

Progress of a Neutron Electric Dipole Search by the TUCAN Collaboration

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“To explain the asymmetry between matter and antimatter in the universe, a new source of CP violation is necessary. The presence of a non-zero permanent electric dipole moment (EDM) in a fundamental particle, such as a neutron, breaks the time-reversal symmetry and implies CP violation if we assume CPT conservation.

A neutron EDM measurement is performed using ultra-cold neutrons (UCNs), that have a kinetic energy of less than 300 neV. The UCNs are confined in a material container placed in an electromagnetic field, and the neutron EDM (nEDM) is measured by precisely observing the spin precession caused by the interaction with the electromagnetic field. Since the current experimental sensitivity is limited by statistical precision, a high-intensity UCN source development is essential.

The TRIUMF Ultra-Cold Advanced Neutron (TUCAN) collaboration aims to construct a high-intensity UCN source to perform an nEDM measurement at 10⁻²⁷ ecm. High-intensity UCN production is possible by using an accelerator neutron source with spallation reactions and a super-thermal method with superfluid helium. The TUCAN collaboration has successfully demonstrated UCN production using a prototype UCN source developed in Japan. Currently, efforts are underway to upgrade the UCN source to establish a world-leading UCN facility.

The nEDM measurement requires a highly uniform and stable magnetic field environment. A magnetic shielding room is under construction at TRIUMF. Other equipment necessary for nEDM experiments is also under development.

In this presentation, the progress made in the TUCAN collaboration and capabilities of nEDM search are discussed.”

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