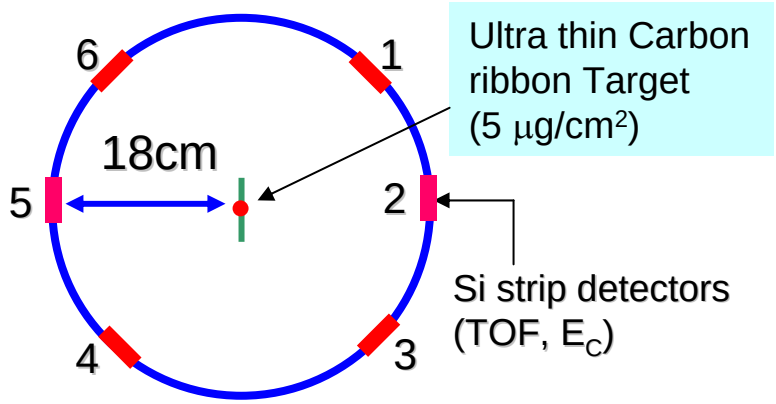
CNI Polarimeters (AGS and RHIC)

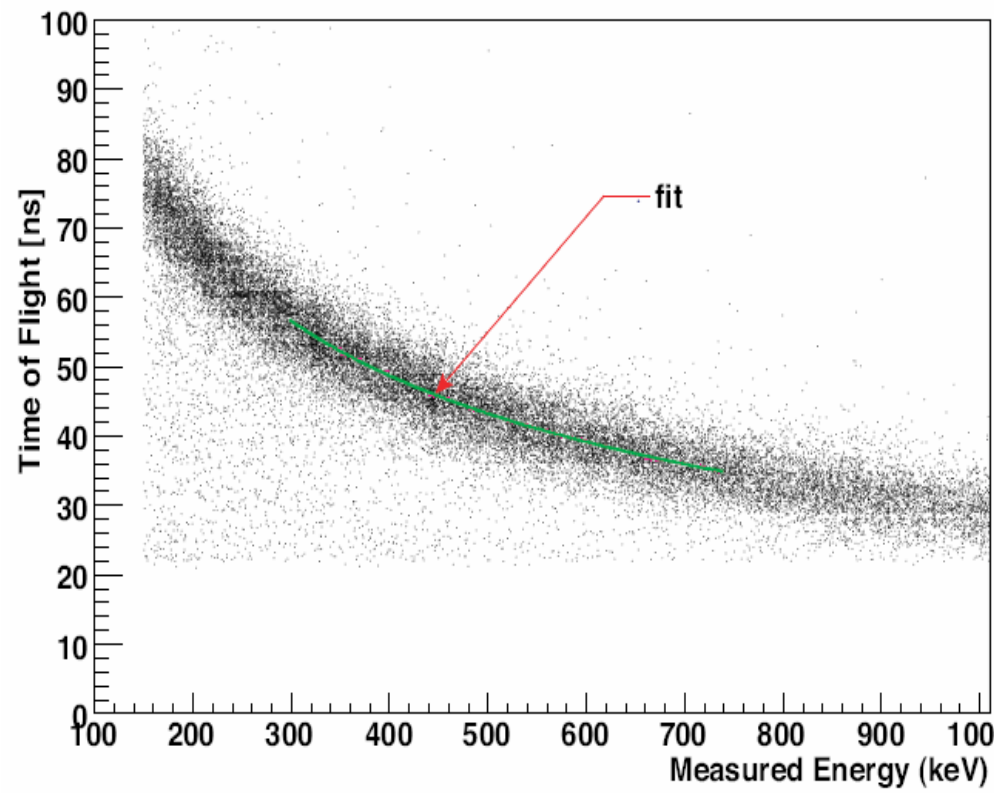
Haixin Huang
for polarimeter group

July 14, 2009
RHIC Retreat 09

pC CNI Polarimeter

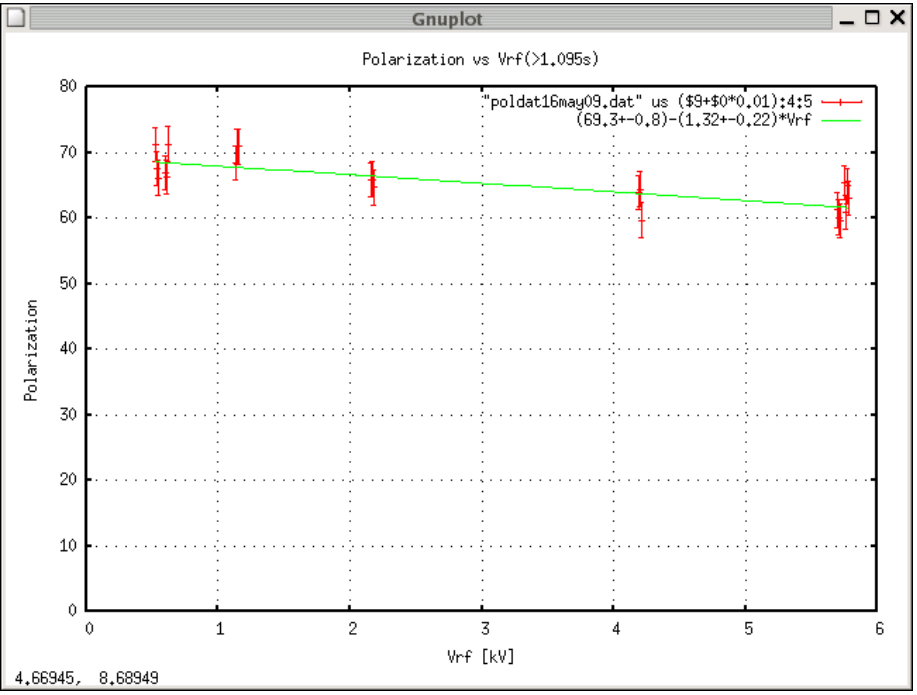
- Two independent polarimeters in each ring (so 4 polarimeters!)
- 12 carbon targets in each polarimeter (6 vertical and 6 horizontal)
- 6 detectors in each polarimeter
- 3 types of detectors:
- "BNL strip": 12 strip in each detector
- Test detector1, "Hamamatsu strip": 12 strip in each of 2 detector (blue2)
- Test detector2, "Hamamatsu single": 2 pads in each of 2 detector (yellow2)

