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Development of a High-Energy Two-Component Gamma Calibration Source

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The detection of electron antineutrinos can provide the means for confirming the presence and monitoring of the operational characteristics of nuclear reactors. Water-based Cherenkov detectors with gadolinium doping are one of the technologies under study for this application. The energy scale of the emitted positron and the de-excitation cascade from neutron capture by gadolinium motivates the development of gamma calibration sources with energies of several MeV. One such potential source is provided by the 13C(α,n)16O reaction. At alpha energies above ~5 MeV, a significant branching ratio exists for the deexcitation of 16O via the emission of a 6.1-MeV gamma ray. The fast neutron also produced from this reaction can be used to tag events in the large water-based detector. 241Am is an appealing alpha source as it has emission energy above the ~5 MeV threshold, high specific activity, and does not possess the regulatory overhead of other alpha sources. We discuss continued refinement of the simulation methods developed to predict source yield as a function of the source design parameters. These include implementing more advanced physics models and transitioning the simulation software to a more generalized framework. We additionally present initial measurement results to demonstrate the production of the calibration signals of interest.

Abstract title

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