APEX Workshop 2012
Instrumentation & Accelerator Components Update for RUN 13

- **RHIC**
  - Electron Lenses
  - Stochastic Cooling
  - DCCT hardware accuracy check, data processing
  - CNI polarimeter target video cameras
  - Traveling wave cavity in sector 2
  - BPM system update
  - WCM software upgrade
  - RHIC BBQ
  - High Frequency Schottky changes
  - IPM new MCPs, AC Resets
- **AGS**
  - F5 Jump Target
  - BBQ progress
  - C5 IPM new corrector magnet
  - Transverse Damper
  - C15 CNI Polarimeter alpha sources
  - D5 new RHIC style IPM
  - BPM Pick-up capacitance measurements
- **Booster**
  - C3 Inflector new PSI Controls, & current readback
  - Special BPMs repaired

- **Summary**

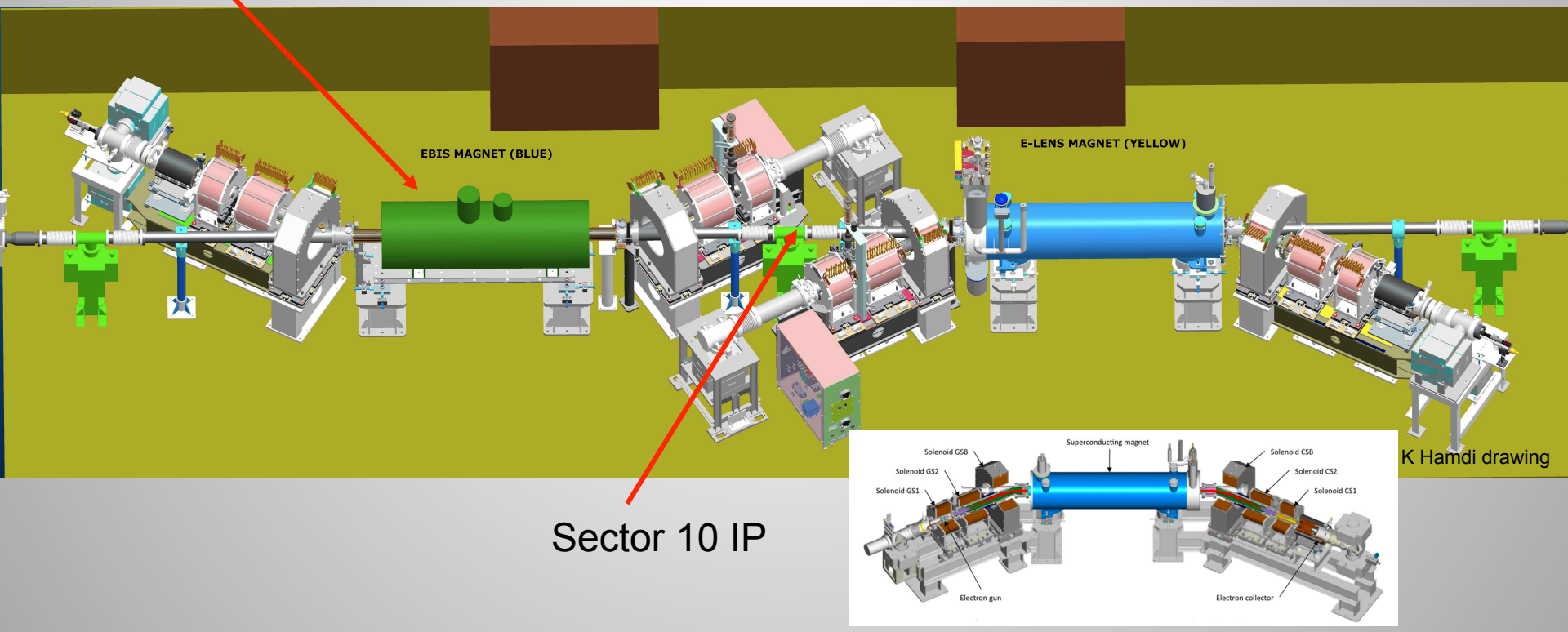
D. Gassner, Instrumentation Systems Group - November 19, 2012

Electron Lenses

Will be installed in sector 10 common region for head-on beam-beam compensation.

We have the capability to “parasitically” commission the e-beam during the abort gap using the modulator. The modulator also allows for compensation of a single bunch.

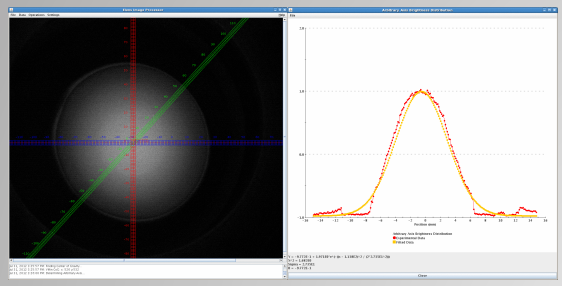
The EBIS test solenoid will be installed for the Blue E-Lens this run.



