Searching for Mirror Neutron - Neutron Oscillations

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The corner stone of standard model of particle physics is the Lorentz symmetry (a special result of which is Einstein's special theory of relativity). It was shown by G. Lüders and Pauli that Lorentz symmetry translates to the join conservation of the three discrete symmetries of Charge inversion, Parity inversion and Time inversion [1, 2]. This equivalence is known as CPT theorem. Weak nuclear force mediated neutral Kaon (particle) decay (to 2 π^0 or to 3 π^0) showed that CP symmetry is violated [3]. Violation of CP symmetry is allowed by the CPT theorem, if T-symmetry is also violated. But to date no CP or T-symmetry violation has been observed in any strong force mediated process. This is known as the Strong-CP problem [4]. It was pointed by Ref. [5] that introduction of a mirror realm (which does not interact with our real realm) could solve the Strong-CP problem and that neutral particles such as neutrons may spontaneously oscillate to their mirror universe counterpart ($n \leftrightarrow n'$) [6]. Consequently, two separate groups performed their experiments in search of such neutron - mirror neutron oscillations and reported having found no evidence of such oscillations [7, 8]. This in-turn set limits on the oscillation time, $\tau_{nn'} > 414$ s. Soon after, Ref. [9] pointed out inconsistencies in the results obtained by these two experiments. Furthermore, Ref. [9] showed that when the results of these two experiments are combined, the inconsistencies can be explained by introducing a mirror neutron oscillation in presence of a magnetic field in the mirror realm. Indeed, the two prior experiments had assumed the absence of any magnetic fields in the mirror realm and only considered applied real magnetic fields. Therefore we need a new experiment to verify or exclude these spurious results. We will look at the very first [preliminary] results of our newest effort to search for mirror neuron oscillations .

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