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Overview of Fierz Interference Analysis from UCNA Experiment

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A non-zero Fierz interference term, the b coefficient in the expansion of the beta decay rate in the Standard Model, can signify contributions to scalar and tensor interactions from physics beyond the Standard Model. In practice, $b \neq 0$ causes shifts in the shape of the electron energy spectra, primarily at low energies since Fierz interference scales like $\frac{m_e}{E}$. In 2010 the UCNA experiment at the Ultracold Neutron facility at Los Alamos Neutron Science Center took data for a beta decay asymmetry A measurement. This same dataset can be used to extract the b coefficient by comparing shifts in the nominal, i.e. $b = 0$, spectra to the data. Here we discuss Monte Carlo simulation methods used in both extracting a value of and estimating an error on b. We use Monte Carlo methods to generate the kinematics for beta decay corresponding to a range of b values and input those kinematics to a GEANT4 simulation of the UCNA apparatus to create simulated beta spectra. This analysis focuses on the systematic errors due to non-linearities in the detector energy response which are modeled by converting simulated spectra into "data-like" spectra. The simulated spectra are compared against each other to extract a value of b and an associated error.

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