



**University  
of Victoria**

Graduate Studies

# **PROGRAMME**

The Final Oral Examination  
for the Degree of

DOCTOR OF PHILOSOPHY  
(Department of Physics and Astronomy)

**Gregory King**

2008 University of Victoria  
2004 University of Victoria

MSc  
BSc (Honours)

## **Search for Lepton Universality Violation Using $Y(3S)$ Decays**

Tuesday, December 16, 2014  
1:00 PM  
Elliott Building, room 105

### Supervisory Committee:

Dr. J. Michael Roney, Department of Physics and Astronomy,  
UVic (Supervisor)

Dr. Robert V. Kowalewski Department of Physics and Astronomy,  
UVic (Member)

Dr. Natia Frank, Department of Chemistry, UVic (Outside Member)

### External Examiner:

Dr. Dugan O'Neil, Department of Physics  
Simon Fraser University

### Chair of Oral Examination:

Dr. Reinhard Illner,  
Department of Mathematics and Statistics, UVic

## **Abstract**

The measurement of the ratio of the branching fractions of  $Y(3S)$  decays into tau leptons over dimuons is a test of lepton universality. A violation of lepton universality would be evidence of new physics (and possibly of a light CP-odd Higgs boson). A sample  $Y(3S)$  decays ( $2.408 \text{ fb}^{-1}$ ) collected with the BaBar detector at the SLAC National Accelerator Laboratory was used to determine that the ratio is  $1.0385 \pm 0.034 \pm 0.019$ . Using the remaining blinded data sample (corresponding to an integrated luminosity of  $25.6 \text{ fb}^{-1}$ ) the estimated statistical sensitivity will be 1.1% and the estimated systematic uncertainty is 1.9%. Prior to this work, previous measurements of the ratio had an estimated total precision of 10%.

## **Awards, Scholarships, Fellowships**

2008-2009 – Pacific Century Graduate Scholarship,  
*University of Victoria*

2008-2009 – Nora & Mark Degoutiere Memorial Scholarship,  
*University of Victoria*

2005 – Charles S. Humphrey Graduate Student Award,  
*University of Victoria*

## **Presentations**

1. King G.J. “*Study of the tau-  $\rightarrow$   $\pi\pi+\pi\eta$   $\nu$  Branching Fraction.*” Winter Nuclear and Particle Physics Conference (WNPPC), Banff, Alberta, Canada, 2007. (oral)
2. King G.J.; “*Search for Lepton Universality Violation at BaBar.*” Triumf Summer Institute, Vancouver, British Columbia, Canada, 2009. (oral)
3. King G. J.; “*Search for Lepton Universality Violation at BaBar.*” BaBar Physics Jamboree, Cincinnati, Ohio, USA, 2010. (oral)

## **Publications**

1. BaBar Collaboration; “Evidence for the  $\eta(b)(1S)$  Meson in Radiative Upsilon(2S) Decay.” *Physical Review Letters* 103.16 (2009): 161801.
2. BaBar Collaboration; “Time-Integrated Luminosity Recorded by the BaBar Detector at the PEP-II  $e^+e^-$  Collider.” *Nuclear Instruments and Methods in Physics Research A* 726 (2013): 203-213.
3. BaBar Collaboration; “Search for Lepton Flavor Violation in the Decays  $\tau_{\pm} \rightarrow e_{\pm} \gamma$  and  $\tau_{\pm} \rightarrow \mu_{\pm} \gamma$ .” *Physical Review Letters* 104.2 (2010): 021802.
4. BaBar Collaboration; “Search for a Low-Mass Higgs Bosons In  $Y(3S) \rightarrow \gamma A_0$ ,  $A_0 \rightarrow \tau^+\tau^-$  at BaBar” *Physical Review Letters* 103.18 (2009): 181801.
5. BaBar Collaboration; “Search for Invisible Decays of the  $Y(1S)$ .” *Physical Review Letters* 103.25 (2009): 251801.
6. BaBar Collaboration; “Search for Dimuon Decays of a Light Scalar Boson in Radiative Transitions  $Y(3S) \rightarrow \gamma A_0$ .” *Physical Review Letters* 103.8 (2009): 081803.