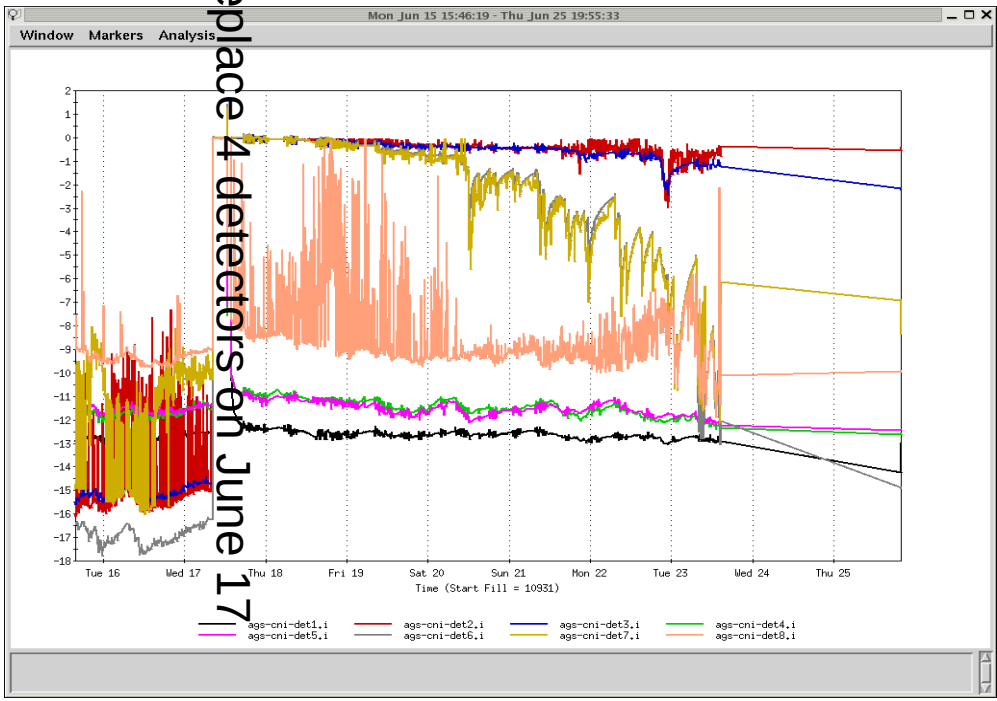




AGS CNI Polarimeter

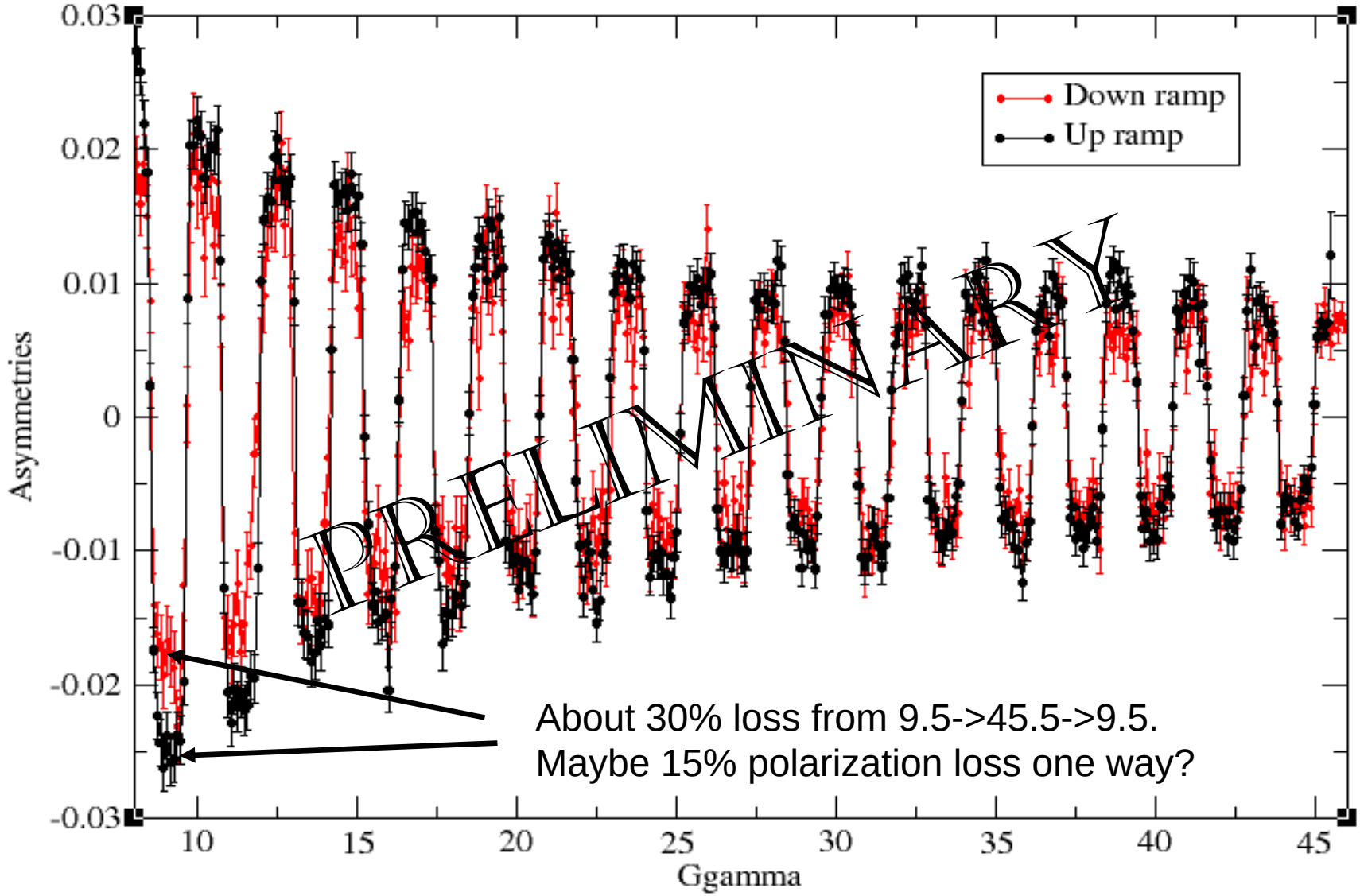
- Target Alignment is not as good as in RHIC. We will adopt the same target installation scheme.
- Dead layer correction was done every week to compensate the gradual Si detector changes.
- The leakage current quickly changed during first a few days of exposure to beam.
- Seen the polarization dependence on rf voltage. Need further investigation.
- We were able to take polarization measurements on both up and down ramps for the first time.





