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

of

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BEng (McMaster University, 2013)

“Measurements of the Radiation Hardness of CsI(Tl) Scintillation Crystals and Comparison Studies with Pure CsI for the Belle II Electromagnetic Calorimeter”

Department of Physics and Astronomy

Thursday, September 10, 2015
10:30 A.M.
Elliott Building
Room 105

Supervisory Committee:
Dr. J. Michael Roney, Department of Physics and Astronomy, University of Victoria (Supervisor)
Dr. Robert Kowalewski, Department of Physics and Astronomy, UVic (Member)

External Examiner:
Dr. Alison Lister, Department of Physics and Astronomy, University of British Columbia

Chair of Oral Examination:
Dr. Terri Lacourse, Department of Biology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

In preparation for the large backgrounds expected to be present in the Belle II detector from the SuperKEKB $e^+e^-$ collider, the radiation hardness of several large (5 x 5 x 30 cm$^3$) thallium doped cesium iodide (CsI(Tl)) scintillation crystals are studied to accumulated ~ 1 MeV photon doses up to 35 Gy. The crystal samples studied consist of 2 spare crystals from the Belle experiment using PIN diode readout and 7 spare crystals from the $BABAR$ experiment using photomultiplier tube readout. The radiation hardness of the scintillation properties of the CsI(Tl) crystals was studied at accumulated doses of 2, 10 and 35 Gy. At each dose, the longitudinal uniformity of the crystals light yield, scintillation decay times, time resolution and energy resolution was measured. As a possible upgrade solution, the scintillation properties of a pure CsI scintillation crystal was also measured and compared to the CsI(Tl) crystal measurements. In addition to experimental work, Monte Carlo simulations using GEANT4 were written to compare ideal pure CsI and CsI(Tl) crystals and to study the effects of radiation damage on the performance of the Belle II electromagnetic calorimeter.