Overview of RHIC Polarimeter

The following overview of the polarimeter consists of two parts. The first half describes the major components that make up the polarimeter and their respective roles. The second half focuses on data flow.

I. Component Parts

The polarimeter contains six silicon detectors. Their orientation is shown in Figure 1, below. In this diagram beam is going into the page.

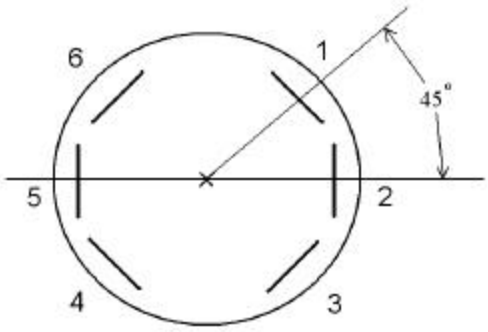

Figure 1. Cross-section of Polarimeter showing the six silicon detectors. Beam is going into the page.

All 6 of the silicon detectors consist of 12 strips. The strips are aligned parallel to the beam direction. See figure 2.

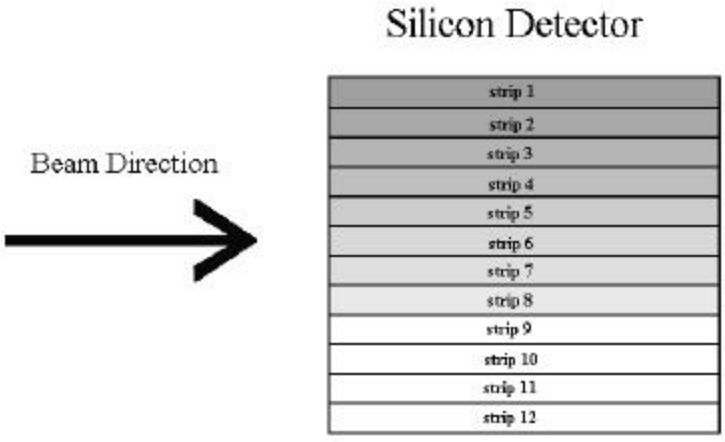

Figure 2. Each silicon detector consists of 12 strips.

As the beam passes through the polarimeter, it strikes a target that is inserted into the center of the six detectors. The target is a thin strand of carbon attached to a holder. Four target holders can be placed on a target frame as can bee seen in figure 3.

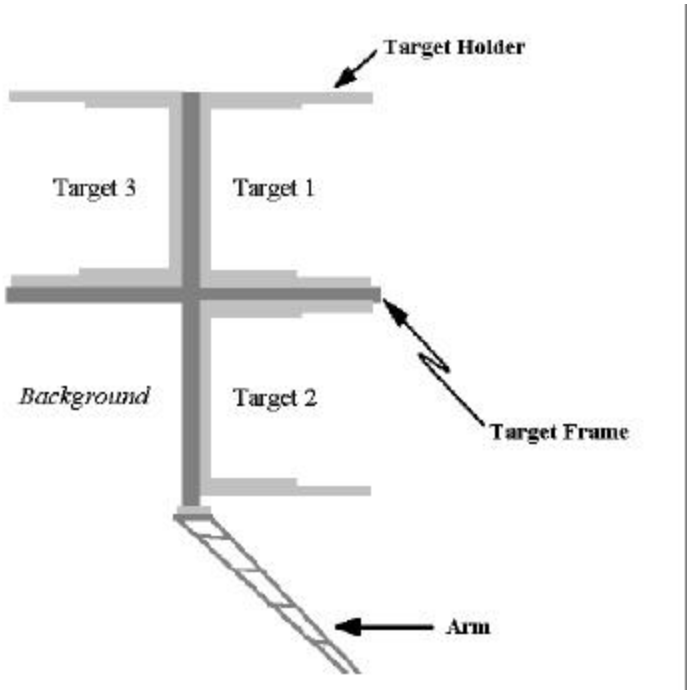

Figure 3. Target Frame.

