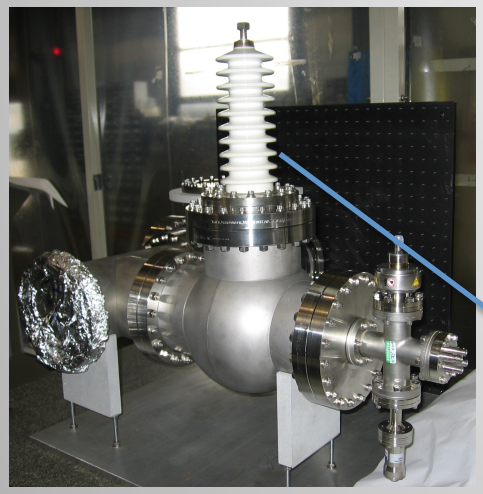
APEX Workshop 2011
Instrumentation & Accelerator Components Update for RUN 12

- EBIS & HEBT
  - LPM HV Cable
  - EBIS CT Calibrator
- Booster
  - C3 Inflector
  - PIP restored
- AGS
  - A15 MW turn-by-turn
  - F5 Jump Target
  - Tungsten absorbers
- ATR
  - BLM's & Flags
- RHIC
  - Spin Flipper
  - BPMs and 10Hz GOFB
  - 9MHz Bouncers and Common Cavity
  - Algorithm development
  - Longitudinal Emittance
  - 9MHz Bouncer & Common Cavities
  - Stochastic Cooling
  - Preparations for high current
  - Dump BLM's & Pressure transducer

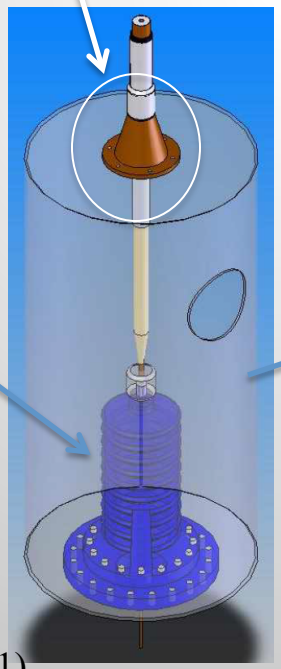
D. Gassner, Instrumentation Systems Group - December 8, 2011

New LPM HV Cable

- Reason:
  - Make high energy, & energy spread measurements via gas stripping
  - Improve energy measurement accuracy
- Need to sweep to ~115kV for 200MeV protons (have 125kV HVPS)
- Was limited to 78kV, by 50uA current limit using old cable.
- Location of leakage is unknown.
- Plan to install better HV cable rated for 150kVDC
  - Dielectric Sciences #2121
- Need to replace HV feedthrough cone, due to smaller cable diameter



LPM vessel, HV insulator on top



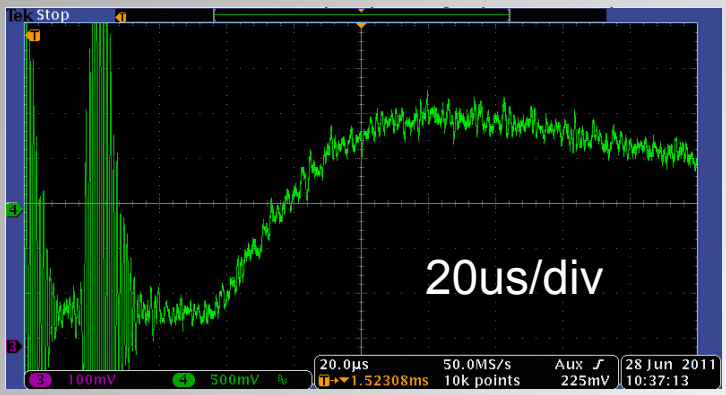
LPM installed in the HEBT transport

Connolly, DeSanto

New EBIS Current Transformer Calibrator

About 100x faster rise.

