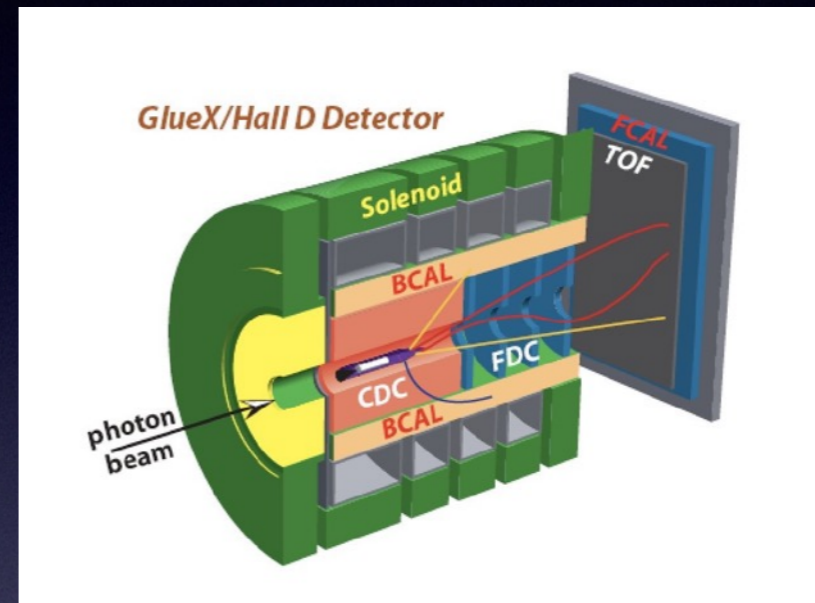


Time-of-Flight Detector (TOF)

By: Brad Cannon
Florida State University

Where it is located

- The TOF detector is located in Hall - D of Jefferson Lab and is a part of the GlueX detector.
- The TOF is placed in the forward region of the GlueX detector. It covers the end of the Barrel Calorimeter (BCAL) and is also in front of the Forward Calorimeter (FCAL).



What the TOF is made of

- The TOF consists of 176 channels. There are 44 channels in each direction (up, down, left, and right). This allows us to detect where a particle physically hits the TOF.
- Each channel consists of a scintillator and photomultiplier tube.
- Each scintillator is wrapped with highly reflective material which prevents light leaking.



