Seminar/Talk

Optogenetic control of signal transduction

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Microbial rhodopsin-based optogenetic tools like ChR2 offer spatio-temporal control over neural activity, yet suffer from certain limitations. They completely over-ride the intrinsic activity of the excitable targeted cell-type and do not allow accurate local control of membrane potential. In this talk, I will highlight complimentary optogenetic approaches that can be used to control specific nodes of intracellular signal transduction, rather than the overall state of depolarization of the cell. Cyclic guanosine monophosphate (cGMP) is one such widely used 2nd messenger in cellular signaling. In sensory neurons, cGMP allows for signal modulation and amplification, before depolarization. Manipulating cGMP levels is required to access this signalling and provide insights into signal encoding. We have achieved this by implementing two photo-activatable guanylyl cyclases - 1) guanylyl cyclase rhodopsin from Blastocladiella emersonii (BeCyclOp) and 2) a mutated version of Beggiatoa sp. bacterial light-activated adenylyl cyclase, with specificity for GTP, termed bPGC (Beggiatoa photoactivated guanylyl cyclase) in heterologous cells (Xenopus oocytes) and in the muscle cells and sensory neurons of C. elegans. We have also determined the differences between the two cyclases with respect to kinetics and catalytic efficiency of cGMP production by directly imaging the cGMP rise in C. elegans, using a genetically encoded cGMP sensor, WincG2 (or worm indicator of cGMP). Apart from light control of cGMP levels, I will also touch on opto-chemical approaches to control cell signalling such as photoswitchable Diacylglycerol (PhoDAG), azocholine, and photoswitchable tethered ligands to control glutamate receptor, nicotinic acetylcholine receptors and glutamate-gated chloride channel in C.elegans. In the end, I will elaborate on our future plans to work with such optogenetic tools in zebrafish and investigate the stress biology.

Friday, July 7, 2017 11:00am - 12:00pm

Mondi Seminar Room 3, Central Building

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