The Tortoise and the Hare: A Race for Answers to Big Questions About the Universe

The production of energetic exotic particles has long been a primary method for discovering the rules that underlie what we observe about the universe. There are, however, a number of gaps in this understanding, which the study of more familiar systems, such as neutrons, atoms, or molecules, can help elucidate. As the overall precision of these experimental efforts increases, there are a growing number of tantalizing anomalies, any of which could point the way to a shift in our understanding of how the universe formed, what makes it up, and whether ours is the only universe or is one of many universes. The race to discover new fundamental physical behavior currently features a diverse array of high-precision approaches, spanning an enormous range of energies. “Ultracold” neutrons (UCN), with twenty orders of magnitude smaller energies than particles produced at the Large Hadron Collider, provide one example of how low-energy measurements can facilitate the requirement for high precision. A classic example of a UCN-based experiment is determination of the free neutron lifetime, an empirical observable involved in a number of potentially interesting anomalies. An experiment called UCNτ that operates at Los Alamos National Laboratory has set the standard for precise determinations of this quantity. Using UCNτ as an example of the physics, engineering, and computational challenges high-precision work entails, this talk will describe the ongoing race to answer some long-standing questions about the universe.

Bio:
Adam Holley grew up in Raleigh, North Carolina, but attended college in Pennsylvania, where he earned a B.S. in physics and mathematics from Haverford College. Uncertain about whether theoretical or experimental physics was right for him, he temporized by teaching high school physics in New York City, where he had the good fortune to collaborate on the development and teaching of a three-year research course for high school students. That experience ultimately helped him decide to become an experimentalist. This he did at North Carolina State University, joining a group of scientists developing the United States' first ultracold neutron (UCN) source at Los Alamos National Lab. He earned his Ph.D. as part of the associated UCNA experiment that for the first time used UCN to measure the neutron beta decay asymmetry. During his subsequent postdoc at Indiana University, Dr. Holley got involved in another beta decay experiment called UCNτ. He continued his involvement with that effort when he joined the faculty at Tennessee Tech, where he leverages unique aspects of UCN physics to involve undergraduates in the work.