Adam H. Marblestone

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Experience

Kernel *Chief Strategy Officer*, 2017-
Technologies for interfacing with the human brain and accelerating human neuroscience.

MIT Media Lab *Research Scientist and "Director of Scientific Architecting"*, Synthetic Neurobiology Group, Full-Time: 2014-2016, Part-Time: 2017-
Advisor: Ed Boyden
Methods for scalable brain circuit mapping and analysis.

BioBright LLC *Co-founder*, 2012-
"Smart Lab" startup funded by investments, DARPA, and industry contracts.

Education

Harvard University *Ph.D., Biophysics, 2014*
Thesis: *Designing scalable biological interfaces*
Advisor: George Church
Research on bio-nanotechnology, synthetic biology and neuro-technology.

Yale University *B.S., Physics, 2009*
Advisor: Michel Devoret
Research on quantum information theory and superconducting quantum circuits.

Key Publications (* indicates equal contribution) [H-Index: 9, Citations: >800]

Physical principles for scalable neural recording
Adam H. Marblestone*, Brad Zamft*, Yael Maguire, Mikhail Shapiro, Josh Glaser, Ted Cybulski, Dario Amodei, P. Benjamin Stranges, Reza Kalhor, David Dalrymple, Dongjin Seo, Elad Alon, Michel M. Maharbiz, Jose M. Carmena, Jan M. Rabaey, Ed Boyden**, George Church**, Konrad Kording**
Frontiers in Computational Neuroscience (2013). Featured in *Nature Physics*.

Towards an integration of deep learning and neuroscience
Adam H. Marblestone, Greg Wayne and Konrad Kording. *Frontiers in Computational Neuroscience* (2016).

The atoms of neural computation Gary Marcus, Adam H. Marblestone and Tom Dean. *Science*. (2014)
Frequently asked question for: The atoms of neural computation Gary Marcus, Adam H. Marblestone and Tom Dean. *ArXiv*. (2014).

Multiplexed neural recording along a single optical fiber via optical reflectometry
Sam Rodriques*, Adam H. Marblestone*, Max Mankin, Lowell Wood and Ed Boyden. *Journal of Biomedical Optics.* (2016)

Measuring cation-dependent DNA polymerase fidelity landscapes by deep sequencing
Brad Zamft*, Adam H. Marblestone*, Konrad Kording, Daniel Schmidt, Daniel Alarcon, Keith Tyo, Ed Boyden and George Church.
PLoS ONE (2012) **7**(8): p. e43876. Featured in *Nature*, *Wired* & elsewhere.

Exponential quantum enhancement for distributed addition with local nonlinearity
Adam H. Marblestone and Michel Devoret. *Quantum Information Processing*. Volume 9 #1 47-59 (2009)

Other Publications (* indicates equal contribution)

Signal-to-pump back-action and self-oscillation in a double-pump Josephson parametric amplifier
Archana Kamal, Adam H. Marblestone and Michel Devoret. *Physical Review B*. 79:184301 (2009)

Statistical analysis of molecular signal recording
Joshua Glaser, Bradley Zamft*, Adam H. Marblestone*, Jeffrey Moffitt, Keith Tyo, Edward Boyden, George Church and Konrad Kording.
PLoS Computational Biology (2013)

Nanoscale imaging of RNA with expansion microscopy
Fei Chen*, Asmamaw T. Wassie*, Allison J. Cote, Anubhav Sinha, Shahar Alon, Shoh Asano, Evan R. Daugharthy, Jae-Byum Chang, Adam Marblestone, George M. Church, Arjun Raj, Edward S. Boyden. *Nature Methods.* (2016)

Rosetta brains: a strategy for molecularly annotated connectomics
Adam H. Marblestone, Evan R. Daugharthy, Reza Kalhor, Ian D. Peikon, Justus M. Kebschull, Seth L. Shipman, Yuriy Mishchenko, Je Hyuk Lee, Konrad P. Kording, Edward S. Boyden, Anthony M. Zador and George M. Church. *ArXiv.* (2014)

