Brain and Mind," with Alan Jasanoff
2015, visit to MIT by U.S. Secretary of Defense, presenter
2015, CBMM Retreat, Entrepreneurship tutorial lecturer
2015, CBMM Summer Workshop for Teachers about the Brain, lecturer
2015, The Accenture and MIT Alliance on Business Analytics, Spring Meeting, Keynote
2014-present, MIT Aging Brain Initiative, founding investigator
2014-present, MIT Neurotech Symposium, co-chair
2014, MIT Laureates and Leaders Program, lecturer
2014, MIT Science and Engineering Program for Teachers, lecturer
2014, MIT CEO Advisory Board, presenter
2014-present, MIT Center for Environmental Health Sciences, faculty member
2014, '15, '23, Center for Brains, Minds, and Machines Summer School, lecturer
2014, MIT Cardinal and Gray Academy (50th reunion) Alumni Event Presentation, "Center for Neurobiological Engineering"
2014, MIT Class of 1974 40th Reunion, dinner speaker
2013, MIT Tech Day featured speaker, "Unraveling the Workings of the Brain"
2013-present, Broad Institute, Associate Member
2013, MIT Simons Center for the Social Brain, Workshop "The Social Brain — New Opportunities for Discovery and Technology Development" Panelist
2012, MIT-MGH Initiative, member
2008, '11, MIT Knight Science Journalism Program lecturer

2013-2014, AT&T Career Development Professor
2012-2015, SkTech faculty search committee
2012, SkTech curriculum committee
2007-2013, Benesse Career Development Professor
2009-present, MIT Interdepartmental Graduate Program in Biophysics, faculty member
2009-present, MIT Molecular and Cellular Neuroscience Track, faculty member
2009-present, MIT Microsystems Technology Laboratories, affiliate member
2009-2010, Technology Review, invited columnist
2008-2020, MIT Department of Brain and Cognitive Sciences, joint professor
2007-2009, Technology Review, official blogger/writer
2007-2010, MIT McGovern Institute for Brain Research, Associate Faculty
2007-present, MIT Picower Institute for Learning and Memory, Affiliate Faculty
2007, MIT Department of Biological Engineering, Affiliate Faculty
2007-2015, MIT Neurotechnology Seminar Series (informal), host
2006-present, MIT Computational and Systems Biology Initiative, Faculty Member

Departmental, MIT McGovern Institute/Picower/BCS
2026, Balancing parenthood and science lunch, guest speaker
2025, MIT Brain and Cognitive Sciences Retreat, Career Panel
2024, Faculty Award for Excellence in Postdoctoral Mentorship, MIT BCS
2024, MIT Brains on Brains Event, panel participant
2022-2023, MIT Picower Institute Faculty Search Committee
2021-present, co-director, K-12 and college outreach related to Diversity, Equity, Inclusion and Justice (DEIJ) for the MIT Department of Brain and Cognitive Science
2019-present, Responsible Conduct in Science, MIT BCS IAP Course 9.S911, guest lecturer
2018-2019, MIT Picower Institute Faculty Search Committee
2018-2019, MIT McGovern Institute Faculty Search Committee
2013, MIT Brains on Brains Event, Neurotechnology Panel and Panel Chair
2013-present, MIT Brain and Cognitive Sciences Undergraduate Advising
2011, MIT BCS Multiphoton Microscope Core Committee
2010, MIT McGovern Institute Symposium: Cells, Circuits, and Behavior, co-organizer

Departmental, MIT Media Lab/Media Arts and Sciences
2022-on, junior faculty mentoring
2017-2018, MIT Media Lab Media Arts and Sciences Faculty Search Committee
2013-2014, MIT Media Lab Media Arts and Sciences Faculty Search Committee
2012, MIT Media Lab Inside/Out Symposium, co-organizer
2009-2020, MIT Media Lab Media Arts and Sciences, Environmental Health and Safety Officer
2008-2009, MIT Media Lab Media Arts and Sciences Faculty Search Committee
2007-2008, MIT Media Lab Media Arts and Sciences Steering Committee (aka MASCOM; academic committee)
2007, MIT Media Lab DCGS (Department Committee on Graduate Studies)
2006-2020, MIT Media Lab IPCOM (Intellectual Property Committee)

Departmental, MIT Biological Engineering
2007-present, MIT Biological Engineering Undergraduate Advising
2007-2009, MIT Biological Engineering Undergraduate Programs Committee

Major Publications

Papers (peer-reviewed and preprints)

1. Maguire, Y., Boyden, E. S., Gershenfeld, N. (2000) Toward a table-top quantum computer, IBM Systems Journal 39:3&4, p.823.

2. Boyden, E. S., Raymond, J. L. (2003) Active reversal of motor memories reveals rules governing memory encoding, Neuron 39(6):1031-42.

3. Boyden, E. S.*, Katoh, A.*, Raymond, J. L. (2004) Cerebellum-dependent learning: The role of multiple plasticity mechanisms, Annual Review of Neuroscience 27:581-609. (* co-first authors)

4. Kimpo, R. R.*, Boyden, E. S.*, Katoh, A., Ke, M. C., Raymond, J. L. (2005) Distinct patterns of stimulus generalization of increases and decreases in VOR gain, Journal of Neurophysiology 94(5):3092-3100. (* equal contribution)

5. 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.

6. Boyden, E. S., Katoh, A., Pyle, J. L., Chatila, T. A., Tsien, R. W., Raymond, J. L. (2006) Selective engagement of plasticity mechanisms for motor memory storage, Neuron 51(6):823-834.

7. Zhang, F., Wang, L.-P., Boyden, E. S., Deisseroth, K. (2006) Channelrhodopsin-2 and optical control of excitable cells, Nature Methods 3(10):785-92.

8. 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.

9. Wang, H., Peca, J., Matsusaki, M., Matsusaki, K., Noguchi, J., Qiu, L., Wang, D., Zhang, F., Boyden, E. S., Deisseroth, K., Kasai, H., Hall, W. C., Feng, G., Augustine, G. J. (2007) High-speed mapping of synaptic connectivity using photostimulation in channelrhodopsin-2 transgenic mice, Proceedings of the National Academy of Sciences 104(19):8143-848.

10. Liao, Y. J., Safa, P., Chen, Y.-R., Sobel, R. A., Boyden, E. S., Tsien, R. W. (2008) Anti-Ca2+ channel antibody attenuates Ca2+ currents and mimics cerebellar ataxia in vivo, Proceedings of the National Academy of Sciences 105(7):2705-2710.

11. 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. (* co-corresponding authors)

12. Han X., Qian X., Stern P., Chuong A. and Boyden E.S. (2009) Informational Lesions: Optical Perturbation of Spike Timing and Neural Synchrony Via Microbial Opsin Gene Fusions, Frontiers in Molecular Neuroscience 2:12.

13. 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. (* co-first authors)

14. Chan, S. Y., Bernstein, J. G., Boyden, E. S. (2010) Scalable Fluidic Injector Arrays for Viral Targeting of Intact 3-D Brain Circuits, Journal of Visualized Experiments 35:1489.

15. Knopfel, T., Lin, M. Z., Levskaya, A., Tian, L., Lin, J. Y., Boyden, E. S. (2010) Toward the Second Generation of Optogenetic Tools, Journal of Neuroscience 30(45):14998-15004.

16. Zorzos, A. N., Boyden, E. S.*, and Fonstad, C. G. (2010) Multiwaveguide implantable probe for light delivery to sets of distributed brain targets, Optics Letters 35(24):4133-5. (* corresponding author)

17. 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. (* co-corresponding authors)

18. 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)

19. Doroudchi, M. M., Greenberg, K. P., Liu, J., Silka, K. A., Boyden, E. S., Lockridge, J. A., Arman, A. C., Janani, R., Boye, S. E., Boye, S. L., Gordon, G. M., Matteo, B. C., Sampath, A. P., Hauswirth, W. W., Horsager, A. (2011) Virally delivered Channelrhodopsin-2 Safely and Effectively Restores Visual Function in Multiple Mouse Models of Blindness, Molecular Therapy 19(7):1220-9.

20. Boyden, E.S. (2011) A history of optogenetics: the development of tools for controlling brain circuits with light, F1000 Biology Reports 3:11.

21. Chow, B. Y.*, Chuong, A. S. *, Klapoetke, N. C. *, Boyden, E. S. (2011) Synthetic Physiology: Strategies for Adapting Tools from Nature for Genetically-Targeted Control of Fast Biological Processes, Methods in Enzymology 497:425-43. (* co-first authors)

22. 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.

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

24. Tsunematsu, T., Kilduff, T., Boyden, E. S., Takahashi, S., Tominaga, M., Yamanaka, A. (2011) Acute optogenetic silencing of orexin/hypocretin neurons induces slow wave sleep in mice, Journal of Neuroscience 31(29): 10529-10539.

25. 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.

26. McCarthy, M. M., Moore-Kochlacs, C., Xuan Gu, T., Boyden, E. S., Han, X., Kopell, N. J. (2011) Striatal origin of the pathologic beta oscillations in Parkinson's disease, Proceedings of the National Academy of Sciences 108(28):11620-5.

27. Bernstein, J. G., Garrity, P. A.*, Boyden, E. S.* (2012) Optogenetics and thermogenetics: technologies for controlling the activity of targeted cells within intact neural circuits, Current Opinion in Neurobiology 22(1):61-71. (* co-corresponding authors)

28. Chow B.Y., Han, X., Boyden, E. S. (2012) Genetically encoded molecular tools for light-driven silencing of targeted neurons, Progress in Brain Research 196:49-61.

29. Bernstein, J. G., Boyden, E. S. (2011) Optogenetic tools for analyzing the neural circuits of behavior, Trends in Cognitive Sciences 15(12):592-600.

30. Kahn, I.*, Desai, M., Knoblich, U., Bernstein, J., Henninger, M., Graybiel, A. M., Boyden, E. S.*, Buckner, R. L. *, Moore, C. I. * (2011) Characterization of the Functional MRI Response Temporal Linearity via Optical Control of Neocortical Pyramidal Neurons, Journal of Neuroscience 31(42):15086-15091. (* co-corresponding authors)

31. 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.

32. Börgers C., Talei Franzesi G., LeBeau F. E., Boyden E. S., Kopell N.J. (2012) Minimal Size of Cell Assemblies Coordinated by Gamma Oscillations, PLoS Computational Biology 8(2):e1002362.

33. Knopfel, T., Boyden, E. S. (2012) Tools for observing and controlling specific molecular or physiological pathways in intact cells and tissues. Preface, Progress in Brain Research 196:vii–viii.

34. 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.

35. 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-corresponding authors)

36. Kim K.M., Baratta M.V., Yang A., Lee D., Boyden E.S.*, Fiorillo C.D.* (2012) Optogenetic mimicry of the transient activation of dopamine neurons by natural reward is sufficient for operant reinforcement, PLoS One 7(4):e33612. (* co-corresponding authors)

37. Karayiorgou M., Flint J., Gogos J.A., Malenka R.C.; the Genetic and Neural Complexity in Psychiatry 2011 Working Group (Bargmann C.I., Boyden E.S., Bullmore E.T., Chan A.W., Davis M., Deisseroth K., Dolmetch R.E., Eggan K., Fears S.C., Freimer N.B., Geschwind D.H., Gordon J., Nickerson D.A., Vanderhaeghen P., Axel R., Zuker C.S., Fischbach G.) (2012) The best of times, the worst of times for psychiatric disease, Nature Neuroscience 15(6):811-812.

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

39. Gerits, A., Farivar, R., Rosen, B. R., Wald, L. L., Boyden, E. S., Vanduffel, W. (2012) Optogenetically Induced Behavioral and Functional Network Changes in Primates, Current Biology, 22(18):1722-1726.

40. Zamft, B. M.*, Marblestone, A. H.*, Kording, K., Schmidt, D., Martin-Alarcon, D., Tyo, K., Boyden, E. S., Church, G. (2012) Measuring Cation Dependent DNA Polymerase Fidelity Landscapes by Deep Sequencing, PLoS ONE 7(8): e43876. (* co-first authors)

41. 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)

42. Boyden, E. S. (2013) Interview with Edward S. Boyden, Trends in Neurosciences 36(1):1-2.

43. Gurkan, U. A., Fan, Y., Xu, F., Erkmen, B., Urkac, E. S., Parlakgul, G., Bernstein, J., Xing, W.*, Boyden, E. S.*, Demirci, U.* (2013) Simple precision creation of digitally specified, spatially heterogeneous, engineered tissue architectures, Advanced Materials 25(8):1192-1198. (* co-corresponding authors)

44. Cavanaugh, J., Monosov, I. E., McAlonan, K., Berman, R. A., Smith, M. K., Cao, V., Wang, K. H., Boyden, E. S., Wurtz, R. H. (2012) Optogenetic Inactivation Modifies Monkey Visuomotor Behavior, Neuron 76:901–907.

45. Chow, B. Y.* and Boyden, E. S.* (2013) Optogenetics and Translational Medicine, Science Translational Medicine 5(177):177ps5. (* co-corresponding authors)

46. Alivisatos, A., Andrews, A., Boyden, E. S., Chun, M., Church, G., Deisseroth, K., Donoghue, J., Fraser, S., Lippincott-Schwartz, J., Looger, L., Masmanidis, S., McEuen, P., Nurmikko, A., Park, H., Peterka, D., Reid, C., Roukes, M., Scherer, A., Schnitzer, M., Sejnowski, T., Shepard, K., Tsao, D., Turrigiano, G., Weiss, P., Xu, C., Yuste, R., Zhuang, X. (2013) Nanotools for Neuroscience and Brain Activity Mapping, ACS Nano 7(3):1850-66.

47. Kahn, I., Knoblich, U., Desai, M., Bernstein, J., Graybiel, A.M., Boyden, E.S., Buckner, R.L., Moore C.I. (2013) Optogenetic drive of neocortical pyramidal neurons generates fMRI signals that are correlated with spiking activity, Brain Research 1511:33-45.

48. Famm, K., Litt, B., Tracey, K.J., Boyden, E.S., Slaoui, M. (2013) Drug discovery: a jump-start for electroceuticals, Nature 496(7444):159-61.

49. Tsunematsu T., Tabuchi S., Tanaka K.F., Boyden E.S., Tominaga M., Yamanaka A. (2013) Long-lasting silencing of orexin/hypocretin neurons using archaerhodopsin induces slow-wave sleep in mice, Behavioural Brain Research, 255:64-74.

50. Kodandaramaiah, S. B., Boyden, E. S.*, Forest, C. F.* (2013) In vivo robotics: the automation of neuroscience and other intact-system biological fields, Annals of the New York Academy of Sciences, 1305(1):63-71. (* co-corresponding authors)

51. Glaser J.I.**, Zamft B.M.*, Marblestone A.H.*, Moffitt J.R., Tyo K., Boyden E.S., Church G., Kording K.P. (2013) Statistical analysis of molecular signal recording, PLoS Computational Biology 9(7):e1003145. (** corresponding author, * equal contribution)

52. Marblestone, A. H.**+, Zamft, B. M.+, Maguire, Y. G., Shapiro, M. G., Cybulski, T. R., Glaser, J. I., Amodei, D., Stranges, P. B., Kalhor, R., Dalrymple, D. A., Seo, D., Alon, E., Maharbiz, M. M., Carmena, J. M., Rabaey, J. M., Boyden, E. S.*, Church, G. M. *, Kording, K. P. * (2013) Physical Principles for Scalable Neural Recording, Frontiers in Computational Neuroscience, 7:137. (** corresponding author, + equal contribution, * equal contribution)

53. Schmidt, D., Tillberg, P. W.*, Chen, F.*, Boyden, E. S. (2014) A fully genetically-encoded protein architecture for optical control of peptide ligand concentration, Nature Communications, 5:3019. (* equal contribution)

54. Klapoetke, N. C., Murata, Y., Kim S. S., Pulver, S. R., Birdsey-Benson, A., Cho, Y. K., Morimoto, T. K., Chuong, A. S., Carpenter, E. J., Tian, Z., Wang, J., Xie, Y., Yan, Z., Zhang, Y., Chow, B.Y., Surek, B., Melkonian, M., Jayaraman, V., Constantine-Paton, M., Wong, G. K.*, Boyden, E. S.* (2014) Independent Optical Excitation of Distinct Neural Populations, Nature Methods 11:338–346. (* co-corresponding authors)

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Patents and Patent Applications

Total: 192 patents granted, and 343 patents pending. Selected patents (25) related to academic research, below. <u>This section was last updated in June 2019 (and is only updated every several years):</u>

Patent #	**Title**
10,317,321	Protein retention expansion microscopy
10,309,879	Expansion microscopy
10,173,061	Methods and apparatus for stimulation of biological tissue
10,120,180	Methods and apparatus for stretched light field microscope
10,106,584	Red-shifted opsin molecules and uses thereof
10,105,551	System for optical stimulation of target cells
10,094,840	Light-activated cation channel and uses thereof
10,059,990	In situ nucleic acid sequencing of expanded biological samples
10,036,758	Delivery of a light-activated cation channel into the brain of a subject
9,829,492	Implantable prosthetic device comprising a cell expressing a channelrhodopsin
9,668,804	Automated cell patch clamping method and apparatus

9,500,641 Red-shifted opsin molecules and uses thereof
9,498,293 Automated cell patch clamping method and apparatus
9,278,159 Light-activated cation channel and uses thereof
9,187,745 System for optical stimulation of target cells
9,163,094 Light-activated fusion proteins and uses therefor
9,101,690 Light-activated cation channel and uses thereof
8,957,028 Red-shifted opsin molecules and uses thereof
8,939,774 Methods and apparatus for three-dimensional microfabricated arrays
8,910,638 Methods and apparatus for high-throughput neural screening
8,906,360 Light-activated cation channel and uses thereof
8,864,805 System for optical stimulation of target cells
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17. Boyden, E. S. (2011) The Birth of Optogenetics, The Scientist, July 2011 Issue. (Cover Story.)

18. Boyden, E. S. (2011) Optogenetics: Using Light to Control the Brain, Cerebrum, The Dana Foundation, November 2011.

19. Boyden, E. S. (2014) Let there be light, Scientific American Mind, November/December 2014.

20. Boyden, E.S. (2024) Section of “Advice to the Next President,” Nautilus, 9/27/2024.

21. Boyden, E., and Kording, K. (2025) Whole-brain, bottom-up neuroscience: The time for it is now, The Transmitter, https://doi.org/10.53053/IPUB1951.

Blogs

1. Various members, alumni, and friends of the Synthetic Neurobiology group at MIT (2025-on) Engineering {X}, Blog hosted at http://engineeringx.substack.com.

