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Precision Measurements of Parity Violation in Neutron-Nucleus Resonance States for Future Time-Reversal Violation Experiments[1]

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The Standard Model of physics is the most complete, most robust, most well-tested theory in physics; it is our rulebook which describes all of the known particles and their interactions. It is the culmination of the work of thousands of physicists over thousands of years and has been found to be an amazingly self-consistent theory. However, even with such an enthusiastic endorsement, we know that the Standard Model is not completely correct. For one, it cannot presently explain many outstanding problems in physics, one of which is the baryon asymmetry of the Universe, or to put more simply: where did all of the matter that constitutes the Universe come from? And where is the antimatter? Nature adores symmetry. In the laboratory, for example, high-energy gamma rays can split into particle-antiparticle pairs in a process known as pair production. But thats just the thingthese reactions ALWAYS occur in particle-antiparticle pairs, and we have not yet seen any experimental evidence to the contrary. Therefore, it would seem that during the Big Bang, matter and antimatter should have been produced in exactly equal amounts. These matter-antimatter particle pairs would then collide and annihilate into photons, leaving almost nothing but a Universe made of radiation. But this is not what we seewe see a Universe made of matter. How can this be? In 1967, Andrei Sakharov proposed three conditions that, together, could explain the matter-antimatter asymmetry of the Universe: one of these conditions was the need for charge conjugation (C) symmetry and time-reversal (T) symmetry to be violated. The Neutron OPtics Time Reversal EXperiment (NOPTREX) collaboration seeks to find evidence of Tviolation in a system that has not yet been probed: resonant neutron-nucleus interactions of heavy nuclei. This talk will discuss the ideas behind the NOPTREX experiments as well as preliminary parity violation measurements that have been conducted at the Los Alamos Neutron Science CEnter (LANSCE).

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