During the last run the fourth quadrant of the target frame was left empty to allow for background measurements. In the future, four targets will be placed on the frame and background measurements will be taken by simply not inserting the frame at all.

When not in use, the target frame sits away from the path of the beam. This is the park position. It is moved into the beam using two distinct movements.

- First it moves linearly upwards, figure 4
- then it is rotated into the beam, figure 5

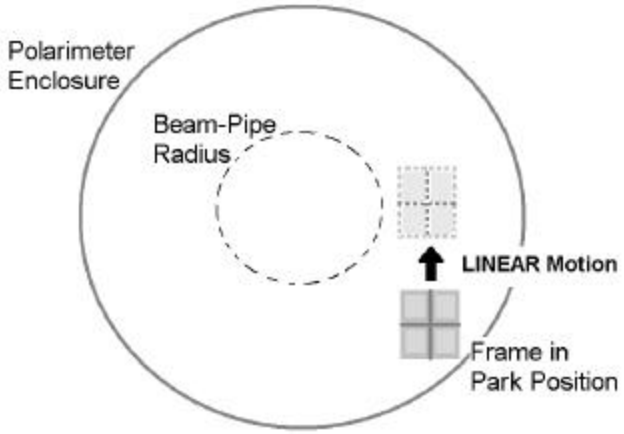

Figure 4. Cross Section of Polarimeter. Beam is going into the page.

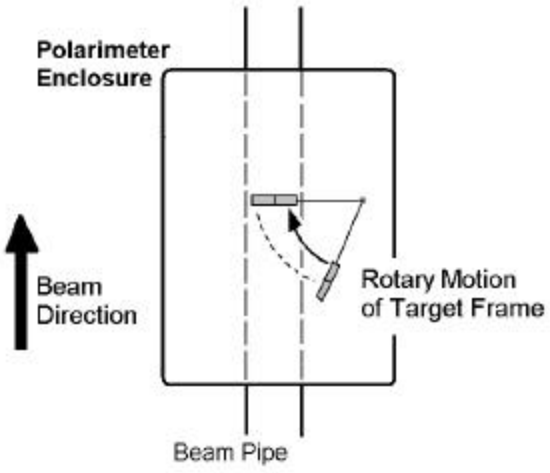

Figure 5. Top View of Polarimeter.

Note that only target 3 and the 'background' target can be inserted into the beam path as shown in figure 4, because they are on the side of the frame closest to the center of the polarimeter. In order to insert targets 1 and 2, the frame needs to come up from the left side of the polarimeter, not the right.

The previous figures refer to the X (linear) and Y (rotary) parameters found on the RHIC/Polarized_protons/Target/Blue(Yellow) PET page.

