A Graphical User Interface-Based Framework for Ultracold Neutron Monte Carlo Simulations

Mina Kemp

TTU Computer Science

The mean lifetime of a free neutron (τ_n) is tied to several tests of the Standard Model, such as unitarity of the CKM matrix. In order to significantly probe topics such as this, a measurement of τ_n with a precision exceeding 0.1s is required. The goal of the UCNτ collaboration is to attain this measurement by means of a "bottle method" wherein ultracold neutrons (UCNs) are confined in a volume using strong magnetic field gradients. Assessing subtle systematic effects in experiments such as these depends in part on high-fidelity simulations. Standard neutron Monte Carlo codes, however, are not typically designed for simulating neutrons with energies as low as those of UCNs, which means that custom codes must be developed. This precludes the possibility of taking advantage of existing geometry or data visualization tools in a straightforward way, prompting the development of a new graphical user interface (GUI)-based framework for the UCN Monte Carlo code *UCNtransport.* This framework allows for the construction/modification of geometries as well as the projection of simulation results onto these geometries. In this presentation, I will describe the creation process, physics-driven design decisions, and current capabilities of this new framework.