Energy Response Model for Liquid Scintillator Detectors

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Liquid scintillator (LS) detectors, composed of LS and photosensors, such as photomultiplier tubes (PMTs), have been widely used in neutrino experiments. Precise calibration of energy response (energy nonlinearity and energy resolution) for different particles in LS detectors is crucial for spectral analysis. For LS detectors used in reactor neutrino experiments, e^+ from the inverse beta decay interaction is the target signal, while γs instead of βs are the most common calibration sources. Therefore, a calibration-based model connecting energy response of e^+ with that of γ is strongly motivated. Once done that, the positron energy response can be calibrated with the existing sources. In this poster, a unified model for both nonlinearity and resolution in LS detectors is presented. The energy resolution contributions by scintillation light and Cherenkov light have been studied in details. Also the utilization of high energy samples, Michel electrons, has been discussed as a potential method for a better description at the high energy range. Besides, the effectiveness and robustness of the proposed method has been verified with different simulated LS detector configurations. This work has already been published as arXiv 2211.02467 and submitted to European Physical Journal C.