Replace 4 detectors on June 17

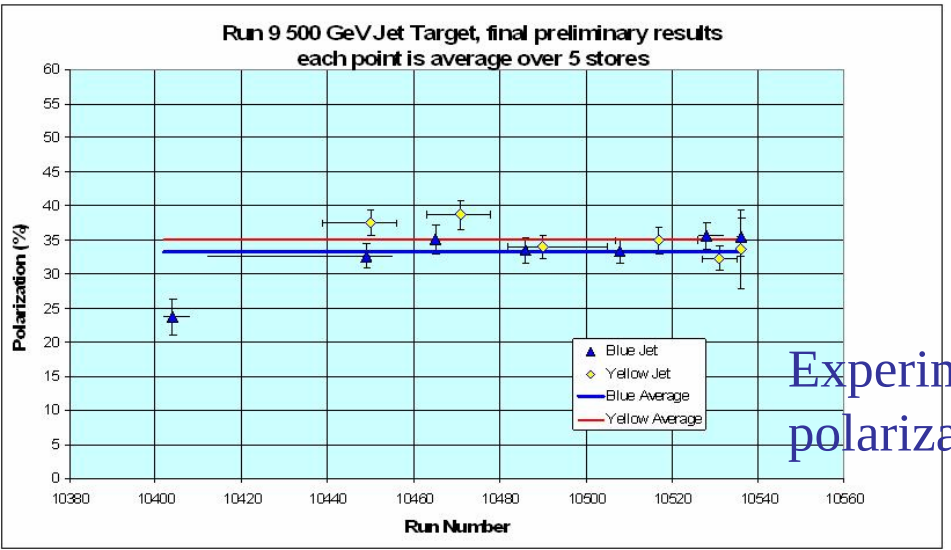
How Much Polarization Loss?

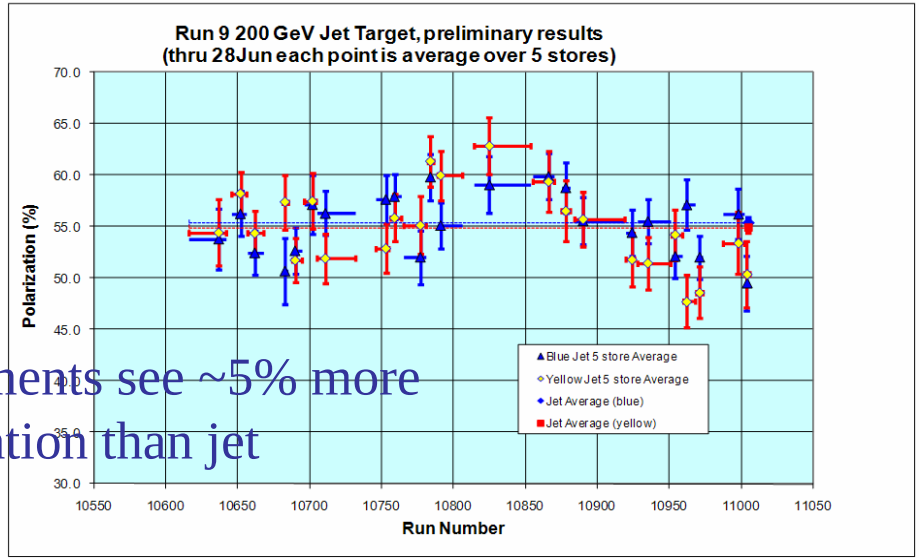


Jet in 2009

(Courtesy of Yousef and Phil Pile)

- The Jet did not have a good start this year: polarization cycling problem, nozzle blocking, trouble with pumps. First good store seen by jet was March 20.
- Two beam running mode was carried out through the run beautifully with little background, which is critical to provide beam polarization for both beams in every fill.
- It was designed to run for Carbon polarimeter calibration. But now it runs constantly as polarization monitor tool. There are manpower and stability issues. Since this is likely the mode we run until we solve issues with carbon polarimeters, we need to address these issues.