Rapid prototyping of three-dimensional DNA-origami shapes with caDNAno
Shawn Douglas, Adam H. Marblestone, Surat Teerapittayanon, Alejandro Vazquez, George Church and William Shih.
Nucleic Acids Research. 37:5001–6 (2009) Open-source software at: http://www.cadnano.org

Conneconomics: the economics of large-scale, dense, high-resolution neural connectomics
Adam H. Marblestone, Evan R Daugharthy, Reza Kalhor, Ian Peikon, Justus Kebschull, Seth L Shipman, Yuriy Mishchenko, David A Dalrymple, Bradley M Zamft, Konrad P Kording, Edward S Boyden, Anthony M Zador, George M Church. *BioRXiv.* (2013)

Multiplexed in-vivo his-tagging of enzyme pathways for in-vitro single-pot multi-enzyme catalysis
Harris H. Wang*, Po-Yi Huang*, George Xu, Wilhelm Haas, Adam H. Marblestone, *et al. ACS Synth. Biol.,* 2012, 1 (2), pp 43–52

Gene assembly from chip-synthesized oligonucleotides
Nikolai Eroshenko*, Sriram Kosuri*, Adam H. Marblestone, Nicholas Conway and George M. Church. *Curr. Protoc. Chem. Biol* (2012)

Molecular threading: mechanical extraction, stretching and placement of DNA molecules at a liquid-air interface
Andrew Payne*, Michael Andregg*, Kent Kemmish, Mark Hamalainen, Wolfgang Lehrach, C. Bowell, A. Bleloch, N. Klejwa, K. Schatz, H. Stark, Adam H. Marblestone, George Church**, Chris Own** and William Andregg**.** *PLoS ONE* 8(7): e69058.

Highly multiplexed three-dimensional subcellular transcriptome sequencing in situ
Jay Lee*, Evan Daugharthy*, Jonathan Scheiman, Reza Kalhor, Joyce Yang, Thomas Ferrante, Richard Terry, Sauveur Jeanty, Chao Li, Ryoji Amamoto, Derek Peters, Brian Turczyk, Adam H. Marblestone, Samuel Inverso, Amy Bernard, Prashant Mali, Xavier Rios, John Aach and George M. Church. *Science.* (2014)

Designing scalable biological interfaces Adam H. Marblestone. PhD Thesis. Biophysics. Harvard University. (2014)

Spatial information in large-scale neural recordings
Ted Cybulski*, Josh Glaser*, Adam H. Marblestone, Brad Zamft, Ed Boyden, George Church and Konrad Kording. *Frontiers in Computational Neuroscience.* (2014)

Rosetta brain George Church, Adam H. Marblestone and Reza Kalhor. The Future of the Brain: Essays from the World's Leading Neuroscientists. (2014)

Designing tools for assumption-proof brain mapping Adam H. Marblestone and Ed Boyden. *Neuron*. (2014)

How to study the brain Gary Marcus, Adam H. Marblestone and Jeremy Freeman. *The Chronicle of Higher Education.* (2014)

Grand challenges for global brain sciences
Joshua T. Vogelstein, Katrin Amunts, Andreas Andreou, Dora Angelaki, Giorgio Ascoli, Cori Bargmann, Randal Burns, Corrado Cali, Frances Chance, Miyoung Chun, George Church, …, Adam H. Marblestone, David Markowitz, Justin McArthur, Brett Mensh, Michael Milham, Partha Mitra, Pedja Neskovic, Miguel Nicolelis, Richard O'Brien, Aude Oliva, Gergo Orban, Hanchuan Peng, Alyssa Picchini-Schaffer, Marina Picciotto, Jean-Baptiste Poline, Mu-ming Poo, Alex Pouget, Sri Raghavachari, Jane Roskams, Terry Sejnowski, Fritz Sommer, Nelson Spruston, Larry Swanson, Arthur Toga, R. Jacob Vogelstein, Rafael Yuste, Anthony Zador, Richard Huganir, Michael Miller. *ArXiv*. (2016)

An optical observatory of molecular complexity in the normal and diseased brain
Mermelstein, Abnet, Rodriques, Marblestone, Boyden. *Whitepaper draft conveyed to Argonne National Lab and Lawrence Berkeley National Lab.*

Understand the cogs to understand cognition
Marblestone, Wayne and Kording. Commentary on: Building Machines That Learn and Think Like People by Lake et al. *Behavioral and Brain Sciences*. *Accepted*.

