Argonne NATIONAL LABORATORY

PHY Seminar

Physics Division Seminar

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Fundamental Symmetry Tests using Trapped Atoms and Ions

Host: Ben Kay

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Nuclear β decay has a long-standing history of shaping and testing the standard model of particle physics, and it continues to this day with elegant, ultra-precise low-energy nuclear measurements. Experiments observing the angular correlations between the electron, neutrino and recoil momenta following the β decay of (un)polarized nuclei can be used to search for exotic currents contributing to the dominant V−A structure of the weak interaction. Precision measurements of the correlation parameters to < 0.1% would be sensitive to (or meaningfully constrain) new physics, complementing other searches at large-scale facilities like the LHC..

Ion and atom traps provide an ideal source of very cold, short-lived radioactive nuclei in an extremely clean and open environment. As such, they are invaluable tools for precision measurements of β-decay parameters. This talk will focus on two such efforts. The TAMUTRAP facility at the Cyclotron Institute, Texas A&M University, will utilize an upgrade to the recently commissioned cylindrical Penning trap – already the world's largest with an inner diameter of 90 mm – to search for scalar currents via the β-ν correlation in the β-delayed proton decay of $T = 2$ nuclei. The other effort, based at TRIUMF in Vancouver, Canada, utilizes neutral atom-trapping techniques with optical pumping methods to highly polarize (> 99%) ^{37}K atoms. Recently, we determined the β asymmetry parameter, A_β, to 0.3% precision, which is comparable to or better than any other nuclear measurement, including the neutron.