2. Denisa Lepadatu and Edward Boyden (2026-on), Universe Conquering, Blog hosted at https://uniconq.substack.com/.

Other writings

1. Boyden, E. S. (1996) The Practical Physicist's OpenGL tutorial. Online.

2. Boyden, E. S. (1997) Tree-based Cluster Weighted Modeling: Towards A Massively Parallel Real-Time Digital Stradivarius. Online.

3. Boyden, E. S. (1997) A physics-based animation engine. Online.

4. Altshuler, R. C., Boyden, E. S., Chase, C. C., Davis, B. M., Delatorre, F. J., Edelson, J., Elgart, J. D., Gates, H. G., Hancher, M. D., Hasan, L. M., Huang, A. S., Knaian, A. N., Lee, F., Newburg, S. O., Polito, B. F., Reynolds, M. S., Smith, E. D., Warmann, E. C. (1998) The ORCA-1: An Autonomous Underwater Vehicle. Online.

5. Boyden, E. S., El Rifai, O., Hubert, B., Karpman, M., Roberts, D. (1999) A High-Performance Tunneling Accelerometer. Online.

Book chapters

1. Task Group Summary 6 (The Brain), The National Academies Keck Futures Initiative: Complex Systems: Task Group Summaries, 2009, ISBN 0-309-13725-X, National Academies Keck Future Initiative, National Academies Press, Washington DC.

2. Boyden, E. S., Han, X., Talei Franzesi, G., Chan, S., Bernstein, J., Qian, X., Li, M. (2009) New Techniques for Investigating Brain Rhythms: Optical Neural Control and Multielectrode Recording, In: Rhythms of the Neocortex: Where Do They Come From and What Are They Good For? (Kopell N., ed.) pp. 65-75. Washington, DC: Society for Neuroscience.

3. Chow, B. Y., Han, X., Bernstein, J. G., Monahan, P. E., Boyden, E. S. (2011) Light-Activated Ion Pumps and Channels for Temporally Precise Optical Control of Activity in Genetically Targeted Neurons, Chapter 6, Photosensitive Molecules for Controlling Biological Function, edited by James J. Chambers and Richard H. Kramer, Neuromethods Series Volume 55, Humana Press.

4. Boyden, E.S. (2010) Optogenetics. Chapter in McGraw-Hill Yearbook of Science & Technology, McGraw-Hill.

5. Chow, B. Y., Han, X., Bernstein, J. G., Monahan, P. E., Boyden, E. S. (2012) Light-Activated Ion Pumps and Channels for Temporally Precise Optical Control of Activity in Genetically Targeted Neurons, p. 305-338, Neuronal Network Analysis: Concepts and Experimental Approaches, edited by Tommaso Fellin and Michael Halassa,Neuromethods Series Volume 67, Humana Press.

6. Boyden, E. S. (2013) Optogenetic tools for controlling neural activity: molecules and hardware. In Optogenetics, edited by Peter Hegemann and Stephan Sigrist. Dahlem Workshop Report, De Gruyter.

Books

1. T. Knopfel and E. Boyden, eds. (2012) Optogenetics: Tools for Controlling and Monitoring Neuronal Activity, Progress in Brain Research, vol. 196, Elsevier.

Invited talks and other presentations

Invited talks (note: some talks 2020-on were virtual/online, due to COVID)

1. (2003) How multiple plasticity mechanisms contribute to versatile motor learning. Stanford Neurosciences Program 2003 Retreat, Monterey, CA.

2. (2005) Causal roles of neurons and neural circuits in learning and behavior. Hertz Foundation Scholars 2005 Retreat, Pt. Reyes, CA.

3. (2006) Solving the brain systematically: tools for the analysis and engineering of neural circuits. Google Tech Talk series, Google, Mountain View, CA.

4. (2006) Cutting-edge technologies for the systematic analysis of neural circuit dynamics. UCSF, Program in Bioengineering Seminar Series, San Francisco, CA.

5. (2006) Resolving the computational role of specific neural circuit elements. McGovern Institute, MIT, Cambridge, MA.

6. (2006) Towards the analysis of cortical computation via optical control of neural activity. Computation and Neural Systems, Caltech, Pasadena, CA.

7. (2006) Enabling technologies for controlling neural circuit functions. Brain Science Program, Brown University, Providence, RI.

8. (2006) Technologies for the systematic analysis of neural circuit function. Center for Brain Science, Harvard University, Cambridge, MA.

9. (2006) Neural Circuit Technology: Towards New Brain Interfaces and Biological Tools. MIT Media Laboratory, MIT, Cambridge, MA.

10. (2006) Engineering tools for engineering the brain. Division of Engineering, Brown University, Providence, RI.

11. (2006) Ultraprecise biological interfaces: Controlling life with light. Opening night talk, Science Foo (SciFoo) Camp, Google, Mountain View, CA.

12. (2006) Launching the Open Brain Stimulator Project. Session leader, Foo Camp, O'Reilly Media, Sebastopol, CA.

13. (2006) The future of neural devices. Stanford Biodesign Program, Stanford, CA.

14. (2006) Systematic approaches for understanding neural circuit function. Center for Basic Neuroscience, UT Southwestern Medical School, Dallas, TX.

15. (2007), Technologies for the Precise Control of Neural Circuits. Sloan-Swartz Seminars on Theoretical Neurobiology, Salk Institute for Biological Studies, San Diego, CA.

16. (2007) New Technologies for Repairing Neural Computations. The Stanley Center for Psychiatric Research, MIT, Cambridge, MA.

17. (2007) Technologies for engineering neural circuit function. Department of Biological Engineering, MIT, Cambridge, MA.

18. (2007) Engineering the Brain: Towards Systematic Cures for Neural Disorders. MIT Media Lab H2.0 (Human 2.0) Symposium, MIT, Cambridge, MA.

19. (2007) Engineering the Brain. Department of Psychiatry, Harvard/MGH, Boston, MA.

20. (2007) Towards enabling ultraprecise optical prosthetics. Massachusetts Eye and Ear Infirmary, Boston, MA.

21. (2007) What Do We Need to Know, to do Practical Cognitive Augmentation? (w/V. Bell), Science Foo (SciFoo) Camp, Google, Mountain View, CA.

22. (2007) Brain-Engineering Technologies: Towards Making us Smarter and Happier. AARP National Event and Expo, Boston, MA.

23. (2007) Engineering the Brain. Emerging Technologies (aka TR ETC, EmTech) Conference at MIT, Sept. 25-27, 2007

24. (2007) Towards ultraprecise optical prosthetics for treating pain: enabling technologies and testing. MGH-Charlestown, Boston, MA.

25. (2007) Controlling neural circuits: towards synthetic neurobiology. Harvard University Division of Applied Sciences, Cambridge, MA.

26. (2007) Principles of controlling neural circuit functions: towards synthetic neurobiology. Intel Corporation, Santa Clara, CA.

27. (2007) Neural Control Technologies and Uses Thereof. Innerspace Foundation, Boston, MA.

28. (2008) Towards a New Generation of Intelligent Brain Interfaces. Canon.

29. (2008) Engineering the brain. Honda.

30. (2008) Talking to the Mind: New Approaches to Engineering the Brain. The International House of Japan. Tokyo, Japan.

31. (2008) New Ideas on how to Get Information Into and Out of the Brain. NEC.

32. (2008) New Ideas on how to Get Information Into and Out of the Brain. Hitachi.

33. (2008) Optical Neuron Control: Understanding and Engineering Normal and Pathological Neural Dynamics. Boston University.

34. (2008) Genetically-Targeted Optical Neuromodulation: Towards Circuitwide Control of Normal and Pathological Neural Computation. Computational and Systems Neuroscience (CoSyNe) Workshop, Snowbird, UT.

35. (2008) Synthetic Neurobiology: Towards Engineering Brain Circuits for Health and Human Augmentation. O'Reilly ETech (Emerging Technology) Conference, San Diego, CA.

36. (2008) Optical Neural Control: Understanding Normal and Pathological Neuronal Circuit Dynamics. MIT Modern Optics and Spectroscopy Seminar Series, Cambridge, MA.

37. (2008) Optical Neural Control: Analyzing and Engineering Normal and Pathological Neuronal Circuit Dynamics. Psychiatry Department, Yale University, New Haven, CT.

38. (2008) Optical Neural Control: Analyzing and Engineering Normal and Pathological Neuronal Circuit Dynamics. Brain and Cognitive Sciences Department, MIT, Cambridge, MA.

39. (2008) Prosthetic Systems for Therapeutic Optical Activation and Silencing of Genetically-Targeted Neurons. MEMS for Implantable Medical Devices Symposium, MIT, Cambridge, MA.

40. (2008) Optical Neural Control: Analyzing and Engineering Normal and Pathological Neuronal Circuit Dynamics. 2008 Neuroscience Spring Symposium, University of Michigan.

41. (2008) Prosthetic Optical Fiber Systems for Therapeutic Neural Activation and Silencing. Corning, Inc., Corning, NY.

42. (2008) Controlling neural circuit elements to understand and engineer their roles in cognition. NYU, New York City, NY.

43. (2008) Optical Neural Control: Analyzing and Engineering Normal and Pathological Neuronal Circuit Dynamics. Neuron to Synapse Meeting, Harvard Medical School, Boston, MA.

44. (2008) Repairing Neural Circuits: Principles for Thinking About Epilepsy, Depression, and Schizophrenia. Kavli Science Journalism Workshop 'Frontiers of Brain Science,' Knight Science Journalism Fellowships Program, MIT, Cambridge, MA.

45. (2008) Optical Neural Control: Analyzing and Engineering Normal and Pathological Neuronal Circuit Dynamics. Neuroimaging Groups presentation, Marine Biology Laboratory, Woods Hole, MA.

46. (2008) What should we really be doing, to understand neural systems?. Grass Lab Tuesday night talk, Marine Biology Laboratory, Woods Hole, MA.

47. (2008) Optical Brain Control: Analyzing and Engineering Normal and Pathological Neural Circuit Dynamics. Integrative Brain Research Symposium, Sapporo, Japan.

48. (2008) Optical Brain Control: Analyzing and Engineering Normal and Pathological Neural Circuit Dynamics. Keynote, NIMH Intramural Retreat, Gettysburg, PA.

49. (2008) Optical Neuron Control: Towards Principles of Controlling Neural Circuits. Integrative Approaches to Brain Complexity Conference, Cold Spring Harbor/Wellcome Trust, Wellcome Trust Conference Center, Hinxton, UK.

50. (2008) Optical methods for controlling and correcting neural circuit functions. In Vivo Imaging in Recovery After Neural Injury: From Microimaging in Animal Models to Functional Imaging in Man. Satellite Symposium to the American Congress of Rehabilitation Medicine (ACRM) and the American Society of Neurologic Rehabilitation (ASNR) Joint Educational Conference, Toronto, Canada.

51. Barry, B., Boyden, E., Lang, E. (2008) Software Technologies in the Delivery of Intelligent Language Hypnosis Engines. Procedural Hypnosis: From Bench Top to Bedside (Symposium), 59th Annual Scientific Program, October 24-26, 2008 Hypnosis 2008: Foundations & Frontiers, Society for Clinical and Experimental Hypnosis.

52. (2008) High-Precision Genetically-Targeted Optical Control of Normal and Pathological Neural Computations. HHMI Conference on Genetic Manipulation of Neuronal Activity, Janelia Farm, Ashburn, VA.

53. (2008) Optical Brain Control: Analyzing and Engineering Normal and Pathological Neural Circuit Dynamics. Carolina Biophysics Symposium, Chapel Hill, NC.

54. (2008) Optical Brain Control: Analyzing and Engineering Normal and Pathological Neural Circuit Dynamics. MIT Synthetic Biology Working Group, Cambridge, MA.

55. (2009) Novel Tools for Precisely Controlling Brain Functions. Brain Research Center and Student Biotechnology Network, University of British Columbia, Vancouver, Canada.

56. (2009) Optical Brain Control: Analyzing and Engineering Normal and Pathological Neural Circuit Dynamics. CIMIT Forum, Boston, MA.

57. (2009) Optical Brain Control: Analyzing and Engineering Normal and Pathological Neural Circuit Dynamics. Dept. of Bioengineering, University of Pennsylvania, Philadelphia, PA.

58. (2009) Optical Control Of Normal and Pathological Neural Circuit Computations. McGovern Symposium, Tsinghua University, Beijing, China.

59. (2009) Optical Neural Control: Towards Systematic Parsing of the Role of Cell Types in Normal and Abnormal Neural Computation. MGH-HST Martinos Center Brainmap Series, Cambridge, MA.

60. (2009) Optical Brain Control: Towards New Therapies for Brain Disorders. Optical Society of America (New England Section Meeting), Cambridge, MA.

61. (2009) Optical Neural Control: Analyzing and Engineering Normal and Pathological Neural Circuit Dynamics. Tufts Neuroscience Symposium, Tufts University, Cambridge, MA.

62. (2009) Towards Understanding The Circuits of Cognition: Engineering Tools for Analyzing Primate Brain Dynamics. Along with Xue Han, New England Primate Research Center (NEPRC), Harvard Medical School, Southborough, MA.

63. (2009) Optical Activation of Neurons. Challenges for 21st Century Photonics, CIPS, MIT, Cambridge, MA.

64. (2009) Optical Brain Control: Towards New Insights and Therapies. Psychiatric Genetics and Translational Research Seminar, Massachusetts General Hospital, Boston, MA.

65. (2009) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies. Cold Spring Harbor Laboratories, NY.

66. (2009) Optical Neural Control Prosthetics. No Barriers Festival, Miami, FL.

67. (2009) Optical Cell-Specific Neuromodulation: Towards Engineering the Brain for Therapeutic Purposes. Medtronic, Minneapolis, MN.

68. (2009) Optical control of the brain: Understanding thought, engineering cures. HST Summer Institute Biomedical Optics Lecture Series, Massachusetts General Hospital, Boston, MA.

69. (2009) Technologies for controlling neural circuit dynamics. Sloan-Swartz 2009 Annual Meeting on Computational Neuroscience.

70. (2009) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies. Indiana University, Bloomington, IN.

71. (2009) Systematic Optical Control of Neural Circuits. Fifth Annual NIH Director's Pioneer Award Symposium, National Institutes of Health, Bethesda, MD.

72. (2009) Synthetic Neurobiology: Optically Engineering the Brain to Augment Its Function. Singularity Summit, New York City, NY.

73. (2009) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies, Salk Institute, San Diego, CA.

74. (2009) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies, Caltech, Pasadena, CA.

75. (2009) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies, NIH, Bethesda, MD.

76. (2009) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies. University of Texas at Austin, Austin, TX.

77. (2009) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies, UNC, Chapel Hill, NC.

78. (2009) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies, USC, Los Angeles, CA.

79. (2009) Engineering the Brain, NextGens Technologies Symposium, TTI/Vanguard, Salt Lake City, UT.

80. (2010) Entering Information Into the Brain to Shape Emotion, Thought, and Action, XPrize Workshop “Brain-Computer Interfaces: Igniting a Revolution”, MIT, Cambridge, MA.

81. (2010) Novel Optical Biological Control Tools: Towards Enabling Integrative Analysis of Neural Systems, Spivack Distinguished Lecture, Boston University, Boston, MA.

82. (2010) Novel Optical Biological Control Tools: Enabling Integrative Analysis and Engineering of Neural Systems, Center for Brain Science, Harvard University, Cambridge, MA.

83. (2010) Novel Optical Biological Control Tools: Towards Enabling Integrative Analysis of Neural Systems, A Meeting of the Minds in Monaco, 1st International Congress on Alzheimer's Disease and Advanced Neurotechnologies, Monaco.

84. (2010) Novel Optical Biological Control Tools: Enabling Integrative Analysis and Engineering of Neural Systems, University of Illinois Urbana-Champaign, Champaign, Illinois.

85. (2010) Novel Optical Biological Control Tools: Enabling Integrative Analysis and Engineering of Neural Systems, Wake Forest University, Winston-Salem, NC.

86. (2010) Novel Optical Biological Control Tools: Enabling Integrative Analysis and Engineering of Neural Systems, Lincoln Labs, MA.

87. (2010) Novel Optical Biological Control Tools: Enabling Integrative Analysis and Engineering of Neural Systems, University of Massachusetts, Amherst.

88. (2010) Optical Neuron Control: Discovery and Engineering of A Second Generation of Tools, Baylor College of Medicine, Houston, TX.

89. (2010) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies, Yale, New Haven, CT.

90. (2010) Controlling Brain Circuits with Light, Lester Wolfe Workshop in Laser Biomedicine: Optogenetics - Probing the Brain with Light, George R. Harrison Spectroscopy Laboratory/MGH Wellman Center for Photomedicine/Harvard—MIT Division of Health Sciences and Technology/CIMIT, Boston, MA

91. (2010) Controlling the Brain with Light, BrainForum 2010: The Brain Revolution, in honor of Rita Levi Montalcini's 101st birthday, Rome, Italy.

92. (2010) Brain Co-Processors for Analyzing and Augmenting the Mind, Big Ideas for Busy People, Cambridge Science Festival, Cambridge, MA

93. (2010) Optical Neural Control: A Platform for Cell-Specific Neuromodulation Therapy, Neurotechnology Industry Organization Neurotech Investing and Partnering Conference, Boston, MA.

94. (2010) Controlling Brain Circuits with Light, Academia Sinica Symposium, Picower Institute for Learning and Memory, MIT, Cambridge, MA.

95. Boyden, E. S., (2010) Controlling Brain Circuits with Light, Max Planck Institute for Biological Cybernetics, Tübingen, Germany.

96. (2010) Controlling Brain Circuits with Light, European Commission, Forum on Implantable Medical Technologies, Medical Devices Expert Group, Working Group on New & Emerging Technologies, Brussels, Belgium.

97. (2010) In Vivo Imaging and Control of Neural Networks: Watching the Brain in Action, Introductory talk, 16th German-American Frontiers of Science Symposium, Potsdam, Germany.

98. (2010) Controlling Brain Circuits with Light: Enabling Integrative Analysis and Engineering of Neural Systems, 27th Symposium of the Center for Visual Science, University of Rochester, Rochester, NY.

99. (2010) Controlling Brain Circuits with Light, H+ Summit, Harvard University, Cambridge, MA.

100. (2010) Controlling Brain Circuits with Light: Enabling Integrative Analysis and Engineering of Neural Systems, Translational Research and Vision, National Eye Institute 40th Anniversary Symposium, NIH, Bethesda, MD.

101. (2010) Controlling Brain Computations with Light. Multi-modal Neural Training Program Symposium, Carnegie Mellon University and University of Pittsburgh, Pittsburgh, PA.

102. (2010) Optogenetics: Targeted Control of Brain Circuits With Light, Gordon Research Conference on Lasers in Medicine and Biology, Holderness, New Hampshire.