Keithley 238 source (old)

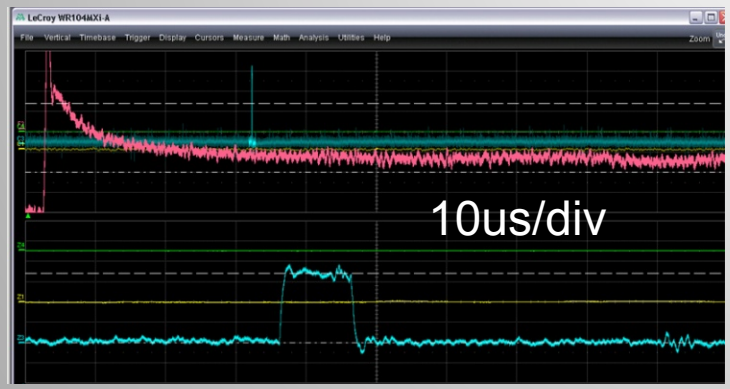


LDP-3811 source (new)

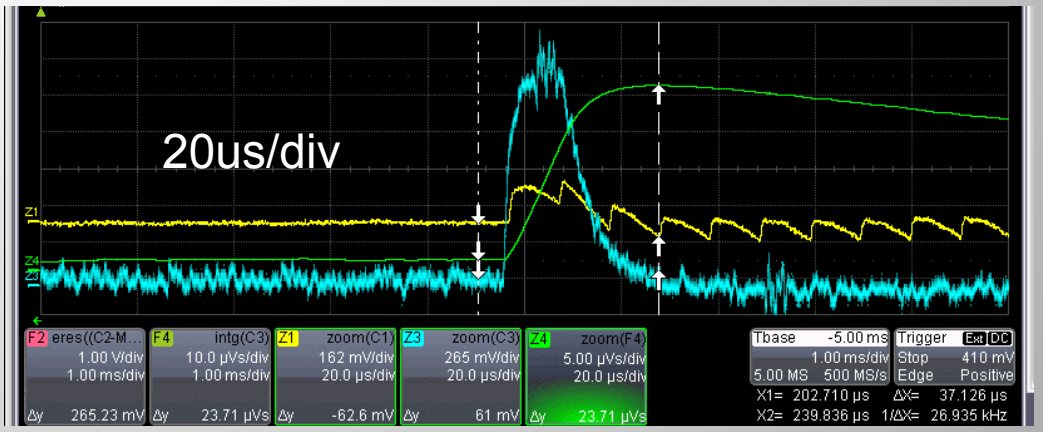
The two green pulses are through xf108 with the long cables, with the sources located in B930 upstairs. Bench testing with short cables was much closer to the 25ns rise time spec, but unrealistic as to how we would use the source.

Zoom on pulse to see rise time of old & new sources, both 500mV/div
note timebase differences

10us, 500uA cal pulse through xf108 as seen on Remote Scope in MCR (bottom turquoise trace)



EBIS Beam pulse (blue)



23.71 uVs = 13.8 e8 Au32 ions 10/26/11 13:13

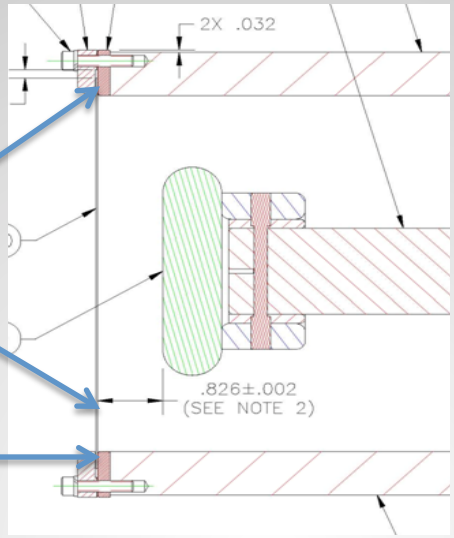
M. Wilinski

Booster C3 Inflector

Increased gap:

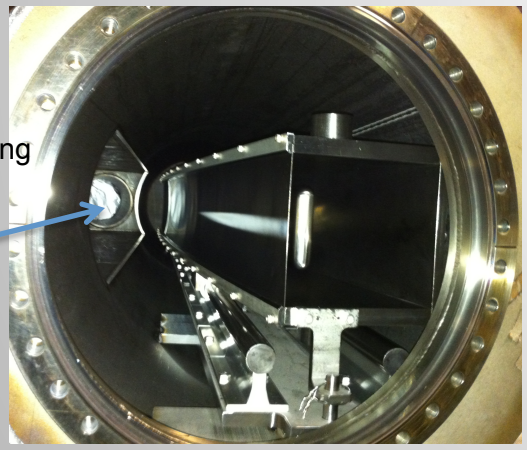
From 17mm to 21mm (0.826”)

