Neutron beta decay measurements planned for the SNS

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A cold neutron beam line, dedicated to fundamental neutron physics (FnPB), is presently being completed at the Oak Ridge, TN, Spallation Neutron Source. Among other experiments, the beamline will host a comprehensive set of precise studies of the neutron beta decay. Neutron beta decay is characterised by the decay rate (or its inverse, the neutron lifetime), and a set of decay parameters describing the kinematical and spin correlations among the participating particles. Within the standard model (SM), the neutron lifetime and three decay parameters ($a$, $A$, and $B$) are fixed by two parameters: the $V_{ud}$ element of the Cabibbo-Kobayashi-Maskawa mixing matrix, and $\lambda = G_A/G_V$, the ratio of axial vector and vector nucleon form factors. This overdetermined system provides a unique opportunity to explore possible departures from the simple SM, as well as the nature of such departures, e.g., left-right supersymmetric extensions, leptoquarks, non-$\left(V-A\right)$ admixtures, etc., with broad implications in subatomic physics. The FnPB neutron beta decay program will include measurements of the neutron lifetime, continuing the present NIST experiment, a measurement of $a$, the electron-neutrino correlation, and $b$, the Fierz interference term, (the “Nab” experiment), along with measurements of $A$ and $B$, the correlations between neutron spin and electron and neutrino momenta, respectively, (the “abBA” experiment). Current plans for these experiments will be discussed in detail.

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