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TUCAN EDM and PENeLOPE

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Ultracold neutrons are indispensable probes for precision experiments in fundamental physics, providing unique opportunities to search for new physics beyond the Standard Model. This presentation will cover the principles and current status of two key experiments poised to utilize high-yield UCN sources: the TUCAN EDM experiment and the PENeLOPE neutron lifetime experiment.

The TUCAN EDM experiment aims to measure the electric dipole moment of the neutron, a quantity directly linked to the universe's matter-antimatter asymmetry. Using a state-of-the-art magnetically shielded room, a double-cell arrangement at room temperature and the TUCAN high-yield UCN source, the experiment is projected to achieve a statistical sensitivity of 10−27 ecm (1-sigma) within 400 days of beam time.

The PENeLOPE experiment addresses the long-standing 4-sigma discrepancy between beam and trap measurements of the neutron lifetime, a crucial parameter for Big Bang nucleosynthesis and the CKM quark mixing matrix. Over the last decade, we have designed and constructed a superconducting magnetic trap with a large storage volume of ~800 liters. This system, commissioned in 2020 at the Technical University of Munich, was transferred to TRIUMF in 2024 to begin its first series of measurements at the new TUCAN UCN source. The design allows for both traditional counting of remaining neutrons and real-time detection of decay protons, enabling a precise measurement with a focus on minimizing systematic uncertainties.

This talk will provide a detailed overview of both experiments, highlighting their potential to contribute to the future scientific program with a high-yield UCN source like the one at the MLZ.

Author: PICKER, Ruediger (TRIUMF)

Co-author: FOR THE TUCAN AND PENELOPE COLLABORATIONS

Presenter: PICKER, Ruediger (TRIUMF)

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