# Announcing the Final Examination of Taylor Venise Douglas for the degree of Doctor of Philosophy in Physics

Date: Thursday, July 9th, 2026

Time: 10:00 AM EST

Room: In-person PSB 160/161 and Virtual (zoom)

https://ucf.zoom.us/j/96568877953?pwd=BPjrL7E5s8S8v21pKfCMk83PHWMARH.1

Meeting ID: 965 6887 7953

Passcode: 534389

Dissertation Title: Actin Cytoskeleton Dynamics, Mechanics and Structures Modulated by Gelsolin, Intracellular Environmental Factors, and Nanomaterials

## Abstract

Actin cytoskeleton dynamics and mechanics are central to many important cellular processes, including cell morphology and motility. Gelsolin is a calcium-regulated, actin binding protein involved in filament severing and filament end-capping. Intracellular environmental factors such as pH and macromolecular crowding can regulate actin cytoskeleton remodeling by gelsolin and filament torsional rigidity. However, it is unclear how pH and macromolecular crowding can influence gelsolin-mediated filament severing activities, gelsolin-bound filament bending mechanics and conformations. The first two parts of this dissertation investigate the role of pH and macromolecular crowding on actin dynamics, filament bending stiffness and structures. To determine how intracellular environmental factors modulate gelsolin-induced actin dynamics, mechanics and conformations, we utilized total internal reflection fluorescence microscopy, pyrene fluorescence assays, and atomic force microscopy. Biophysical analysis demonstrates that acidic pH enhances gelsolin severing and disassembly, and crowders increase filament length reduction by gelsolin. Moreover, we show that gelsolin enhances filament flexural rigidity and shortens filament helical half-pitch with intracellular factors. The last part of this dissertation investigates the role of molybdenum disulfide ($MoS_2$) nanomaterial and $MoS_2$ binding peptide 1 (MoSBP1) on actin assembly dynamics by fluorescence microscopy imaging and pyrene polymerization kinetics. Nanomaterials used in biomedical applications have been shown to influence cytoskeletal structures and cell morphogenesis. However, it is not known how the individual and combined effects of $MoS_2$ and MoSBP1 affect actin polymerization kinetics and filament mechanics. We show that individual filament elongation and bulk assembly rates are accelerated with $MoS_2$, while MoSBP1 inhibits actin assembly. Similarly, the combined effects of $MoS_2$ and MoSBP1 hinder actin assembly kinetics. Together, these studies elucidate how gelsolin, intracellular environmental factors, and nanomaterials regulate actin dynamics and mechanics.

Outline of Studies:

Major: Physics

Educational Career:

M.S. in Physics, University of Central Florida, Orlando, Fl, U.S.A

B.S. in Biophysics, Rowan University, Glassboro, NJ, U.S.A

Dissertation Committee:

Dr. Ellen Hyeran Kang (Chair)

Dr. Bo Chen

Dr. Aniket Bhattacharya

Dr. Kyu Young Han (External Committee Member)

Dr. Lorraine Leon (External Committee Member )

Approved for distribution by Ellen H. Kang, committee chair, on June 18th, 2026.

The public is welcome to attend.