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A New Tool for (α,n) Yield Calculations and Radiogenic Neutron Backgrounds in DEAP-3600

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Neutron-induced nuclear recoils present one of the dominant backgrounds in many low-background experiments. These neutrons are largely radiogenic in origin, coming from fission and (α,n) reactions in detector components. The (α,n) neutron production rate in a material depends on the composition of the material as well as the energies of the α decays that occur within it. In this talk, we will present NeuCBOT, a new tool for calculating the (α,n) yields and neutron energy spectra for arbitrary materials exposed to contamination from a given set of α energies or α-emitting isotopes, and we will benchmark these calculations against calculations made by SOURCES-4A and various measured yields.

We will discuss these yield calculations in the context of DEAP-3600, a dark matter detector located at SNOlab, searching for nuclear recoils produced by Weakly Interacting Massive Particles. Using NeuCBOT and Geant4 simulations, we will predict the neutron-induced nuclear recoil backgrounds in DEAP-3600. We will then present in-situ measurements of neutron interactions in DEAP-3600 to show that these predictions are consistent with our observations, and that the neutron backgrounds are within the experiment's design goals.

Summary

I will be presenting a new neutron yield calculator, NeuCBOT, as well as discussing the expected neutron backgrounds in DEAP-3600, including in-situ limits on the neutron background rate, consistent with these predictions.

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