Seminar/Talk

Synchrony and Synaptic Signaling in Cerebellar Circuits

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The cerebellum permits a wide range of behaviors that involve sensorimotor integration. We have been investigating how specific cellular and synaptic specializations of cerebellar neurons measured in vitro, give rise to circuit activity in vivo. We have investigated these issues by studying Purkinje neurons as well as the large neurons of the mouse cerebellar nuclei, which form the major excitatory premotor projection from the cerebellum. Large CbN cells have ion channels that favor spontaneous action potential firing and GABAA receptors that generate ultra-fast inhibitory synaptic currents, raising the possibility that these biophysical attributes may permit CbN cells to respond differently to the degree of temporal coherence of their Purkinje cell inputs. In vivo, self-initiated motor programs associated with whisking correlates with asynchronous changes in Purkinje cell simple spiking that are asynchronous across the population. The resulting inhibition converges with mossy fiber excitation to yield little change in CbN cell firing, such that cerebellar output is low or cancelled. In contrast, externally applied sensory stimuli elicits a transient, synchronous inhibition of Purkinje cell simple spiking. During the resulting strong disinhibition of CbN cells, sensory-induced excitation from mossy fibers effectively drives cerebellar outputs that increase the magnitude of reflexive whisking. Purkinje cell synchrony, therefore, may be a key variable contributing to the “positive effort” hypothesized by David Marr in 1969 to be necessary for cerebellar control of movement.

Friday, April 30, 2021 03:00pm - 04:00pm
Online

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