

Electron capture spectroscopy and isotope production: research toward neutrino mass measurement

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Calorimetric spectroscopy via electron capture (ECS) is a candidate for a direct measurement of the neutrino mass, for isotopes with a Q -value of a few KeV. The use of the synthetic, rare, and unusual isotope Ho-163 has significant advantages but substantial new challenges. Two absolutely essential challenges to overcome are the production of Ho-163 and measuring ECS spectra with very high resolution: There are no fully validated methods for making Ho-163 at the purities and quantities required. Nor has there been any ECS of any isotope with the required 1-2 eV FWHM resolution. We will report on both areas. We discuss the possible methods of accelerator and reactor production and the separation of Ho-163 by high-pressure liquid chromatography. Our transition edge sensor testing has used a surrogate electron-capture-decaying isotope, Fe-55, embedded within microcalorimeter absorbers. This encapsulation aims to capture and thermalize all the energy of the excited daughter atom (Mn-55) independent of the de-excitation pathway. Preliminary tests so far have shown better than 10 eV resolution for Fe-55 embedded in small Au absorbers attached to TES microcalorimeters, with variability based on encapsulation method and isotopic purity.

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Primary author: Dr KUNDE, Gerd J (Los Alamos National Laboratory)

Presenter: Dr KUNDE, Gerd J (Los Alamos National Laboratory)

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