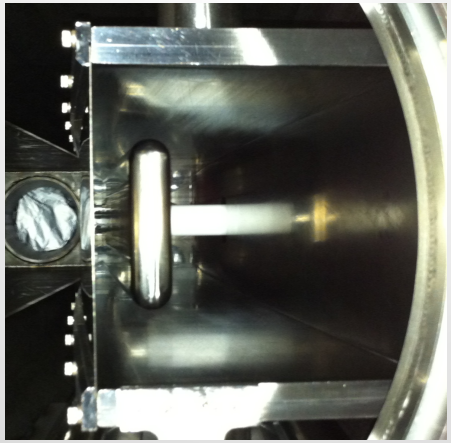
Added 4mm shims under the titanium foil along the length of the ~95” inflector.



The Inflector was surveyed back in with a 2mm offset, so the inflector foil is now 2mm closer to the beam.

Booster Circulating beam pipe





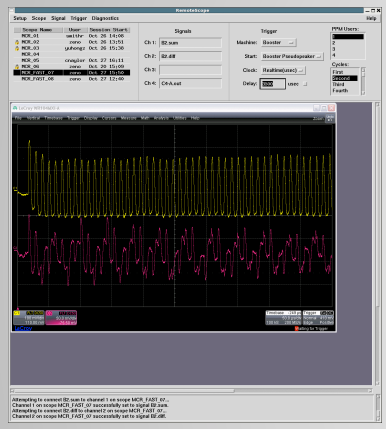
Inside views of downstream end of the inflector before installing shims

- HVPS Status, 85kV Glassman, one plus 2 spares will be ready with new ado interface to Controls (was SLD).

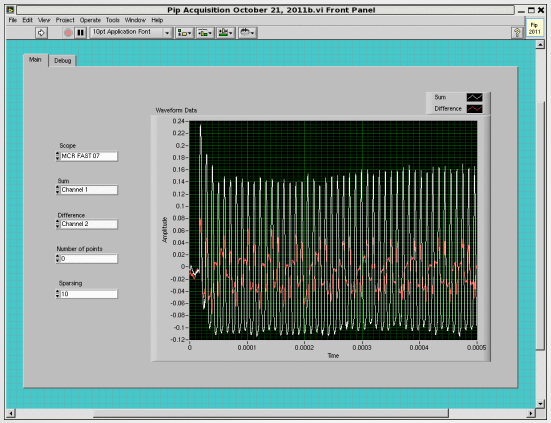
Badea, Lehn, Saetta

PIP Restored

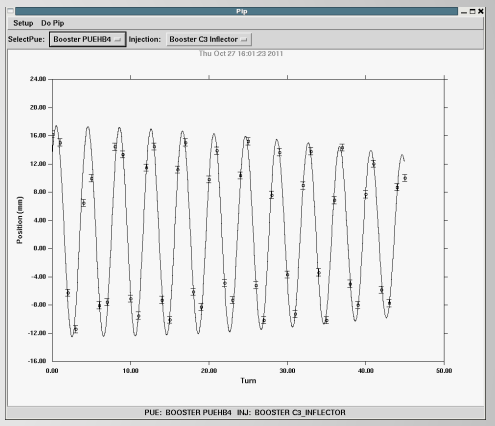
New LabView code for getting the Booster BPM Sum and Diff signals from the fast remote scopes.