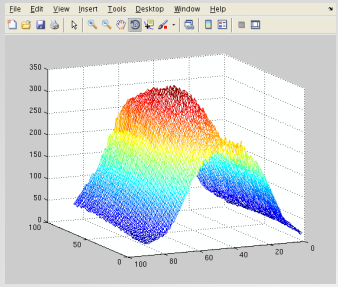
Fischer, et al

Electron Lenses

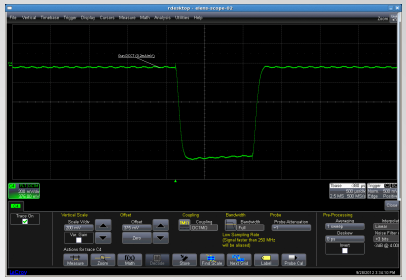
Test bench progress: Gun, Collector, some diagnostics & Controls, etc…



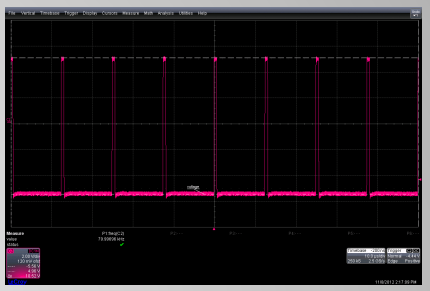
YAG profile monitor



Pin Hole Pr Mon



Current monitoring



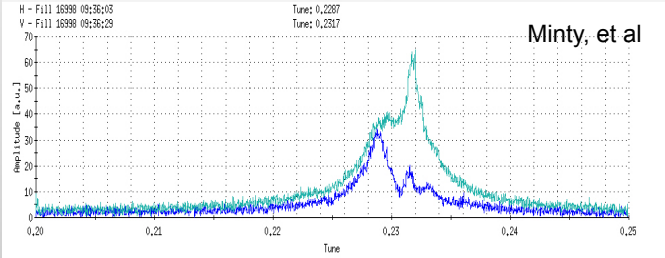
80KHz Gun Modulator

Not tested at test bench:

SC Solenoid magnets, BPMs, Back-scattered Electron Detector, etc.

E-Lens RHIC Diagnostics:

- bunch-by-bunch beam loss based on
  - WCM data (work in progress, easy at a 1 Hz rate, more difficult at higher rates)
  - Pin Diode measurements at the collimators, gated scalar data (Drees, et al)
- Can make bunch-by-bunch BTF measurements (demonstrated in Run-12)

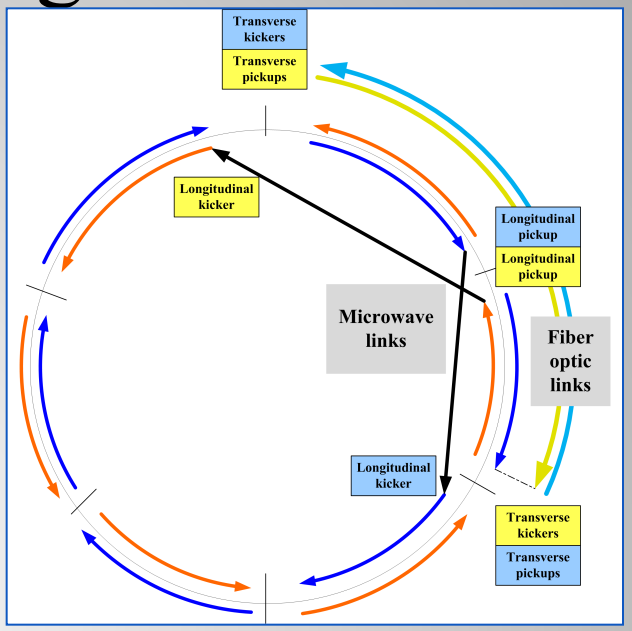


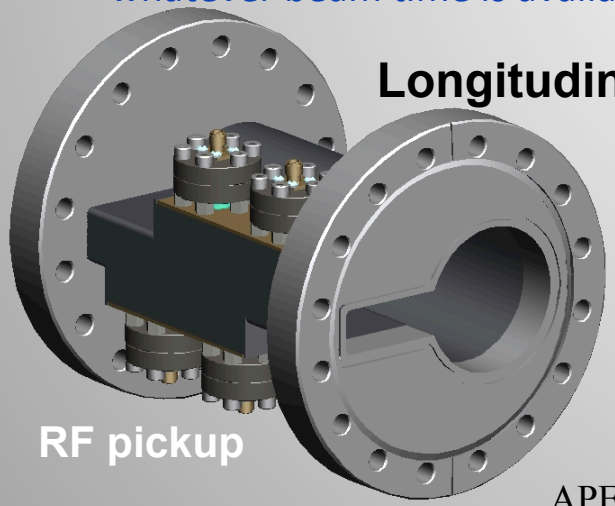
Gated BBQ/BTF single bunch with 1 collision