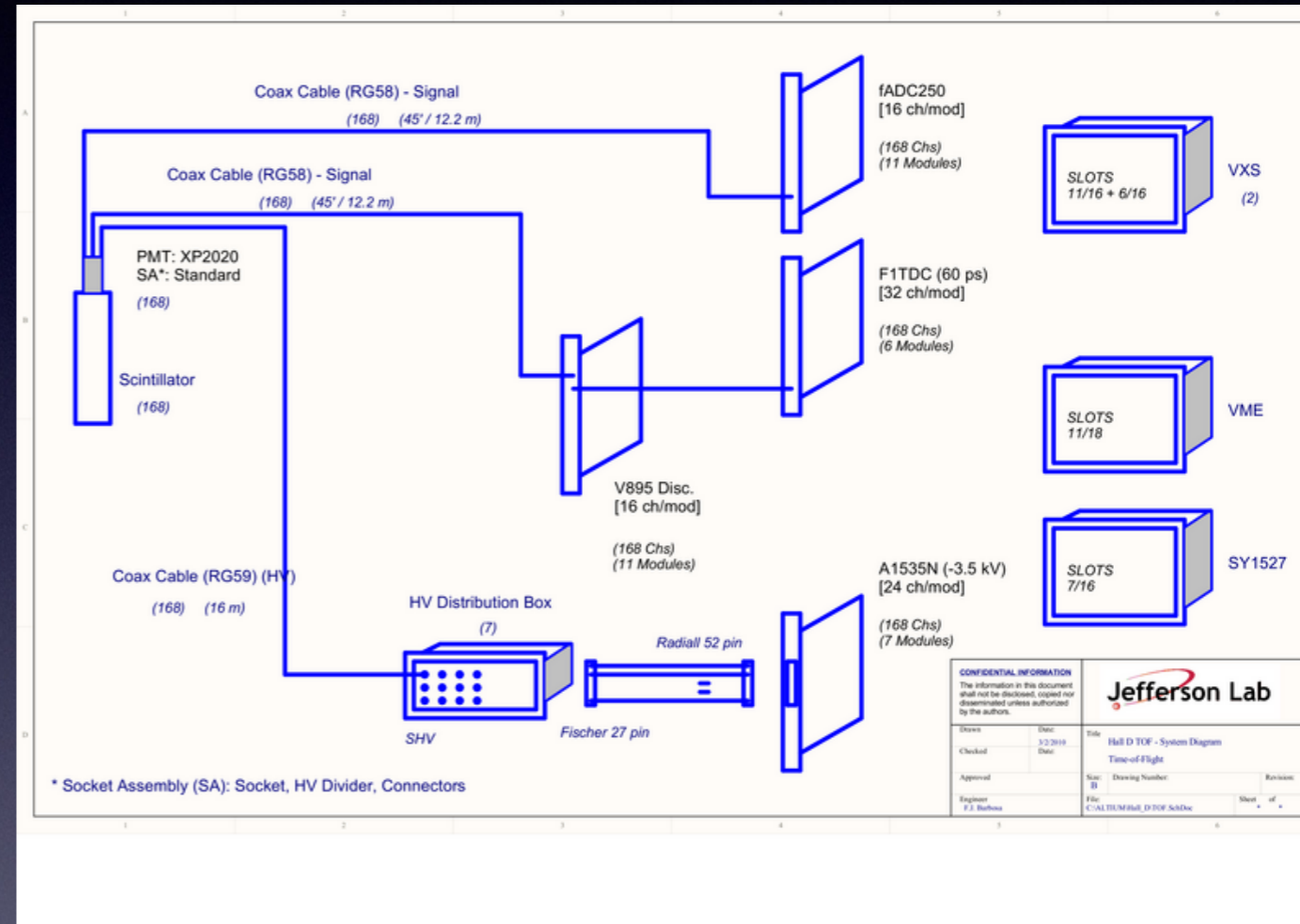
How the TOF Detects Particles

- When a particle enters the TOF, it will excite an electron within the scintillator.
- The excited electron will then radiate a photon which then travels through the transparent scintillator.
- The photon then enters the Photo-Multiplier-Tube (PMT) which converts the light signal into an amplified electrical pulse.