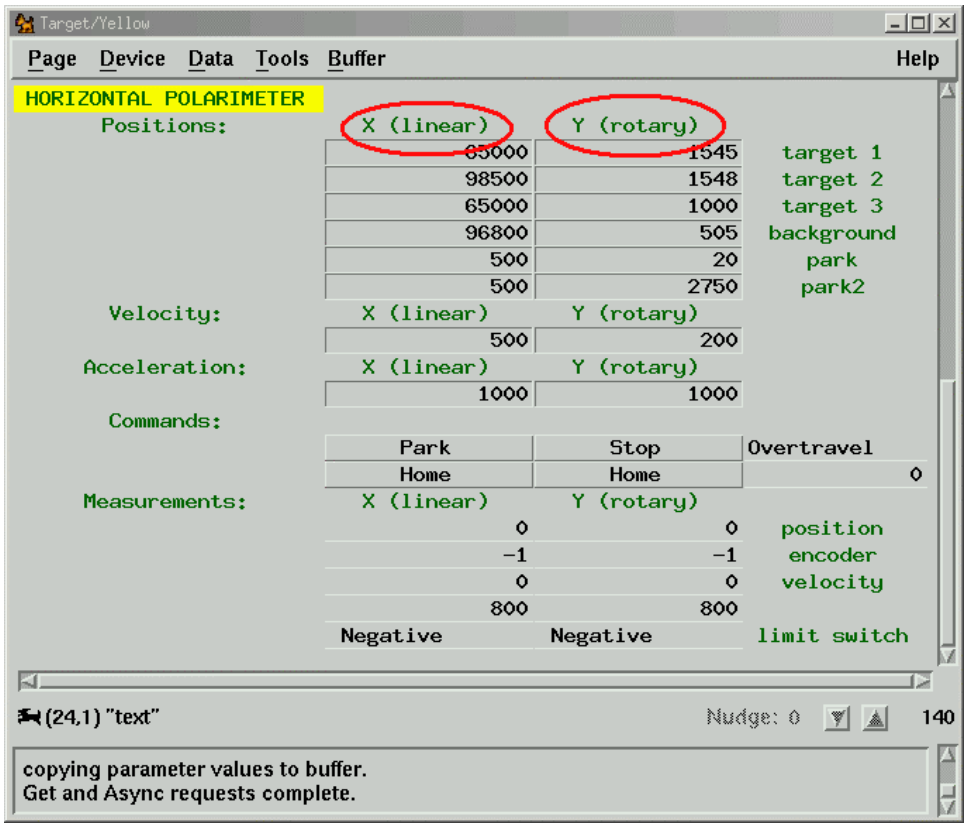

Figure 6. Target/Yellow PET Page.

There are actually two target frames in the polarimeter. The above discussion described the functionality of the **Vertical** target frame. The operation of the **Horizontal** frame is identical except that it is parked to the side of the beam path and its "linear" motion is horizontal. It therefore rotates vertically into the beam path.

When a horizontal target is used, the 2nd and 5th detectors (figure 1) will report weak signals because the frame blocks some of the scattered carbon.

During an experimental run, the user would not switch frames unless all of the respective targets were nonfunctional. Also note that an interlock system prevents both target frames from being moved at the same time.

II. Data Flow

Once a target is selected via pet, the polarimeter manager will read back its position until it has confirmed that it is in place. At that point, the CAMC initializes and the V124 module retrieves the spin pattern. Following that, the DAQ initializes and the system is ready to collect data.

When a bunch passes through the target, carbon atoms are scattered off toward the left and right. All 72 strips (6 Si detectors **x** 12 strips per detector) send a signal to the waveform digitizers (WFD). A single WFD can process 4 channels, so there are $72 \div 4 = 18$ WFD's in the system. (The Jet Target uses 24).

The WFD records various signal parameters

- a 'DataRun' command from pet will instruct the WFD to collect detailed information about the signal
- a 'Run' command from pet only requires that essential parameters like the signal amplitude be recorded

Once the polarimeter manager sees that the count limit has been reached (typically 10 ~ 20 million events) the DAQ will stop and the target is removed.