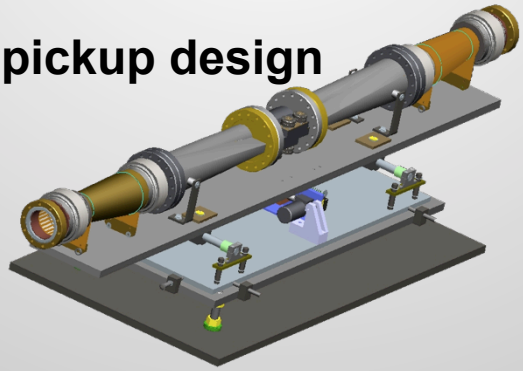
Fischer, Gu, Miller, Pikin, Tan, et al

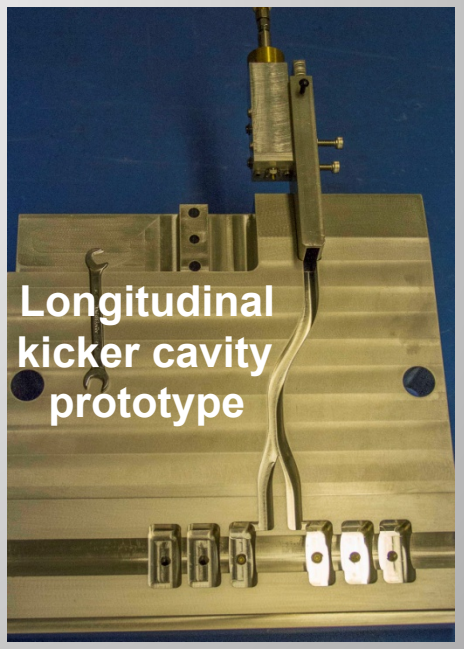
Stochastic Cooling

- Major effort this shutdown is on new longitudinal pickups for both rings. The stands and motion are installed (sector 1 & 2), the actual pickups are still being fabricated. The old pickups will remain installed, even if the new pickups go in.
- Also working on significant software upgrades, adding power meters to the outputs of all longitudinal power amps, continuing incremental work to improve performance of LLRF and microwave links, etc.
- Major R&D effort at this point is the new longitudinal kickers to be installed for Run14. These should give better performance and higher reliability than the existing longitudinal kickers.
- Even though this is a proton run, we intend to have all systems ready for operation for the full run, and to take advantage of whatever beam time is available for testing.









K. Mernick, M. Brennan

RHIC DCCT Hardware Calibration

The following parameters were studied to determine the systems accuracy:

1) Temperature effects
2) Fill pattern dependencies
3) Possible cable length effects
4) Calibration Instrument errors
5) DCCT calibration zero and slope drifts
6) Possible noise contributions
7) DVM vs. MADC readout
8) Debunched beam contributions

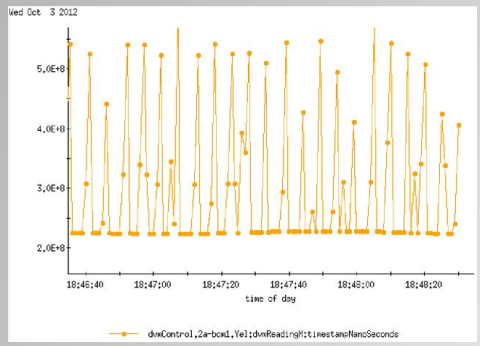
Except for 8) which isn't an instrument issue, the overall accuracy for Blue was estimated at ~0.5% when using the MADC and ~0.3% when using the DVM readout.

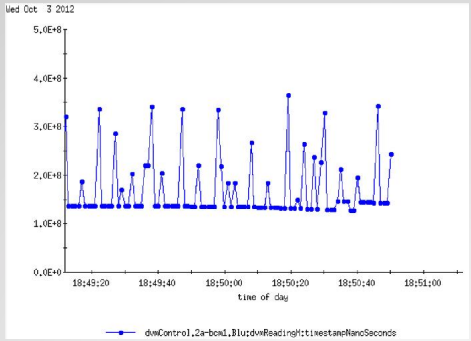
For Yellow there is ~4% discrepancy (reads low) that we have isolated to the DCCT hardware in the beam line. We plan to do visual inspection of the Yellow DCCT, testing with the spare DCCT in the lab, and contacting J. Bergoz.

Thieberger, Wilinski, Minty, Marusic

RHIC DCCT Data Processing

Improvements have been made in the data processing.