103. (2010) Brain Co-Processors. Science Foo (SciFoo) Camp, Google, Mountain View, CA. (Selected as highlighted talk for presentation in final session.)

104. (2010) Optical Control of Biological and Neural Functions Using Retinal Proteins, 14th International Conference on Retinal Proteins, Santa Cruz, CA.

105. (2010) New Optical Reagents and Strategies for Controlling Neural Circuit Dynamics, Gordon Conference on Mechanisms Of Epilepsy & Neuronal Synchronization, Waterville, ME.

106. (2010) Enabling Systematic Neuroscience with Novel Optical Neural Control Strategies, INCF Neuroinformatics Congress, Kobe, Japan.

107. (2010) Controlling the Brain with Light: From Genomic Mining of Molecular Tools, to Neural Circuit Solving, UNC-Wilmington.

108. (2010) Controlling Brain Circuits With Light, EmTech@MIT, Cambridge, MA.

109. (2010) Controlling Brain Circuits With Light, Aspen Brain Forum: Building Better Brains: Neural Prosthetics and Beyond, Aspen, Colorado.

110. (2010) Controlling Brain Computations: Towards New Brain Insights and Brain Therapies, Allen Institute for Brain Science Symposium, Open Questions in Neuroscience, Seattle, WA.

111. (2010) Controlling brain circuits with light: Harnessing ecological diversity and molecular optimization to make new neuroscience tools, Genetic Manipulation of Neuronal Activity II, Janelia Farm, VA.

112. (2010) Novel optical neural control tools: towards enabling integrative analysis of neural systems, Minisymposium: Toward the Second Generation of Optogenetic Tools (Minisymposium co-chair), Society for Neuroscience, San Diego, CA.

113. (2010) Controlling Brain Circuits with Light: Towards the Next Generation of Tools. Harvard Neurobiology and Children's Hospital, Boston, MA.

114. (2010) Controlling Brain Circuits with Light, Purdue University, West Lafayette, IL.

115. (2010) Controlling Brain Circuits with Light, Medical University of South Carolina, Charleston, SC.

116. (2011) Inventing Tools for Controlling Brain Circuits With Light, Harvard School of Engineering and Applied Sciences, Cambridge, MA.

117. (2011) Optogenetics. Alfred Mann Foundation, Valencia, CA.

118. (2011) Controlling the Brain With Light. Plenary Lecture, Hot Topics Opening Session, SPIE, Moscone Center, San Francisco, CA.

119. (2011) Controlling Brain Circuits with Light: Enabling Integrative Analysis and Engineering of Neural Systems, Issekutz Memorial Lecture, Dalhousie University, Halifax, Canada.

120. (2011) Controlling Brain Circuits with Light: Optogenetics, Association for Research in Otolaryngology MidWinter Meeting, Baltimore, MD.

121. (2011) Controlling Brain Circuits With Light (published on TED.com as "A light switch for neurons"), TED (Technology, Entertainment, and Design Conference), Long Beach, CA.

122. (2011) Optogenetics: Molecular Tools & Hardware for Controlling the Brain with Light, UT Health Sciences, Houston, TX.

123. (2011) Optogenetics: Controlling Brain Circuits with Light, University of Chicago, Chicago, IL.

124. (2011) Optical reagents and strategies for controlling neural circuit dynamics, Boehringer Ingelheim Fonds 103rd International Titisee Conference, Genetic analysis of neural circuits, Titisee, Germany.

125. (2011) Controlling Brain Circuits With Light, University of Freiburg, Freiburg, Germany.

126. (2011) Optogenetics: Tools for Controlling Brain Circuits with Light, Cornell Weill Medical College, New York, NY.

127. (2011) Controlling Brain Circuits with Light, Keynote Talk, University of Pennsylvania Mahoney Institute of Neurological Sciences, 27th Annual Retreat, Philadelphia, PA.

128. (2011) Controlling The Brain With Light: New Molecular Tools and Devices for Optogenetics, Molecular and Cellular Neuroscience Seminar Series, MIT, Cambridge, MA.

129. (2011) Controlling brain circuits with light: New tools for analyzing neural systems. 15th Annual Conference on Cognitive and Neural Systems, Boston University, Boston, MA.

130. (2011) Optogenetics and Neurodegeneration. New Frontiers in Neurodegeneration Symposium, UMass Medical School Neurotherapeutics Institute/Biogen Idec, Cambridge, MA.

131. (2011) Optogenetics: Controlling Brain Circuits With Light, Dept of Pharmacology, Oxford University, Oxford, UK.

132. (2011) Towards Understanding the Brain as a Computational Circuit, Dept of Physiology, Oxford University, Oxford, UK.

133. (2011) Optogenetics: New Toolsets for Controlling Brain Circuits with Light, Karolinska Institute, Stockholm, Sweden.

134. (2011) Controlling Brain Circuits With Light: Analyzing and Engineering Neural Circuit Dynamics, Genetic and Neural Complexity of Psychiatry, Santorini, Greece.

135. (2011) Optogenetics: Tools for Controlling Brain Circuits With Light, National Institute for Drug Abuse, Baltimore, MD.

136. (2011) Optogenetics: Controlling Brain Circuits With Light, University of Washington, Seattle, WA.

137. (2011) Massively-Parallel Recording of Neural Activity: System Prototypes, Allen Distinguished Investigators Symposium, Seattle, WA.

138. (2011) New Technologies for Analyzing and Engineering the Brain: How 21st Century Tools are Opening up New Fronts on Thought, Emotion, and Disease, Kavli Science Journalism Workshop ‘Brain Science,’ Knight Science Journalism Fellowships Program, MIT, Cambridge, MA.

139. (2011) Controlling Brain Circuits with Light: Molecules, Hardware, Strategies, and Applications, Causal Neuroscience: interacting with neural circuits, FENS-IBRO-SFN School, Bertinoro, Italy.

140. (2011) Optogenetics: Tools for Controlling Brain Circuits With Light, BioMethods Boston Conference, Boston, MA.

141. (2011) Optogenetics: New Tools for Controlling Brain Circuits with Light, University of Louisville, Kentucky.

142. (2011) Technologies for the Systematic Analysis of How Brain Circuits Perform Computations, Keynote, 4th Conference on Artificial General Intelligence, Google, Mountain View, CA.

143. (2011) Optogenetics: Controlling the Brain with Light, MIT Club of Northern California.

144. (2011) Optogenetics and Other Neural Circuit Analysis Tools, Halcyon Molecular, Redwood City, CA.

145. (2011) Optogenetics and Other Neural Circuit Analysis Tools, UC Berkeley.

146. (2011) Optogenetics and Other Neural Circuit Analysis Tools, Erasmus MC, Rotterdam, The Netherlands.

147. (2011) Optogenetics: Controlling Neural Circuits with Light, 7th NIH Inter-Institute Workshop on Optical Diagnostic and Biophotonic Methods from Bench to Bedside, NIH, Bethesda, MD.

148. (2011) Optogenetics: Controlling Brain Circuits With Light, Selected Talk, 7th NIH Director's Pioneer Award Symposium, Bethesda, MD.

149. (2011) Optogenetics and Other Neural Circuit Analysis Tools, Keynote, Harvard Biophysics Retreat.

150. (2011) Neural Networks for Solving Neural Networks, Networks Solving Networks Meeting, MIT Media Lab, Cambridge, MA.

151. (2011) Optogenetics: Controlling Brain Circuits With Light, Keynote, Taiwan Neuroscience Society Meeting, Taipei, Taiwan.

152. (2011) Optogenetics and Other Neural Circuit Analysis Tools, Adrian Seminar, University of Cambridge, Cambridge, UK.

153. (2011) Controlling brain circuits with light: Towards systematic analysis of neural circuit functions. Symposium on the Emerging Genetics and Neurobiology of Severe Mental Illness, Broad Institute, Cambridge, MA.

154. (2011) Optogenetics and Other Neural Circuit Analysis Tools, Champalimaud Institute for the Unknown, Lisbon, Portugal.

155. (2011) Engineering the Mind, Ar Seminar Series for the Public, Inaugural Lecture, Champalimaud Institute for the Unknown, Lisbon, Portugal.

156. (2011) Enhancing the Brain - Past, Present and Future, Honors Colloquium, University of Rhode Island.

157. (2011) Technologies for Analyzing the Computations of the Brain, invited talk, IBM Watson Research Center, Yorktown Heights, NY.

158. (2011) Optogenetics and Other Neural Circuit Analysis Tools, 15th Annual Future of Light Symposium, Boston University Photonics Center, Boston University, Boston, MA.

159. (2011) Optogenetics and Other Neural Circuit Analysis Tools, Albert Einstein College of Medicine, Bronx, NY.

160. (2011) Optogenetics and Other Neural Circuit Analysis Tools, University of Connecticut.

161. (2011) Optogenetics: Tools for Controlling the Brain With Light, 14th Annual International Symposium on Neural Regeneration, Monterey, CA.

162. (2011) Optogenetics and Other Neural Circuit Analysis Tools, Sackler Lecture, Leiden University Medical Center, Leiden, The Netherlands.

163. (2012) Optogenetics, Robotic Neurophysiology, and Other Neural Circuit Analysis Tools, UCLA, Los Angeles, CA.

164. (2012) Optogenetics, Robotic Neurophysiology, and Other Neural Circuit Analysis Tools, USC, Los Angeles, CA.

165. (2012) Optogenetics: Tools for Controlling Brain Circuits With Light, Invited Talk, Photosensory Receptors & Signal Transduction Gordon Research Conference, Galveston, TX.

166. (2012) Engineering Creativity ("Interactive Dinner"), Discussion Leader, World Economic Forum Annual Meeting, Davos, Switzerland.

167. (2012) Leading Under Pressure ("WorkStudio"), Discussion Leader, World Economic Forum Annual Meeting, Davos, Switzerland.

168. (2012) Controlling neurons with light: Illuminating the path to fixing brain disorders, Speaker, Future Science with Nature Magazine ("IdeasLab"), World Economic Forum Annual Meeting, Davos, Switzerland.

169. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, Vollum Institute, Oregon Health Science University, Portland, OR.

170. (2012) Engineering the Brain, MIT Techfair, MIT, Cambridge, MA.

171. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, Brainmap Seminar, MGH Charlestown.

172. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, Tufts, Medford, MA.

173. (2012) Controlling the Brain With Light: New Technologies for Repairing Neural Circuits, The Brain: An Owner's Guide Lecture Series, UT Dallas BrainHealth Center, Dallas, TX.

174. (2012) Optogenetics. Optogenetics in neurons and beyond, Cell Press Webinar, March 15, 2012, Online.

175. (2012) Optogenetics and Other Tools For Analyzing and Engineering Neural Circuits, Case Western Reserve University, Cleveland, OH.

176. (2012) Optogenetics, In Vivo Robotics, and Other Neural Circuit Technologies, University of Oregon, Eugene, OR.

177. Bonsen, J. P., (2012) Curating Innovation: Creative Inventing for Solving Big Problems, Workshop, Media Lab Inside/Out Symposium, MIT, Cambridge, MA.

178. (2012) Adapting Tools From Nature To Engineer The Brain, Media Lab Inside/Out Symposium, MIT, Cambridge, MA.

179. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, Yale, New Haven, CT.

180. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, Lincoln Labs, Lexington, MA.

181. (2012) Optogenetics and other tools for analyzing neural circuits, Bagrit Lecture, Imperial College London.

182. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, David Colman Symposium, Montreal Neurological Institute/McGill University, Montreal, Canada.

183. (2012) Optogenetics, In Vivo Robotics And Other Tools for Brain Understanding, IEEE/IET Hosted Talk, Cambridge, MA.

184. (2012) Technologies for Understanding How the Brain Computes, Analog Devices, Wilmington, MA.

185. (2012) Technologies for Understanding and Fixing the Brain, NOVA ScienceNow ScienceCafe, Cambridge, MA.

186. (2012) Technologies for Analyzing and Engineering Brain Computations, “Cracking the Neural Code” Meeting, Aspen Brain Forum, Aspen, CO.

187. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, Max Planck Institute for Dynamics and Self-Organization, Gottingen, Germany.

188. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, Max Planck Institute for Brain Research, Frankfurt, Germany.

189. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, University of Tokyo, Tokyo, Japan.

190. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, Nagoya University, Nagoya, Japan.

191. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuit Tools, Japan Neuroscience Society 35th Annual Meeting, Nagoya, Japan.

192. (2012) Optogenetics: Controlling the Brain With Light, Perl/UNC Prize Lecture, UNC, Chapel Hill, NC.

193. (2012) Engineering the Brain & Transforming World Health, IET Inspec Webinar, Online.

194. (2012) Optogenetics: Molecules and Devices Enabling Precision Control of Neural Circuits with Light. 7th Brain Research Conference, Optogenetics and Pharmacogenetics, Society for Neuroscience Official pre-meeting, New Orleans, LA.

195. (2012) Optogenetics. Harvey Prize Lecture. Cambridge, MA.

196. (2012) Some ideas for how to do scalable neural circuit voltage imaging, Janelia Voltage Imaging Workshop, Janelia Farm, Ashburn, VA.

197. (2012) Some technologies for the brain activity map, 8th Kavli Futures Symposium: Tool Development for the Brain Activity Map, Washington, DC.

198. (2012) Synthetic Neurobiology, MIT Smart Customization Seminar, MIT, Cambridge, MA.

199. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuits Tools, Biological Imaging Lecture Series, University of Wisconsin Madison.

200. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuits Tools, Biochemistry, University of Wisconsin Madison.

201. (2012) Optogenetics, Robotic Electrophysiology, and Other Neural Circuits Tools, Psychiatry Grand Rounds, UT Southwestern.

202. (2013) Tools for Integrative Neuroscience: Optogenetics, Scalable Neural Recording, Molecular Brain Mapping, and 3-D Brain Building, Allen Institute for Brain Science, Seattle, WA.

203. (2013) Synthetic Intelligence, MIT Media Lab @ Tokyo 2013, Tokyo, Japan.

204. (2013) Science: The Next Revolution (“Interactive Dinner”), Discussion Leader, World Economic Forum Annual Meeting, Davos, Switzerland.

205. Boyden, E. S (2013) Nanorobots that repair the brain, Science Uncovered with Nature Magazine (“IdeasLab”), World Economic Forum Annual Meeting, Davos, Switzerland.

206. (2013) X Factors: Preparing for the Unknown (“Interactive Session”), World Economic Forum Annual Meeting, Davos, Switzerland.

207. (2013) Optogenetics, Invited Session Speaker, Association of Research in Otolarygology, Baltimore, MD.

208. (2013) Optogenetics, In Vivo Robotics, 3-D Neural Interfacing, & Brain Building, Young Innovator In Biomedical Engineering Series, Georgia Tech, Atlanta, GA.

209. (2013) Engineering the Brain, Hertz Foundation Board Dinner, San Mateo, CA.

210. Boyden, E. S (2013) Optogenetics, In Vivo Robotics, 3-D Neural Interfacing, & Brain Building, Neuroscience Day, University of New Mexico, Albuquerque, NM.

211. (2013) Technologies for Integrative Analysis of Cell Types, NIH Single Cell Meeting, Bethesda, MD.

212. Boyden, E. S (2013) Optogenetics, In Vivo Robotics, 3-D Neural Interfacing, & Brain Building, Lundbeck, Copenhagen, Denmark.

213. (2013) Optogenetics. MIT Opto 2013 Conference, MIT, Cambridge, MA.

214. (2013) Technologies for Mapping Brain Computations. BU Medical School, Boston, MA.

215. (2013) Engineering the Brain, MIT Tech Day Kresge Symposium.

216. (2013) Engineering the Brain, DARPA Invited Presentation, Defense Science Office, Arlington, VA.

217. (2013) Tools for Analyzing and Engineering the Brain, Global Future 2045 (GF2045) Congress, Alice Tully Hall, Lincoln Center, New York, NY.

218. (2013) Optogenetics, In Vivo Robotics, 3-D Brain Building: Tools for Analyzing and Engineering the Brain, Leica Scientific Forum Lecture, Bernstein Center for Computational Neuroscience Berlin, Berlin, Germany.

219. (2013) Optogenetics, In Vivo Robotics, 3-D Brain Building: Tools for Analyzing and Engineering the Brain, Leica Scientific Forum Lecture, Max-Planck-Institute Heidelberg, Heidelberg, Germany.

220. (2013) Optogenetics, In Vivo Robotics, 3-D Brain Building: Tools for Analyzing and Engineering the Brain, Leica Scientific Forum Lecture, Max Planck Institute of Neurobiology, Munich, Germany.

221. (2013) Invited Presentation, Large-Scale Recording Technologies and Structural Neurobiology, National Institutes of Health Advisory Committee to the Director Brain Research through Advancing Innovative Neurotechnologies(BRAIN) Working Group, Rockefeller University, New York City, NY.

222. (2013) Engineering The Brain, Friday Evening Lecture, Marine Biology Laboratory, Woods Hole, MA.

223. (2013) Optogenetics and novel methods for imaging neural activity, NSF Workshop on Mapping and Engineering the Brain, Arlington, VA.

224. (2013) Optogenetics. New Advances in Optical Imaging of Live Cells & Organisms, Cold Spring Harbor Asia, Suzhou, China.

225. (2013) Tools for Mapping Brain Computations, MIT/MGH Initiative Symposium in Neuroscience, MIT, Cambridge, MA.

226. (2013) Tools for Mapping Brain Computations, Herman P. Schwan Distinguished Lecture, University of Pennsylvania.

227. (2013) Optogenetics and Other Tools for Controlling and Analyzing Neural Circuits, Accelerating Translational Neurotechnology: Fourth Annual Aspen Brain Forum, Aspen, CO.

228. (2013) Optogenetics. Harvard Mind, Brain, and Behavior Junior Symposium 2013: New Methods in Brain Science: Optogenetics, the Connectome, and Functional Imaging 2.0, Harvard University, Cambridge, MA.

229. (2013) Optogenetics. Inaugural MIT Institute for Medical Engineering and Science Symposium, MIT.

230. (2013) Engineering the Brain, EmTech 2013 Conference, MIT Technology Review, MIT, Cambridge, MA.

231. (2013) Optogenetics. Gabbay Award Lecture, Brandeis University.

232. (2013) Tools for Mapping Brain Computations, Industry-Academy Symposium in CNS, Tel Aviv University.

233. (2013) Optogenetics. Israeli BRAIN Prize Competition Talk, 1st International Israeli Brain Technology Conference, Tel Aviv, Israel.

234. (2013) Optogenetics. Invited presentation, Brain Prize Day, Aarhus University, Denmark.

235. (2013) Optogenetics: Tools for Controlling Brain Circuits with Light, Brain Prize Meeting, Hindsgavl Castle, Denmark.