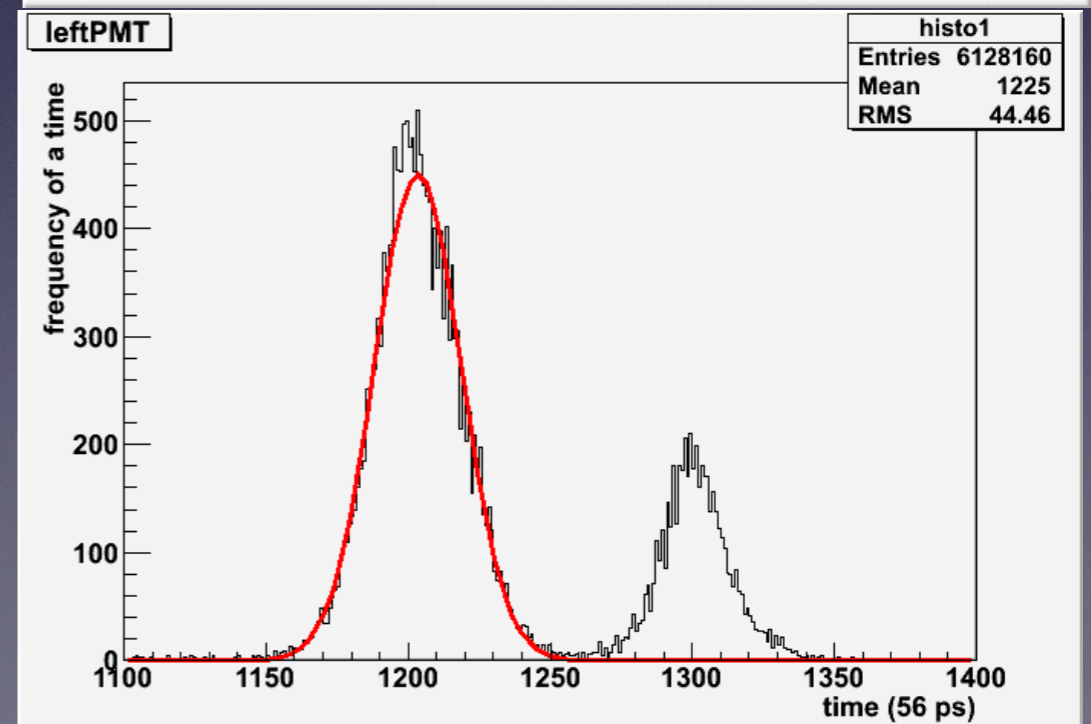
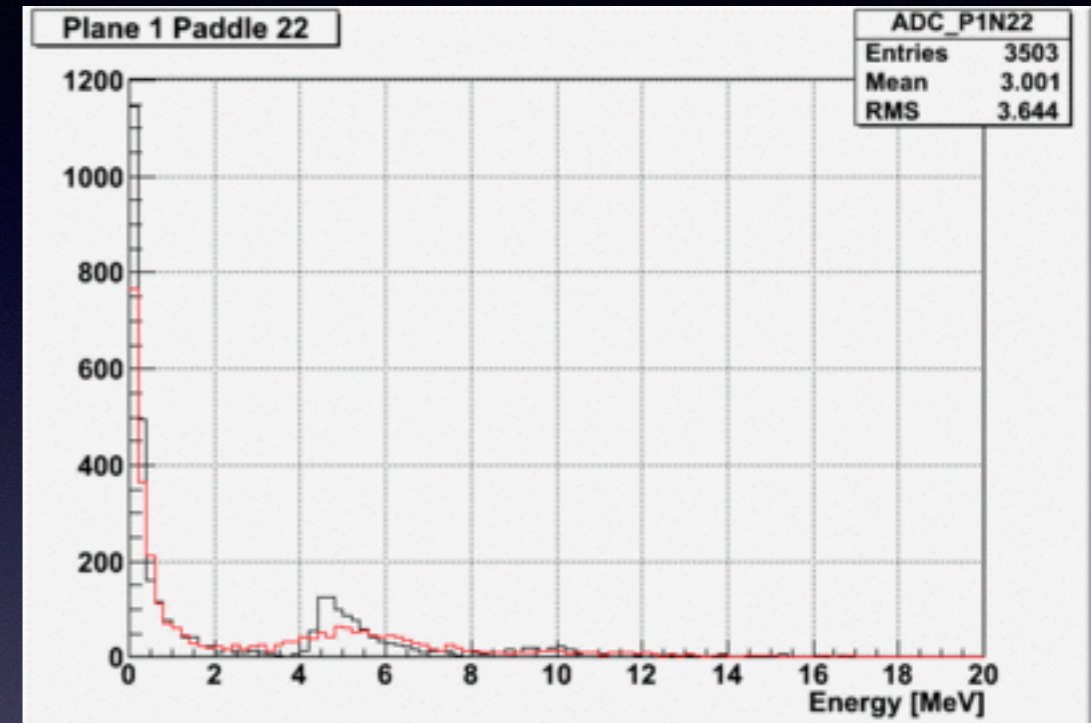
Electronics of the TOF

- The PMT's have three cables attached to them; two output cables and one High Voltage (HV) input cable.
- The HV cable is used to power the PMT so it works.
- One of the output cables sends a signal to a fADC which stands for flash Analog to Digital Converter.
- The other output cable sends a signal to a TDC which stands for Time to Digital Converter.



