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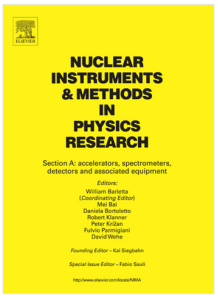

A new approach to counting measurements: Addressing the problems with ISO-11929

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A new approach to counting measurements: Addressing the problems with ISO-11929

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ABSTRACT:

We present an alternative approach to making counting measurements of radioactivity which offers probabilistic interpretations of the measurements. Unlike the approach in the current international standard (ISO-11929), our approach, which uses an assumed prior probability distribution of the true amount in the sample, is able to answer the question of interest for most users of the standard: "what is the probability distribution of the true amount in the sample, given the data?" The final interpretation of the measurement requires information not necessarily available at the measurement stage. However, we provide an analytical formula for what we term the "measurement strength" that depends only on measurement-stage count quantities. We show that, when the sources are rare, the posterior odds that the sample true value exceeds ε are the measurement strength times the prior odds, independently of ε, the prior odds, and the distribution of the calibration coefficient. We recommend that the measurement lab immediately follow-up on unusually high samples using an "action threshold" on the measurement strength which is similar to the decision threshold recommended by the current standard. We further recommend that the measurement lab perform large background studies in order to characterize non constancy of background, including possible time correlation of background.

Keywords: Bayesian analysis; Decision Thresholds; ISO 11929; Likelihood Functions; Counting Measurements

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