In-situ technologies enable a pan-omic human cell atlas
Shahar Alon, Edward S. Boyden, Fei Chen, George M. Church, Evan R. Daugharthy, Samuel Inverso, Adam Marblestone, Sam Rodriques, Chao-Ting Wu
Whitepaper circulated at Chan-Zuckerberg Initiative Human Cell Atlas meeting (Feb 2017). https://www.readcoor.com/s/CZI_final-lbza.pdf

In-preparation papers

Hierarchical dynamical structure in *C. elegans* neural activity Semon Rezchikov, Adam Marblestone, et al. *In preparation*. [Co-last author]

Expansion in-situ sequencing
S. Alon*, F. Chen*, E. R. Daugharthy*, A. Payne, P. W. Tillberg, A. T. Wassie, …, Adam H. Marblestone**, G. M. Church**, E. S. Boyden**.
In prep. [Co-last author]

Implosion fabrication Oran*, Rodriques*, Gao, Asano, Scott, Chen, Tillberg, Marblestone** and Boyden**. *In preparation.* [Co-last author]

Theory of optically barcoded connectomics Yoon, Dai, Wohlwend, Marblestone*, Boyden*. *In preparation.* [Co-last author]

Variable binding, supervised deep learning and temporal buffering with thalamic latches Hayworth, Marblestone. *In preparation.*

Awards and honors

Invited participant at Sci Foo
Fannie and John Hertz Foundation Fellowship
James Mills Peirce Fellowship at Harvard
Barry M. Goldwater Scholarship
Stanford Graduate Fellowship (declined)
Fulbright Scholarship (declined)

Other Experience

OccamzRazor Advisor (2015-) Knowledge capture and sharing platform for scientists. Funded by angel investments.
Expii Consultant (2014) Online participatory math education. Funded by VCs.
Fannie and John Hertz Foundation Fellowship Interviewer (2015-) Identifying next-generation science/engineering leaders
Open Philanthropy Project Scientific Advisor (2013-) Advising on biological tools & techniques, AI, nanotechnology, science policy, and more
Brain Preservation Foundation Scientific Advisor (2015-)
MIT Media Lab Advisory group member on the "Future of Science+Art/Design/Engineering" (2016-) [$10,000 award]
Peer Reviewer for: *PLoS Computational Biology*, *JoVE, Nature Communications*
Co-creator: *Neurotechnology Architecting Network*, featured in White House BRAIN Initiative 9/30/2014 announcement, http://neuroarchitecting.org/
Workshops Organized or Initiated:
"Molecular Additive Manufacturing", Cambridge University UK, (2016)
Kavli Futures Symposium, "Towards a Taxonomy of Cortical Computations", Co-organized with Gary Marcus, Funded $60k by Kavli Foundation (2015)
Cosyne Workshop, "Tools and Approaches for Ground-Truth Neuroscience", Co-organized with Annabelle Singer (2015)

New York Stem Cell Foundation Workshop, "Immuno-engineering", Co-initiated workshop (2015)
Rapporteur: BrainX.io global brain research coordination meeting (2016)

