High-precision digital $\beta$ counting for superallowed $\beta$-decay studies

Lixin Chen, John C. Hardy, Cyclotron Institute, Texas A&M University, College Station, TX 77843, USA — Superallowed $\beta$-decay ft values must be measured to high precision in order to test the Electroweak Standard Model and probe new physics beyond it. To establish a more robust $\beta$ counting system for high precision half-life measurements, we have developed a new digital $\beta$ counting system, which we have now tested on-line. An 8-bit digitizer with 1 GS/s sampling rate was used to record the waveforms from our gas proportional counter, and a software filter applied to discriminate and count genuine decay events. The software filter uses pulse-shape analysis to separate genuine $\beta$-decay events from proportional-counter spurious pulses. The digital counting method and the results obtained from our recent on-line test experiments will be presented in detail. This work demonstrates the first successful application of a high-speed digitizer and off-line digital-signal-processing techniques to high precision nuclear $\beta$-decay lifetime measurements.