236. (2013) Towards the Brainome: Tools for Understanding Molecules, Connectivity, Activity, and Behavior, Society for Neuroscience Short Course, "The Science of Large Data Sets: Spikes, Fields, and Voxels," lecturer.

237. (2013) Optical, Molecular, and Robotic Tools for Integrative Single Cell Analysis, Society for Neuroscience Symposium “All for one and one for all: progress in single cell Neurobiology”, San Diego, CA.

238. (2013) Technologies for Mapping and Engineering the Brain, What is Life? Lecture, Karolinska Institute, Stockholm, Sweden.

239. (2013) Optogenetics: Tools for Analyzing and Controlling Brain Circuits with Light, Royal Swedish Academy of Sciences Symposium: Optogenetics, Stockholm, Sweden.

240. (2013) Optogenetics: Tools for Mapping and Controlling Brain Dynamics, CURE the Epilepsies: Frontiers in Research Seminar Series, Albert Einstein College of Medicine, Bronx, NY.

241. (2014) Tools for Mapping and Engineering Brain Computations, Yale University.

242. (2014) Tools for Mapping and Engineering Brain Computations, Honors Program, NYU.

243. (2014) Tools for Mapping and Engineering Brain Computations, Bioconference Live.

244. (2014) Tools for Mapping Brain Computations, Distinguished Seminar Series, Institute for Computational Medicine, Johns Hopkins University.

245. (2014) Tools for recording and controlling neural activity, Neuronal Circuits Meeting, Cold Spring Harbor.

246. (2014) Optical Tools for Mapping and Engineering the Brain, Lester Wolfe Workshop on Laser Biomedicine, Massachusetts General Hospital, Boston, MA.

247. (2014) Tools for Mapping Brain Computations, Carl P. Duncan Lecture, Northwestern University.

248. (2014) Tools for Mapping Brain Computations, XXVIII Sandbjerg Symposium, Danish Society for Neuroscience.

249. (2014) Tools for mapping and engineering brain circuits, Genetic Manipulation of Neuronal Activity III, Janelia Farm, Ashburn, VA.

250. (2014) New tools to study and engineer brain circuits, The Brain: Achievements and challenges, Molecular Frontiers Symposium, Royal Swedish Academy of Sciences, Stockholm, Sweden.

251. (2014) Tools for mapping brain computations, Featured Plenary Speaker, Canadian Neuroscience Meeting, Montreal, Canada.

252. (2014) Tools for mapping brain computations, Schuetze Award Lecture, Columbia University.

253. (2014) Optogenetics, Special Lecture, 9th FENS Forum for Neuroscience, Milan, Italy.

254. (2014) Optogenetics. 7th World Congress of Biomechanics, Boston, MA.

255. (2014) Optical Tools for Mapping Brain Computations, Gordon Conference on Lasers in Medicine and Biology, Holderness, NH.

256. (2014) Optogenetics: Membrane Transport Proteins as Tools for Mapping the Brain, Keynote, Gordon Conference on Membrane Transport Proteins, West Dover, VT.

257. (2014) Tools for Mapping and Engineering the Brain, 2nd Workshop, Micro- and Nanotechnologies for Medicine: Emerging Frontiers and Applications, Brigham and Women's Hospital, Harvard, Cambridge, MA.

258. (2014) Tools for Mapping and Engineering the Brain, MIT Club of Northern California, Palo Alto, CA.

259. (2014) Tools for Mapping and Engineering the Brain, Canary Center, Stanford University, Palo Alto, CA.

260. (2014) Tools for Mapping and Engineering the Brain, Rambus, Sunnyvale, CA.

261. (2014) Tools for Mapping and Engineering the Brain, Singularity University, NASA Ames, Mountain View, CA.

262. (2014) Tools for Mapping, Recording, and Controlling Neural Circuits, Monitoring Molecules in Neuroscience, Plenary Lecture, Los Angeles, CA.

263. (2014) Tools for Mapping and Engineering the Brain, Draper Executive Seminar on Neurotechnology, Draper Lab, Cambridge, MA.

264. (2014) Tools for Mapping and Engineering Brain Computations, Director's Special Colloquium, Argonne National Laboratory, Argonne, IL.

265. (2014) Tools for Mapping and Engineering Brain Computations, Biophysics Colloquium, Cornell University, Ithaca, NY.

266. (2014) Tools for Mapping Brain Computations, Fourth Biennial Conference on Resting State/Brain Connectivity, MIT, Cambridge, MA.

267. (2014) Tools for Mapping and Engineering Brain Computations, Applied Physics Colloquium, Harvard University.

268. (2014) Robots that can Drill Ultraprecise Craniotomies and Automatically Record Neurons, SYM02: Neuro-Vation, Congress of Neurological Surgeons Annual Meeting, Boston, MA.

269. (2014) Molecular Tools for Mapping and Controlling Neural Circuits, SYM02: Neuro-Vation, Congress of Neurological Surgeons Annual Meeting, Boston, MA.

270. (2014) Tools for Mapping and Engineering the Brain, The Scientist Webinar, New Models and Tools for Studying Synaptic Development and Function.

271. (2014) Tools for Mapping and Fixing the Brain, Translational Neuroscience Center Inaugural Symposium, Children's Hospital, Harvard Medical School.

272. (2014) From Here to Where? Following the Brain Map, Plenary Talk, Techonomy.

273. (2014) Mapping the brain at scale: collecting the data necessary to infer the computations carried out by neural circuits, Google, Mt. View, CA.

274. (2014) Towards a Comprehensive Atlas of the Mechanisms of Brain Computation, IEEE EMBS BRAIN Grand Challenges Conference, Washington, DC.

275. (2014) Optical Tools for Mapping and Engineering the Brain, DFG-NSF workshop "New Perspectives of Neurotechnology and Neuroengineering," NSF, Washington, DC.

276. (2014) Tools for Mapping and Repairing the Brain, Thirty Third Annual Seminar Series, The Human Brain: Research, Progress, and Policy, MIT Club of Washington DC.

277. (2014) Tools for Mapping and Repairing the Brain, Lincoln Lab ARTS Conference, MIT.

278. (2014) Tools for Multiscale Analysis of Biological Systems, Biochemistry Lecture, Massachusetts General Hospital, Boston, MA.

279. (2014) Understanding Brains and Minds, Russian-American Research Symposium, Moscow, Russia.

280. (2014) Super-resolution microscopy across arbitrary scales, NIH High-Risk High-Reward Symposium, Bethesda, MD.

281. (2014) Tools for Mapping, Recording, and Fixing Brains, "Talking Science" Lecture, Munich, Germany.

282. (2015) Tools for Understanding and Fixing Complex Biological Systems, MGH BioMEMS Resource Center Seminar, Harvard University, MGH Charlestown.

283. (2015) Tools for Understanding and Fixing Complex Biological Systems, Feinstein Institute, NY.

284. (2015) Tools for Understanding and Fixing Complex Biological Systems, Northeastern University, Boston, MA.

285. (2015) Tools for Mapping and Fixing the Brain, NIDA, Baltimore, MD.

286. (2015) Tools for Mapping and Fixing the Brain, Army Research Laboratory, Aberdeen Proving Ground, MD.

287. (2015) Tools for Mapping and Fixing the Brain, World CNS Summit 2015, Boston, MA.

288. (2015) Expansion Microscopy, NYSCF Webinar.

289. (2015) Optical Tools for Mapping and Engineering the Brain, SPIE Optogenetics Conference, Keynote.

290. (2015) Tools for Brain-Wide Mapping of the Computations of Intelligence, Center for Brains, Minds, and Machines Seminar, Harvard.

291. (2015) Tools for Mapping and Fixing the Brain, Brain Forum 2015, Lausanne, Switzerland.

292. (2015) Tools for Mapping and Fixing the Brain, Carnegie Prize Lecture, Carnegie Mellon University.

293. (2015) Tools for Understanding and Fixing the Brain, Massachusetts Neurological Association, Waltham, MA.

294. (2015) Tools for Mapping and Fixing the Brain, Neural Engineering and Systems Design BootCamp, DARPA.

295. (2015) Expansion Microscopy, Plenary Talk, 3rd NIH Single Cell Meeting, NIH, Bethesda, MD.

296. (2015) Towards Imaging DNA, RNA, and Proteins With Nanoscale Precision Throughout Entire Neurons and Neural Networks, NIH Workshop on Defining Cellular Phenotypes, NIH, Bethesda, MD.

297. (2015) Expansion Microscopy, Janelia Zebrafish Workshop, Janelia Farm.

298. (2015) Tools for Mapping and Controlling Complex Biological Systems, 2nd International Workshop on Mammalian Synthetic Biology, MIT.

299. (2015) Tools for Mapping and Fixing Complex Biological Systems, Wayne Crill Lecture, University of Washington.

300. (2015) Tools for Mapping and Fixing Complex Biological Systems, Institute for Disease Modeling, Bellevue, WA.

301. (2015) Tools for Mapping and Fixing Complex Biological Systems, Milton Gordon Lecture, University of Washington.

302. (2015) Precision tools for optically mapping and repairing the brain, Frontiers in Neurophotonics Summer School, Quebec City, Canada.

303. (2015) Tools for Mapping and Repairing the Brain, Dana Foundation/AAAS Capitol Hill Briefing, Washington, DC.

304. (2015) Tools for Mapping and Fixing the Brain, Albany 2015: the 19th Conversation, SUNY Albany, Albany, NY.

305. (2015) Mapping the Control Knobs of Autoimmune Attack, NYSCF Immunoengineering Working Group Meeting, New York, NY.

306. (2015) Tools for Mapping and Fixing Complex Biological Systems, Xerox PARC, Palo Alto, CA.

307. (2015) Expansion Microscopy, Science Foo (SciFoo) Camp, Google, Mountain View, CA.

308. (2015) Why is understanding the brain so difficult? The Future of the Brain segment, Science Foo (SciFoo) Camp, Google, Mountain View, CA.

309. (2015) Tools for Mapping and Fixing Complex Biological Systems, “Dinner and Ideas,” 3scan, San Francisco, CA.

310. (2015) Tools for Mapping and Fixing Complex Biological Systems, webinar, Photonics Media.

311. (2015) Tools for mapping and repairing complex biological systems, 3rd Annual Workshop on Micro- and Nanotechnologies for Medicine: Emerging Frontiers and Applications, Cambridge, MA.

312. (2015) Tools for Mapping Brain Computations, Program on Challenges in Computational Neuroscience (CCNS) Workshop, Statistical and Applied Mathematical Sciences Institute, Research Triangle Park, NC.

313. (2015) Tools for mapping and repairing the brain, Beyond Monoamines: Towards New Conceptualizations and Treatments for Major Depression Workshop, Radcliffe Institute, Cambridge, MA.

314. (2015) Expansion Microscopy, 21st International Conference on DNA Computing and Molecular Programming, Wyss Institute for Biologically Inspired Engineering, Harvard University, Cambridge, MA.

315. (2015) Tools for analyzing and repairing complex biological systems, NIH Director’s Lecture, NIH, Bethesda, MD.

316. (2015) Tools for analyzing and repairing the brain, MindEx 2015, Mind First Foundation/Harvard Personal Genome Project, Cambridge, MA

317. (2015) Tools for analyzing and repairing complex biological systems, Novartis Venture Fund annual retreat.

318. (2015) Tools for analyzing and repairing complex biological systems, Epilepsy Innovation Meeting, Epilepsy Foundation, Cambridge MA

319. (2015) Tools for analyzing and repairing the brain, Kavli Workshop on Cortical Computation, Cambridge MA

320. (2015) Tools for analyzing and repairing the brain, L'Universite Paris Descartes, Paris, France.

321. (2015) Tools for analyzing and repairing complex biological systems, Keynote Address, Gulf Coast Cluster for Neuroengineering 5th Annual NeuroEngineering Symposium (Rice, Baylor, UT Houston, UT Galveston, MD Anderson), Houston, TX.

322. (2015) Lighting up Biology, Science Writers 2015, Council for the Advancement of Science Writing New Horizons in Science, Cambridge, MA, Plenary Talk.

323. (2015) Tools for analyzing and repairing the brain, McLean Hospital, Belmont, MA.

324. (2015). Seeing very small things, PopTech 2015, Camden, ME.

325. (2015) Tools for mapping and repairing the brain, Wellesley College, Wellesley, MA.

326. (2015) Tools for understanding and repairing the brain, MIT Neurotech 2015, MIT, Cambridge, MA.

327. (2015) Tools for analyzing and modulating brain circuits, Behavior & Neurogenetics of Nonhuman Primates, Cold Spring Harbor Laboratory, 2015.

328. (2015) Tools for Understanding and Fixing Complex Biological Systems, Stanley Seminar, Cold Spring Harbor Laboratory, 2015.

329. (2015) Tools for Analyzing and Repairing Complex Biological Systems, Huck Institutes Distinguished Lecture Series, Penn State, State College, PA.

330. (2015) Vascular Interfaces for Brain Imaging and Stimulation, Research Highlight Talks, 2nd Annual BRAIN Initiative Investigators Meeting, Bethesda, MD.

331. (2015), with Ian Wickersham: Identifying and Accessing Cells and Circuits, Technology Integration Cross-Cutting Theme, 2nd Annual BRAIN Initiative Investigators Meeting, Bethesda, MD.

332. (2015) Thinking backwards from the goal of really simple data analysis, BICCC Break Out Session: Cell Type Histology & Morphology, 2nd Annual BRAIN Initiative Investigators Meeting, Bethesda, MD.

333. (2015) Tools for Mapping and Repairing Complex Biological Systems, Biochemistry, UCSF, San Francisco, CA.

334. (2016) Tools for analyzing brain circuits implementing intelligence, The Science and Engineering of Intelligence: A bridge across Vassar Street, MIT, Cambridge, MA.

335. (2016) (2016) Engineering Revolutions ("BetaZone"), World Economic Forum Annual Meeting, Davos, Switzerland. Delivered lecture twice.

336. (2016) Will Science Save Us?, Discussion Leader, Nature Publishing Group, World Economic Forum Annual Meeting, Davos, Switzerland.

337. (2016) Tools for Mapping and Repairing Complex Biological Systems, Longitudinal Seminar for the Master's Program in Clinical and Translational Investigation (MPCTI) and the Program in Clinical and Translational Science (PCaTS) at Harvard Medical School

338. (2016) Expansion microscopy: toward large-volume, 3D, nanoscale, multiplexed molecular mapping, 4th Annual Klarman Cell Observatory Retreat, Broad Institute, Cambridge, MA.

339. (2016) Tools for Analyzing and Repairing Brains and Other Complex Biological Systems, Schueler Lecture, Tulane University, New Orleans, LA.

340. (2016) Reverse Engineering, and Repairing, the Brain and Mind, MIT Sidney Pacific Presidential Fellows Distinguished Lecture Series.

341. (2016) Tools for Analyzing and Repairing Complex Biological Systems, Optogenetics in Neuroscience, Symposium, Biophysical Society 60th Annual Meeting, Los Angeles, CA.

342. (2016) Mapping, Observing, and Controlling the Brain Using Light, Mind Control: Past, Present, and Future, Mind Brain Behavior Initiative, Harvard University.

343. (2016) Tools for Mapping and Controlling Complex Biological Systems, 2016 Gene Circuits LabLinks, Broad Institute.

344. (2016) Tools for Mapping and Controlling Complex Biological Systems, Harvard Medical School, Division of Immunology Trainee Forum.

345. (2016) Tools for Analyzing and Repairing the Brain, Neuroscience Graduate Program, USC.

346. (2016) Optical Tools for Analyzing and Repairing Complex Biological Systems, Biology, Caltech.

347. (2016) Tools for Mapping and Repairing Complex Biological Systems, Cell Circuits and Epigenomics Seminar Series, Broad Institute.

348. (2016) Expansion Microscopy, High-Resolution Circuit Reconstruction Conference, Janelia Farm.

349. (2016) Tools for Analyzing and Repairing the Brain, Stanford Neuroscience Institute Seminar Series, Stanford.

350. (2016) Tools for Comprehensive Analysis of Brain Circuitry, The Brain in Focus: New Approaches to Imaging Neurons and Neural Circuits, Rungstedgaard, Denmark.

351. (2016) Tools for Analyzing and Repairing Brains and Other Biological Systems, Institute for Biophysical Dynamics, U Chicago.

352. (2016) Optical Tools for Analyzing and Repairing Complex Biological Systems, Salk Institute Thursday Seminar Series, Salk Institute.

353. (2016) Tools for Ground-Truth Analysis and Control of Neural Circuits, Computational Neuroscience and Vision Systems, University of Massachusetts Amherst.

354. (2016) Expansion Microscopy (published on TED.com as “Baby diapers inspired this new way to study the brain”), TED (Technology, Entertainment, and Design) Summit Conference, Banff, Canada.

355. (2016) Tools for Mapping and Controlling Neural Circuitry, Optogenetic Approaches to Understanding Neural Circuits & Behavior, Sunday River, Newry, ME.

356. (2016) New tools for mapping and engineering the brain: optogenetics and expansion microscopy, 2nd Proteins and Peptides International Conference, University of Geneva, Switzerland.

357. (2016) Ground-Truthing Medicine, Effective Altruism Global, Berkeley, CA.

358. (2016) Introduction to Expansion Microscopy, Expansion Microscopy Workshop, Janelia Research Campus.

359. (2016) Tools for Analyzing and Controlling Biological Systems, Litwack Lecture, North Carolina State University.

360. (2016) Tools for Mapping and Controlling the Brain, Neurotechnology Center Kavli Futures Symposium, Columbia University.

361. (2016) Tools for Analyzing and Repairing Complex Biological Systems, Wellman Center for Photomedicine, MGH.

362. (2016) Technologies for Mapping and Repairing the Brain, Reading Your Mind: Understanding your brain through physical responses, MDG Forum, Regis College.

363. (2016) Expansion Microscopy, Keynote, National Society of for Histotechnology Annual Symposium, Long Beach, CA.

364. (2016) Optical Tools for Analyzing and Repairing Complex Biological Systems, 13th Key Symposium 2016: Bioelectronic Medicine - Technology Targeting Molecular Mechanisms, New York Academy of Sciences, New York, NY.

365. (2016) Perspectives on Optogenetics, Optogenetics Day, Neurex, Strasbourg, France.

366. (2016) Optogenetics and Expansion Microscopy: Molecular Tools for Mapping and Controlling Complex Biological Systems, Institut de Science et d'Ingénierie Supramoléculaires, U. Strasbourg.

367. (2016) Ground-truthing Medicine, Hello Tomorrow Summit, Keynote, Paris, France.

368. (2016) Towards ground-truth analysis of neural circuit computations, Genetic Manipulation of Neuronal Activity IV, Janelia Research Campus, Ashburn, VA.

369. (2016) Technologies for Mapping and Repairing the Brain at a Fundamental Level, Center for BrainHealth, UT Dallas, Dallas, TX.

