High Energy Resolution in High-Pressure Xe Gas TPCs

Helmuth Spieler

Physics Division
Lawrence Berkeley National Laboratory, Berkeley, California

Searches for rare events such as neutrinoless double beta decay require discrimination between backgrounds and desired events. In part this can be achieved by energy resolution, but the ability to record the event topology is extremely useful. Existing data indicate that high-pressure Xe gas can provide excellent energy resolution in addition to sufficient position resolution in a TPC to reconstruct the event topology. Existing data indicate a Fano factor of 0.15, so the relative energy resolution at 2.5 MeV, the Q-value of Xe, could be as low as $3 \cdot 10^{-3}$ FWHM, only a factor of 2 to 3 worse than a Ge diode. Exploiting this intrinsic resolution requires internal gain with very small fluctuations, which can be achieved by utilizing electroluminescence. This converts the ionization signal charge to light. Existing measurements have been at lower energies, so the resolution must be verified at 2.5 MeV. This requires a chamber of about 1 m size operating at a pressure of 20 bars, so as a first step to test energy scaling we are constructing a small chamber operating at the same pressure with an energy range up to 700 keV. The presentation will describe the chamber and discuss the techniques required to actually achieve the predicted energy resolution.