

# THE KAVLI FOUNDATION

[Key Events](#) in the Formation of the BRAIN Initiative  
September 2011 – April 2013

Date	Event	Outcome	Documents
<a href="#">Dec 2012</a>	8 <sup>th</sup> Kavli Futures Symposium: Tool Development for the Brain Activity Map	<a href="#">ACS Nano article:</a> BAM Tool Development Roadmap	<a href="#">Agenda</a> <a href="#">Participants</a> <a href="#">Group Photos</a>

**8<sup>th</sup> Kavli Futures Symposium: *Tool Development for the Brain Activity Map***

December 1 and 2, 2012

Le Meridien Hotel

1121 19<sup>th</sup> Street North, Arlington, VA 22209

**Goals:**

- Explore the role that Nanoscience and other new physical science approaches and technologies can play in the future of experimental and applied Neuroscience.
- Provide the Brain Activity Map Project with a detailed plan for current, emerging, and future technology development.
- Identify challenges to large-scale sensing and interacting with brain.
- Generate 5, 10 and 15-year milestones for the Brain Activity Map Project.
- Generate a paper to be submitted for publication highlighting the potential of technologies for Neuroscience.

**Agenda**

**Saturday, December 1**

**Lunch** (*Amuse Restaurant*) noon-1:00 pm

**Introduction: BAM** (*Vivace Room*) 1:00-1:45 pm

- Background on BAM: What, why, how, who, when? (25 min) Chun/Church/Donoghue/Yuste
- Welcome from Tom Kalil OSTP. (10 min) Justification for a large-scale brain project.
- Expertise of the participants, introductions. (10 min)

**Neuroscience Background** 1:45-3:15 pm

- *1:45 pm* State-of-the-art electrical recording and stimulation (Donoghue) (30 min)
- *2:15 pm* Open discussion (15 min)
- *2:30 pm* State-of-the-art optical recording and stimulation (Yuste) (30 min)
- *3:00 pm* Open discussion (15 min)

**Nanoscience Background** 3:15-4:00 pm

- *3:15 pm* State-of-the-art nano (Alivisatos/Scherer/McEuen) (30 min)
- *3:45 pm* Open discussion (15 min)

**Emerging technologies and new ideas – Nano (5 minute talks+5 minute discussion)** 4:00-6:00 pm

- Arto Nurmikko ..... Multi-probe implants for clinical application and experimental investigation
- Tim Harris ..... Micro- and nano-systems to interrogate neurons
- Sotiris Masmanidis..... Electrophysiological recording with multiple probes
- Paul Weiss..... New materials for new devices: graphene and others
- Ken Shepard..... Large electrode count chip-based nanoprobe

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- Hongkun Park ..... Vertical nanowire arrays to measure neuronal activity
- Anne Andrews ..... Nanotechnology with Soft Matter
- Paul McEuen ..... Nanotechnology to measure cells and neurons
- Ed Boyden ..... Optogenetics and multiprobes
- Axel Scherer ..... Opto-electronic interfaces to individual neurons
- George Church ..... Genetic and hybrid methods

~5:45pm *End of afternoon sessions*

**Dinner** (*Amuse Restaurant*)

6:00 pm

**Emerging technologies and new ideas – Neuro (5 minute talks+5 minute discussion)**

7:00 pm

(*Vivace Room*)

- Loren Looger ..... Genetic calcium and voltage indicators
- Jennifer Lippincott-Schwartz .... Novel imaging approaches
- Darcy Peterka ..... All optical 3D imaging and stimulation
- Mark Schnitzer ..... Imaging the activity of ~1000 neurons in behaving mice
- Scott Fraser ..... Light sheet imaging
- Paul Alivisatos ..... Quantum dots and optical solutions
- Chris Xu ..... Improving the optical imaging depth
- Clay Reid ..... *in vivo* calcium imaging
- Gina Turrigiano ..... Challenges of probing state-dependent cortical plasticity in the freely behaving animal
- Doris Tsao ..... Whole brain imaging
- Xiaowei Zhuang ..... Superresolution imaging

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**Sunday, December 2, 2012**

**Breakfast** (*Vivace foyer*) 8:00 am

**Summary of emerging and future technologies** (*Vivace Room*) 9:00 am

- Nanotechnology review (Axel Scherer; 20 min)
- Applications to Neuroscience (Rafa Yuste; 20 min)
- Applications to the Human Brain (John Donoghue; 20 min)

**Breakout Sessions** 10:00-11:30 am

**Detailed discussion concerning various approaches**

- Group 1: Probes
- Group 2: Imaging technologies
- Group 3: Others

**Issues to discuss**

- Emerging and future technologies
- Major barriers for proposed technologies
- Essential groundwork research and engineering necessary
- Specific milestones for short term, medium term and long term
- Timelines for each solution
- Costs to achieve success (rough estimates of funds required)