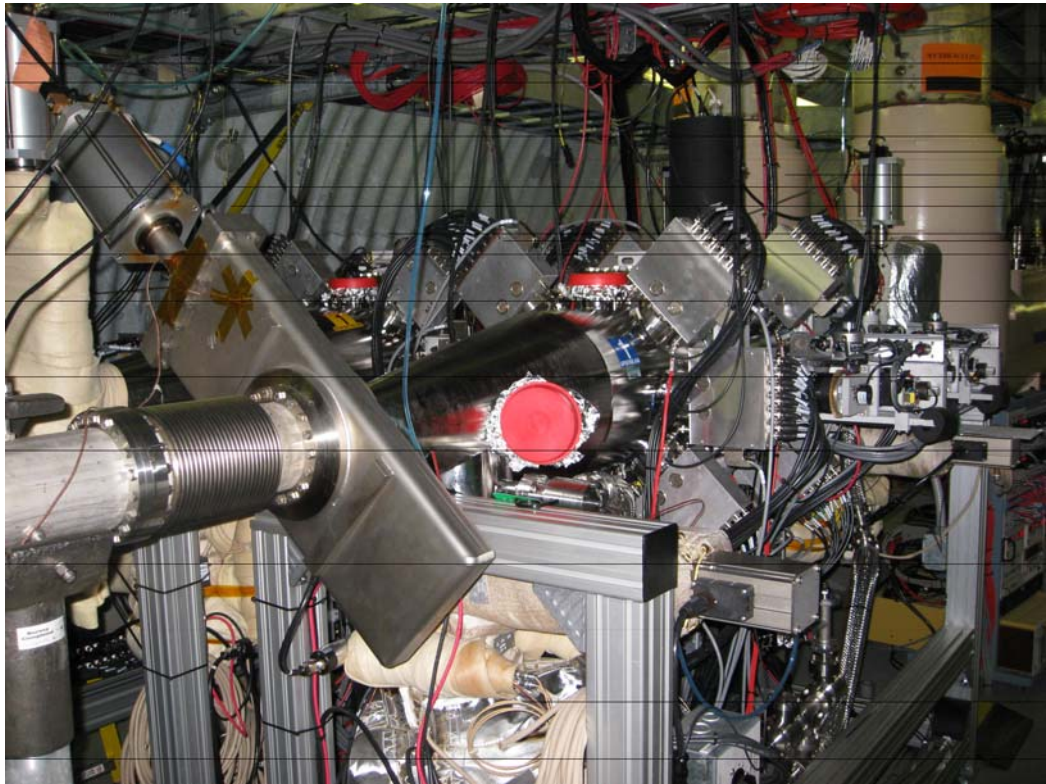


Experiments see ~5% more polarization than jet

Highlight of RHIC Polarimeter Upgrades

- It was a great effort lead by Anatoli to finish on time for RHIC run9.
- The new vacuum chambers are built and two identical polarimeters are in each ring.
- The main advantage is that we can take polarization measurements with both vertical and horizontal targets in sequence quickly. So we do have both polarization profile measurements. The emittance measurements can also be done sequentially.

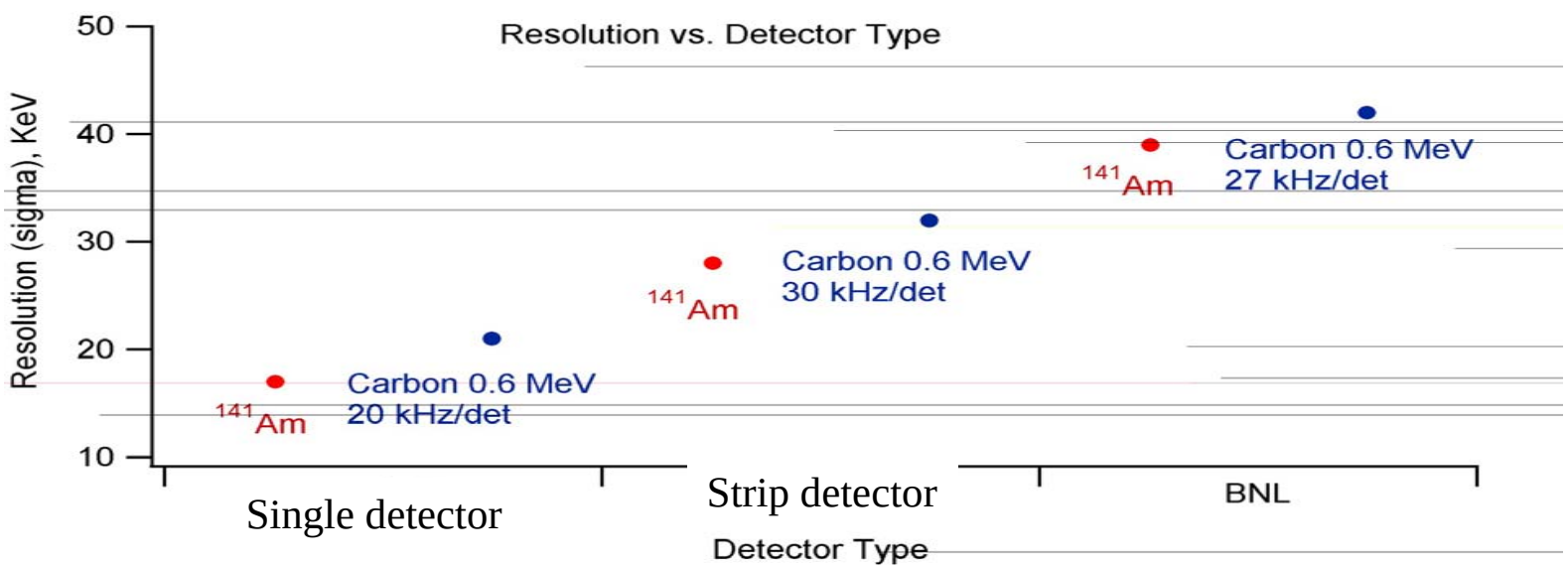
- Target driving motors are replaced and alignment of targets are excellent.
- New Detector test is possible with additional detector ports.
- The added view ports are very useful to check targets easily.
- Using MUX switch to run polarimeter 1 and 2.