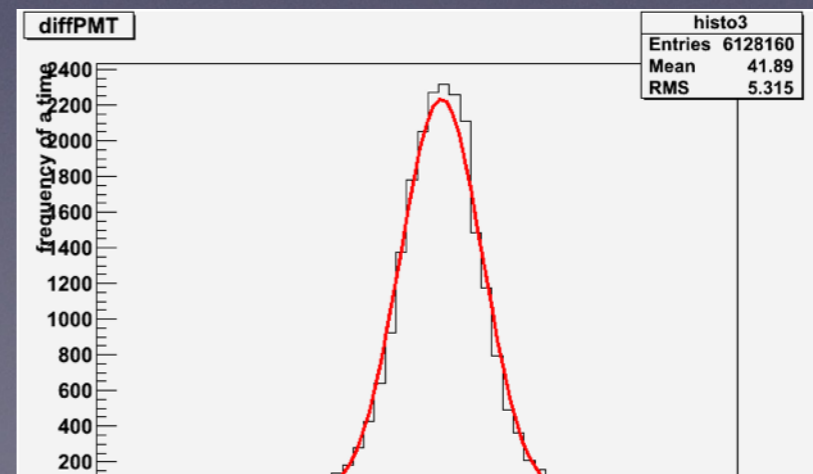
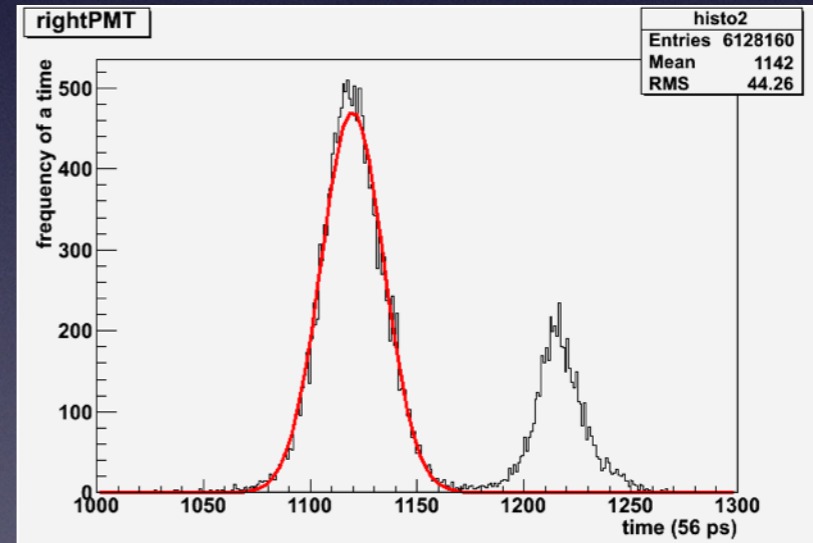
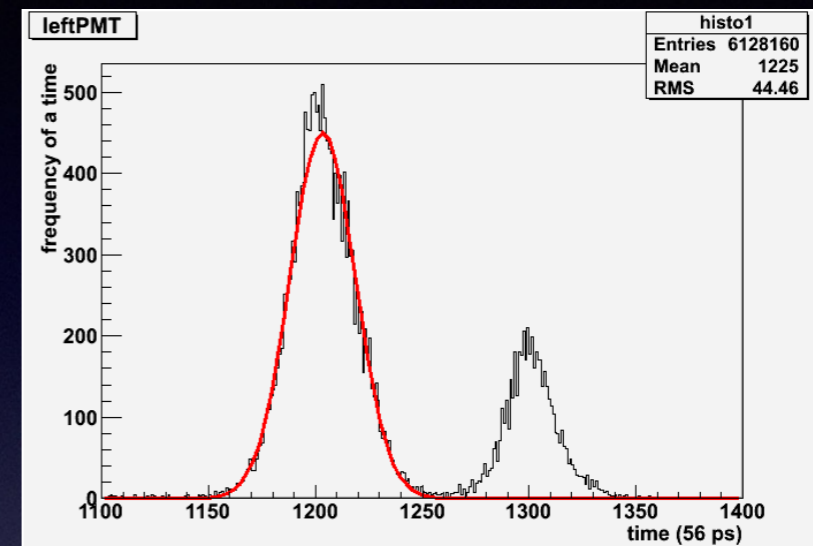
fADC and TDC

- An fADC essentially measures the energy of a particle. When the fADC “sees” a voltage rise above a certain threshold, it outputs the voltage value digitally.
- A TDC provides the time that a pulse was measured or recorded by the PMT.