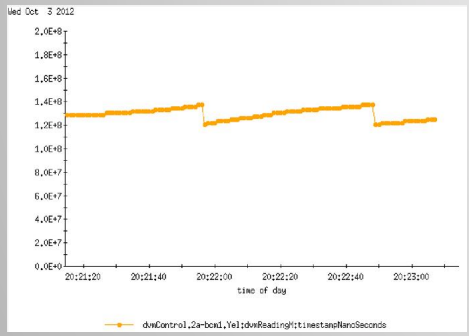


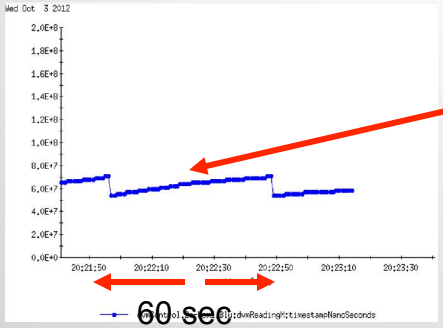


DCCT time stamp data before fix was applied

The DCCT DAQ system was configured to acquire data at a 1 Hz rate. It was found that the time stamps of the received data varied by 300ms (Yellow) & ~200ms(Blue) with a baseline delay of about 225ms (Y) & 150ms (B) from the 1Hz event time.

Most of the spikes in the above plots were traced back to an internal calibration process which was running that interrupted data delivery. Some of the spikes were caused by external users requesting data.





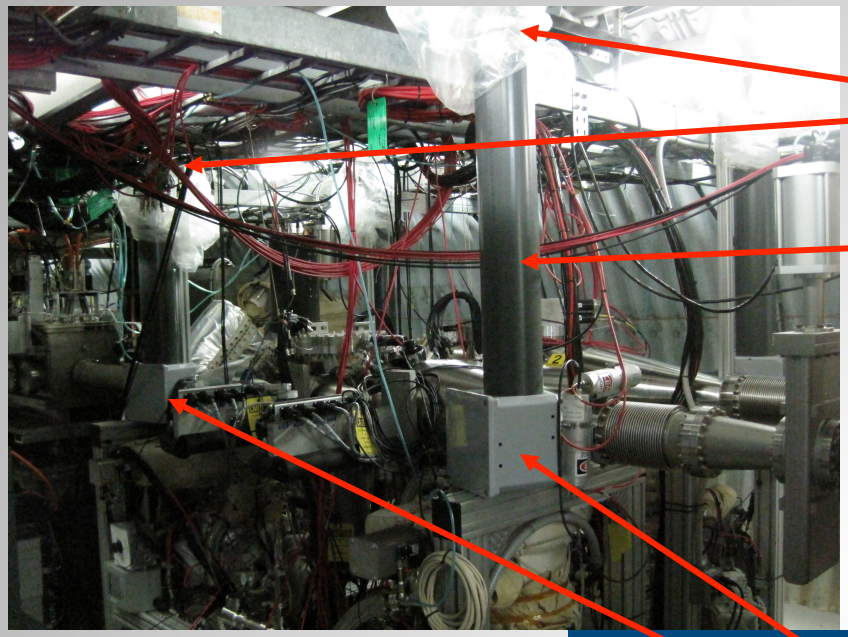
DCCT time stamp data after fix was applied

The slow drift of the time stamp (~20ms over ~1 minute) is likely due to the difference between RHIC timing and the line synched 60Hz Keithley sampling rate

The sampling rate was increased from 1 to 10Hz, this is potentially useful for improved beam lifetime and losses/hour calculations.

