Announcing the Final Examination of Tyrone Thames for the degree of Doctor of Philosophy in Physics

Date: November 15, 2023
Time: 1:00 p.m.
Room: PSB 445
Zoom: https://ucf.zoom.us/j/96757255635?pwd=V00wNVJBRndOcHJOUGJSTFFWekFyQT09

Dissertation title: Solid State Nuclear Magnetic Resonance Probing of Structures of the Rous Sarcoma Virus Capsid, Amyloid Beta, and Reflectin Proteins

Abstract:
Solid State Nuclear Magnetic Resonance (ssNMR) spectroscopy can be a powerful tool for investigating the atomic-level structures and dynamics of biological macromolecules, including proteins. In this dissertation, I present an ssNMR study of three diverse proteins, revealing insights into their respective secondary structures, conformational variations, and intermolecular interactions. Additionally, I introduce novel computational methods to facilitate the assignment of chemical shifts in protein ssNMR spectra. The first of the proteins is the capsid protein of the Rous Sarcoma Virus. In previous research, the structure of the hexameric lattice of the in-vitro tubular assembly of the capsid protein was found. In this study, chemical shift assignments were completed and the structure of the T=1 dodecahedral assembly of a mutant variant of the capsid was found, filling in further the picture of how full in-vivo capsids are formed. The second protein studied was amyloid-beta 42, a particularly cytotoxic variant of the main component of amyloid plaques in the brains of Alzheimer's disease patients. Chemical shift assignments were made on ssNMR data from samples aggregated in cholesterol-containing phosphatidylcholine (POPC) lipid vesicles, and secondary structure and molecular distance information was found. Lastly, preliminary chemical shift assignments, statistics, and structural analysis was done on the 2Cx4 variant of the Hawaiian bobtail squid reflectin protein. The reflectin protein, used in the squid's camouflage mechanism, possesses optically reflective and proton-conductive properties. The final part of the dissertation addresses a major bottleneck in ssNMR studies—the assignment of chemical shifts. I introduce VisualAssist, a suite of computational tools designed to streamline and expedite the assignment process. The developed computational methods are validated on the diverse set of proteins above, demonstrating their general applicability and efficiency.

Outline of Studies:
Major: Physics

Educational Career:
B. S. California State University Long Beach, Long Beach, CA, 2016

Committee in Charge:
Dr. Bo Chen (Chair)
Dr. Alfonse Schulte
Dr. Suren Tatulian
Dr. Lorraine Leon (External Committee Member)

Approved for distribution by Dr. Bo Chen, Committee Chair, on October 26th, 2023.

The public is welcome to attend in-person or remotely.