COLD AND ULTRA-COLD NEUTRONS AS PROBES OF NEW PHYSICS

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Despite the great success of the Standard Model, many key questions in particle physics, astrophysics, and cosmology are unanswered. In particular, more than 95% of the universe consists of unknown dark matter and dark energy. Today, a major goal of particle physics is to look for evidence of new physics beyond the Standard Model. Collider searches for new physics are well suited to the direct production of new high-mass particles, whereas low-energy precision experiments search for traces that new particles leave in known processes. Direct and indirect evidence of new physics are highly complementary.
High-precision experiments with extremely slow, cold and ultra-cold neutrons address some of the unanswered questions, for instance, on the nature of the fundamental forces and underlying symmetries, the origin, evolution, and fate of the universe, or on the nature of the gravitational force at very small distances. For example, the limit on the electric dipole moment of the neutron constrains the CP violating phases, the lifetime of the neutron determines the relative helium abundance in the universe, and neutrons bouncing over a mirror probe dark matter and dark energy.
New facilities and technological developments now give window for significant improvement in precision by one to two orders of magnitude. In this talk, I will give an overview of current and planned facilities and experiments, as well as an overview of some of the applications of neutrons to astrophysics, cosmology, and physics beyond the Standard Model.