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Monte Carlo Analyisis of Alpha Backgrounds

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The necessity to account for backgrounds is a well known issue for any feasible Dark Matter detection experiment. One of the major sources of backgrounds is the emission of alpha particles associated with the decay of small amounts of radioactive isotopes present in the experiment.

Due to the quantum nature of radioactive decay, it is impossible to develop a deterministic model for the timing of the alpha particles. Furthermore, in the case of bubble chambers, the expansion and compression time –which follows any ionizing interaction within the chamber, and which permits to re-reach the superheated fluid state –render the detector "blind"after any detection, which further complicates the accounting of backgrounds.

In order to address this, a Monte Carlo based object-oriented simulation program was developed. The program is able to account for the dead-time associated to both alpha and non-alpha detections, and is able to predict the rate at which the isotopes are decaying within the chamber with promising accuracy, fast computation times and small memory requirements. Furthermore, the program is able to recreate the chain of events and associate every alpha observation to the decay process which generated it.

The program is currently being used to analyze the rate at which Rn-222 is being injected into the chamber of the PICO-40L experiment at the SNOLAB underground laboratory; but if proven reliable, could potentially be used to carry this sort of analysis in a vast amount of detection experiments.

Topics - Please choose one:

Experiment / Theory

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