Dr. Jeffrey S. Diamond

Synaptic Physiology Section
NINDS Intramural Research Program
National Institutes of Health
Bethesda, Maryland, USA

Specialized synapses compute visual information in the retina

Abstract:

Contrast is computed throughout the nervous system to encode changing inputs efficiently. The retina encodes luminance and contrast over a wide range of visual conditions and so must adapt its responses to maintain sensitivity and avoid saturation. We have examined how rod bipolar cell (RBC) ribbon synapses in the mammalian retina compute contrast and encode luminance in response to step changes in light levels. We find that RBC synapses respond to changes in luminance by varying the occupancy of their readily releasable vesicle pool (RRP); the transient response to a change in luminance corresponds to a psychophysically relevant measure of contrast. Feedback inhibition extends the luminance range over which this contrast computation is performed and also enhanced the fidelity with which the synapse encodes single photon responses. A morphologically constrained Monte Carlo diffusion simulation of the ribbon synapse reproduces the physiological data, suggests specific benefits of presynaptic ribbons, and makes predictions about the mechanisms by which vesicles move along the ribbon toward the presynaptic membrane.