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Treatment of material radioassay measurements in projecting sensitivity for low-background experiments

Low-background experiments typically perform radioassay on detector construction materials, and use the resulting radioimpurity estimates to project experiment sensitivity. However, as the radiopurity of the materials improves and approaches the detection limit of the radioassay techniques, the radioimpurity concentration of the materials cannot be conclusively determined. Instead, only an upper limit can be placed on the radioimpurity concentrations. This presents a problem as the values cannot be trivially incorporated into sensitivity projections. The most straightforward approach is to treat the upper limit as if it is the determined radioimpurity concentration. This is often considered "conservative" as the resulting sensitivity is likely to be worse than the *true* sensitivity. Another approach is to transform the upper limit into a distribution. Depending on the choice of the distribution, this may or may not provide a more accurate estimate of the *true* sensitivity. By analyzing sensitivity projections as a statistical estimation problem, we evaluated different ways of treating radioassay measurement results (values and upper limits) when projecting sensitivity for low-background experiments. We developed a figure of merit that incorporates a notion of conservativeness to quantitatively explore the consequences of attempts to bias sensitivity projections, and proposed a method to report sensitivity.

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