

Fundamental Physics with Ultracold Neutrons at TRIUMF

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Ultracold neutrons enable some of the most precise measurements of neutron properties. With energies in the nano-electronvolt range, these neutrons can be trapped in material or magnetic bottles and observed for extended periods. These long observation times allow for highly accurate determinations of fundamental quantities, including the electric dipole moment of the neutron, the neutron lifetime, the interaction of neutrons with gravity, beta-decay parameters, and potential decay channels beyond the Standard Model. Each of these measurements serves as a crucial test of fundamental physics, contributing to our understanding of the early universe, symmetries, as well as the search for new physics.

At TRIUMF, Canada's national particle accelerator centre in Vancouver, the TUCAN collaboration is commissioning a next-generation ultracold neutron source. By utilizing superfluid helium, this new source aims to significantly increase ultracold neutron production, thereby improving the statistical precision of neutron property measurements, including the search for the neutron electric dipole moment at TRIUMF.

This talk will provide an introduction to ultracold neutrons, review recent progress within the TUCAN collaboration, including the first ultracold neutron production with the new ultracold neutron source, and discuss the experimental challenges in achieving high-precision measurements. It will also highlight Canada's role in advancing the global effort to determine the fundamental properties of the neutron.

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