370. (2016) Optical Tools for Analyzing and Repairing the Brain, Karen L. Wrenn Lectureship, Duke University.

371. (2016) Tools for Understanding and Repairing the Brain, Research Update in Neuroscience for Neurosurgeons Course, Marine Biology Laboratory, Woods Hole, MA.

372. (2016) Tools for Systematically Analyzing Neural Circuits, Molecular and Cellular Cognition Society, San Diego, CA.

373. (2016) Expansion Microscopy and Expansion Sequencing: Towards Comprehensive Molecular Interrogation of Complex Biological Systems, Illumina Science & Technology Seminar Series, San Francisco, CA.

374. (2016) Expansion Microscopy: Towards Nanoscale Multiplexed Mapping of Biological Systems, Oncology Seminar Series, Koch Institute, MIT, Cambridge MA.

375. (2016) Lecture on Expansion Microscopy, Precision Medicine and Emerging Methods of Bioimaging panel, Association of Academic Health Centers 2016 Research Meeting, Washington, DC.

376. (2017) Expansion Microscopy and Optogenetics, 14th Annual Advanced Imaging Methods Workshop at UC Berkeley, Berkeley, CA.

377. (2017) Expansion Microscopy, AAAS/Science Webinar, Washington, DC.

378. (2017) Towards Comprehensive Biological Analysis of Intact Cells and Tissues: Expansion Microscopy, Optogenetics, and Other Tools, Brigham and Womens Pathology Grand Rounds, Brigham and Womens Hospital, Boston, MA.

379. (2017) Optical Tools for Analyzing and Repairing Brain Circuits, Max Planck Florida Sunposium 2017, Palm Beach, FL.

380. (2017) Optical Tools for Analyzing and Repairing Complex Biological Systems, Friday Lecture Series, Rockefeller University.

381. (2016) Ultra-Multiplexed Nanoscale in Situ Proteomics for Understanding Synapse Types, Brain Initiative Cell Census Consortium 3rd Annual BRAIN Initiative Investigators Pre-Meeting, Rockville, MD.

382. (2017) Nanoscale Resolution, Multiplexed, 3-D Molecular Imaging Across Large Volumes: Expansion Microscopy, Human Cell Atlas Meeting, Chan Zuckerberg Science, Stanford University.

383. (2017) Optogenetics and Expansion Microscopy: New Ways of Using Light to Understand Biological Systems, Keynote, Boston Photonics Centennial Conference, Harvard University.

384. (2017) Towards 3-D Multiplexed, Multimodal Imaging of Biomolecules Throughout Cells and Tissues, BRAIN Initiative Technology Integration Webinar.

385. (2017) Optical Tools for Mapping and Repairing the Brain: Expansion Microscopy and Optogenetics, 10th Annual Future of Genomic Medicine Conference, La Jolla, CA.

386. (2017) Tools for Analyzing and Repairing the Brain, Breakthroughs in Biology (Hadad) lecture, Haverford College.

387. (2017) Tools for Mapping and Controlling Complex Biological Systems, Department of Genetics, Washington University in St. Louis.

388. (2017) Expansion Microscopy and Optogenetics: Tools for Deconstructing Neural Circuits, OneChemistry Symposium, Chemistry's Role in the Brain Initiative, Johns Hopkins University.

389. (2017) Expansion microscopy, Frontiers in Imaging Science, Janelia Research Campus.

390. (2017) Expansion microscopy, Whitehead Institute Symposium on Frontiers in Biological Microscopy Technologies, Whitehead Institute, Cambridge, MA.

391. (2017) Expansion microscopy, keynote lecture, Foundations of Nanoscience, Snowbird, UT.

392. (2017) Optical tools for analyzing and repairing complex biological systems, Science and Technology Speaker Series, Sandia National Laboratory.

393. (2017) Tools for Mapping and Controlling Brain Circuits: Optogenetics and Expansion Microscopy, plenary lecture, Society of Biological Psychiatry, Annual Meeting, San Diego, CA.

394. (2017) Tools for Analyzing and Repairing Complex Biological Systems, Center for Interdisciplinary Research in Benign Urology, Beth Israel Deaconess Medical Center and Harvard Medical School.

395. (2017) Optical Tools for Analyzing and Repairing Complex Biological Systems, Massachusetts General Hospital Cancer for Cancer Research, Charlestown, MA.

396. (2017) Expansion Microscopy and Optogenetics: Tools for Mapping and Controlling Biological Systems, Frontiers in Imaging Lecture, Analytical & Quantitative Light Microscopy Course, Marine Biology Laboratory, Woods Hole, MA.

397. (2017) Optogenetic Technologies and Beyond: Tools for Mapping and Repairing Complex Biological Systems, Symposium, ARVO, Baltimore, MD.

398. (2017) Expansion Microscopy and Optogenetics: Tools for Mapping and Controlling Biological Systems, Harvard Program in Neuroscience 2017 Biennial Spring Symposium, Harvard Medical School, Boston, MA.

399. (2017) Things that Will Blow your Mind lecture, Milken Global Conference, Los Angeles, CA.

400. (2017) Tools for Analyzing and Repairing Complex Biological Systems, Rowland Institute Biweekly Seminar, Cambridge, MA.

401. (2017) with Nir Grossman, Noninvasive deep brain stimulation via delivery of temporally interfering electric fields, Noninvasive Brain Stimulation Scientific Interest Group Seminar, NIH Webinar.

402. (2017) The Future of the Brain: Curing, Augmenting, Simulating, Y Conf, San Francisco, CA.

403. (2017) Optical Tools for Understanding Biological Systems, Roger Tsien Keynote Lecture, CYTO 2017, Boston, MA.

404. (2017) Expansion microscopy, imaging neural dynamics, and optogenetics, Neuroimaging Seminar Series, Marine Biology Laboratory, Woods Hole, MA.

405. (2017) Optical Tools for Understanding Biology: Expansion Microscopy, Optogenetics, and More, Centre for Stem Cells and Regenerative Medicine, King's College London.

406. (2017) Expansion Microscopy, CRUK Researchers' Retreat 2017, Francis Crick Institute, London.

407. (2017) Tools for Seeing and Controlling Biological Systems, plenary lecture, European Conferences on Biomedical Optics, Munich, Germany.

408. (2017) Tools for Mapping and Repairing the Brain, The Brain Prize Symposium: The Functions of Neural Networks, Lund University 350th Anniversary Jubilee, Lund, Sweden.

409. (2017) Optical tools for analyzing and repairing complex biological systems, Society of General Physiologists, 71st Annual Symposium, Woods Hole, MA.

410. (2017) Optical Tools for Analyzing and Repairing Complex Biological Systems, 14th Horizons in Molecular Biology Conference, Max Planck Institute for Biophysical Chemistry, Gottingen, Germany.

411. (2017) Technologies for Analyzing and Repairing the Brain, Wearable Tech + Digital Health + Neurotech, Applysci Conference, MIT.

412. (2017) Technologies for Understanding and Repairing Complex Biological Systems, Reprogramming biological form and function: the dark matter of biology, Allen Discovery Center Opening Event, Tufts University.

413. (2017) New Tools for Understanding and Engineering the Brain, 2017 MIT Health Sensing & Imaging Conference, MIT.

414. (2017) Expansion Microscopy & Optogenetics: Tools for Mapping and Repairing Biology, Novartis Institutes of Biomedical Research, Cambridge, MA.

415. (2017) Optical Tools for Analyzing and Repairing Brain Circuits: Expansion Microscopy, Optogenetics, and More, 2nd annual Cornell Neurotech Symposium, Cornell University, Ithaca, NY.

416. (2017) Tools for mapping and repairing disease states: can we make therapeutic invention into a mature design science, BioTech Week Boston, Boston, MA.

417. (2017) Optical Tools for Mapping and Controlling Complex Biological Systems, Neuroscience Seminar Series, UT Southwestern, Dallas, TX.

418. (2017) Expansion Microscopy, Optogenetics, and Other Tools for Mapping and Repairing the Brain, Grand Rounds, Department of Psychiatry and Behavioral Sciences at the University of Texas Health Science Center at Houston, Houston, TX.

419. (2017) Expansion Microscopy and Optogenetics: Towards Mapping and Control of Complex Biological Systems, Department of Translational Molecular Pathology Distinguished Speaker Seminar Series, UT MD Anderson Cancer Center, Houston, TX.

420. (2017) Towards Comprehensive Analysis of Neural Circuit Functions, plenary talk, 142nd Annual Meeting of the American Neurological Association, San Diego, CA.

421. (2017) Creating and Disseminating Different Kinds of Neurotechnologies, Kavli Futures Symposium on Next-Gen, Open-Source Neurotechnology Dissemination, Los Angeles, CA.

422. (2017) Tools for Understanding and Repairing the Brain, Research Update in Neuroscience for Neurosurgeons Course, Marine Biology Laboratory, Woods Hole, MA.

423. (2017) Tools for Mapping and Repairing the Brain, Third Annual Selected Topics in Craniomaxillofacial Surgery: An International Symposium on Cranioplasty and Implantable Neurotechnology, Shriners Hospitals for Children, Boston, MA.

424. (2017) Nanotechnologies for Analyzing and Repairing the Brain, Keynote, Nanotechnology in Medicine Network, University of Manchester, Manchester, UK.

425. (2017) Optical tools for analyzing and repairing complex biological systems, Keynote, Single Cell Analyses, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.

426. (2017) Optical tools for analyzing and repairing biological systems, Drexel Prize in Biotechnology lecture, 2017 International Symposium on Molecular Medicine and Infectious Disease, Drexel University, Philadelphia, PA.

427. (2017) Optical Tools for Mapping Structure and Function in the Zebrafish Brain, International Workshop on Zebrafish Neural Circuits and Behavior, NIH, Bethesda, MD.

428. (2017) Optical Tools for Analyzing and Repairing Complex Biological Systems, Gail F. Beach Memorial Visiting Lectureship Series, Miami Project to Cure Paralysis, Miami, FL.

429. (2018) From Brain Maps to AI, OpenAI / Neuralink, San Francisco, CA.

430. (2018) Technologies for Analyzing and Controlling Neural Circuits, State of the Brain: Genetic Dissection of Brain Circuits and Behavior in Health and Disease, Keystone Symposia on Molecular and Cellular Biology, Keystone, CO.

431. (2018) "Most excited about" talk, Grand Challenge Summit, Cancer Research UK, London, UK.

432. (2018) Neurophotonic strategies for observing and controlling neural circuits, Neurotechnologies Plenary Session, SPIE Photonics West, San Francisco, CA.

433. (2018) Optical tools for analyzing and controlling neural circuits, Keynote, Optogenetics and Optical Manipulation 2018, SPIE Photonics West, San Francisco, CA.

434. (2018) Tools for Mapping and Repairing Complex Biological Systems, Amgen, Cambridge, MA.

435. (2018) Expansion Pathology: Nanoscale 3-D Molecular Imaging of Clinical Samples for More Accurate Diagnosis of Disease, Pathology Grand Rounds, Beth Israel Deaconess Medical Center, Boston, MA.

436. (2018) Optical Tools for Analyzing Neural Circuits and Other Biological Systems, HHMI Science Meeting, Janelia Research Campus.

437. (2018) Tools for mapping and repairing brain circuitry, 8th Wearable Tech + Digital Health + NeuroTech Silicon Valley conference, Stanford University.

438. (2018) Tools for Mapping and Repairing Complex Biological Systems, Joint Division of Biology/Center for Molecular Medicine Seminar Series, UC San Diego.

439. (2018) Tools for Analyzing and Repairing Brain Circuits, Cell Press Lablinks, Translational Neuroscience: Bridging the Gap, Broad Institute, Cambridge, MA.

440. (2018) Molecular Tools for Analyzing and Controlling Complex Biological Systems, Department of Chemistry, MIT.

441. (2018) Expansion Microscopy, Optogenetics, and Other Tools for Mapping and Repairing Biological Systems, Biophysics, CU Boulder, Boulder, CO.

442. (2018) Tools for Mapping and Controlling Complex Biological Systems, Keynote, Imaging: Innovations to Enhance Aging Research, Geroscience Interest Group, NIH.

443. (2018) Expansion Microscopy: Towards Mapping of Entire Biological Systems, Tucson Symposium, Tucson, AZ.

444. (2018) Tools for Mapping and Repairing Complex Biological Systems, Harvard Catalyst Clinical and Translational Research Academy, Harvard Medical School.

445. (2018) Tools for Mapping, Recording, and Controlling Neural Circuits, Gordon Conference, Neuroelectronic Interfaces, Galveston, TX.

446. (2018) Tools for Analyzing and Controlling Complex Biological Systems, Topics in Bioengineering Seminar, Harvard School of Engineering and Applied Sciences, Harvard University.

447. (2018) Tools for Mapping and Repairing Complex Biological Systems, New York Stem Cell Foundation, NY, NY.

448. (2018) Optogenetics in 2018: Where do we stand? Heart Rhythm Society Meeting, Boston, MA.

449. (2018) How Technologies for Mapping the Brain Could Lead to New Kinds of Artificial Intelligence, Keynote, International Conference on Pattern Recognition and Artificial Intelligence, Montreal, Canada.

450. (2018) Temporal Interference and it's Potential to Transform DBS Therapy, Dinner Speaker, Deep Brain Stimulation Think Tank, Atlanta, GA.

451. (2018) Brains & Behavior: Order & Disorder in the Nervous System, 83rd Cold Spring Harbor Laboratory Symposium on Quantitative Biology, Cold Spring Harbor Laboratory.

452. (2018) Optical Tools for Analyzing and Repairing Complex Biological Systems, NIH High-Risk, High-Reward Research Symposium, Bethesda, MD.

453. (2018) Novel Tools for Nanoscale Molecular Mapping and High-Speed Neural Dynamics Imaging, Gordon Research Conference on Image Science, Stonehill College, Easton, MA.

454. (2018) Tools for Analyzing and Repairing Complex Biological Systems, 2018 University of California Systemwide Bioengineering Symposium, Riverside Convention Center, Riverside, CA.

455. (2018) Tools for Mapping and Controlling the Brain, 2018 Blavatnik Science Symposium, New York, NY.

456. (2018) Molecular Tools for the Analysis and Repair of the Brain, Proteins & Peptides Conference 2018, Geneva, Switzerland.

457. (2018) Technologies for Understanding and Repairing the Brain, Colloquium, CERN.

458. (2018) Tools for Mapping and Repairing Complex Biological Systems, Institute for Computational Health Sciences, UCSF.

459. (2018) Tools for Mapping and Repairing Brain Circuits, Mechanisms of Epilepsy and Neuronal Synchronization Gordon Research Conference, West Dover, VT.

460. (2018) Tools for Analyzing and Repairing the Brain, Brainmind Summit, Stanford University.

461. (2018) Tools for Analyzing and Repairing the Brain, Neuroscience Grand Rounds, Massachusetts General Hospital, Boston, MA.

462. (2018) Expansion Microscopy, Optical Clearing and Expansion Microscopy symposium, Science for Life laboratory, Stockholm, Sweden.

463. (2018) Keynote, Gather Festival, Stockholm, Sweden.

464. (2018), Towards Integrative Optical Interrogation of the Brain, Society for Neuroscience Short Course, "Functional, Structural, and Molecular Imaging, and Big Data Analysis," co-organizer and lecturer, San Diego, CA.

465. (2018) Optical Control and Readout of Neural Activity Through Discovered and Engineered Retinal Proteins, 18th International Conference on Retinal Proteins, Hockley Valley Resort, Ontario, Canada.

466. (2018) Technologies for Understanding and Treating Alzheimer's Disease, Reconfiguring the Landscape for the Alzheimer's Challenge Workshop, Wequassett Resort, Harwich, MA.

467. (2018) Engineering Serendipity: How to Tackle Scientific Problems in the 21st Century, Creative Matters Lecture Series, U Iowa, Iowa City, IA.

468. (2018) Engineering Serendipity, Riding Today's Wave of Disruptive Technology, Innovation Outreach Program, Washington, D.C.

469. (2018) Expansion Microscopy, Optogenetics, and other Tools for Analyzing Complex Biology, Cell Biology Program, Memorial Sloan Kettering Cancer Center, New York, NY.

470. (2018) Neuroscience + synthetic biology: the neobiological revolution, Keynote Fireside Chat, Synbiobeta 2018, San Francisco, CA.

471. (2018) Engineering Serendipity: The Path to Controlling Neurons With Light, Gairdner Student Lecture, U Alberta, Edmonton, Canada.

472. (2018) Optogenetics: Tools for Optically Mapping and Repairing the Brain, Gairdner Faculty Lecture, U Alberta, Edmonton, Canada.

473. (2018) Engineering Serendipity: The Path to Controlling Neurons With Light, Gairdner Student Lecture, U Calgary, Calgary, Canada.

474. (2018) Optogenetics: Tools for Optically Mapping and Repairing the Brain, Gairdner Faculty Lecture, U Calgary, Calgary, Canada.

475. (2018) Optogenetics: Tools for Optically Mapping and Repairing the Brain, Gairdner Lecture, U Toronto, Toronto, Canada.

476. (2018) Expansion Microscopy, New Observations in Neuroscience Using Superresolution Microscopy, Mini-Symposium, Society for Neuroscience, San Diego, CA.

477. (2018) Expansion Microscopy, Keynote, Labeling and Nanoscopy, Heidelberg, Germany.

478. (2018) Mapping and Repairing the Brain: Implications for Global Health, Harvard Global Health Institute, Cambridge, MA.

479. (2018) Tools for Mapping and Repairing the Brain, Program in Neuroscience Seminar, University of Maryland.

480. (2018) Tools for Mapping and Repairing Complex Biological Systems, Keynote, 4th Science for Life Conference, Utrecht Life Sciences.

481. (2018) Expansion Microscopy: Towards Nanoresolution Mapping of Proteomes Throughout Cells and Tissues, Brain Cell 3D Proteomic Map Workshop, Online Webinar.

482. (2018) Optical Methods for Mapping and Controlling Complex Biological Systems, 22nd Annual BU Photonics Center Symposium, Boston University.

483. (2018) Engineering the Brain, World.Minds, Zurich, Switzerland.

484. (2018) Tools for Analyzing and Repairing the Brain, Presidential Distinguished Lecturer, 57th Annual Meeting, American College of Neuropsychopharmacology, Hollywood, Florida.

485. (2018) Evolving and Designing Optical Tools for Observing and Controlling Neural Circuits, 7th NTC Symposium, Voltage Imaging: A Next-Generation Technology for Neuroscience, Columbia University.

486. (2019) Tools for Analyzing and Controlling Complex Biological Systems, Endocrinology Grand Rounds, Beth Israel Deaconess Medical Center, Boston, MA.