New Detector Test

(courtesy of Boris Morozov)

- We studied extensively the new Hamamatsu large area (1cm x 1cm) Si PIN photodiode for direct detection of Carbon ions. Results show several advantages to use these devices instead of the strip detectors:
  - they have a factor of ~2 better resolution (21 KeV vs. 43 KeV) which allows us to measure elastic carbons at ~ t=-0.005GeV/c^2, where analyzing power is higher;
  - they have ~ 20 times less bias current after 4 months running with the RHIC beam (0.23mkA vs. 4mkA);
  - they simplify the readout electronics as well as DAQ: instead of the 12 channels per port one can use 4 channels only and make polarimeter more robust.



Operation Issues

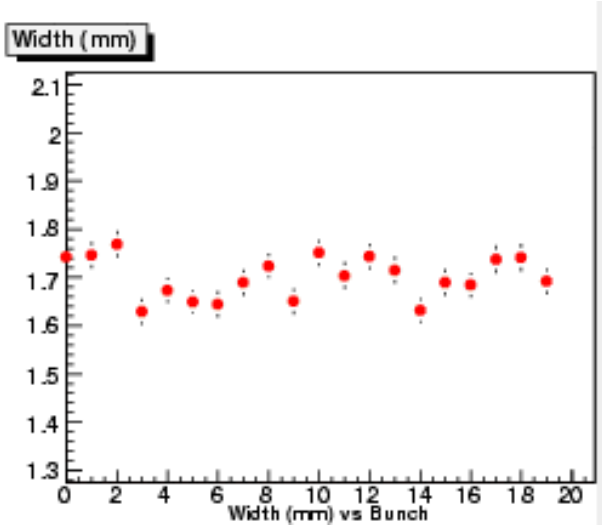
- Operation in MCR is less an issue this year: the application rarely causes problem which prevented the polarimeter to deliver a value. If it did, we have second polarimeter as backup.
- Rare cases: the applications sometimes pickup wrong start and end positions; disk full so no analysis done, switch stuck to a middle state (not controlling any of the two polarimeters).
- The whole scheme of data taking works toward final offline analysis to provide polarization values for experimenters. Less attention is on the online values for accelerator tuning.
- Ramp measurement was tried but the analysis part did not work and the target position feedback loop is hard to implement.
- We have a slow start this year again (ready in 2 weeks), but mainly due to double number of polarimeters. Maintain the knowledge over runs is an issue now. On the positive side, the current team gained a lot experience during this long run.
- AC unit failure in the counting house. We need to have a better AC system and a high temp alarm installed there.

