University of Victoria | Graduate Studies

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

of

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MSc (University of Victoria, 2011)
BSc (Mount Allison University, 2009)

"Searching for Hidden Sector Dark Matter with Fixed Target Neutrino Experiments"

Department of Physics and Astronomy

Friday, August 19, 2016
10:00 A.M.
David Turpin Building
Room A144

Supervisory Committee:
Dr. Adam Ritz, Department of Physics and Astronomy, University of Victoria (Supervisor)
Dr. Pavel Kovtun, Department of Physics and Astronomy, UVic (Member)
Dr. Maxim Pospelov, Department of Physics and Astronomy, UVic (Member)
Dr. Poman So, Department of Electrical and Computer Engineering, UVic (Outside Member)

External Examiner:
Dr. Hooman Davoudiasl, Department of Physics, Brookhaven National Laboratory

Chair of Oral Examination:
Dr. Adam Krawitz, Department of Psychology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

We study the sensitivity of fixed target neutrino experiments (LSND, T2K, CENNS, and COHERENT) and proton beam dumps (MiniBooNE off-target, and SHiP) to sub-GeV dark matter. In order to reproduce the observed thermal relic abundance, these states are coupled to the Standard Model via new, low mass mediators in the form of a kinetically mixed U(1)0 vector mediator or a vector mediator gauging baryon number. We present a model for the production of low mass dark matter from protonnucleon collisions in fixed targets. Sensitivity projections are made using signals from elastic electron- and nucleon-dark matter scattering, as well as coherent nuclear-dark matter scattering and dark matter induced inelastic π^0 production. A fixed target Monte Carlo code has been developed for this analysis, and documentation is included. We find that analyses using current and future proton fixed target experiments are capable of placing new limits on the hidden sector dark matter parameter space for dark matter masses of up to 500MeV and mediator masses as large as a few GeV.