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BSc Honours (Biology and English), University of Victoria, 2007  
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DEPARTMENT OF MEDICAL NEUROSCIENCE

TITLE OF THESIS: Motion Coding Strategies in the Retina

TIME/DATE: 2:30 pm, Monday, February 25, 2013

PLACE: Faculty of Medicine Dean's Council Room, Clinical Research Building, Room C-206, 5849 University Avenue

EXAMINING COMMITTEE:

Dr. Alberto E. Pereda, Dominick P. Purpura Department of Neuroscience, Albert Einstein College of Medicine (External Examiner)

Dr. Stefan R. Krueger, Department of Physiology & Biophysics, Dalhousie University (Reader)

Dr. Steven Barnes, Department of Physiology & Biophysics, Dalhousie University (Reader)

Dr. Gautam B. Awatramani, Department of Biology, University of Victoria; Department of Medical Neuroscience, Dalhousie University (Co-Supervisor)

Dr. William H. Baldridge, Department of Medical Neuroscience, Dalhousie University (Co-Supervisor)

DEPARTMENTAL REPRESENTATIVE: Dr. Ying Zhang, Department of Medical Neuroscience, Dalhousie University

CHAIR: Dr. Marty Leonard, PhD Defence Panel, Faculty of Graduate Studies

ABSTRACT

Early experimental work suggested that the retina’s main role was to detect changes in brightness and contrast, namely working as a light detector, and that most of the complex computations in the visual system happened upstream in the brain. In reality, there is a growing wealth of literature indicating that the retina itself processes multiple channels of visual information (contrast, motion, orientation, etc.), making it much more complex than it originally appeared. For instance, there now appear to be over 20 types of retinal ganglion cells. To this end, the work in this thesis will focus on the identification and characterization of a single type of retinal ganglion cell in the mouse retina. In the first section of my results, I will show that this cell type, identified as the only GFP+ ganglion cell in the transgenic Hb9::eGFP retina, is a directionally selective ganglion cell (DSGC), that preferentially responds to objects moving upward through the visual field. This cell has a pronounced morphological asymmetry that helps it to synergistically (along with asymmetric inhibition) generate directionally selective responses. In the second results section, I will describe a novel phenomenon exhibited by Hb9+ DSGCs: Thanks to gap junction mediated signals, Hb9+ cells are able to anticipate moving stimuli and correct for lags that are inherent in visual signals generated by photoreceptors. In the third results section I will elucidate the mechanisms for the gap junction mediated anticipatory signals outlined in the second results section. Together, these results provide a significant advancement in our understanding of how the retina processes moving stimuli and provide a compelling example of how chemical and electrical synapses interact to allow for exquisite signal multiplexing.