Contribution ID: **275** Type: **Invited Speaker / Conférencier invité**

Testing Fundamental Symmetries with the Next Generation Ultracold Neutron Source at TRIUMF

Monday 16 June 2014 13:45 (30 minutes)

Ultracold neutrons are neutrons that have been cooled below 3 mK. At this temperature they travel at a speed less than ˜8 m/s and exhibit the peculiar behavior of being able to be stored in magnetic, material, and gravitational bottles for periods ranging up to their beta-decay lifetime (˜15 min). They present a new avenue for performing fundamental neutron experiments such as: searching for a non-zero neutron electric dipole moment (nEDM), precise measurement of the neutron lifetime, and precise measurements of neutron beta decay correlation coefficients to name a few. These measurements have important consequences for extensions to the standard model of particle physics which could help explain the baryon asymmetry of our universe.

In the past, UCN were obtained by cooling neutrons from fission based nuclear reactors. However over the last 15 years several new sources of UCN, called super thermal sources, have been pioneered. Here spallation neutrons are cooled by cryogenic convertors and afford UCN densities many orders of magnitude over reactor based systems. One such super thermal source based on conversion in superfluid helium is being developed at RCNP (Japan) and will be moved and installed at TRIUMF (Canada) in 2016. The first experiment planned is a highly anticipated measurement of the neutron's EDM with an order of magnitude better sensitivity than current measurements. I will provide an overview of the rich physics opportunities available to UCN experiments and the current status of the TRIUMF UCN source.

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Session Classification: (M1-6) Testing Fundamental Symmetries I - DNP-PPD-DTP-DIMP / Tests de symétries fondamentales session 1 - DPN-PPD-DPT-DPIM

Track Classification: Nuclear Physics / Physique nucléaire (DNP-DPN)