2010 Finalist

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eppendorf & Science PRIZE FOR NEUROBIOLOGY

Photo courtesy of Donna Coveney

Ed Boyden is an assistant professor at MIT where he leads the Synthetic Neurobiology Group. His group develops new tools for controlling and observing neural circuits in order to understand how neuralcircuits compute and to support the repair of intractable brain disorders. Dr. Boyden received his Ph.D. in neurosciences from Stanford University working with Jennifer Raymond and Richard Tsien, where he researched the task-selectivity of the molecular mechanisms of memory storage. In a collaboration with Georg Nagel and Karl Deisseroth, he developed the use of channelrhodopsin-2 (ChR2) for activating neurons with light. His group at MIT has since developed a number of powerful molecular tools for optically silencing neural activity, as well as new hardware platforms for light delivery to the brain, and has distributed these optogenetic tools to hundreds of research groups worldwide. He has contributed to over 200 papers or patent filings and has given over 100 invited seminars on optogenetics.

Molecular Tools for Controlling Brain Circuits with Light

The brain is composed of many kinds of cell which differ from one another in molecular composition, shape, physiology, and pattern of connectivity. It is important to be able to assess experimentally the causal role that a given kind of cell plays in the emergent dynamics of the circuit in which it is embedded. In order to understand how this diversity of cells works together as a circuit to implement the computations that generate behavior, and how these computations go awry in states associated with neurological and psychiatric disorders. We have developed a suite of genetically-encoded molecular tools that, when expressed in defined sets of cells in the brain, enable them to be electrically activated or silenced in a temporally-precise fashion using pulses of light. These optogenetic tools have found widespread use in neurobiology, enabling explorations of the necessity and sufficiency of specific classes of neurons to mediate normal and pathological neural dynamics and behavior in organisms ranging from *C. elegans* to macaque, thanks to their high performance and their ease of use in conjunction with transgenic methodologies for targeting cell types and pathways in the nervous system.