# Measuring the Absolute $\nu_\mu$ Flux using a Fine-Grain Straw-tube Tracker

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To conduct precision oscillation physics at the intensity frontier, such as LBNE in Project-X era, is that the $\nu_\mu$ and $\bar{\nu}_\mu$ charged-current cross-sections be known to $\simeq 3-4\%$ precision. An in-situ determination of the absolute $\nu_\mu$ flux with a commensurate precision will be highly desirable.

We propose a method of measuring the absolute $\nu_\mu$-flux using the $\nu_\mu$-e neutral current (NC) scattering. The cross-section of this process is known to be $\simeq 1\%$ precision using the weak-mixing angle measured at the colliders. Thus, if the backgrounds can be drastically reduced and the remaining background constrained, then $\nu_\mu$-e NC scattering will provide a means to measure the absolute flux.

The fine-grain straw-tube tracker (STT), currently a candidate for the LBNE near-detector, can accomplish a $\nu_\mu$-e NC scattering with $\simeq 3\%$ precision. (See S.R.Mishra's contribution.) The STT is capable of measuring $\nu_\mu$-, $\bar{\nu}_\mu$-, $\nu_e$-, and $\bar{\nu}_e$-CC with very high precision. To identify the $\nu_\mu$-e NC events, we isolate interactions having a single negative track, require that the track be an electron using the transition-radiation measurements, and finally require that the track be collinear with the incident neutrino, i.e. $\zeta_e = E_e \times (1 - \cos\theta_e) < 0.001$. The background, mostly from $\nu$-nucleon NC where the only observable is an $e^-$ from an asymmetric photon decay, is reduced to $< 10^{-5}$ whereas the 64% of the signal survive. Our estimate indicates that with a 700 kW beam and a five year exposure, a sample of $> 1500$ signal events can be measured with a small, and benign, background.