I. Introduction

Photo-multiplier tubes (PMTs) are devices capable of detecting single photons, making them widely useful for many scientific applications. Specific examples of their recent employment are in a Ring Imaging Cherenkov Detector (RICH) in Jefferson Lab’s Hall B and in PET scans used in medical imaging. The recent calibration of the RICH PMTs can be used to analyze the performance of these imaging devices and their potential in medical imaging.

II. Objectives

In many physics experiments, photons must be counted at a high rate. In addition, greater precision in the position and time of counting can greatly improve the results of experiments. In the RICH detector at JLab, particles are identified based on the size of a ring shaped radiation produced when the particle travels through a radiating material. In PET scans (positron emission tomography), photons emitted in opposite directions due to e⁺e⁻ annihilation are detected simultaneously to reconstruct an image of the body.

III. Approach

PMTs utilize the photoelectric effect and a dynode system to transform a photon hit into a measurable signal. The MAPMTs in the RICH detector are 5cm x 5cm with an 8x8 grid of channels allowing for a spatial accuracy within 0.1 mrad. Additionally, their speed along with the speed of the readout electronics results in a time accuracy within 1 ns.

IV. Results

The calibration studies of the RICH detector revealed that the PMTs and output electronics have some strange sources of noise and some extremely high rate channels which affect others, but overall they are performing well. For the last year, the PMTs in the RICH detector have been successful in identifying particles produced in scattering experiments by their few (~12) photons produced per event.

V. Conclusions

The fundamental studies performed in nuclear physics experiments now require detectors highly accurate in both time and distance. This has resulted in the production of improved, highly accurate single photon detectors. These can be employed in medical imaging devices for improved results.

VI. References.

1. Jefferson Lab, https://www.jlab.org/about