A Search for Shot-Wavelength Neutrino Oscillation From a Nuclear Reactor

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ABSTRACT

The Precision Reactor Oscillation and SPECTrum Experiment (PROSPECT) is designed to probe short baseline oscillations of antineutrinos in search of eV-scale sterile neutrinos and precisely measure the ^{235}U reactor antineutrino spectrum from the High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory. The PROSPECT antineutrino detector (AD) provides excellent background rejection and position resolution due to its segmented design and use of ^{6}Li-loaded liquid scintillator. Due to characteristics of its decay chain, ^{227}Ac was added as a calibration source that was dissolved isotropically throughout the liquid scintillator. Using the correlated production of alphas from ^{219}Rn $\rightarrow$ ^{215}Po $\rightarrow$ ^{211}Pb in the ^{227}Ac decay chain we can measure the rate of ^{227}Ac in each segment of the detector. This allows us to precisely determine the relative segment to segment volume variation to 1%. These measurements can then be applied as corrections to measurements of neutrino oscillation through the PROSPECT AD.

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In 1930 Wolfgang Pauli postulates a particle, that he calls neutron, to explain how beta decay could conserve energy, momentum, and angular momentum. This new particle would have to be neutral and non-interacting. Describing his idea as a ”desperate remedy”, even Pauli was unsure if this particle would ever be detected. In 1933 Enrico Fermi further develops the theory of beta decay in which Pauli's particle plays an integral part. It becomes clear that this particle, which Fermi renames the neutrino (”little neutral one”), must be very light, less than 1% the mass of the proton, and interact very weakly with matter. The discovery of this neutrino wouldn't happen until 20 years later.

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REFERENCES

[1] P. Huber, Phys. Rev. **C84**, 024617 (2011), [Erratum: Phys. Rev.C85,029901(2012)], 1106.0687.