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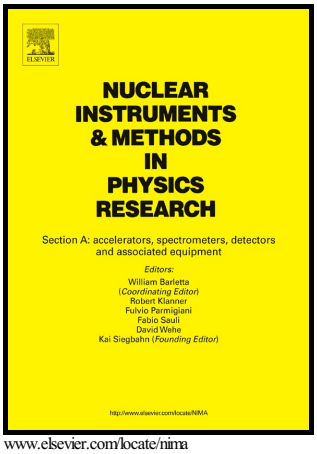

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Model Independent Approach to the Single Photoelectron Calibration of Photomultiplier Tubes

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Abstract

The accurate calibration of photomultiplier tubes is critical in a wide variety of applications for which it is necessary to know the absolute number of detected photons or precisely determine the resolution of the signal. Conventional calibration methods rely on fitting the photomultiplier response to a low intensity light source with analytical approximations to the single photoelectron distribution. We show that this approach often leads to biased estimates due to an inability to model the full distribution accurately, especially at low charge values. We present a simple statistical method to extract the relevant single photoelectron calibration parameters (first two central moments) without making any assumptions about the underlying single photoelectron distribution. We illustrate the use of this method through the calibration of a Hamamatsu R11410 photomultiplier tube and study the accuracy and precision of the method using Monte Carlo simulations. The method is found to have significantly reduced bias compared to conventional methods and works under a wide range of light intensities, making it suitable for the simultaneous calibration of large arrays of photomultiplier tubes where uniform illumina-

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