Contribution ID: **1381** Type: **Invited Speaker / Conférencier invité**

Tests of the electroweak interaction from studies of the beta decay of trapped 8Li ions

Wednesday, 15 June 2016 08:30 (30 minutes)

Detailed studies of nuclear beta decay can provide stringent tests of the Standard Model of particle physics. In the beta decay of ^{8}Li, the nucleus emits an electron and an antineutrino, and the daughter ^{8}Be nucleus is left in an excited state which breaks up into two alpha particles. The angular correlations between these decay products are sensitive to any possible tensor contribution to the pure "vector minus axial-vector"structure of the electroweak interaction. The Beta-decay Paul Trap (BPT), an open-geometry radiofrequency-quadrupole ion trap which is instrumented with an array of double-sided silicon strip detectors, has been used to precisely study these angular correlations. The BPT is used to suspend the ^{8}Li nuclei in vacuum so that the energy and momentum of the two alpha particles and the direction of the electron can be precisely determined. From this information, the energy and direction of each emitted antineutrino, despite them being virtually undetectable, could be inferred from energy and momentum considerations and the angular distribution of the neutrinos from the decay was precisely determined. For the first time in over half a century, the tensor-interaction limits obtained from electron-neutrino angular measurements have been improved. In addition, data of similar quality on the decay of ^{8}B has been obtained, which, when combined with the data from the ^{8}Li decay, will provide additional tests of fundamental symmetries.

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Session Classification: W1-3 Testing Fundamental Symmetries I (DNP-PPD-DTP) / Tests de symétries fondamentales I (DPN-PPD-DPT)

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