

**University of Vermont
Theoretical and Applied Physics**

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**Fundamental Physics with Ultracold Neutrons: A New
Approach to a Challenging Problem**

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Ultracold Neutrons (UCN) are neutrons which move at speeds less than about 8 m/s, making it possible to store these neutrons for times approaching the natural lifetime of the neutron. These long storage times also facilitate high-precision measurements of the properties of the neutrons themselves, including the decay of the neutron via the weak interaction. This fundamental process influenced the primordial elemental distribution, governs energy generation in the sun, aspects of neutron stars, and terrestrial neutrino detectors. The standard model of particle physics provides very detailed predictions for neutron decay, permitting a high-precision confrontation between theory and experiment and indirectly probing for physics beyond the standard model. This method of exploring for new physics is often complimentary to high energy particle physics direct searches like those planned at CERN, but are sensitive to a host of extensions to the standard model, such as supersymmetry, charged Higgs particles, and left-right symmetric models. We describe the status of beta-decay measurements with UCN in general, and our experiment, UCNA, to measure angular correlations in neutron decay. Our 2008 dataset should lead to a 1% measurement of the beta-asymmetry in polarized neutron decay, with improvements currently underway. UCNA is located at the Los Alamos Neutron Science Center (LANSCE), and utilizes a solid deuterium ultracold neutron source, the first of its kind. The source technology we utilize makes possible very competitive UCN sources at universities, so we conclude with a brief description of the UCN source under construction at the PULSTAR facility at NCSU, where we envision neutron research programs in nuclear and condensed matter research.

Wednesday, September 16, 2009

4:00 p.m.

Room A442 Cook Physical Science Building

Refreshments will be provided at 3:30 p.m. in Room A429.