



**University
of Victoria**

Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Science

of

ALEX HOGGARTH

BSc (Dalhousie University, 2012)

**“Multiple Layers of Inhibition in the Direction Coding Circuit
in Mouse Retina”**

Department of Biology (Neuroscience)

Thursday, July 28, 2016

2:30 P.M.

Medical Science Building

Room 210

Supervisory Committee:

Dr. Gautam Awatramani, Department of Biology, University of Victoria (Supervisor)

Dr. Bob Chow, Department of Biology, UVic (Member)

External Examiner:

Dr. Craig Brown, Division of Medical Sciences, UVic

Chair of Oral Examination:

Dr. Kenneth Stewart, Department of Economics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Local and global forms of inhibition control directionally selective ganglion cells (DSGCs) in the mammalian retina. Specifically, local inhibition arising from GABAergic starburst amacrine cells (SACs) strongly contributes to direction selectivity. In this thesis, I demonstrate that increasing ambient illumination leads to the recruitment of GABAergic wide-field amacrine cells (WACs) endowing the DS circuit with an additional feature: size selectivity. Using a combination of electrophysiology, pharmacology and light/electron microscopy, I demonstrate that WACs predominantly contact presynaptic bipolar cells, which drive direct excitation and feed-forward inhibition (through SACs) to DSGCs, therefore maintaining the appropriate balance of inhibition/excitation required for generating DS. This circuit arrangement permits high-fidelity direction coding over a range of ambient light levels, over which size selectivity is adjusted. Together, these results provide novel insights into the anatomical and functional arrangement of multiple inhibitory interneurons within a single computational module in the retina.