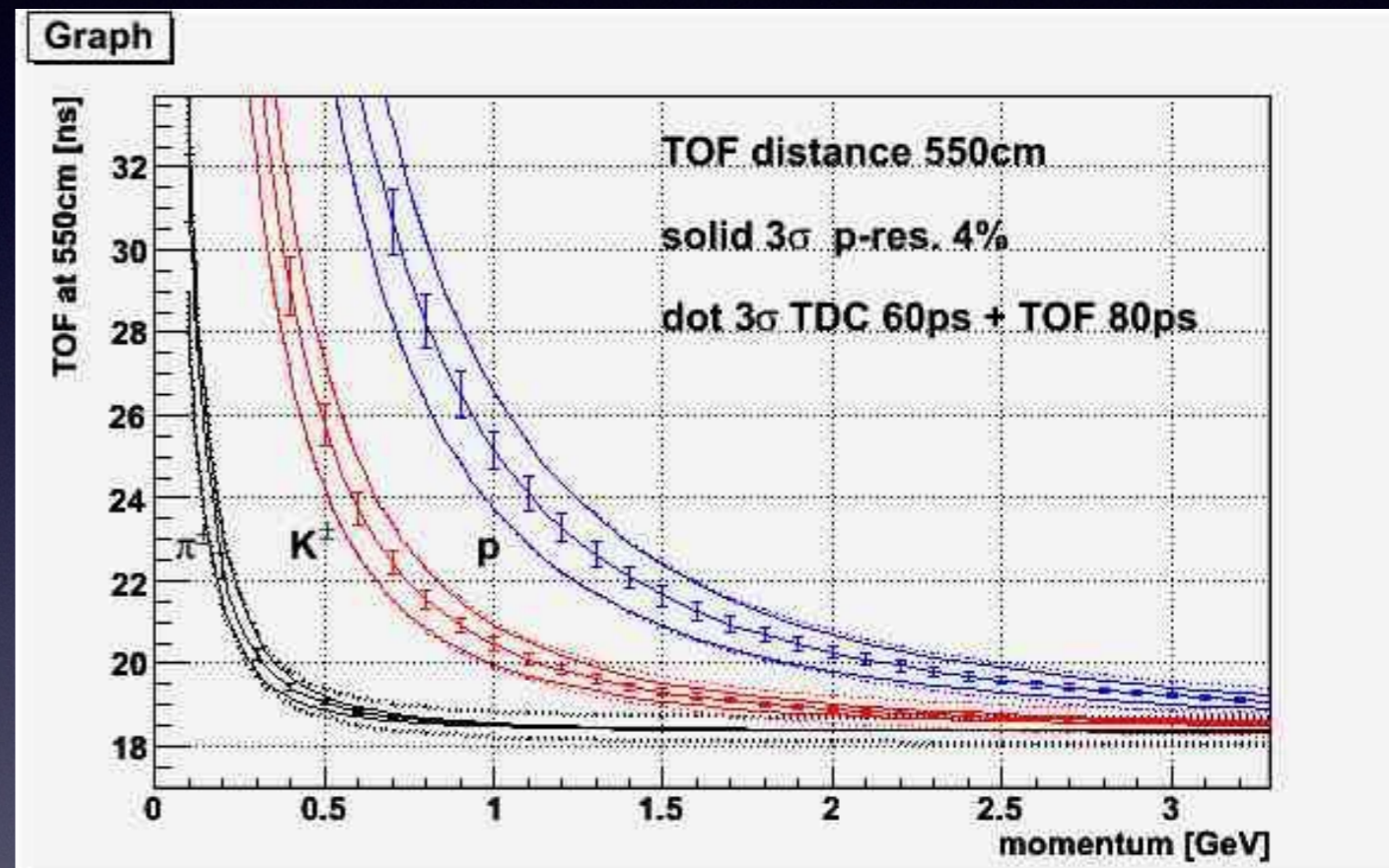
TOF Measurements

- By knowing the amount of time it took the pulse to hit the TDC on one side, and comparing it to the measurement on the other side, we can deduce where the particle was hit on the TOF.
- For example, if both sides give the same time, then we know the hit took place in the center of the scintillator.