B2 Sum & Diff signals



PIP Application with same signals

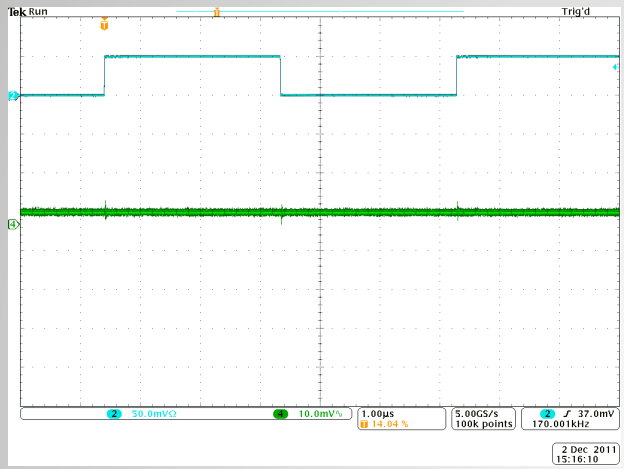


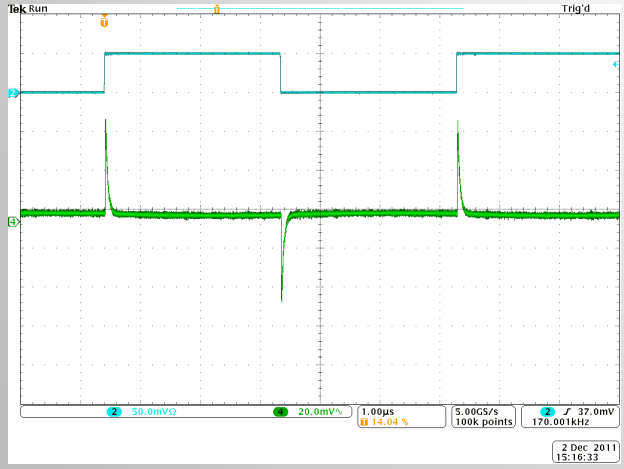
PIP fitted parameters

The program determines several parameters of the injected beam including the tunes and the position and angle of the incoming beam

