



WILLIAM & MARY

CHARTERED 1693

Final Oral Examination for the Ph. D. Degree

Department of Physics



**Marco Antonio Merchand Medina**

**“Study of Scalar Extensions for Physics Beyond the Standard Model”**

Wednesday, 15 April 2020, 12:30 p.m. Eastern Time (US/Canada)

You are invited to join the scheduled Zoom meeting hosted by Professor Marc Sher at  
<https://cwm.zoom.us/j/7116417933> Meeting ID: 711 641 7933

**Abstract:** In this thesis we investigate the phenomenology of beyond the Standard Model scenarios with extra scalar fields. A review and motivation of extended electroweak symmetry breaking is presented. Then we address observational evidence of new physics such as possible lepton flavor violating processes and the relic abundance of dark matter by implementing models with three Higgs doublets. The complementarity between theoretical restrictions and experimental bounds on some of the predicted signals is leveraged to sharpen the allowed parameter space. After that we study embeddings of two-Higgs doublets into the Randall-Sundrum model with emphasis on the scalar fluctuations of the metric tensor and the stabilization mechanism: i) the viability of Higgs-radion unification is reappraised as well as some amendments to it, ii) additionally, kinetic mixing between radion and two Higgs doublets is explored. Theoretical predictions are tested against the most current experimental data and new avenues of discovery are highlighted. We devote the last part of this thesis to study how the axion solution to the strong CP problem can be unified with the dynamical flavor symmetry explanation for the huge hierarchies observed on the fermions.

**Bio:** Marco is a physics student from Mexico. He earned his Bachelor degree from the University of Colima, Mexico in 2014. In the fall of the same year he started the physics Ph.D. program at William & Mary. In 2016 he joined the High Energy physics group and started doing research under the supervision of Prof. Marc Sher. After graduation he will start a Postdoc position at the University of Warsaw in September.