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Analysis of Dark Mirror Neutron Search Experiment

Mirror matter has been proposed as a potential explanation for dark matter, with neutron-mirror neutron ($n \leftrightarrow n'$) oscillations providing a possible signature of its existence. To search for this effect, we conducted an experiment using a cold neutron beam and the GP-SANS instrument at the High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory. The experiment aims to observe these oscillations within a specific dark matter model in which neutrons and mirror neutrons have a slightly different mass (Δm). Under this hypothesis, a magnetic field can compensate for this effect otherwise forbidden by Δm. In our configuration, a cadmium absorber is placed between two 25-Gauss magnets. Ordinary neutrons are blocked by the cadmium, while mirror neutrons—which do not interact with normal matter—pass through, traverse the second magnetic field, and regenerate into detectable neutrons. Given the low probability of oscillation, careful distinction between signal and background was essential. Preliminary analysis yields an effect probability of $(0.11 \pm 2.56) \times 10^{-13}$ per neutron, establishing a limit for probability of this Δm-model to be $< 5 \times 10^{-13}$ per neutron with 95\% confidence. Our further experiments at HFIR will explore alternative models of ($n \leftrightarrow n'$) oscillations.

Topical Area

Emerging research and multimodal techniques

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