Coding for Q_{weak} Analysis Software

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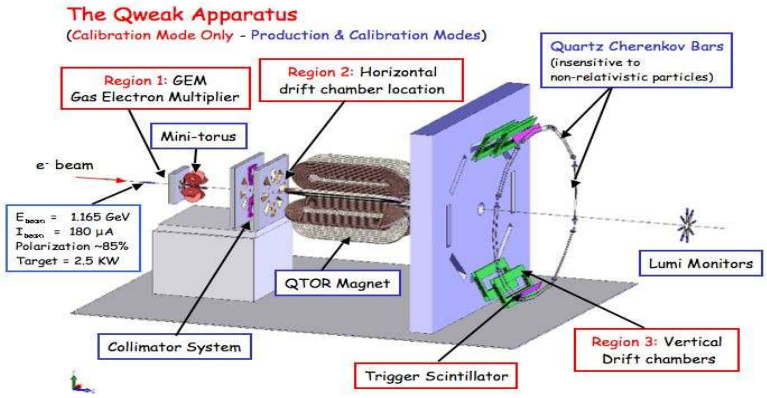
During my summer work with the Ohio University Physics Department I worked with members of the Qweak team. Qweak is a particle physics experiment that is to be conducted at Jefferson Laboratory (www.jlab.org) in Virginia in 2009. My work consisted of doing coding for a part of the analysis software. Additionally I worked on a side project for several days that involved testing the transmission characteristics of crystals to be used in a different Jefferson Lab experiment.

Background information:

The Qweak experiment will test predictions of the Standard Model in order to look for new physics. It will work by scattering low energy electrons off a proton target in order to determine the weak charge (Qweak) of the proton, the value of which is predicted by the Standard Model. If the measurements deviate from those predicted by the Standard Model it will be a sign of new physics. (For more information see www.jlab.org/qweak/)

I wrote some of the code for the analysis software, specifically the part that deals with transferring raw data from the wire chamber detectors into a more visable form such as histograms. A wire chamber is a set up that detects the presence and location of charged particles. It uses an array of wires suspended in a gas filled chamber; the casing of the chamber is at ground, while the wires are held at high voltage. As a charged particle passes near a wire it ionizes the gas around it, these ions then drift to the wire and can be detected as a small pulse of current. By setting up wires in a three dimensional grid the path of a charged particle can be reconstructed. Qweak will be using two wire chambers shown in Figure 1 regions two and three below.

Figure 1:



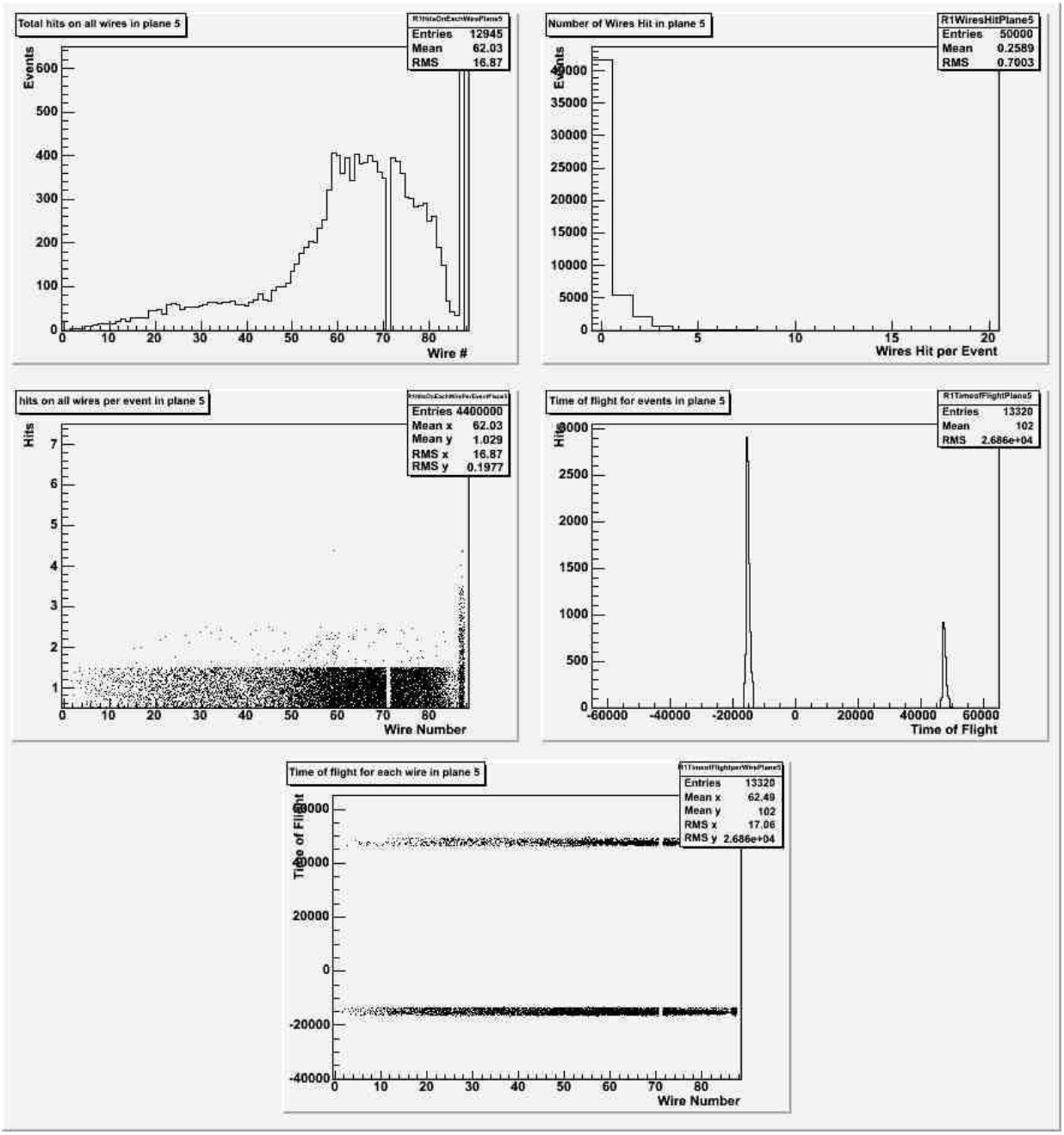
Work description:

As I am new to C++ and coding, I spent the first part of the summer learning the basics. Then, I got familiar with the ROOT (http://root.cern.ch/) framework that I would later be using to create histograms for Qweak.

The remainder of the summer was spent working on the main code for Qweak. Here, I took raw data collected from a wire chamber that is similar to the one to be used in Qweak in the form of a three dimensional vector (dimensions(Plane,Wire,Hits)) and used it to create different types of histograms in ROOT. This process involved creating the histograms in a root file, filling them with data from the vector, and subsequently deleting them to reduce memory usage. The different types of histograms that I created are attached (see figure 1). After I was finished with this process I created a macro, a set of code that allows you to give a simple input and receive a desired output, which would conveniently display the many sets of histograms in an easy to read format. It works by displaying the five sets of twelve histograms (one for each plane in this particular wire chamber) in five different windows. Additionally, each of the five sets can be called individually.

With the macro and the code for Qweak finished the summer was at an end and this concluded my work with the Qweak team.

Figure 2:



Here you can see the five types of histograms that I made. One important function of the histograms is to identify defective wires. In the two leftmost histograms you can see that there are two defective wires in this plane, as evidenced by the absence of hits near wire 70, and the abnormal abundance of hits near wire 88.