



**University  
of Victoria**

Graduate Studies

Notice of the Final Oral Examination  
for the Degree of Doctor of Philosophy

of

**JOSEPH EDWARD KOLTHAMMER**

BS (Case Western Reserve University, 2006)

**“Chirality Control and Magnetization Dynamics in a Dual Vortex Spin  
Valve Nanopillar”**

Department of Physics and Astronomy

Wednesday, April 12, 2017

1:00 P.M.

David Turpin Building

Room A136

Supervisory Committee:

Dr. Byoung-Chul Choi, Department of Physics and Astronomy, University of Victoria (Supervisor)

Dr. Rogerio de Sousa, Department of Physics and Astronomy, UVic (Member)

Dr. Geoff Steeves, Department of Physics and Astronomy, UVic (Member)

Dr. Robin Hicks, Department of Chemistry, UVic (Outside Member)

External Examiner:

Dr. Erol Girt, Department of Physics, Simon Fraser University

Chair of Oral Examination:

Dr. John Walsh, Department of Education Psychology & Leadership Studies, UVic

## **Abstract**

A new method for dynamic chirality control of a magnetic vortex is demonstrated with micromagnetic simulations. Spin transfer torque and giant magnetoresistance in an asymmetric spin valve nanopillar provide fast, reliable, and compact single-bit manipulation and readout. Magnetization relaxation following chirality switching proceeds via formation and dissipation of spin wave eigenmodes. Combined time- and frequency-domain analysis reveals a novel radial eigenmode spectrum with large edge amplitudes and nonuniform phase in the fundamental mode, in contrast with existing analytical models and experimental precedents. With the aim to determine the sources of this departure, we implement signal processing methods to identify and characterize the effects of interlayer coupling and nanoscale spatial confinement on the magnetization dynamics. Variation of the interlayer coupling and relative chirality is found to modify the eigenfrequencies but not the eigenfunctions. Examination of the interlayer phase and dynamic stray field provides quantitative and qualitative explanation of frequency splitting with relative chirality.