487. (2019) Debugging the Human Brain, Savoy Place, IET London.

488. (2019) Tools for Mapping and Repairing the Brain, Neuroscience Seminar Series, Tufts University.

489. (2019) From Brain Mapping to 3-D Printing Nanotechnology: A Journey of Curiosity, IEEE Boston Sensors Council Chapter Meeting, Analog Devices, Boston, MA.

490. (2019) Tools for noninvasively controlling and observing neural circuits, Plenary Talk, 3rd International Brain Stimulation Conference, Vancouver, Canada.

491. (2019) From Structure to Function: Optical Tools for Analyzing the Complexity of the Brain, Patrick J. McGovern Memorial Symposium, MIT.

492. (2019) Engineering Serendipity: The Path to Controlling Neurons With Light, Gairdner Student Lectures (three lectures), Northern Ontario School of Medicine (NOSM).

493. (2019) Optogenetics: Tools for Optically Mapping and Repairing the Brain, Gairdner Lecture, Northern Ontario School of Medicine.

494. (2019) Tools for Understanding and Repairing the Brain, Science North, Sudbury, Canada.

495. (2019) Tools for Analyzing and Repairing the Brain, ICM, Paris, France.

496. (2019) Nanotechnology for Mapping, Controlling, and Building Brain Circuits and Other Complex Systems, NanoLund, Lund University.

497. (2019) Tools for Analyzing and Controlling Complex Biological Systems, Frontiers in Biology, Rennes, France.

498. (2019) Optical Tools for Analyzing and Repairing Complex Biological Systems, NSF Imaging in the Behaving Brain Workshop, Harvard University.

499. (2019) From Structure to Function: Optical Tools for Mapping, Physiologically Interrogating, and Controlling Neural Circuits, Faculty of Medicine, Dalhousie University.

500. (2019) Expansion Microscopy: Towards Scalable, Nanoprecise, Comprehensive Mapping of Disease States, Pathology Research Day, Dalhousie University.

501. (2019) Tools for Analyzing and Controlling Complex Biological Systems, Harvard Chinese Life Science Annual Conference, Harvard Medical School.

502. (2019) Tools for Analyzing and Repairing Complex Biological Systems, Beatrice and Jacob H. Conn Lectureship in Regenerative Medicine, Johns Hopkins University.

503. (2019) Optical Tools for Analyzing and Repairing Complex Biological Systems, University of Michigan Neuroscience Symposium.

504. (2019) Tools for Analyzing and Repairing the Brain, Keynote, Center for Brain Science Retreat, Harvard.

505. (2019) Expansion Microscopy: Nanoscale Imaging of Large Biological Specimens on Ordinary Microscopes, Presidential Symposium, American Association of Neuropathologists Annual Meeting, Atlanta, GA.

506. (2019) Tools for Analyzing and Controlling Complex Biological Systems, Canadian Student Health Research Forum, Winnipeg, Canada.

507. (2019) Technologies for observing and controlling high-speed physiological dynamics, Novel Technologies for the Study of Cognitive Function, Neuroscience School of Advanced Studies, Venice, Italy.

508. (2019) Tools for Observing and Controlling Neural Circuits, Keynote, OptoDBS, Geneva.

509. (2019) Expansion Microscopy, CAJAL Course on Interacting with Neural Circuits, Lisbon, Portugal.

510. (2019) Tools for Mapping and Perturbing Brain Circuits, Prospects in Theoretical Physics, "Great Problems in Biology for Physicists," Institute for Advanced Study.

511. (2019) Expansion Microscopy, Optogenetics, and Voltage Imaging (two lectures), Norwegian Research School of Neuroscience Summer School in Neuroscience, Molecular Genetic Tools for the Study of Neural Circuits, Tromso, Norway.

512. (2019) Tools for Mapping and Controlling the Brain, The V Applied Mathematics, Modeling and Computational Science, International Conference, Waterloo, Canada.

513. (2019) Optical Tools for Analyzing and Repairing Complex Biological Systems, Britton Chance Lecture for Advances in Basic Imaging Research, World Molecular Imaging Congress, Montreal, Canada.

514. (2019) Towards the Comprehensive Mapping of Normal and Pathological Brain Mechanisms, BrainMind Summit, Stanford University.

515. (2019) Tools for Understanding and Repairing the Brain, Research Update in Neuroscience for Neurosurgeons, Woods Hole, MA.

516. (2019) Updates in Optogenetics for Neuromodulation, Fifth Annual Selected Topics in Neuroplastic and Reconstructive Surgery, Boston MA.

517. (2019) Tools for Analyzing and Controlling Complex Biological Systems, IST Austria.

518. (2019) Tools for Mapping and Controlling the Brain, Max Planck Institute for Brain Research.

519. (2019) Technologies for Analyzing and Repairing the Brain, Transformative Technologies Conference, Palo Alto, CA.

520. (2019) Tools for Analyzing and Controlling Complex Biological Systems, 20th Fredric S. Fay Memorial Lecture, U Mass Medical.

521. (2019) Tools for Mapping and Controlling Complex Biological Systems, UMass Amherst.

522. (2019) Optical Tools for Analyzing and Controlling Brain Circuits, Optogenetic Technologies and Applications, AIChE / Society for Biological Engineering, Boston MA.

533. (2019) Tools for Mapping and Controlling the Brain and Other Complex Biological Systems, University Lecture Series, UT Southwestern.

534. (2019) Tools for Analyzing and Repairing the Brain, Gurley Lecture, UC Santa Barbara.

535. (2019) Optical Tools for Analyzing and Repairing Complex Biological Systems, Boston University Neurophotonics Symposium.

536. (2020) Tools for Analyzing and Controlling Brain Circuits, Brains & Behavior (B&B) Distinguished Lecture, Georgia State University.

537. (2020) Technologies for Mapping and Repairing Brain Circuits, Keynote, 18th International Symposium on Neural Regeneration, Asilomar, California.

538. (2020) Optical tools for analyzing and controlling the brain, Keynote, Optogenetics and Optical Manipulation 2020, SPIE Photonics West, San Francisco, CA.

539. (2020) Technologies for Analyzing and Repairing the Brain, Ann Romney Center for Neurologic Diseases, Brigham and Women's Hospital, Boston, MA.

540. (2020) Tools for Analyzing and Repairing Complex Biological Systems, Biology Colloquium, Florida State University.

541. (2020) Optogenetics, C/T Research Academy, Research Career Development Seminar, Harvard Clinical and Translational Science Center.

542. (2020) Inventing and Applying Tools for the Integrative Investigation of Brain Circuits, Brain and Cognitive Sciences, MIT.

543. (2020) Tools for Analyzing and Repairing the Brain, “Geniuses and Game Changers”, MIT Technology Day.

544. (2020) Expansion Microscopy, Imaging ONE WORLD, CRUK Cambridge Institute.

545. (2020) Tools for Analyzing and Controlling Brain Circuits, Optogenetics: from new tools to applications, FENS 2020 Virtual Forum.

546. (2020) Tools for Analyzing and Controlling Complex Biological Systems, Cell and Developmental Biology, University College London.

547. (2020) Tools for Imaging and Controlling Neural Circuits, Inscopix Insights Webinar.

548. (2020) Tools for Analyzing and Repairing Biological Systems, Cambridge University Scientific Society.

549. (2020) Expansion Microscopy, Microscopy and Microanalysis 2020 Virtual Meeting.

550. (2020) Technologies for Understanding and Repairing the Brain, The Future Lecture Series, MIT-CHIEF.

551. (2020) Tools for Analyzing and Controlling Biological Systems, Cellular and Molecular Biology (CMB) Short Course, “Seeing is Believing: Advancing Research with Scientific Microscopy", University of Michigan.

552. (2020) Tools for Analyzing and Repairing the Brain, Instituto de Investigaciones Biológicas Clemente Estable, Montevideo, Uruguay.

553. (2020) Tools for Analyzing and Repairing the Brain, International Congress: Neuroscience and Public Policies, Lima, Peru.

554. (2020) Multiplexed Nanoscale Protein Mapping Through Expansion Microscopy and Immuno-SABER, New Awardee Talk, Brain Initiative Cell Census Network (BICCN) Fall 2020 Virtual Meeting.

555. (2020) Expansion microscopy and how it can be used to enable nanoscale multiplexed imaging of proteins, RNAs, and cellular morphologies, Demo, Brain Initiative Cell Census Network (BICCN) Fall 2020 Virtual Meeting.

556. (2020) Optical Tools for Analyzing and Repairing Complex Biological Systems, Wyant College of Optical Sciences, U Arizona.

557. (2020) Tools for Analyzing the Brain and Other Complex Biological Systems, Department of Biological Sciences, UT El Paso.

558. (2020) Expansion Microscopy and Expansion Sequencing, Illumina Spatial Genomics and Transcriptomics Expert Panel.

559. (2020) Technologies for Observing and Controlling Biological Systems, Materials Science and Engineering, Stanford University.

560. (2020) Tools for Analyzing and Controlling Complex Biological Systems, BioE Talks Series, EPFL.

561. (2020) Center for Mind, Brain, Computation and Technology, Stanford University.

562. (2020) Tools for Analyzing and Repairing the Brain, EmTech China 2020.

563. (2020) Tools for Mapping, Recording, and Writing to the Brain; Brain Computer Interfaces: Innovation, Security, and Society; Columbia-IBM Center for Blockchain and Data Transparency.

564. (2020) Optical tools for analyzing and controlling the brain, Neuronexus Neurotechnologies Symposium, keynote.

565. (2020) Optical Tools for Analyzing and Repairing Biological Systems, iCANX.

566. (2020) Tools for Analyzing and Repairing Biological Systems, Clinician Engineer Hub.

567. (2020) New Tools for Multiplexed Imaging of Biomolecules and Signals Throughout Neural Circuits, Cognitive and Systems Neuroscience, HHMI Science Meeting.

568. (2020) Tools for Analyzing and Controlling Complex Biological Systems, Imperial College Synthetic Biology Society.

569. (2020) Optical Tools for Analyzing and Repairing Complex Biological Systems, Photonics Webinar.

570. (2020) Tools for Analyzing and Controlling the Brain, International Society for Neurodegenerative Diseases Conference 2020.

571. (2020) Tools for Analyzing and Controlling Brain Circuits, NIDA-NIAAA Frontiers in Addiction Research Mini-Convention.

572. (2021) Tools for Analyzing and Repairing Brain Circuits, BIDMC Cognitive Neurology Unit/Center for Noninvasive Brain Stimulation Grand Rounds.

573. (2021) Tools for Analyzing and Repairing the Brain, Israel Society for Neuroscience, virtual forum, keynote.

574. (2021) Multiplexed Imaging of Protein Organization and Cellular Signals Throughout Brain Circuits, BICCN Monthly Network Call Presentation.

575. (2021) Tools for Analyzing and Controlling Biological Systems, Bioengineering Departmental Seminar, Imperial College.

576. (2021) Tools for Analyzing and Repairing the Brain, Adrian Seminar in Neuroscience, Cambridge University.

577. (2021) Shining a Light on the Brain, Croonian Lecture.

578. (2021) Molecular Tools for Imaging and Controlling Complex Biological Systems, Physical Research Interest Group (RIG) Seminar, Department of Chemistry, Cambridge University.

579. (2021) Optical Tools for Analyzing and Repairing Complex Biological Systems, SPIE BiOS Digital Forum.

580. (2021) Neurotechnology, MIT Club of Great Britain.

581. (2021) Towards Solving the Brain with New Neurotechnologies, Entrepreneurs' Organization New Delhi.

582. (2021) Technologies for Analyzing and Controlling Brain Circuits, Bassoe Lecture, American Neuropsychiatric Association.

583. (2021) Tools for Understanding and Repairing the Brain, Regional Centre for Biotechnology, Haryana, India.

584. (2021) Technologies for Analyzing and Controlling Biological Systems, Terasaki Institute.

585. (2021) Tools for Multimodal Molecular Mapping of Biological Systems, Steele Lab, MGH/Harvard.

586. (2021) Tools for Analyzing and Repairing the Brain, keynote, Spring Symposium, Laboratory for Integrative Neuroscience, University of Illinois Chicago.

587. (2021) Tools for Analyzing and Repairing Biological Systems, Chemical Engineering Seminar, Northeastern University.

588. (2021) Tools for Analyzing and Controlling Biological Systems, Single-Cell Analysis Symposium: eSCAlating towards scientific breakthroughs, MilliporeSigma.

589. (2021) Tools for Analyzing and Repairing Biological Systems, Advances in Medical Imaging, SAE Media Group Webinar.

590. (2021) Tools for Analyzing and Repairing Biological Systems, Synthetic Biology Day '21, Bilkent University Synthetic Biology Society.

591. (2021) Tools for Analyzing and RepairingComplex Biological Systems, AI and Medicine: Promises and Limits, French National Academy of Medicine/MIT/Health Data Hub.

592. (2021) Tools for Analyzing and Controlling Complex Biological Systems, Cambridge University Biological Society.

593. (2021) Tools for Analyzing and Controlling Biological Systems, NHLBI Systems Biology Symposium.

594. (2021) Can We Simulate an Entire Brain in the Next 5 Years?, Sci Foo Lightning Talks.

595. (2021) Optical Tools for Analyzing and Controlling Biological Systems, 2021 Fitzpatrick Institute for Photonics Symposium, Frontiers in Photonics, Duke University.

596. (2021) Tools for Analyzing and Repairing the Brain, DZNE.

597. (2021) Tools for Analyzing and Repairing the Brain, Peter and Eva Safar Lecture, Department of Critical Care Medicine, U Pittsburgh.

598. (2021) Tools for Analyzing and Controlling Biological Systems, Graduate School of Health Sciences, Koç University.

599. (2021) Tools for Analyzing and Repairing the Brain, Frontiers of BrainHealth, Center for BrainHealth, UT Dallas.

600. (2021) Expansion Microscopy, Webinar, Réseau Technologique Microscopie photonique de Fluorescence Multidimensionnelle.

601. (2021) Tools for Analyzing and Controlling Biological Systems, Breakthrough Week, Faculty of Physics, University of Warsaw, Poland.

602. (2021) Tools for Analyzing and Controlling Brain Circuits, UTHealth Neuroscience Research Center.

603. (2021) Technologies for understanding and repairing the brain, “TRANSHUMAN RACE: The Symposium,” Human Augmentation Research & Technology, Eindhoven University of Technology/

604. (2021) Tools for Analyzing and Repairing Biological Systems, plenary lecturer, 2021 Spring Korean BioChip Society on-line conference.

605. (2021) Tools to Accelerate Neuroscience Progress, Foresight's Existential Hope Group, Foresight Institute.

606. (2021) Tools for Analyzing and Controlling Brain Circuits, TCIM 23, Tau Consortium, Rainwater Charitable Foundation.

607. (2021) Tools for Analyzing and Controlling Complex Biological Systems, MRC Laboratory of Molecular Biology (LMB)-Molecular Biology Institute of Barcelona (IBMB) Graduate Life Sciences Symposium.

608. (2021) Tools for Analyzing and Controlling Complex Biological Systems, Team iGEM, IISER Thiruvananthapuram.

609. (2021) Expansion Microscopy and Implosion Fabrication, 3D Nano Assembly for Photonics Workshop, Caltech.

610. (2021) Can Mapping the Brain, Help Us Simulate It? Sparks! Serendipity Forum, CERN.

611. (2021) Towards Solving the Brain with New Neurotechnologies, Wired Health: Tech.

612. (2021) Expansion Microscopy: Development and Application, UBC Tissue Clearing and Expansion 2021.

613. (2021) Tools for Analyzing and Controlling Biological Systems, EUREKA! Symposium, Graduate School of Life Sciences, Universität Würzburg.

614. (2021) Tools for Analyzing and Controlling Complex Biological Systems, Laufer Center, Stony Brook University.

615. (2021) Molecular Technologies for Understanding and Helping the Brain, Life Members Wisdom Clinical Perspectives: From Macro to Micro: A Review of Interventions for Neuropsychiatric Disorders: Restraints, Surgeries, Neuromodulation Therapies, Psychotherapies, and Pharmaceuticals to Molecular Biotechnologies, American Academy of Child & Adolescent Psychiatry Annual Meeting.

616. (2021) Tools for Analyzing and Repairing the Brain in Alzheimer's Disease, 2nd Targeting Therapy of Alzheimer’s and Related Neurodegenerative Diseases Virtual Conference.

617. (2021) Tools for Analyzing and Repairing the Brain, UCLA Joint Seminars in Neuroscience, BRI Annual Poster Session Distinguished Lecture.

618. (2021) Tools for Analyzing and Repairing the Brain, Keynote, Neurotechnologies: Current Developments, Applications and Ethical Issues, King's College London.

619. (2021) Towards Simulating the Brain, Artificial Intelligence as a Force for the Good of Humanity, Virgin Unite.

620. (2021) Tools for Analyzing and Repairing the Brain, Kshitij Symposium, Indian Institute of Technology, Kharagpur.

621. (2022) Optical Tools for Imaging and Controlling Biological Systems, Advanced Imaging Methods Workshop, UC Berkeley.

622. (2022) Optical Tools for Analyzing and Controlling Biological Systems, Molecular Life Sciences Seminar, Ohio State.

623. (2022) Tools for Analyzing and Controlling the Brain, Neural Engineering Seminar Series, Penn State.

624. (2022) Tools for Analyzing and Controlling Biological Systems, St. John's University.

625. (2022) Tools for Analyzing and Controlling Biological Systems, Biomedical Engineering Seminar, American University of Beirut.

626. (2022) Biomining New Tools For Analyzing and Controlling Complex Biological Systems, Marine Natural Products Gordon Research Conference.

627. (2022) Waterloo Nanotechnology Conference, Keynote.

628. (2022) Tools for Analyzing and Repairing the Brain, Storrs Symposium, U Connecticut.

629. (2022) Tools for Mapping and Controlling the Brain, Foresight Institute Existential Hope Group.

630. (2022) Optical Tools for Analyzing and Controlling Biological Systems, Advances in Precision Medicine: Genomic Innovation and Precision Medicine, Columbia University.

631. (2022) Tools for Analyzing and Controlling Biological Systems, Spatial Biology Association Meeting.

632. (2022) Tools for Analyzing and Repairing Complex Biological Systems, Latta Lecture, University of Nebraska Medical Center.

633. (2022) Tools for Analyzing and Controlling Biological Systems, Berkeley Bioengineering Seminar Series.

634. (2022) Tools for Analyzing and Repairing the Brain, MatchPoints Conference, Aarhus University, Keynote.

635. (2022) Optical Tools for Analyzing and Repairing Biological Systems, Light-Sheet Fluorescence Microscopy Conference, Marine Biological Laboratory.

636. (2022) Tools for Analyzing and Controlling Biological Systems, Membrane Biology Seminar, UT Health Science Center at Houston.