Marusic, Minty

RHIC CNI Polarimeter - Target Video

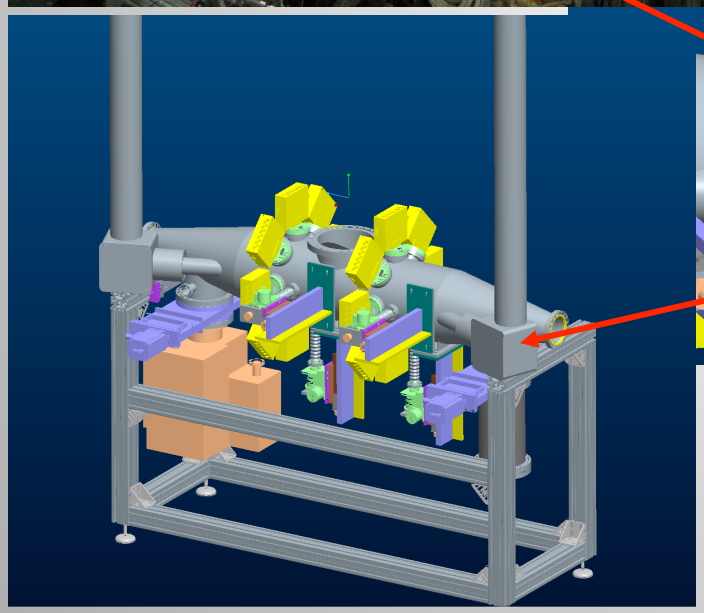


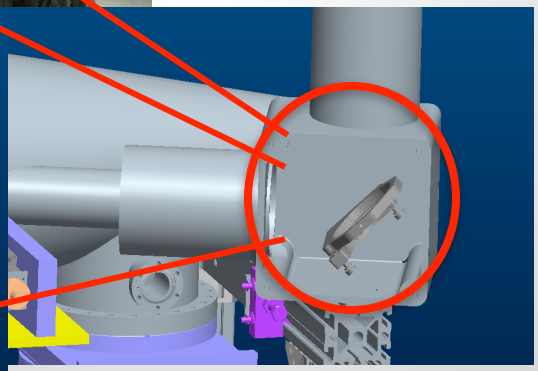
Four new video cameras installed above cable tray, one for each target.

Each has an enclosed optical path & mirror.

Streaming video to the MCR Video server via Ethernet.

Monitor target condition & thermal effects.





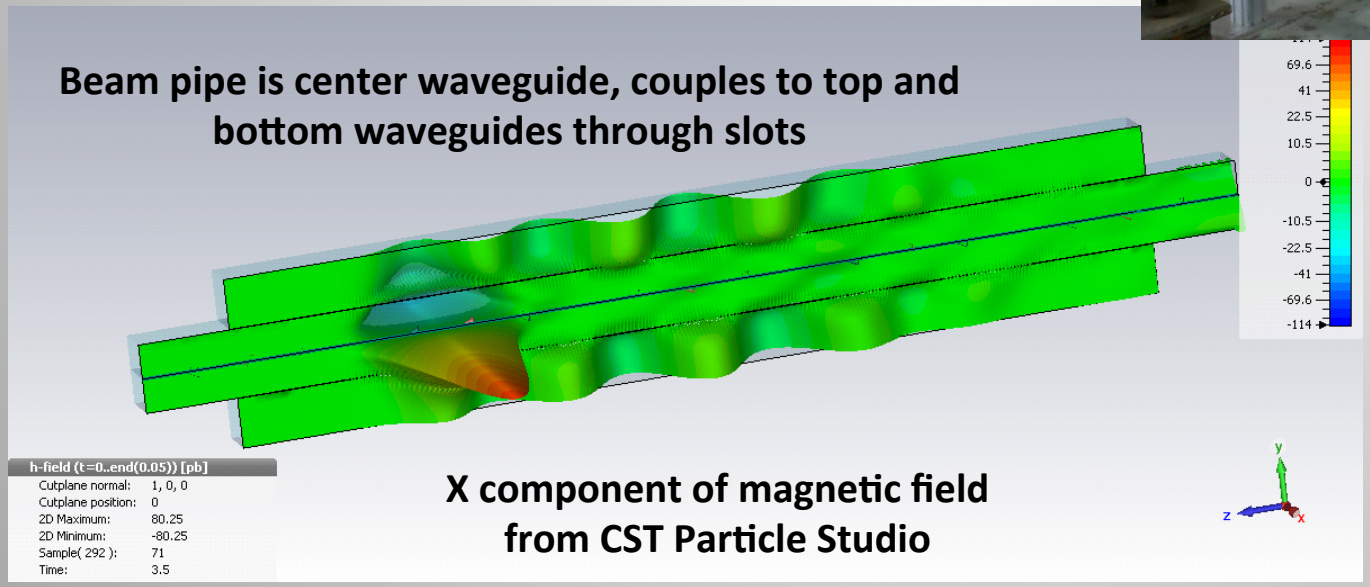
Mirror mount

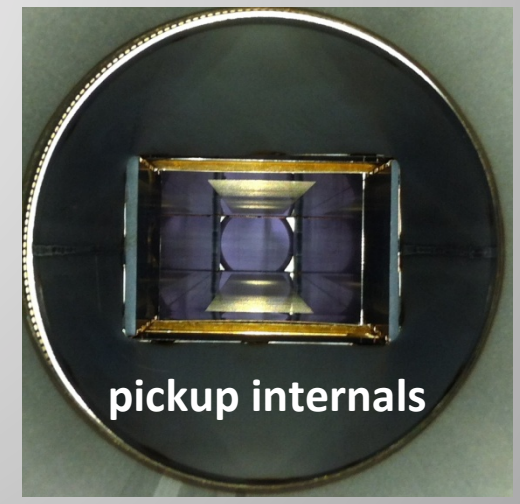
Snapshot from video showing the CNI target passing through the beam – Run 12

Zelenski, Mahler, Biscardi, et al

RHIC Traveling Wave Pickup

- The travelling wave pickup was built at CERN based on a design from Fermilab as part of LARP collaboration
- It was previously installed in RHIC in IR10, but was removed a few years ago to make room for E-lens
- Installed in blue sector 2 (to measure Q_y and ξ_y)
- Measures Schottky signal around 1.7 GHz with ~100 MHz bandwidth – unlike the HF Schottky pickups (500kHz BW), it has high enough bandwidth to allow gating the signal to measure bunch-by-bunch tune and chromaticity
- Similar pickups in Tevatron and LHC have been used successfully for this purpose.