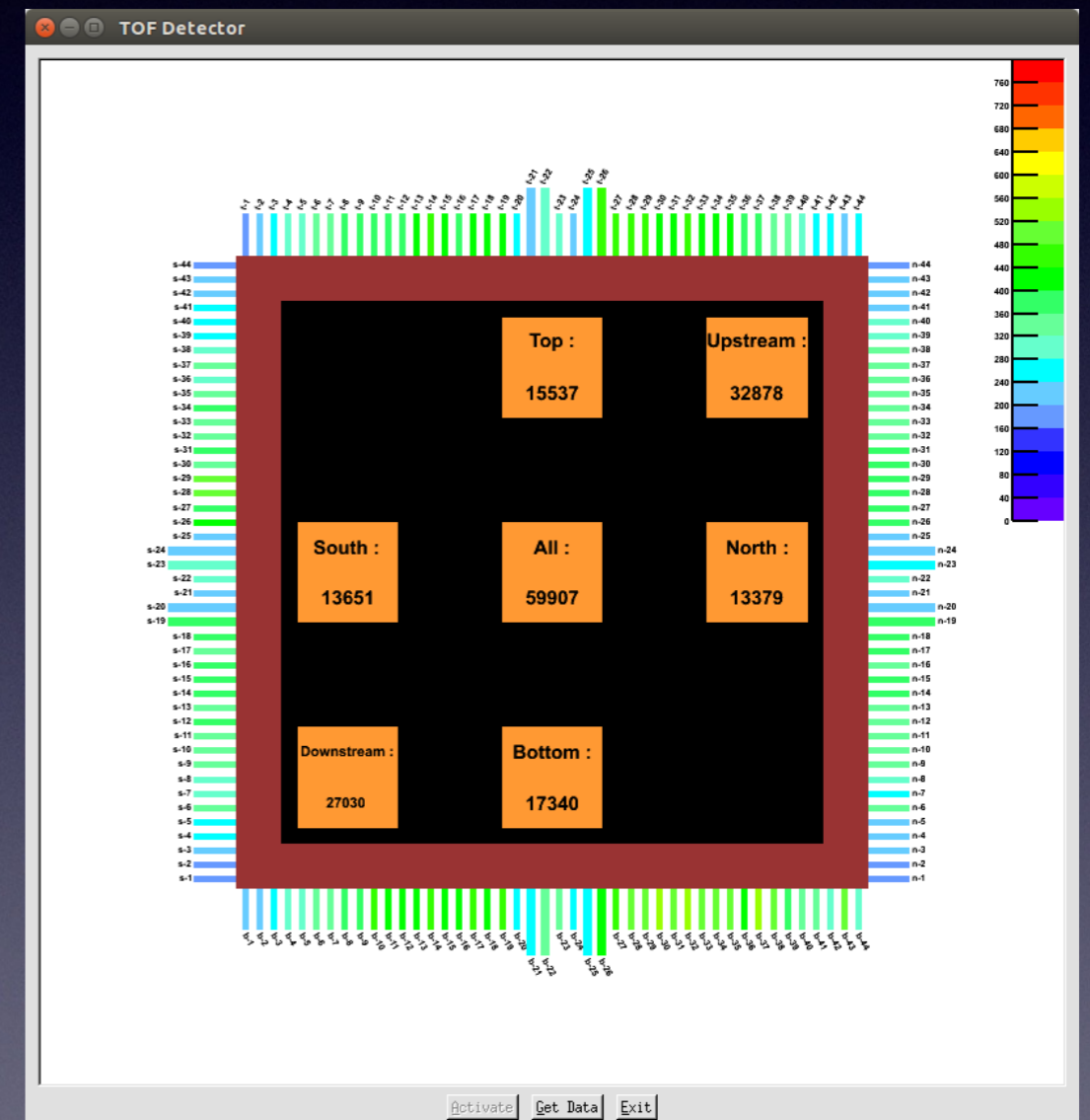
Particle Identification (PID)

- The momentum of charged particles is measured in the drift chambers of the GlueX detector.
- However, in the relativistic limit, it becomes more difficult to identify particles.
- Knowing the distance the particles travelled and the time that it took, we can calculate a velocity.
- Knowing the velocity and momentum allows us to solve for the mass and to make better PID's



Monitoring the Health of the TOF

- In order to ensure that the TOF maintains good form, a GUI was created to monitor the activity of the TOF.
- The GUI displays the frequency of hits for every PMT on the TOF.
- If one PMT produces too few or too many events, the GUI informs the personell on shift.



Thanks!

The End