637. (2022) Tools for Analyzing and Repairing the Brain, Restoring and Extending the Human Brain, Rice University, Keynote.

638. (2022) Tools for Analyzing and Controlling Biological Systems, U Chicago Genehackers.

639. (2022) Optical tools for seeing and controlling the brain, Korean Society for Brain and Neural Sciences Annual Meeting, Plenary Lecture.

640. (2022) Tools for Analyzing and Repairing the Brain, Max Planck Florida Institute for Neuroscience Seminar Series.

641. (2022) Technologies for Mapping and Controlling Aging-Related Processes, Systems Aging Gordon Research Conference.

642. (2022) Optical Tools for Observing and Controlling Biological Systems, 21st International European Light Microscopy Initiative Meeting, Keynote.

643. (2022) Optical Tools for Mapping and Controlling Complex Biological Systems, Cell Biology of the Neuron Gordon Research Conference, Keynote

644. (2022) Tools for Analyzing and Controlling Biological Systems, Bioengineering Solutions for Biology and Medicine, Keynote

645. (2022) Tools for Analyzing and Controlling the Brain, Neural Pathways Underlying Brain Function and Pathologies.

646. (2022) Tools for Analyzing the Zebrafish Brain, Imaging Structure and Function of the Zebrafish Brain Conference.

647. (2022) Problem Solving in the 21st Century, Future Forum.

648. (2022) Tools for Analyzing and Repairing the Brain, Brenda Milner Lecture Series, University of Lethbridge, Keynote.

649. (2022) Optical tools for analyzing and controlling biological systems, School of Life Sciences Symposium 2022, EPFL.

650. (2022) Tools for Analyzing and Repairing Biological Systems, Princess Margaret Cancer Centre.

651. (2022) Tools for Analyzing and Repairing the Brain, Horizons in Neuroscience: Organoids, Optogenetics and Remote Control, German society of Biochemistry and Molecular Biology.

652. (2022) Tools for Seeing and Controlling Biological Systems, Workshop for Interaction and Scientific Collaboration, U Albany, SUNY, Keynote.

653. (2022) Tools for Analyzing and Repairing the Brain, Neuroscience and Neuromimetics Lecture Series, MIT Lincoln Lab.

654. (2022) Tools for Analyzing and Repairing the Brain, Sundaram Lecture, Massachusetts General Hospital.

655. (2022) Technologies for Analyzing and Repairing the Brain, Learning Technology and Decision-Making, UT El Paso.

656. (2022) Basics of Expansion Microscopy and Perspectives, Federal University of Rio de Janeiro.

657. (2022) Optogenetics and Other Optical Tools for Analyzing Biological Systems, 3rd Optogenetic Technologies and Applications Conference (AiChE), Heidelberg, Germany, Keynote.

658. (2022) Tools for Analyzing and Controlling Biological Systems, Boston University Biomedical Engineering Graduate Student Research Symposium, Keynote.

659. (2023) Expansion Microscopy, 56th Winter Seminar on Biophysical Chemistry, Molecular Biology and Cybernetics of Cell Functions, Klosters, Switzerland.

660. (2023) Towards Simulating the Brain as it Generates Decisions and Emotions, The Institute, San Francisco.

661. (2023) Tools for Analyzing and Repairing Biological Systems, Stark Seminar Series, Indiana University School of Medicine.

662. (2023) Spatiotemporally Multiplexed Imaging of Biological Signaling Networks, HHMI Science Meeting, Janelia Research Campus.

663. (2023) Tools for Analyzing and Repairing Biological Systems: Towards Increasing the Robustness of Warfighters, presentation to Defense Threat Reduction Agency.

664. (2023) Optical Tools for Analyzing and Repairing the Brain, Advanced Materials for Neuroelectronic Interfaces Seminar Series, Materials Science and Engineering Department, Seoul National University.

665. (2023) Expansion Microscopy, Patricia Levy Zusman International Workshop on Neuroregeneration, Department of Neurosurgery and the Center for Neuroregeneration, Houston Methodist, Keynote.

666. (2023) Optical Tools for Analyzing and Repairing Biological Systems, University of Padova.

667. (2023) Expansion Microscopy: Development and Application, Expansion Microscopy User Group Meeting, hosted by the Royal Microscopy Society.

668. (2023) Optical Tools for Analyzing and Controlling Biological Systems, Association of Biomolecular Resource Facilities Annual Meeting, Boston, MA, Keynote.

669. (2023) Analyzing and Repairing the Brain, Exner Lecture, Vienna, Austria.

670. (2023) Expansion Microscopy: Development and Application, EMBL Course: Expansion Microscopy, EMBL Heidelberg.

671. (2023) Optical Tools for Analyzing and Repairing Biological Systems, Imaging tissues, cells and molecules, Westlake-Science/AAAS Joint Online Symposium.

672. (2023) Expansion Microscopy: Development and Application, Tissue Microstructure Imaging, Gordon Research Conference, Easton, MA.

673. (2023) Optical Tools for Analyzing and Repairing Biological Systems, Proteins and Peptides, Structure, Function and Biotechnology, Geneva, Switzerland.

674. (2023) Tools for Longevity Biotech, Longevity Biotech Mixer, Cambridge, MA.

675. (2023) Optical Tools for Analyzing Complex Biological Systems, Chemical Imaging, Gordon Research Conference, Easton, MA.

676. (2023) Optical tools for analyzing and controlling biological systems, Optogenetics Meeting 2023, Volpriehausen, Germany.

677. (2023) Precision Multiplexed Imaging of Molecules and Signals Throughout Biological Systems, Single Cell Genomics 2023, Engelberg, Switzerland.

678. (2023) Tools for Deconstructing Mechanisms of Brain Computation, 2nd Bi-Annual Eric R. Kandel Lecture, Columbia University.

679. (2023) Tools for Observing and Controlling the Brain, Tau Consortium Stem Cell Group Seminar.

680. (2023) Tools for Understanding and Repairing the Brain, Society of Neurological Surgeons 2023 Research Update in Neuroscience for Neurosurgeons (RUNN) Course, Marine Biology Lab, Woods Hole, MA.

681. (2023) Tools for Analyzing and Repairing the Brain, Exploring by the Seat of Your Pants (EBTSOYP) Series, Gairdner Foundation.

682. (2023) Engineering the Brain, Woods Lecture, Butler University.

683. (2023) Tools for Analyzing and Controlling Brain Computations, Neurotechnology and its Societal and Ethical Implications Workshop, Casina Pio IV, Pontifical Academy of Sciences, Vatican City

684. (2023) Tools for Analyzing and Repairing the Brain and Other Biological Systems, Life Science Seminar Series, University of Geneva.

685. (2024) Expansion Microscopy, Harvard Tissue Clearing Workshop, Harvard University.

686. (2024) Optical Tools for Analyzing and Controlling Biological Computation, Tissue Talks Seminar Series, Columbia University.

687. (2024) Tools for Analyzing and Repairing the Brain, Merson Lecture, Queensland Brain Institute.

688. (2024) Tools for Systematic Imaging of Biological Structure and Function, Spatial Transcriptomic Symposium, Columbia.

689. (2024) Noninvasive Brain Stimulation through Temporal Interference, Featured Speaker, American Society for Stereotactic and Functional Neurosurgery Biennial Meeting, Nashville, TN.

690. (2024) Technologies for Stimulating and Simulating the Brain, Neurotech, WBE & BCI, LabWeek Field Building, Edge Esmeralda, Healdsburg, CA.

691. (2024) Optical Tools for Seeing and Controlling Biological Systems, Plenary Lecture, BioEM, Crete, Greece.

692. (2024) Optical Tools for Analyzing and Repairing Biological Systems, Harrington Symposium on Optical Methods in Quantitative Bio-Imaging: Concept to Application, UT Austin.

693. (2024) Tools for Analyzing and Controlling Biological Systems, 19th Symposium, Visualizing Biology: from the nano to the macro scale, Armenise Harvard Foundation, Harvard.

694. (2024) Tools for Analyzing and Controlling Biological Systems, Plenary Lecture, Microscopy & Microanalysis, Cleveland, OH.

695. (2024) Tools for analyzing, repairing, and simulating the brain, Peking University.

696. (2024) Tools for analyzing, repairing, and simulating the brain, Beijing Brain Conference, Chinese Institute for Brain Research.

697. (2024) Tools for Analyzing, Repairing, and Simulating Biological Systems, 21st Horizons in Molecular Biology Symposium, Max Planck Institute for Multidisciplinary Sciences, Göttingen, Germany.

698. (2024) Tools for Analyzing, Repairing, and Simulating the Brain, Keynote, Integrated Program in Neuroscience Annual Retreat, McGill University.

699. (2024) Tools for Analyzing, Controlling, and Simulating Biological Systems, Biomedical Engineering, Northwestern University.

700. (2024) Tools for Analyzing, Controlling, and Simulating Biological Systems, Applied Physics, Materials & Mechanics Colloquium, School of Engineering and Applied Sciences (SEAS), Harvard University.

701. (2024) Tools for Analyzing, Repairing, and Simulating the Brain, Integrative Neuroscience at Dartmouth (IND), Dartmouth College.

702. (2024) Tools for Analyzing, Repairing, and Simulating the Brain, 2024 Research Update in Neuroscience for Neurosurgeons (RUNN) Course, Marine Biology Lab, Woods Hole, MA.

703. (2024) Expansion Microscopy: Multimodal Nanomapping of Biomolecules Throughout Brain Circuits, BICAN (BRAIN Initiative Cell Atlas Network) Monthly Network Meeting.

704. (2024) Tools for Analyzing, Repairing, and Simulating the Brain, Institute of Biomedical Sciences (IBMS), Academia Sinica, Taipei, Taiwan.

705. (2024) Repairing the Brain, Exploring By The Seat of Your Pants, Gairdner talk.

706. (2024) Technology for analyzing and repairing the brain, Neurodegenerative Diseases: Biology & Therapeutics, Cold Spring Harbor.

707. (2025) Tools for Analyzing and Repairing the Brain, Neuroscience Colloquium Series, McMaster University.

708. (2025) Tools for Analyzing and Controlling Biological Systems, Pritzker School of Molecular Engineering, The University of Chicago.

709. (2025) Technologies for Deconstructing Biological Systems, Biological Chemistry and Molecular Pharmacology, Harvard Medical School.

710. (2025) Ground Truth Deconstruction of Biological Systems (w/D. Lepadatu), Roatan Institute of Technology (RIT) Summer School, Infinita City, Honduras.

711. (2025) Expansion Microscopy, Tissue Clearing Workshop, Harvard Medical School.

712. (2025) Tools for Analyzing, Repairing, and Simulating Biological Systems, St. Jude Children’s Hospital.

713. (2025) Tools for Analyzing, Repairing, and Simulating Biological Systems, Department of Pharmacology, Yale University.

714. (2025) Tools for Imaging, Controlling, and Modeling Biological Systems, Innovative Nanobiotechnology for Advanced Diagnostics and Therapeutics, Pittcon, Boston, MA.

715. (2025) Tools for Analyzing, Controlling, and Simulating Biological Systems, The Scientist, webinar.

716. (2025) Tools for Understanding, Repairing, and Simulating the Brain, Imagine Solutions, Naples, Florida.

717. (2025) Involuntary Collaboration, dinner talk, BrainMind, Mountain View, CA.

718. (2025) The Creative Brain in Motion (w/Y. Nakhimova), BrainMind, Mountain View, CA.

719. (2025) Towards Biologically Accurate Computer Simulations of the Brain, lightning talk, BrainMind, Mountain View, CA.

720. (2025) Towards Accurate Computer Simulations of The Brain, Neurotech Virtual Seminar Group, Foresight Institute.

721. (2025) Tools for Understanding, Repairing, and Simulating Biological Systems, Future of Biology Conference, Harvard Undergraduate OpenBio.

722. (2025) Towards Biologically Accurate Computer Simulations of the Brain, Lightning Talk, Imagination in Action: Pioneering the New Era with AI,

723. (2025) Towards Comprehensive Imaging and Control of Biological Systems, Optica Biophotonics Congress 2025, Coronado, CA.

724. (2025) Technologies for Analyzing and Repairing the Brain, NIH-Georgetown Scientific Conference.

725. (2025) Texas Academy of Math and Science, commencement address.

726. (2025) Towards solving the structure of a cell, Howard Hughes Medical Institute Science Meeting, Janelia.

727. (2025) Technologies for Understanding and Repairing Biological Systems, Mass Eye and Ear Research Day, keynote.

728. (2025) Towards Simulating the Brain in Computer Software, DeSci.Berlin.

729. (2025) Tools for Analyzing, Controlling, and Simulating Biological Systems, 2025 Harvard Chinese Life Science Annual Symposium.

730. (2025) What can engineers do, to help us understand and improve consciousness?, Human Tech Week, keynote.

731. (2025) Towards Biologically Accurate Computer Simulations of the Brain, Lightning Talk, SciFoo, Mountain View, CA.

732. (2025) Can we measure consciousness?, SciFoo, Mountain View, CA.

733. (2025) Technologies for Understanding Biological Systems, Kyoichi Tanaka Lecture, Proteins and Peptides Conference, Geneva, Switzerland.

734. (2025) Wired Health, Boston, MA, keynote.

735. (2025) Tools for Analyzing, Repairing, and Simulating Brains, Volker Henn Lecture, ETH Zurich.

736. (2025) Expansion Microscopy: a Democratized Platform for Nanoscale Discovery and Innovation, Presidential Lecture, Göttingen Expansion Forum 2025.

737. (2025) Tools for Understanding and Repairing the Brain, Joint Tumor Section Symposium Congress of Neurological Surgeons, Los Angeles, CA, keynote.

738. (2025) The Technological Path to Whole Brain Simulation, 2025 Neuro BCI, WBE, & AGI Workshop, Foresight Institute, San Francisco, CA.

739. (2025) Tools for Understanding, Repairing, and Simulating Biological Systems, Synthetic Biology for Brain Disease Research, The Scientist, webinar.

740. (2025) Tools for Understanding, Repairing, and Simulating the Brain, Research Update in Neuroscience for Neurosurgeons (RUNN) Course, Marine Biology Lab, Woods Hole, MA.

741. (2025) Tools for Understanding and Repairing the Brain, Workshop, National Academy of Neuropsychology, Los Angeles, CA.

742. (2025) A Light Switch for Neurons, Academy of Consultation-liaison Psychiatry Annual Conference, San Antonio, TX, plenary speaker.

743. (2025) Technologies for Repairing and Simulating the Brain, DeSci Summit Abu Dhabi, Cleveland Clinic Abu Dhabi.

744. (2026) Tools for Analyzing, Repairing, and Simulating the Brain, Cortex Club, Oxford University.

745. (2026) Precision Optical Tools for Multiplexed Imaging of Molecules and Signals in Cells and Tissues, BRAIN Cascade Seminar.

746. (2026) Novel Tools for Simple, Highly Multiplexed Imaging of Molecules and Signals, NIDA Genetics and Epigenetics Webinar.

747. (2026) Multiplex Imaging of Astrocytic Immune Dysfunction in Aging, Live Tissue Omics Grantee Kickoff Meeting, Chan Zuckerberg Initiative Biohub, Chicago.

748. (2026) Tools for Analyzing, Repairing, and Simulating the Brain, International Anesthesia Research Society Annual Meeting, Montreal, Canada, Presidential Lecture.

749. (2026) The Ground Truth Institute, Foresight Vision Weekend, London UK.

750. (2026) Optical Tools for Understanding and Repairing Biological Systems, 26th International Meeting of the European Light Microscopy Initiative, Keynote.

751. (2026) Tools for Understanding, Repairing, and Simulating the Brain, Neurobiology Course Monday Night lecture, Marine Biology Lab, Woods Hole, MA.

752. (2026) Optical Tools for Imaging and Controlling Biological Systems, 2026 Summer School in Neurovascular Imaging Across Scales in Animals and Humans, Boston University.

753. (2026) Optical Tools for Seeing and Controlling Biological Systems, Methods and Applications in Fluorescence, Copenhagen, Denmark, Keynote.

Other non-peer-reviewed talks and conference papers (last updated Aug 19, 2025, and updated about once a year)

1. Schoner, B., Cooper, C., Douglas, C., Boyden, E. S., Gershenfeld, N. (1998) Cluster Weighted Modeling for Time Series (How to Build a Digital Strad). Workshop on Nonlinear Dynamics and Statistics, Issac Newton Institute, Cambridge.

2. Chen, G., Foletti, D. L., Boyden, E. S., Holz, R. W., Scheller, R. H., Tsien, R. W. (2000) Differential functions of Rab3A in regulating excitatory and inhibitory transmission in hippocampal neurons. Society for Neuroscience, Online.

3. Boyden, E. S., Raymond, J. L. (2002) Induction, timecourse, and persistence of mouse vestibulo-ocular reflex adaptation. Society for Neuroscience, Online.

4. Boyden, E. S., Chatila, T. A., Raymond, J. L. (2003) Motor memories in the vestibulo-ocular reflex of CaMKIV knockout mice. Society for Neuroscience, Online.

5. Mong, C., Cao, Y. Q., Boyden, E. S., Abbott, L. C., Tsien, R. W. (2003) Properties of cortical spreading depression across visual cortex in mice with spontaneous mutations in P/Q-type Ca+2 channels. Society for Neuroscience, Online.

6. Liao, Y. J., Boyden, E. S., Tsien, R. W. (2003) Anti-calcium channel antibody affects cerebellar synaptic transmission in a model of acquired channelopathy. Society for Neuroscience, Online.

7. Liao, Y. J., Safa, P., Boyden, E. S., Tsien, R. W. (2004) Antibody-mediated altered cerebellar transmission. Channels, Receptors, and Synapses Meeting, Cold Spring Harbor, NY, April 2004.

8. Kimpo, R. R., Katoh, A., Boyden, E. S., Raymond, J. L. (2004) Patterns of generalization constrain encoding of learned opposite changes in the vestibulo-ocular reflex. Society for Neuroscience, Online.

9. Liao, Y. J., Safa, P., Boyden, E. S., Tsien R. W. (2004) Antibody-mediated channelopathy in a model of paraneoplastic cerebellar ataxia. Society for Neuroscience, Online.

10. Boyden, E. S., Content-selective neural mechanisms of memory encoding. (2005) Catalyzing the Future, Fannie and John Hertz Foundation Symposium.

11. Boyden, E. S., Zhang, F., Bamberg, E., Nagel, G., and Deisseroth, K. (2005) Millisecond-timescale optical control of neural computation via channelrhodopsin-2. Talk, at Society For Neuroscience, Online.

12. Zhang, F., Boyden, E. S., Deisseroth, K. (2005) Genetic and optical strategies for using channelrhodopsin-2 to control diverse neural functions. Society for Neuroscience, Online.

