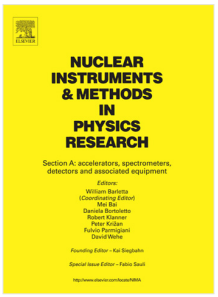
Accepted Manuscript



Precision analysis of the photomultiplier response to ultra low signals

Pavel Degtiarenko

PII: S0168-9002(17)30825-2
DOI: http://dx.doi.org/10.1016/j.nima.2017.07.053
Reference: NIMA 60002

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date : 24 August 2016
Revised date : 26 July 2017
Accepted date : 27 July 2017

Please cite this article as: P. Degtiarenko, Precision analysis of the photomultiplier response to ultra low signals, *Nuclear Inst. and Methods in Physics Research, A* (2017), http://dx.doi.org/10.1016/j.nima.2017.07.053

Precision analysis of the photomultiplier response to ultra low signals

Pavel Degtiarenko*

Jefferson Lab, Newport News, Virginia, USA

Abstract

A new computational model for the description of the photon detector response functions measured in conditions of low light is presented, together with examples of the observed photomultiplier signal amplitude distributions, successfully described using the parameterized model equation. In extension to the previously known approximations, the new model describes the underlying discrete statistical behavior of the photoelectron cascade multiplication processes in photon detectors with complex non-uniform gain structure of the first dynode. Important features of the model include the ability to represent the true single-photoelectron spectra from different photomultipliers with a variety of parameterized shapes, reflecting the variability in the design and in the individual parameters of the detectors. The new software tool is available for evaluation of the detectors' performance, response, and efficiency parameters that may be used in various applications including the ultra low background experiments such as the searches for Dark Matter and rare decays, underground neutrino studies, optimizing operations of the Cherenkov light detectors, help in the detector selection procedures, and in the experiment simulations.

Keywords: Photon detector, Photomultiplier, Photoelectron, Signal amplitude spectra, Photon detection efficiency

*Corresponding author Tel: +1 757 269 6274, Fax: +1 757 269 6050
Email address: pavel@jlab.org (Pavel Degtiarenko)