Selected Talks/Lectures

Tianjin University (Tianjin, China): 5 lectures for undergraduates on *design principles for DNA self-assembly* (2012) [with M. Dai]
Harvard Medical School *nm2cm: bridging top-down and bottom-up nanotechnology* (2012) [initiated and organized meeting]
TEDx Beacon Street (Boston, USA): *Billion-year-old information technologies* (2012)
COSYNE Beyond Optogenetics Workshop (Snowbird, USA): *Molecular ticker-tapes* (2013)
Bar-Ilan University (Ramat Gan, Israel): *Molecular information storage technologies* (2013)
Stanford University (Palo Alto, USA): Guest lecturer in the course *Computational Models of the Neocortex* (2013)
Harvard Medical School *Physics of brain activity mapping* (2013) [initiated and co-organized meeting]
Rehabilitation Institute of Chicago (Chicago, USA): *An architecture for neural recording via optical time-domain reflectometry* (2013)
Vannevar Group (Palo Alto, USA): *Collaboratively surveying neuro-technological possibility space* (2013)
MIT Media Lab (Cambridge MA, USA): *Networked biology* (2014)
MIT Center for Bits and Atoms workshop on Bits <=> Biology (Cambridge MA, USA): *Digital encoding for scalable brain mapping* (2014)
University of Waterloo Theoretical Neuroscience Summer School (Waterloo ON, CA): *Semantic pointer operations on word similarity spaces* (2014)
Northeastern University Center for Complex Network Research (Boston MA, USA): *Towards a complete activity map for the smallest brain* (2014)
White House OSTP/NPI Photonics Industry Neurotechnology Group (Washington DC, USA): *Photonics needs for scalable neural interfacing* (2014)
Radcliffe Institute Workshop on Programmable Molecular Robots (Cambridge MA, USA): *Bigger nanorobots* (2014)
MIT Biophysics Program Student Seminar Series (Cambridge MA, USA): *The physics of whole-brain mapping* (2014)
Society for Neuroscience 2014 (Washington DC, USA): *Fiber optic reflectometry as a next-generation electrode* (2014)
MSRI workshop on Breaking the Neural Code (Berkeley, USA): *Rosetta brain* (2014)
Stanford University (Palo Alto, USA): Guest lecturer in the course *Computational Models of the Neocortex* (2015)
Harvard Effective Altruism (Cambridge, USA): *Effective altruism, technological convergence and scientific roadmapping* (2015)
Digital Garage Conference: Hacking the Human Body (San Francisco, USA): *Mapping the brain in search of the architecture of the mind* (2015)
MIT Media Lab (Cambridge, USA): Guest lecture in the couurse *New Destinations in Artificial Intelligence* (2015)
MSRI workshop on the Theory of Neural Computation (Berkeley, USA): *Rosetta brain maps and what they might teach us* (2015)
Brandeis Computational Neuroscience Journal Club (Waltham, USA): *Towards technologies and frameworks for scalable brain mapping* (2016)
Panelist for MIT Center for Brains Minds and Machines (Cambridge, USA) *Debate on AI and neuroscience, moderated by Max Tegmark* (2016)
Future of Humanity Institute at Oxford (Oxford, UK): *A roadmap for connecting neuroscience and machine learning* (2016)
Stanford University (Palo Alto, USA): Guest lecturer in the course *Computational Models of the Neocortex* (2016)
Wyss Institute (Boston, USA): IARPA MICRONS site visit talk on *ExM validation of FISSEQ-BOINC connectomics* (2016)
SciFoo (Mountain View, USA): *Participant in panel discussion on artificial intelligence, co-led session on scientific tools* (2016)
Sanger Institute (Hinxton, UK): Talks on *FISSEQ-BOINC connectomics, and on BioBright smart lab* (2016)
IARPA MICRONS Technical Exchange Meeting (Bethesda, USA): *Validating FISSEQ-BOINC connectomics* (2017)
US Army Neural-Inspired AI Army Science Planning Strategy Meeting (Aberdeen, USA): *Towards an integration of deep learning and neuroscience* (2016)
Columbia Workshop on Brain Circuits, Memory and Computation (NY, USA): *Towards neural substrates of variable binding and deep learning* (2017)
Cosyne Workshop - Electrons, fluorophores, and nucleotides: bridging the gaps in high-throughput connectomics (Snowbird, USA):
Towards a "best of all worlds" connectomics: integrating expansion microscopy tracing, in-situ barcoding and machine learning (2017)
Connectomics Berlin (Berlin, Germany): *Combining expansion microscopy and in-situ barcoding for connectomics* (2017)
Stanford University (Palo Alto, USA): Guest lecturer in the course *Computational Models of the Neocortex* (2017)
Quantifying Structure in Large Neural Datasets (New York, USA): *Rosetta Brain Neuroanatomy* (2017)
Advancing Neuroscience with the National Labs (Chicago, USA): *Scalable Optical Connectomics* (2017)
Machine Learning meets Biology (Geneva, Switzerland): *Towards an Integration of Deep Learning and Neuroscience* (2017)
YConf (San Francisco, USA): *TBD* (2017)
Effective Altruism Global (Boston, USA): *TBD* (2017)