K. Gardner & C. Degen

AGS Injection Emittance Measurement
BTA MW166 and AGS A15MW

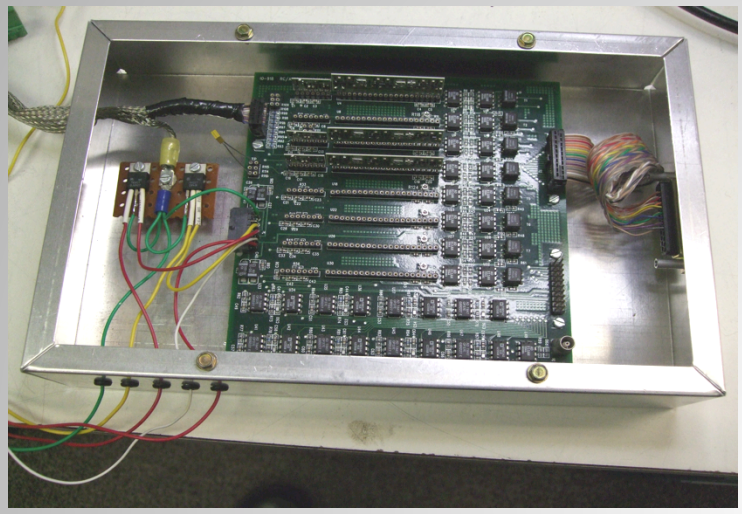


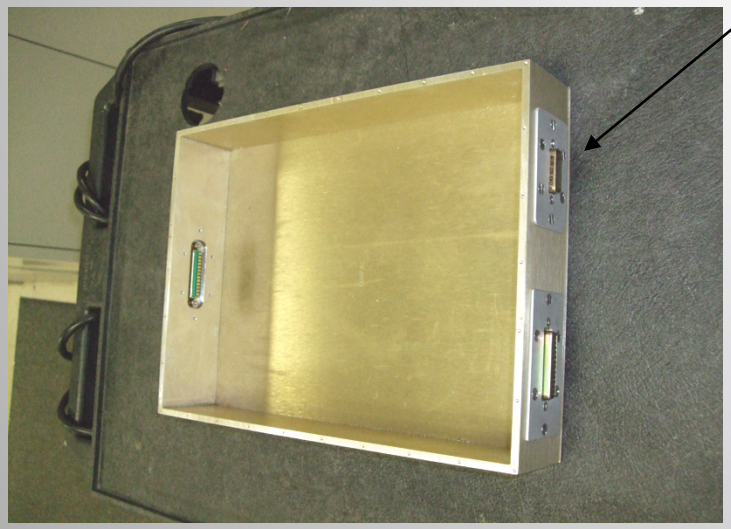


- Initial tests will be conducted at BTA MW-166 where the noise is less severe so the amplifier configuration can be optimized before testing at A-15.
- Various amplifier types were tested with pulses applied through a 5 pF capacitor. A charge amp (same as RHIC IPM) gives the best results for noise and sensitivity. Signal loss is high even with short input cables. The top green trace is the input at the charge amp through a 12 inch cable; the bottom green trace is the output.

C. Dawson

A15 MW Electronics



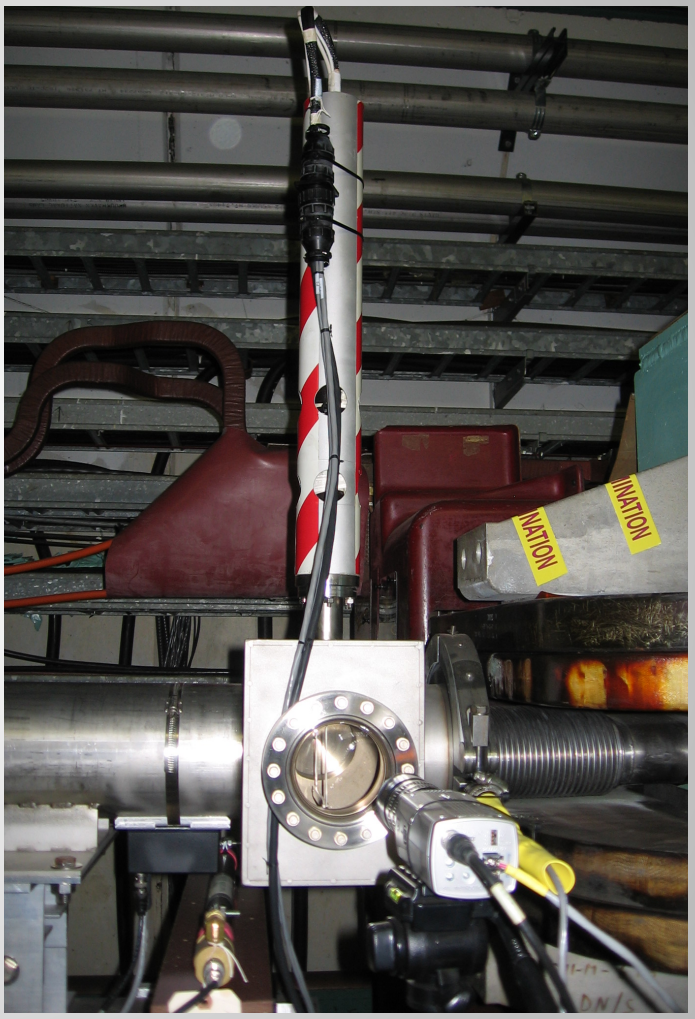


- The enclosure used for the earlier tests did not provide much in the way of shielding or minimization of conducted noise.
- The new enclosure provides good shielding and the connectors for input output and power are all metal shell D connectors. The power connector incorporates feed through capacitors to help reduce conducted noise.
- We would like to test with 4-8 dedicated wires from MW-166. A choice of wires is needed soon to allow construction of a 'Y' cable to split these wires off to the test electronics.