K. Mernick

RHIC BPM Enhancements for Run 13

(still under development)

- Increased size of the turn-by-turn buffer from 1024 to 4096 turns. ADO parameter selects size to be 1024, 2048 or 4096. This should improve spin flipper study data analysis.
- Turn-by-turn data will automatically update on abort event, returning the 1024, 2048, or 4096 turns prior to the abort for post-mortem analysis. Will not be triggered on dump event.
- Million turn data will be updated in an ADO parameter, eliminating the need to use custom LabVIEW VI. Makes it easier to access the data. The data buffer size is selectable via ADO parameter to be 64k, 128k, 192k, 256k, 512k, 1024k.
- The BPM electronics AC-reset modules were having problems with their fuse blowing due to in-rush current, sometimes melting the fuse holder. All AC-reset modules are now upgraded to a more robust design (~80).
- BPM feed through's, plan to replace 10 this shutdown.
- Cold BPM cable measurements using thermocouples at sectors 12 & 1 (Q5 Blue), & sector 5 (Q9 B&Y). Prepare for high intensity.

Cerniglia, Hulsart, Michnoff

RHIC Wall Current Monitor

This was how system looked like during Run 12 (arrows indicate data flow):

4 WCM scopes -->
WCM PC -->
WCM FEC / WCM ADOs -->
--> CDEV managers: WCMManager --> WCMCorrelation
--> ADO managers: wcmEmittMan, wcmBunchLengthMan
--> LabView manager: wcmServer -->
LabView applications: wcmProfile, wcmInjection, wcmCorrelation
--> pet, Gpm, Loggers, etc.

The final version of the system should look like this:

4 WCM scopes -->
ADO manager: WCMManager -->
--> wcmEmittMan
--> LabView applications: wcmProfile, wcmInjection, wcmCorrelation
--> pet, Gpm, Loggers, etc.

Eliminating the WCM PC and simplifying the data flow should improve performance and flexibility.

Marusic, Minty, Mernick, Degen, Lee, et al

RHIC Systems

BBQ

Plan to replace 3/8” Heliax cables that have lots of splices and bullets causing mystery problems with new cables to increase reliability.

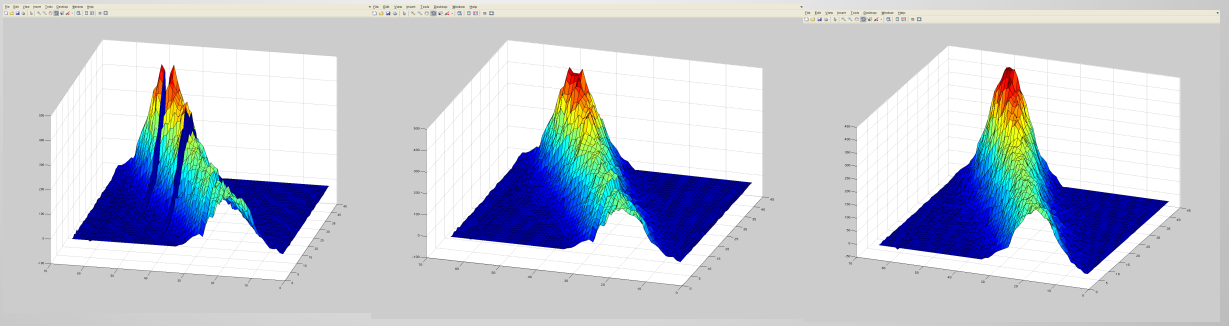
HF Schottky

Will try to move the signal amplifiers out of the tunnel and install new cables. This allows easy access to make amplifier adjustments, change attenuators and see the raw signals.

IPM

New MCP’s in the Verticals in Blue & Yellow for this run.
Horizontals will get new MCP’s when we install the new R-SC L PU’s
The low voltage power supplies in the tunnel will get remote AC resets modules.
See Roger Connolly’s talk on IPM Calibrations, preview below:

Evolution of measurement matrix



Only background Subtraction & bad ch’s

Bad channels have been ‘repaired’.

Gain corrections applied.

AGS F5 Vertical Jump Target

- The F5 Jump Target linear motor motion controllers and drivers had been moved to J7 plunging stripping foil a few years ago. This disabled the whole system.
- New modern motor controller and driver is set up and being tested now.
- Plan to restore F5 Vertical JT to operations for this run.
- Can be used to scrape off polarized proton beam halo to increase net polarization.