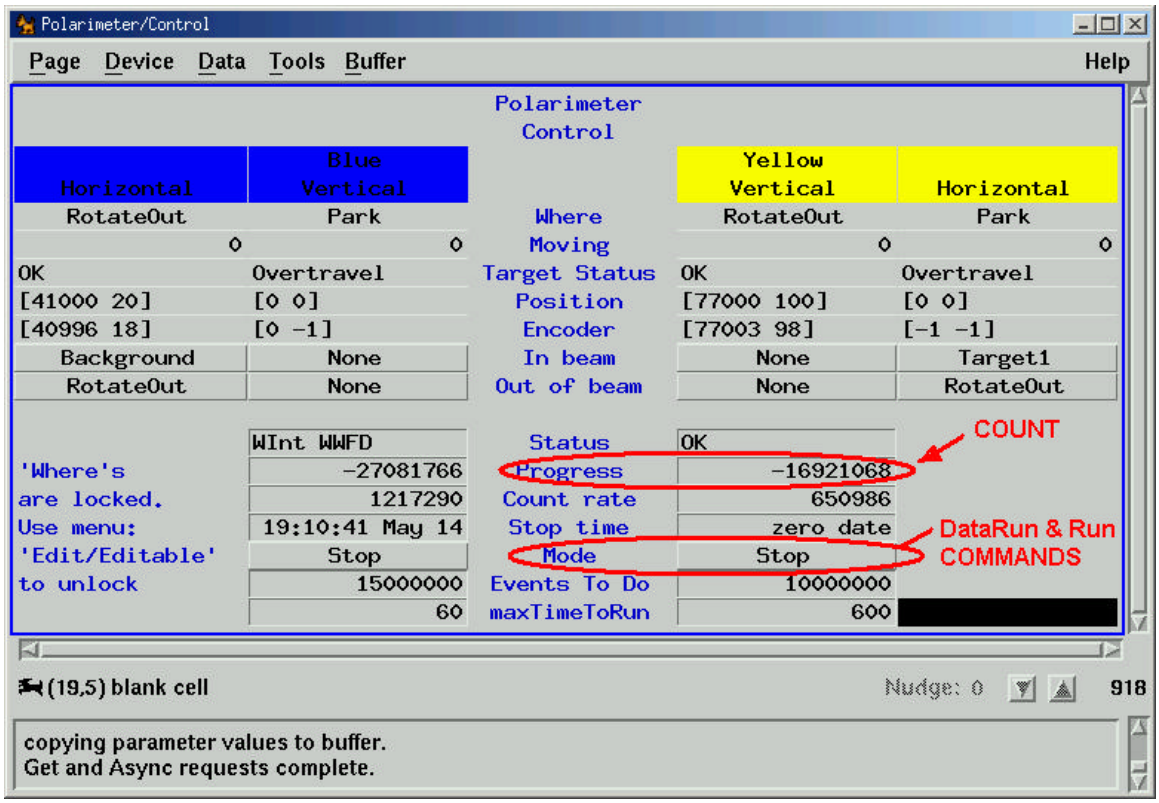

Figure 8. The 'Run' and 'DataRun' commands are issued from the RHIC/Polarized_protons/Polarimeter/Control PET page. The total count can be seen on the *Progress* line.

The local Linux box analyzes the data to identify good events. Specifically, the time of flight from the target to the detector is plotted against the signal amplitude (energy). Events that fall on the expected curve are considered good. See figure 7, below.

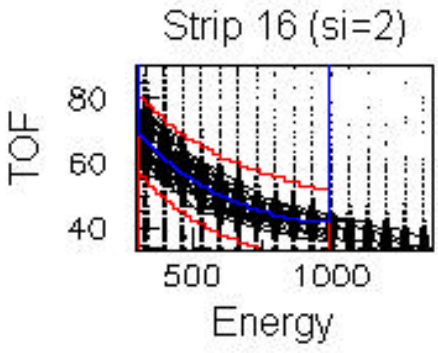

Figure 7.

While events are detected on both sides of the polarimeter for a given bunch, the quantity per side is uneven. This asymmetry determines the polarity of the beam. Figure 8 provides a general schematic for the flow of data after a bunch passes through the target.

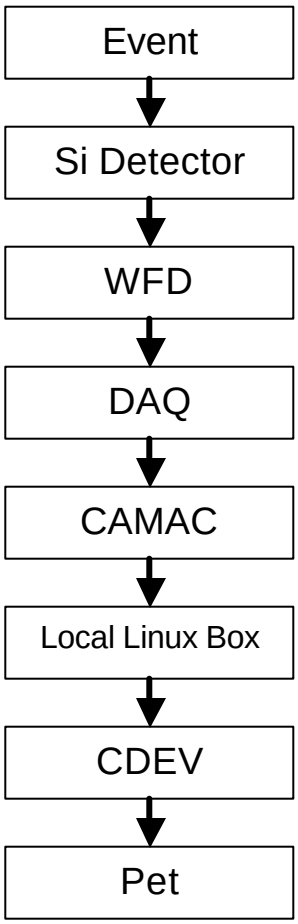

Figure 8. Data Flow from Polarimeter.