Analysis of Photo-Anode Multipliers (MA-PMTs) for a Ring Imaging Cherenkov (RICH) detector

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Introduction

Future experiments at the Thomas Jefferson Laboratory require the addition of a new RICH detector to the CLAS12 spectrometer. RICH will be used to discriminate between sub-atomic charged particles called pions and kaons by analyzing the Cerenkov light that is emitted by this particle jets when they are moving faster than the speed of light in a radiator material.

Methodology

Cherenkov radiation will be caught by approximately 400 Hamamatsu H12700 MA-PMTs. These MA-PMTs are connected to flash analog-to-digital converters. The output from these FADCs is being analyzed. I am analyzing test data that is being taken at Jefferson Lab by developing C++ codes and using the ROOT program.

Data Analysis

Above: An example graph of the ADC channel for a pixel within a PMT. The red+green lines to the left is the pedestal, while the magenta line and black points line shows the SPS.

Above: Here are examples of graphs that have a constant HV, constant threshold or initial gain, and varying initial gain or threshold respectively. In graphs 1-3, each color set of points is a trial with different initial gain values. The values are 16, 32, 64, 128, and 256. In graph 3, the gray set with 256 initial gain yields bad data. Routing out this bad data is part of the data analysis. Graph 4 varied threshold for 4 different runs (25, 50, 100, & 200). Observing that they is a heavy overlap in the data points is part of the data analysis.

The RICH Detector

These are pictures of the Hamamatsu H12700 Multi-Anode Photo-Multiplier Tubes mounted on the laser stand.

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