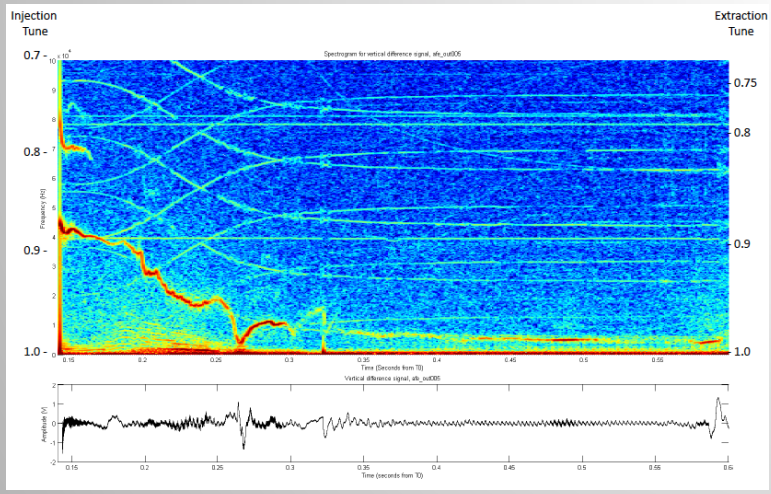
AGS F5 Vertical Jump Target

DeSanto, Degen, Olsen, Saetta

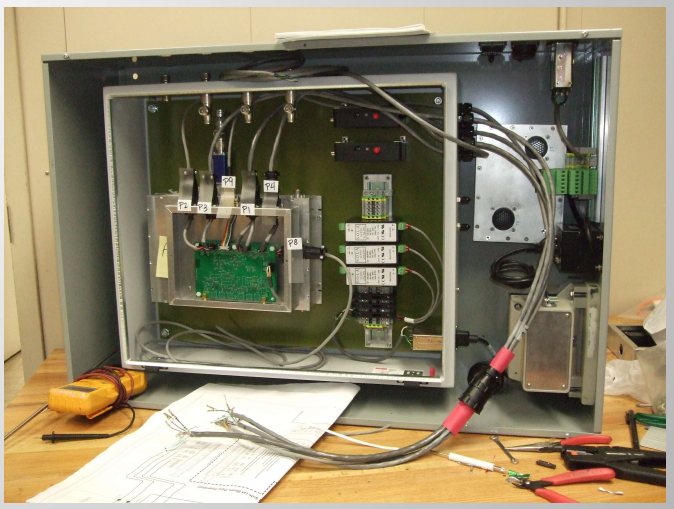
AGS BBQ (Base Band Tune)

- Direct Diode Detection theory of operation.
- The plan for the AGS is to attempt to measure the tune parasitically, without a kicker, as is done at CERN in LEIR, PS, SPS, and LHC
- The firmware and software development has not started yet. Kevin plans to have a very simple setup for data acquisition at the beginning of the run. Once we have some data, he can start working on the measurement algorithm.

AGS BBQ G3 PUE location



AGS BBQ preliminary vertical data taken April 2010 during the polarized proton run.



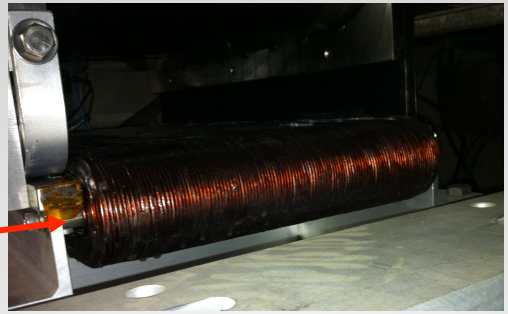
AGS BBQ Electronics will replace the existing G3 PUE pre-amp