C. Dawson

F5 Vertical Jump Target

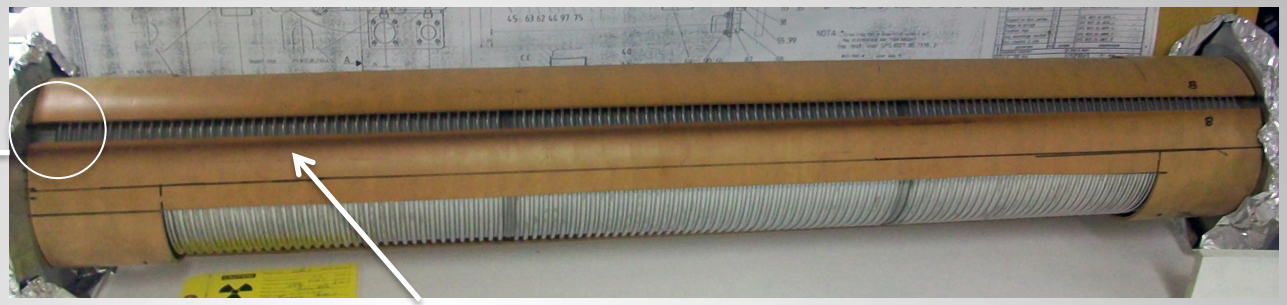
- Linear motion controllers and drivers moved to J7 plunging stripping foil.
- New modern controller and driver being bench tested now.
- Plan to restore Vertical JT operations.



AGS F5 Vertical Jump Target

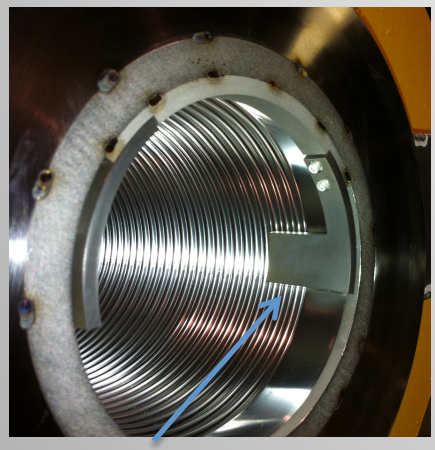
AGS Jump Quads - Tungsten Absorbers

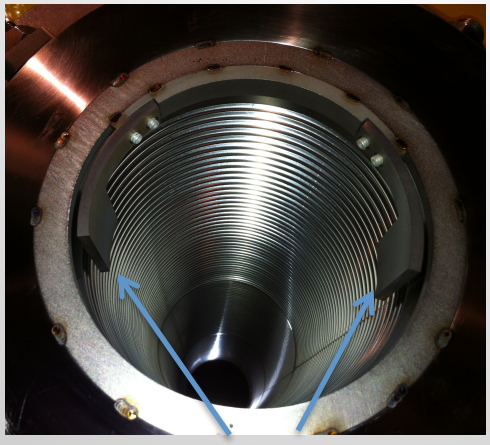
Tungsten absorbers installed in upstream ends of I5 & J5 to protect thin vacuum chamber walls from beam losses.