**Break** 11:30-12:00 pm

**Lunch** (*Vivace foyer*) 12:00-1:00 pm

**Plenary Session: Group Plans, Milestones** (*Vivace Room*) 1:00-4:00 pm

Conclusions from breakout groups

- Group 1 presentations and discussion
- Group 2 presentations and discussion
- Group 3 presentations and discussion

**Summary of emerging and future technologies** 4:00-4:30 pm

- Consensus plan for realizable new technologies

**Adjourn**

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**Organizers**

- John Donoghue** ..... Director, Institute for Brain Science, Brown University
- Axel Scherer** ..... Professor of Electrical Engineering, Applied Physics, and Physics, Caltech,  
Co-Director, Kavli Nanoscience Institute
- Rafa Yuste** ..... Professor, Biological Sciences and Neuroscience  
Co-Director, The Kavli Institute for Brain Science, Columbia University

**Participants**

- Paul Alivisatos** ..... Professor of Chemistry and Materials Science, UC Berkeley  
Director of Lawrence Berkeley National Laboratory
- Anne Andrews** ..... Professor of Psychiatry at the University of California, Los Angeles
- Ed Boyden** ..... Leader, Synthetic Neurobiology Group, MIT
- George Church** ..... Professor of Genetics, Harvard Medical School
- Karl Deisseroth** ..... Associate Professor of Bioengineering and Psychiatry, Stanford University
- Scott Fraser** ..... Professor, Department of Biomedical Engineering, University of Southern  
California
- Tim Harris** ..... Director, Applied Physics and Instrumentation Group, HHMI Janelia Farm
- Jennifer Lippincott-Schwartz** ..... Distinguished NIH Investigator, Section on Organelle Biology, NICHD
- Loren Looger** ..... Group Leader, Looger Lab, HHMI Janelia Farm
- Sotiris Masmanidis** ..... Assistant Professor, Department of Neurobiology, UC Los Angeles
- Paul McEuen** ..... Professor of Physics at Cornell,  
Director, Kavli Institute at Cornell for Nanoscale Science
- Arto Nurmikko** ..... Professor of Engineering and Physics, Brown University
- Hongkun Park** ..... Professor of Chemistry and of Physics, Harvard University
- Darcy Peterka** ..... Research Specialist, Yuste Lab, Columbia University
- Clay Reid** ..... Allen Institute for Brain Science
- Mark Schnitzer** ..... Associate Professor of Biology and Applied Physics, Stanford University
- Ken Shepard** ..... Professor of Electrical Engineering, Columbia University
- Doris Tsao** ..... Assistant Professor, Biology, Caltech
- Gina Turrigiano** ..... Professor of Biology, Brandeis University

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**Paul Weiss**..... Fred Kavli Chair in Nanosystems Sciences  
UCLA California NanoSystems Institute Director

**Chris Xu** ..... Associate Professor, Applied and Engineering Physics, Cornell University

**Xiaowei Zhuang** ..... Professor of Chemistry and Chemical Biology  
Professor of Physics, Harvard University

**Observers**

**Mary Ann Asson-Batres**..... Program Director, NSF

**Jim Deshler** ..... Program Director, NSF

**Julie Dickinson** ..... Program Director, NSF

**Greg Farber** ..... Office of Technology Development and Coordination, NIMH

**Bob Finkelstein** ..... Head of Intramural Program, NINDS

**Matt Goodman** ..... Program Manager, Defense Sciences Office, DARPA

**Mary Ann Horn** ..... Program Director, NSF

**Tom Insel** ..... Director, National Institute of Mental Health

**Tom Kalil** ..... Deputy Director for Policy, OSTP

**Bruce Kushing** ..... Program Director, NSF

**Walter Koroshetz** ..... Deputy Director, NINDS, Office Of The Director

**Geoff Ling** ..... Program Manager, Defense Sciences Office, DARPA

**Kip Ludwig** ..... Program Director, NINDS

**Peter McCartney** ..... Program Director, NSF

**Dietmar Plenz** ..... Chief of the Section on Critical Brain Dynamics in the Intramural Research  
Program at the NIMH

**Jay Schnitzer** ..... Director, Defense Sciences Office, DARPA

**Edmund Talley** ..... Program Director, Channel Synapses and Circuits Cluster, NINDS

**Akaysha Tang** ..... Program Director, NSF

**Diane Witt** ..... Program Director, Neural Systems, NSF

**Kaiming Ye** ..... Program Director, NSF

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**The Kavli Foundation**

**Miyoung Chun** ..... Vice President of Science Programs

**Jim Cohen**..... Communications Director

**Chris Martin** ..... Science Program Officer

**Alan Brown** ..... Science Writer

**Margie Patlak**..... Science Writer