K. Mernick

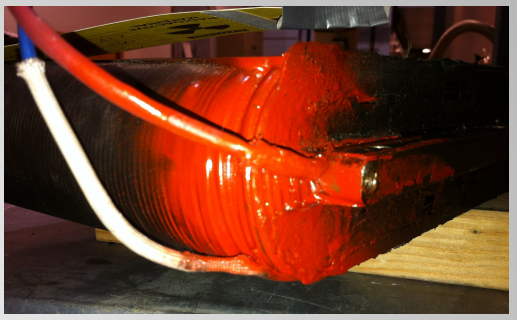
AGS Systems

Shorted C5 IPM corrector magnet coil repaired

C5 IPM in AGS



New coil installed



Shorted coil, attempted repair

Transverse Damper

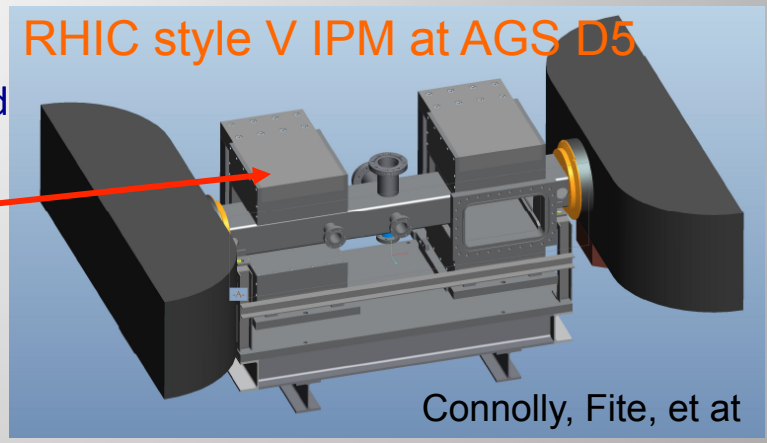
- 2 Kalmus Amplifiers from the Booster Barrier Bucket were returned to the AGS transverse dampers
- We now have a full compliment of 4 working systems in the AGS
- Have 2 spare sets of tubes, 2 more sets on order.

C15 CNI Polarimeter Alpha sources.

- 3 of the 6 had minor contamination leaks, were removed
- 3 new replacement Alpha sources are on order

New RHIC Style V IPM to be installed at D5.

- May not be functional this run.



BPM Pick-up capacitance measurements

Understand BPM pick-up characteristics and improve performance

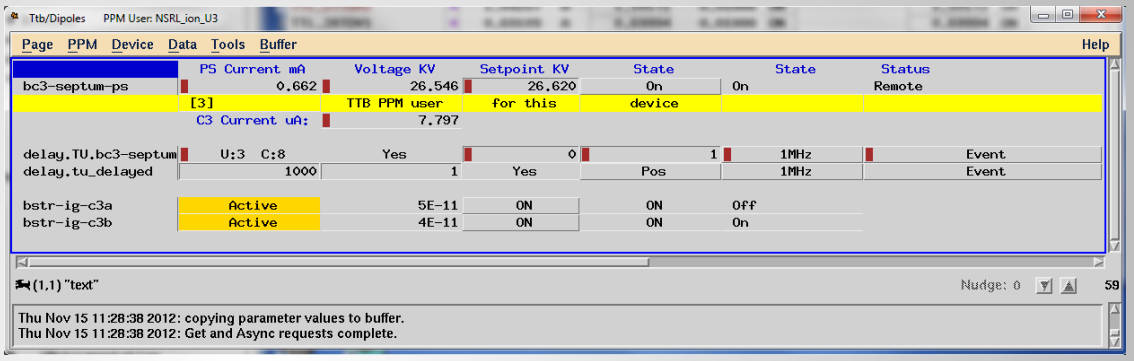
Booster

C3 Inflector PSI Controls improvements

Septum (uA) and PS dummy load (mA) currents reported separately on pet

Software averaging to reduce noise

Better fault indications



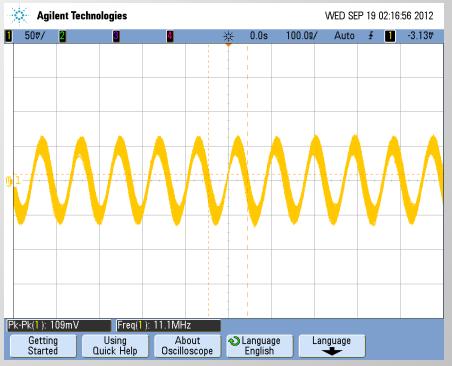
Marusic, Morris, Saetta

Special BPM's

The D1 Special PUE in Booster did not have functional gain control from the start of Run-12.

Upon investigation it was discovered that the 5V gain control cable was disconnected at C3 by the Inflector. That signal is daisy chained to the D1 amplifier for gain control. It is theorized that the signal was disconnected during the inflector modifications as all special PUEs were tested and found to be fine in August 2011.

All special PUEs (B2, C4, D1) were tested in Sept. 2012, and found to be ok.



D1 in high gain mode with 10MHz 100mV test signal

Wilinski, et al

Summary

- **Electron Lenses will be installed soon.**
  - Many systems have been tested at the test bench.
    - Gun, Modulator, Collector, YAG & Pin Hole profile monitors, Current monitoring systems, some Controls…
  - There are still many systems not tested that will be tested in the tunnel
    - SC Magnets, BPM's, Back-scattered Detector, more Controls, etc..
  - Parasitic commissioning capability
- **Stochastic Cooling new Longitudinal Pick-Ups**
  - Plan to install this shutdown
  - Will replace Horizontal RHIC IPM MCPs when the vacuum is opened (one bake-out)
- **Select other FY12 developments**
  - Development of single-bunch measurement capabilities for E-Lens (WCM, PD's, BTF)
  - Preparations for high intensity operations and studies (cold BPM cable temperatures)
  - BPM enhancements (turn-by-turn upgrade to 4096 turns, million-turn readout via ADOs, post-mortem triggered readout)
  - Improved turn-by-turn data analysis methods
    - See C. Liu's talk "Precision Optics Measurements in RHIC and Future Applications"