Patents

In-situ nucleic acid sequencing of expanded biological samples
Inventors Edward Stuart Boyden, Fei Chen, Shahar Alon, George Church, Paul Warren Tillberg, Adam Marblestone, Evan Daugharthy
https://www.google.com/patents/US20160304952

Ligation-based assembly of nucleic acid molecules guided by self-assembled DNA nanostructures
Zhang, David Y; Marblestone, Adam H; Yin, Peng. *US provisional patent filed.*

Methods and apparatus for multiplexed neural interfacing via optical micro-fibers
Marblestone, Amodei, Church, Boyden, Wood. *US provisional patent filed.*

Single molecule protein identification by spectral sequencing
Rodriques, Marblestone, Boyden. *US provisional patent filed.*

Nanofabrication by shrinking of patterned gels
Rodriques, Marblestone, Chen, Tillberg, Boyden. *US provisional patent filed.*

Chen, Alon, Wassie, Sinha, Marblestone, Boyden. *US provisional patent filed.*

Posters

Next-generation expansion microscopy with lipid labels for morphological analysis of neurons.
J. Kang, E. Karagiannis, J-B. Chang, G. Huynh, Adam H. Marblestone and E. Boyden. *Society for Neuroscience* (2016)

3D Reconstruction of Neural Circuits using Expansion Microscopy
Y-.G. Yoon, P. Dai, J. Wohlwend, J.-B. Chang, A. Marblestone* and E. S. Boyden*. *Society for Neuroscience* (2016)

ExFISH: Nanoscale imaging of RNA with expansion microscopy
A. Wassie, F. Chen, A. Cote, A. Sinha, S. Alon, S. Asano, E. Daugharthy, J.-B. Chang, A. Marblestone, G. Church, A. Raj, E. S. Boyden. *Society for Neuroscience* (2016)

Expansion microscopy of lipids for scalable morphological analysis of neurons and neural circuits
E. Karagiannis, Adam H. Marblestone, E. Boyden. *Society for Neuroscience* (2015)

Expansion Sequencing (ExSEQ): comprehensive in-situ transcriptome characterization throughout intact brain circuits
S. Alon, F. Chen, E. Daugharthy, P. Tillberg, Adam H. Marblestone, A. Wassie, G. Church, E. Boyden. *Society for Neuroscience* (2015)

Vascular Interfaces for Brain Imaging and Stimulation
Bob Desimone, Edward Boyden, Elazer Edelman, Ken Shepard, Colin Derdeyn, Eric Leuthardt, Bruce Fischl, Jon Polimeni, George Church, Adam H. Marblestone. 2nd Annual BRAIN Initiative Investigators Meeting, Bethesda, MD. (2015)

Physical Principles for Whole-Brain Activity Mapping
Adam H. Marblestone, Bradley Zamft, Yael Maguire, Mikhail Shapiro, Joshua Glaser, Ben Stranges, Reza Kalhor, DJ Seo, Elad Alon, Michel Maharbiz Jose Carmena, George Church, Konrad Kording and Ed Boyden. *Society for Neuroscience* (2014)

DIY physiological sensors: towards the Arduino of physiology Charles Fracchia (MIT), Adam H. Marblestone and Stephen Heisig (IBM)
GET: Genomes, Environments & Traits (2013)

Controllable release of gold nanoparticles from a switchable DNA box Sun*, Schaus*, Wu*, Marblestone, Wang, Perkons, Shih and Yin
10th Annual Conference, Foundations of Nanoscience: Self-Assembled Architectures and Devices (2013)

Continuous in-vivo multiplex genome engineering Kevin Esvelt*, Adam H. Marblestone* and George Church**.** *Wyss Institute Annual Retreat* (2012)