13. Boyden, E. S., Safa, P., Pyle, J. L., Neogi, M., Raymond, J. L., Tsien, R. W. (2005) Gene expression patterns in the medial vestibular nucleus indicate the direction of motor learning in the vestibulo-ocular reflex. Talk, at Society for Neuroscience, Online.

14. Wang H., Peca J., Qiu L., Wang D., Zhang F., Boyden E. S., Deisseroth K., Feng G., Augustine G. J., Hall W. C. (2006) Circuit analysis using optical stimulation in ChR2 transgenic mice. Society for Neuroscience, Online.

15. Peca, J., Wang, H., Arenkiel, B. R., Matsusaki, M., Davison, I. G., Matsusaki, K., Noguchi, J., Qiu, L., Wang, D., Zhang, F., Zhao, S., Berglund, K., Feliciano, C., Boyden, E. S., Kasai, H., Hall, W. C., Deisseroth, K., Ehlers, M. D., Augustin, G. J., Feng, G. (2007) A transgenic tool for controlling neuronal activity with light, Society for Neuroscience, Online.

16. Han, X., and Boyden, E. S. (2007) Two-Color, Bi-Directional Optical Voltage Control of Genetically-Targeted Neurons, Spotlight Presentation, Computational and Systems Neuroscience (CoSyNe), Salt Lake City, UT, Feb 22-25, 2007.

17. (Henninger, M. A.), Bernstein, J., Ko, E., Strelzoff, A., Chan, S. C. Y., Gidwaney, V., Stickgold, E., Tentori, A. M., McConnell, J., Rodriguez, A., Monahan, P., Talei Franzesi, G., Han, X., Qian, X., Boyden, E. S. (2008) A scalable toolbox for systematic, cell-specific optical control of entire 3-D neural circuits in the intact mammalian brain. Society for Neuroscience, Online. (M. A. Henninger sponsored the abstract submission, but J. Bernstein performed the key work.)

18. Han, X., Qian, X., Bernstein, J., Zhou, H., Graybiel, A., Desimone, R., Boyden, E. S. (2008) Millisecond-timescale optical control of specific genetically-targeted neurons and neural circuits in primate cerebral cortex. Society for Neuroscience, Online.

19. Han, X., Qian, X., Talei Franzesi G., Stern, P., Boyden, E. S. (2008) Molecular toolboxes for quantitatively precise, genetically-targeted optical control of normal and pathological neural network dynamics. Society for Neuroscience, Online.

20. Horsager, A., Liu, J.-W., Boyden, E. S., Arman, A. C., Matteo, B. C.,, Sampath, A. P., Hauswirth, W.W. (2009) Restoring visual function in adult rd1 mice using virally-delivered channelrhodopsin. Association for Research in Vision and Opthalmology, Online.

21. Liu, J.-W., Horsager, A., Ding, M., Mani, S., Chiodo, V.A., Boyden, E.S., Hauswirth, W.W. (2009) AAV-mediated ON Bipolar Cell Targeting In The rd1 Mouse Lacking Photoreceptors. Association for Research in Vision and Opthalmology, Online.

22. Tsien, R. W., Barrett, C. F., Safa, P., Chen, Y.-R., Boyden, E. S., Liao, Y. J. (2008) Genetic and Acquired Neural Diseases Involving Voltage-gated Calcium Channels. Abstract, Sixty-Second Annual Meeting of the Society of General Physiologists, Woods Hole, MA.

23. Boyden, E. (2009) Optical neural control: towards treating neurological and psychiatric disorders. Talk at Photons and Neurons, Conference 7180, BiOS 2009, Photonics West 2009, SPIE, January 2009.

24. Han, X., Qian, X., Bernstein, J., Zhou, H., Graybiel, A., Desimone, R., Boyden, E.S. (2009) Safety and efficacy of genetically-targeted optical neuromodulation in non-human primates. Talk at Photons and Neurons, Conference 7180, BiOS 2009, Photonics West 2009, SPIE, January 2009.

25. Han, X., Qian, X., Bernstein, J., Zhou, H., Graybiel, A., Desimone, R., Boyden, E.S. (2009) Excitatory-inhibitory network interactions during cell-specific optical cortical control. Talk at Photons and Neurons, Conference 7180, BiOS 2009, Photonics West 2009, SPIE, January 2009.

26. Lang, E. V., Diamond, S. G., Flory, N., Barry, B., (Boyden, E. S.) (2008) Hypnosis and Empathic Communication in Medical Practice -- A Report. American Psychological Association Convention, Session 1264.

27. Bernstein, J. G., Baratta, M. V., Ko, E. Y., Henninger, M. A. Li, M., Goosens, K., Boyden, E. S. (2009) Modulation of fear behavior via optical fiber arrays targeted to bilateral prefrontal cortex. Society for Neuroscience, Online.

28. Talei Franzesi, G., Borgers, C., Qian, X., Li, M., Han, X., Kopell, N., LeBeau, F., Whittington, M., Boyden, E. S. (2009) Dynamical properties of gamma-frequency cell assemblies in the hippocampus probed with optical neural control and computational modeling. Society for Neuroscience, Online.

29. McCarthy, M., Han, X., Boyden, E. S., Kopell, N. (2009) Striatum as a possible source of exaggerated beta oscillations in Parkinson's Disease: insights from computational models. Society for Neuroscience, Online.

30. Zorzos, A. N., Bernstein, J. G., Boyden, E.S., Fonstad, C. G. (2009) Integrated microstructure lightguides for ultradense optical neural control of 3-dimensional neural circuits. Society for Neuroscience, Online.

31. Zorzos, A. N., Dietrich, A., Talei Franzesi, G., Chow, B., Han, X., Fonstad, C. G., Boyden, E.S. (2009) Light-proof neural recording electrodes. Society for Neuroscience, Online.

32. Desai, M., Bernstein, J., Atallah, H., Kahn, I., Moore, C. I., Kopell, N., Graybiel, A., Boyden, E. S. (2009) Integration of optical neural control and high-field fMRI: Towards systematic exploration of functional neural dynamics with 'Opto-fMRI'. Society for Neuroscience, Online.

33. Horsager, A., Liu, J.-W., Boyden, E.S., Arman, A.C., Matteo, B.C., Sampath, A.P., Hauswirth, W.W. (2009) Circuit-specific expression of channelrhodopsin restores visual function in blind rd1, rd16, and rho -/- mice. Society for Neuroscience, Online.

34. Shin, S.-L., Boyden, E. S., Katoh, A., Zhao, G. Q., Raymond, J.L. (2009) Adaptive timing is impaired in mice deficient in presynaptic LTP. Society for Neuroscience, Online.

35. Chow, B.Y., Han, X., Qian, X., Li, M., Chuong, A. S., Monahan, P.E., Dobry, A.S., Boyden, E.S. (2009) High-efficacy, temporally-precise, in vivo neural silencing via light-driven proton pumping. Society for Neuroscience, Online.

36. Chow, B.Y., Han, X., Qian, X., Li, M., Chuong, A. S., Monahan, P.E., Dobry, A.S., Boyden, E.S. (2009) Multiple-color optical silencing of distinct neural populations using novel classes of light-driven ion pumps. Society for Neuroscience, Online.

37. Cao, R., Cardin, J., Higashikobo, B., Knoblich, U., Brumberg, J. C., Boyden, E. S., Moore, C. I. (2009) Testing the hemoneural hypothesis: Specific control of blood flow and functional two photon imaging. Society for Neuroscience, Online.

38. Boyden, E. S. (2009) Optical Neural Control: Engineering Therapeutic Circuit Dynamics: Application to Post-Traumatic Stress Disorder, Talk 7-9, Poster P31-11, PTSD Treatment, Military Health Research Forum, Kansas City, MO.

39. Chow, B. Y., Han, X., Klapoetke, N. C., Dobry, A. S., Desimone, R., Boyden, E. S. (2010) NOVEL CLASSES OF OPTICAL NEURAL CONTROL TOOLS REVEALED VIA SCREENING OF PHYLOGENETIC DIVERSITY, Cold Spring Harbor Meeting on Neural Circuits, Cold Spring Harbor, NY.

40. Bernstein, J. G., Zorzos, A. N., Baratta, M. V., Ko, E. Y., Yang, A., Li, M., Talei Franzesi, G., Goosens, K. A., Fonstad, C. G., Boyden, E. S. (2010) Hardware for Optical Perturbation of 3-D Neural Circuits: Towards High-Throughput Screening of Neural Circuit Targets, Cold Spring Harbor Meeting on Neural Circuits, Cold Spring Harbor, NY.

41. Zimmerman, C., Wasserman, S., Boyden, E. (2010) Classroom NMR System, Institute of Biological Engineering Annual Conference, Cambridge, MA.

42. Talei Franzesi, G., Borgers, C., Qian, X., Li, M., Han, X., Kopell, N. J., Le Beau, F., Whittington, M.A., Boyden, E.S. (2010) Dynamical properties of gamma-frequency cell assemblies in the hippocampus probed with optical neural control and computational modeling. Collaborative Research in Computational Neuroscience (CRCNS) Meeting, Johns Hopkins University, Baltimore, Maryland.

43. Kim, K., Baratta, M. V., Yang, A., Lee, D., Boyden, E. S., Fiorillo, C. D. (2010) Optical activation of dopamine neurons for 200 milliseconds is sufficient for operant reinforcement. Society for Neuroscience, Online.

44. Chuong, A. S., Klapoetke, N. C., Chow, B. Y., Dobry, A. S., Han, X., Boyden, E. S. (2010) Development of next-generation optical neural silencers through directed combinatorial optimization. Society for Neuroscience, Online.

45. Klapoetke, N., Chuong, A., Chow, B., Morimoto, T., Han, X., Boyden, E. S. (2010) Novel classes of optogenetic reagent derived from screening genomic and ecological diversity. Society for Neuroscience, Online.

46. Han, X., Chow, B. Y., (Li, M.), Yang, A., Zhou, H., Rajimehr, R., Klapoetke, N., Chuong, A., Desimone, R., Boyden, E. S. (2010) Temporally precise optical neural silencing in the nonhuman primate brain. Society for Neuroscience, Online.

47. Allen, B. D., Bernstein, J., Guerra, A., Talei Franzesi, G., Yang, A., Wang, V., Sternberg, J., Boyden, E. S. (2010) Strategies for practical use of multi-site optical neural control hardware in vivo. Society for Neuroscience, Online.

48. Wentz, C., Bernstein, J., Guerra, A., Monahan, P., Simon, J., Farrell, M., Liu, Y., Boyden, E. S. (2010) Wireless Optical Control of Neural Circuits in Freely-Moving Animals. Society for Neuroscience, Online.

49. Desai, M., Kahn, I., Bernstein, J., Atallah, H., Kopell, N., Buckner, R. L., Moore, C.I., Graybiel, A.M., Boyden, E.S. (2010) Opto-fMRI: Ultra-High Resolution Causal Circuit Mapping, and Application to Analysis of Network Dynamics. Society for Neuroscience. Online.

50. Kahn, I., Knoblich, U., Desai, M., Bernstein, J., Graybiel, A.M., Boyden, E.S., Buckner, R.L., Moore, C.I. (2010) Opto-fMRI: Blood oxygenation level-dependent (BOLD) response is correlated with optically-driven pyramidal spiking activity. Society for Neuroscience. Online.

51. Kodandaramaiah, S. B., Malik, S., Dergance, M. J., Forest, C. R., and Boyden, E. S. (2010) Design and Performance of Telescoping Micropipette Arrays for High Throughput in Vivo Patch Clamping, Proceedings of the 25th Annual Meeting of the American Society for Precision Engineering 2010, V. 50, p. 246-249, Atlanta, GA, October 31-November 4, 2010.

52. Becerra, L., Brenner, G., Bishop, J., Chang, P.-C., Shin, H.-S., Boyden, E. Borsook, D. (2011) Opto-fMRI in awake rodents: Activation and deactivation BOLD signal induced by excitation and inhibition of neurons, 2011 Annual Meeting of the International Society for Magnetic Resonance in Medicine, Montreal, Quebec, Canada.

53. Ririe, DG, Boada DM, Martin TJ, Boyden E, Eisenach JC (2011) Optical inhibition of neurons in whole rat dorsal root ganglion after in vivo intrathecal viral vector induced expression of the optically active proton pump Arch-T, American Society of Anesthesiologists.

54. Acker, L., Hauswirth, W., Boyden, E. S., Brown, M. C. and Lee, D. J. (2011) Channelrhodopsin-2 gene expression in central auditory neurons: Toward an optical prosthesis. Abstr Assoc Res Otolaryngol 33(484).

55. Borgers, C., Talei Franzesi, G., Boyden, E. S., Kopell, N. (2011) On the size of cell assemblies and the loss of gamma rhythms. Society for Neuroscience. Online.

56. Klapoetke, N., Morimoto, T., Chuong, A., Melkonian, B., Melkonian, M., Chow, B., Wong, G., Boyden, E. S. (2011) Multiple-color optical excitation of distinct neural populations using sets of novel channelrhodopsins derived from algal genomic diversity. Society for Neuroscience. Online.

57. Kodandaramaiah, S., Boyden, E. S., Forest, C. (2011) Automated patch clamping of neurons in the mammalian brain in vivo. Society for Neuroscience. Online.

58. Henninger, M. A., Horstmeyer, R., Zorzos, A., Scholvin, J., Lanman, D., Raskar, R., Boyden, E. S. (2011) A novel concept for an implantable probe for deep-brain optical measurement of the activity of large populations of neurons. Society for Neuroscience. Online.

59. Scholvin, J., Zorzos, A. N., Talei Franzesi, G., Kodandaramaiah, S., Allen, B. D., Kinney, J., Moore-Kochlacs, C., Singer, A. C., Wasserman, S., Wentz, C., Yamaguchi, M., Forest, C.,

Kopell, N., Fonstad, C., Boyden, E. S. (2011) High channel-count silicon neural recording probes for 3d characterization of optogenetically modulated neural dynamics. Society for Neuroscience. Online.

60. Baratta, M. V., Kodandaramaiah, S., Monahan, P. E., Kim, K., Yang, A., Forest, C. R., Goosens, K. A., Boyden, E. S. (2011) Effects of stress on aversive learning require temporally precise serotonergic signaling. Society for Neuroscience. Online.

61. Chuong, A. S., Klapoetke, N. C., Henninger, M. A., Acker, L. C., Chow, B. Y., Han, X., Boyden, E. S. (2011) Red-shifted optogenetic neural silencers: improvements, and in vivo use for inactivation of large brain volumes. Society for Neuroscience. Online.

62. Ahn, M. C., Wentz, C. T., Bernstein, J., Boyden, E. S. (2011) A fully wireless toolset for high-throughput freely-behaving optogenetic research. Society for Neuroscience. Online.

63. Zorzos, A. N., Scholvin, J., Fonstad, C. G., Boyden, E. S. (2011) A novel 3-D microfabricated lightguide array for optogenetic control of distributed neural circuits in the mammalian brain. Society for Neuroscience. Online.

64. Boada, D. M., Ririe, D. G., Martin, T. J., Boyden, E., Eisenach, J. C. (2011) In Vivo Optical inhibition of peripheral neurons after intrathecal administration of viral vector and neuronal expression of the optically active proton pump Arch-T in rat. Society for Neuroscience. Online.

65. Perea, G., Yang, A., Chow, B. Y., Boyden, E. S., Sur, M. (2011) CHANNELRHODOPSIN-2-STIMULATED ASTROCYTES INCREASE SYNAPTIC TRANSMISSION IN VISUAL CORTEX. Society for Neuroscience. Online.

66. Becerra, L., Brenner, G., Shin, H.-s., Bishop, J., Bartmettler, G., Wallin, D., Borsook, D., Boyden, E. S. (2011) OptofMRI Activation to thermal (heat) in awake rodents with and without optically silencing the Anterior Cingulate Cortex. Society for Neuroscience. Online.

67. Madarasz, T., Roy, S. S., Boyden, E. S., LeDoux, J. E., Johansen, J. P. (2011) Making predictions in a complex world: mechanisms of contingency degradation in fear conditioning. Society for Neuroscience. Online.

68. Borgers, C., Talei Franzesi, G., Boyden, E., Kopell, N. (2011) Minimal size of cell assemblies coordinated by gamma oscillations, 2011 Collaborative Research in Computational Neuroscience (CRCNS) PI Meeting, Princeton University, Princeton, NJ.

69. Kodandaramaiah, S., Talei Franzesi, G., Chow, B., Boyden, E. S., Forest, C. (2011) Automated whole-cell patch clamp electrophysiology of neurons in vivo, 2011 Collaborative Research in Computational Neuroscience (CRCNS) PI Meeting, Princeton University, Princeton, NJ.

70. Talei Franzesi, G., Klapoetke, N., Chuong, A., Morimoto, T., Melkonian, B., Melkonian, M., Henninger, M., Acker, L., Han, X., Chow, B., Wong, G. K., Boyden, E. (2011) Optogenetic reagents optimized simultaneously for high-amplitude currents, precision kinetics, and tissue-penetrating wavelength, 2011 Collaborative Research in Computational Neuroscience (CRCNS) PI Meeting, Princeton University, Princeton, NJ.

71. Madisen, L., Mao, T., Koch, H., Zhuo, J., Monetti, C., Hsu, T., Kidney, J., Gu, H., Mills, M., Boyden, E., Jones, A., Ramirez, N., Nagy, A., Svoboda, K., Han, X., Turner, E., Zeng, H. (2011) Cell-type manipulation of neuronal activity using Cre-responder and Cre-driver mice. Society for Neuroscience. Online.

72. Schoner, B., Cooper, C., Douglas, C. L., Boyden, E. S., Gershenfeld, N. A. (1999) Data-driven modeling of acoustical instruments, Journal of the Acoustic Society of America 105(2):1328.

73. Boyden, E. S., Chatila, T. A., Raymond, J. L. (2004) The contribution of inverse plasticity mechanisms to cerebellum-dependent learning. Talk, at Computational and Systems Neuroscience (CoSyNe), Cold Spring Harbor, NY, March 24-28, 2004.

74. Chow B, Han X, Qian X and Boyden E (2009) High-performance halorhodopsin variants for improved genetically-targetable optical neural silencing. Frontiers in Systems Neuroscience. Conference Abstract: Computational and systems neuroscience. doi: 10.3389/conf.neuro.10.2009.03.347

75. Boyden E, Franzesi G T, Qian X, Li M, Han X, Borgers C, Kopell N J, Le Beau F and Whittington M A (2009) Probing mechanisms of gamma rhythmogenesis with cell type-specific optical neural control. Frontiers in Systems Neuroscience. Conference Abstract: Computational and systems neuroscience. doi: 10.3389/conf.neuro.10.2009.03.299

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