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Development of a radioxenon detector with a high-resolution beta detector

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Beta-gamma detectors are utilized extensively for the detection of radioxenon, but the beta detection is primarily performed with a plastic scintillator cell. Two areas of improvement for plastic scintillators are the sample carry-over ("memory effect") and energy resolution. While the scintillator can be coated to remove the memory effect, the energy resolution must be improved with a different detector material. Silicon is the current leading candidate for the future beta cell material due to the much-improved energy resolution compared to plastic scintillators (factor of ~3x). PNNL is developing a silicon beta cell for use as a potential modular replacement within Xenon International (a next-generation radioxenon detection system currently undergoing acceptance testing for potential inclusion in the International Monitoring System). The beta cell utilizes four different silicon detectors to create an active volume for the radioxenon within an outer gas cell. Since there are four separate beta signals (compared to one for plastic scintillators), data acquisition modifications are required. In this presentation, we detail the design, efficiency measurements, and long-term testing of the silicon beta cell and potential improvements in isotopic discrimination. Additionally, we discuss the required data acquisition and analysis updates needed to best utilize the silicon improvements.

Promotional text

Improving identification of nuclear explosions in a sea of anthropogenic backgrounds with the improved isotopic discrimination available with a silicon beta cell

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