Acknowledgements in published works

Legenstein, Papadimitriou, Vempala, Maass "Assembly pointers for variable binding in networks of spiking neurons" *NIPS CoCo Workshop* (2016)
Kalhor, Reza, Prashant Mali, and George M. Church. "Rapidly evolving homing CRISPR barcodes." *Nature Methods* (2016)
Jonas, Eric and Kording, Konrad. "Can a neuroscientist fix a microprocessor?" http://biorxiv.org/content/early/2016/05/26/055624
Chen, Fei, Paul W. Tillberg, and Edward S. Boyden. "Expansion microscopy." *Science* 347.6221 (2015): 543-548.
Chen, Ho-Lin, David Doty, and Shinnosuke Seki. "Program Size and Temperature in Self-Assembly." *Algorithmica* 72.3 (2015): 884-899.
Seo, Dongjin, et al. "Neural dust: An ultrasonic, low power solution for chronic brain-machine interfaces." *arXiv preprint arXiv:1307.2196* (2013).
Douglas, Shawn, Ido Bachelet and George Church. "A logic-gated nanorobot for targeted transport of molecular payloads." *Science* 335.6070 (2012)

Press coverage

Mentioned in Import AI, Feb 2017
Mentioned in "Building better brain", Neurotech Business Report, 2017
Mentioned in "Elon Musk backs brain-computer interface venture", International Business Times, March 2017
Mentioned in "Silicon valley's race to develop a brain-computer interface", Technology Review, March 2017
Mentioned in "Kernel is trying to hack the human brain – but neuroscience has a long way to go", The Verge, Feb 2017
Quoted in "Kernel Acquires KRS to Build Next-Generation Neural Interfaces" (2017)
Cited in "Recording the brain with light", Hertz Foundation Newsletter (2016)
Cited in "Seeing RNA at the nanoscale", Science Bulleting, 2016
Interviewed for O'Reilly book on neuroscience and AI written by Jack Clark (2016)
Mentioned in "The smart lab blends the best of humans and automation", Glenn Martin, O'Reilly Radar, July 2016
Quoted in "Government seeks high-fidelity brain computer interface", Adam Piore, Technology Review, Feb 2016
Mentioned in "Wyss Institute will lead IARPA funded brain mapping consortium", Eurekalert, Jan 2016
Cited in "Brain-machine interfaces as a challenge to the 'moment of singularity'", Philip Kennedy, H+ Magazine, Dec 2015
Mentioned in "Face it, your brain is a computer", Gary Marcus, New York Times Sunday Review, June 2015
Mentioned in "Fifteen MIT scientists receive NIH BRAIN Initiative grants", MIT News, Sept 2014
Cited in "Brain Teaser", Mark Buchanan, Nature Physics, September 2013
Cited in "The world according to Itskov: Futurists convene at GF2045 (Part 2)", Stuart Mason Dambrot, Phys.org, Aug 2013
Cited in "Physical principles for scalable neural recording", John Hewitt, Medical Xpress, July 2013
Cited in "Neuroscience: Solving the brain", Alison Abbott, Nature, July 2013
Cited in "The science behind Obama's brain project", Jean-François Gariépy, BrainFacts.org, April 2013

Other Educational Experiences

Center for Theoretical Neuroscience Summer School, *large-scale spiking neural network models*, University of Waterloo, 2014
NSF I-CORPs, *completed program as entrepreneurial co-lead for BioBright,* http://www.nsf.gov/awardsearch/showAward?AWD_ID=1522517, 2015
Stanford University Mathematics Camp, *algebraic topology*, Stanford University, 2004

Teaching

MIT Instructor for "Revolutionary Ventures" graduate course (MIT Course Numbers: 9.455 ~ 15.128 ~ 20.454 ~ MAS.883) at MIT in Fall 2015
Instructor for "Cognitive Integration" seminar (MAS.S63) at MIT Media Lab in Spring 2016
Co-created C. elegans optogenetics demo lab for the 2014 "Neurotechnology In Action" graduate course, based on cheap off-the-shelf hardware
Individual students supervised: J. Wohlwend, S. Rezchikov, D. Barabasi (Notre Dame). Mentor for MIT PRIMES program.

