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Towards a neutron electric dipole moment measurement with an advanced ultracold neutron source at TRIUMF

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Measurements of the neutron electric dipole moment (EDM) occupy an important place in today's particle physics. A finite value of the neutron EDM would indicate time-reversal symmetry violation, and based on the CPT theorem, also CP violation. Hence, it serves as a sensitive probe for CP violation. The current best upper limit of $1.8 \times 10^{-26}\, e \cdot \mathrm{cm}$ (90% C.L.) [1] is obtained through measurements of spin precession frequencies of stored ultracold neutrons (UCNs) under electric and magnetic fields. Limited numbers of UCNs available for the experiments have statistically limited the precision of recent measurements.

The TUCAN (TRIUMF Ultra-Cold Advanced Neutron) collaboration aims to measure the neutron EDM with an improved precision by using a new high-intensity UCN source currently being constructed at TRIUMF. Our UCN production scheme based on spallation neutron production and super-thermal UCN conversion with superfluid helium has been successfully demonstrated by a prototype UCN source [2]. With the new improved source, a statistical EDM sensitivity of $10^{-27}\, e \cdot \mathrm{cm}$ (68% C.L.) is expected to be attained in about 400 days of measurement.

Recently, core components of the new UCN source, such as optimized neutron moderators [3], a high-performance helium cryostat [4], and a nickel-phosphorus coated UCN production vessel have been built, tested and are being commissioned at TRIUMF. Developments of components of the neutron EDM spectrometer, such as a magnetically shielded room, atomic magnetometers, UCN polarization analyzers and an UCN precession chamber are also advancing in parallel [5].

In this presentation, an overview of the recent works by the TUCAN collaboration will be presented, and prospects for the new EDM measurement will be discussed.

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Primary author: Dr HIGUCHI, Takashi (Research Center for Nuclear Physics, Osaka University)

Presenter: Dr HIGUCHI, Takashi (Research Center for Nuclear Physics, Osaka University)

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