Nonlinead Dynamics of Single Photon Response in Invertebrate Photoreceptors

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Photoreceptors of Drosophila compound eye are capable of responding to single photons which they transduce into transient, all-or-nothing, electric depolarizations of the cell called the Quantum Bumps. This system lends itself to an uncommonly quantitative investigation making it an ideal case study of signal transduction. Most of the molecular components of the G-protein mediated signaling pathway underlying invertebrate phototransduction are now known.

The open question addressed in this talk is how this system functions as a whole. I will formulate, analyze and test a quantitative model which explains how quantum bumps emerge from the stochastic non-linear dynamics of the signaling cascade and shows excellent agreement with the observed wild-type and mutant phenotypes. The model offers insight into the role of the positive and negative feedback as well as the role of stochastic fluctuations and spatial localization in dynamical signaling. It also provides a quantitative framework for the design and interpretation of future experiments.