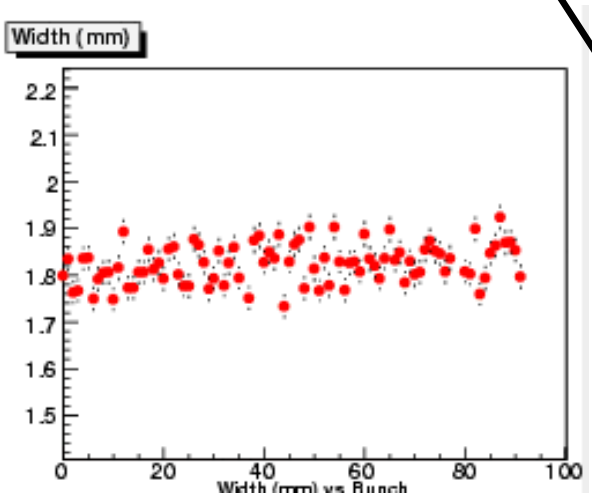
Targets

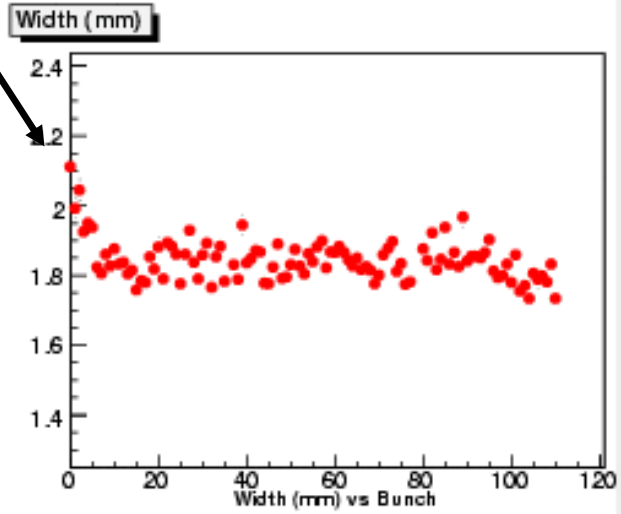
- The target making process is getting better. As the masks have been used for many years, the width of the targets is not well controlled anymore. This resulted to many large targets. We will use new masks and replace them more frequently in the future. In addition, we need a better procedure to select them.
- Casualty during target installation is greatly reduced due to the new scheme of installation.
- Twelve targets in each polarimeter assured we have enough targets to run through the whole run.
- We lost targets during two scrubbing sessions, mostly from the “active” axes (closer to beam). We need to move them all to home positions in the future. But that alone can not eliminate the risk of losing targets.
- New target making scheme is under development in collaboration with TRIUMF.

Emittance by CNI Polarimeter

- The emittance measurements did generate wrong (too small) emittance information in March and April.
- It has been fixed during early part of 100GeV run.
- The bunch by bunch emittance provided by CNI polarimeter proved that injection kicker mismatch blows up first a few bunches.







Polarization Issues

- We run both polarimeter 1 and 2 for most part of the run. It gives a very important opportunity to detect and handle the systematic errors/problems, which we haven't had before from the comparison with H-Jet (due to its limited stat. precision). In current analysis we care only about constancy of the ratio. In offline, i.e. fully corrected analysis the ratio should be 1—an ambitious goal.
- Inconsistency (variation and different levels) of polarization at RHIC injection and AGS. It's worse with more bunches. Contamination due to high background at injection? A_N issue? Need a jet run at injection (a few days) to address the A_N part.
- Might be ~5% drop in the pC measurements from the beginning to the end of the run due to detector degradation ("dead layer" increase)
- Rate problem is more severe at 250GeV. Two consequences due to high rate:
  - Preamplifier saturation. This can be solved with better electronics;
  - Double hit in one bunch crossing.
- Two approaches are on the table (besides changing electronics):
  - It can only be solved by thinner target (possible, not guaranteed); smaller Si strips (a lot potential problems: edge effect, crosstalk) or less intensity (not our choice).
  - Using the detectors tested this run, which were proved can handle the high rates and are commercially available.
- A polarimeter workshop will be held at the end of the month to discuss the problems and future directions.

Sources of Polarization variation

Some of the polarization ratio variation between the two polarimeters can not be explained by target change (rate, energy loss in the target). For some fills, the variation happened with no change in target, maybe we need to check other beam parameters.

	Source	Monitoring
Radiation damage	Dead Layer increase?	Change in Energy measurements ⇒ lower reconstructed C-mass
“After rest” (~ a few days)	Dead Layer decrease?	Change in Energy measurements ⇒ higher reconstructed C-mass
Rate effect	Dead Time Shift in energy measurements Event miscounting	Rate, dead time and shift in energy measurements (from gen. pulses), reconstructed C-mass
Target	Energy loss in target	Comparison of 90 degree and 45 degree detectors?