Harvard *Co-mentored Harvard's biomolecular engineering and synthetic biology team:* 3rd overall (2011) and best wiki (2012) in BIOMOD
Individual students supervised: N. Donoghue (Brown), A. Payne (Toronto), J. Lovelock (Toronto), W. Chen, J. Pritt, E. Wu
Teaching Fellow: Bio-Inspired Molecular Engineering (2011), Biomolecular Engineering and Synthetic Biology (2011, 2013)
Co-developed course structure and materials. *Certificate of Distinction in Teaching.*

Yale *Peer Tutor*: Intensive Introductory Physics

Skills

Programming: C, Java, Python, Actionscript, Matlab, Mathematica
Experimental: electronics design and production, microcontrollers, optics, micro-fluidic device fabrication; mechanical rapid prototyping (laser cutter, 3D printer, CNC micro-mill); nano-scale imaging (AFM, TEM, SEM, TIRF); molecular biology, Gibson cloning, MAGE, liquid handling robot; bacterial and mammalian cell culture; DNA nanostructures; Illumina sequencing
Selected coursework (at Amherst College, Yale, Harvard and MIT)*:* quantum mechanics I & II, statistical physics, mesoscopic physics, quantum theory of solids, physics of information technology, general relativity, classical mechanics, principles of neuro-science, principles of neuro-engineering, mathematical methods of physics, how to make (almost) anything, biological instrumentation and measurement, advanced computational biology, algorithms, data structures and programming techniques, experimental strategies in cellular biology, biochemistry, organic chemistry, vector calculus and linear algebra, real analysis, groups rings & fields, intro to Lie groups, theory of statistics, neuro-technology ventures

Research Funding

IARPA MICRONS D16PC00008 — PI: George Church — 2016-2020
Cortical architecture and algorithms for machine listening
The goal of this project is to develop cortically inspired algorithms using brain mapping. We will demonstrate novel scalable connectomic technologies based on in-situ DNA barcode readout, similar to those described in our Rosetta Brain whitepaper (http://arxiv.org/abs/1404.5103).
Role: Co-investigator, PI for MIT, co-authored proposal. — Funding: >$21,000,000 across several institutions

DARPA HR0011-16-9-0004 — PI: Charles Fracchia — 2016-2017
BioBright: A platform for real-time tracking of biological experiments
Role: Led proposal conception, writing, budgeting and contract negotiation — Funding: $698,000

NIH 1R24MH106075-01 — PI: Robert Desimone — 2014-2017
Vascular interfaces for brain imaging and stimulation
The goal of the study is to initiate a collaborative effort to design a human-applicable vascular neural interface for multiplexed neural recording and stimulation, and to carry out preliminary pilot theoretical and experimental projects to validate the basic parameters of the resulting concepts.
Role: Collaborator, co-authored proposal, organized proposal team — Funding: ~$1,500,000

MIT McGovern Institute Neurotechnology (MINT) program — PI: Michael Mermelstein — 2015
3D tessellation imaging (3DTI) for large-volume, super-resolution, multi-color microscopy
Role: Co-authored proposal — Funding: $100,000

Open Philanthropy Project — 2016-2019
Gift to support Synthetic Neurobiology Group research
Role: Co-authored proposal — Funding: $2,970,000

NIH R01-MH103910-02 (Transformative Research Award) — PI: Kording, Church, Boyden, Tyo — 2013-2017
Recording neural activity into DNA
Role: Co-authored proposal, generated preliminary data — Funding: >$9,000,000 across the three institutions

MetaKnowledge Network — PI: Marblestone, Boyden — 10/2014-08/2015
Beagle: A tool to empower individuals and teams to organize and share scientific insights
Role: Co-PI, authored proposal, oversaw project — Funding: ~$110,000

NIH R01 — PI: Kasthuri, Cai, Boyden — 2016-
An Accessible Toolbox for Comprehensive Analysis of Neural Tissue Architecture
Role: Co-authored proposal — Funding: >$1,500,000 across three institutions