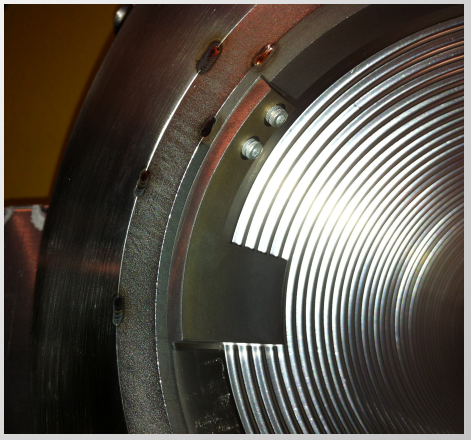


Leak in I5 vacuum chamber

Dark stripe on I5 vacuum chamber



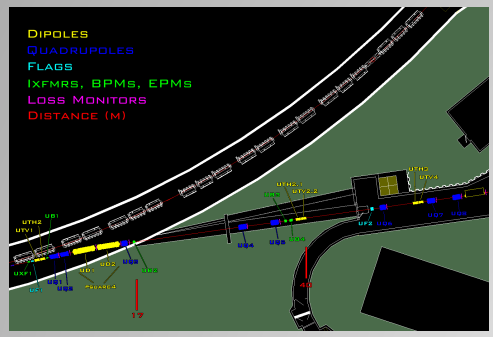


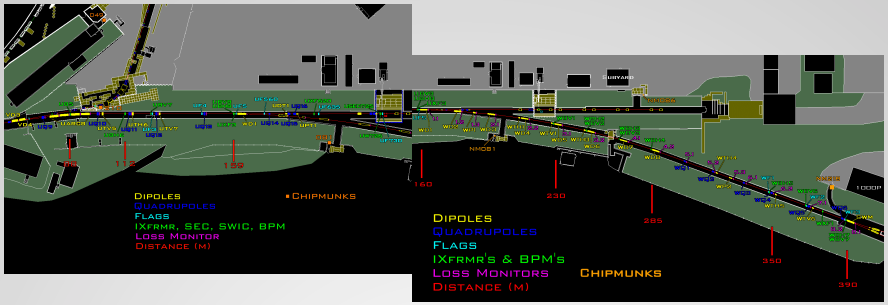


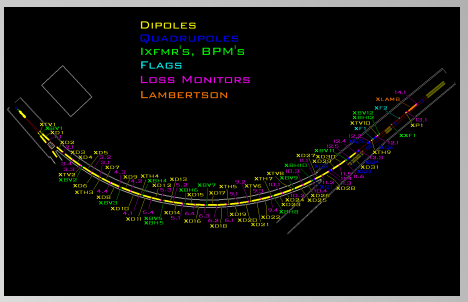
Tungsten absorbers installed as shown above at I5 & J5 Jump Quads

Glenn, Thieberger, Liaw, Lehn

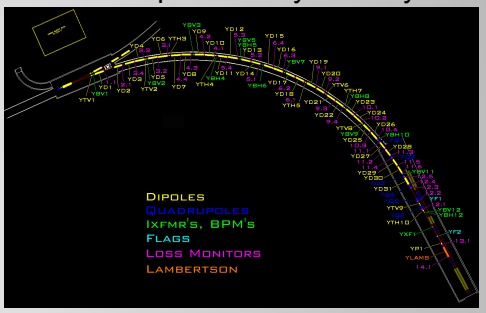
AtR BLM's and UF1 & 2



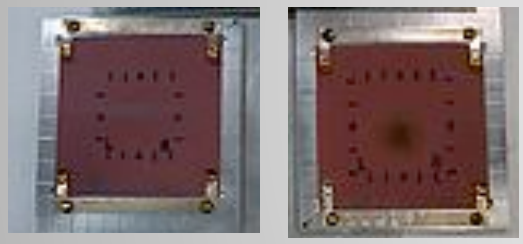




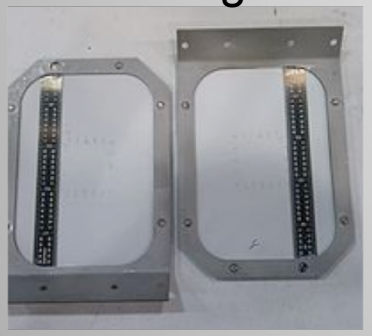
AtR maps courtesy T Shrey



UF1 & 2 Old and New



Old AlOx flags with burn spots



New GdOS:Tb with calibration rulers

All AtR Flags are now the same GdOS:Tb

The remaining 27 AtR BLM daisy chains were broken.

There are now 81 single point monitors that used to be joined into small groups.

There are now a total of 139 BLM's in the ~800m of AtR transport.

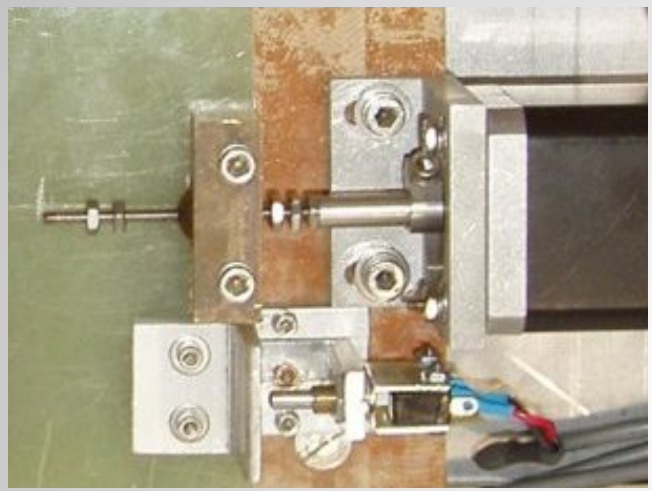
Curcio, Ravenhall, Ziminski

Spin Flipper

Tuning chassis motion upgrade (one chassis/magnet = 5)

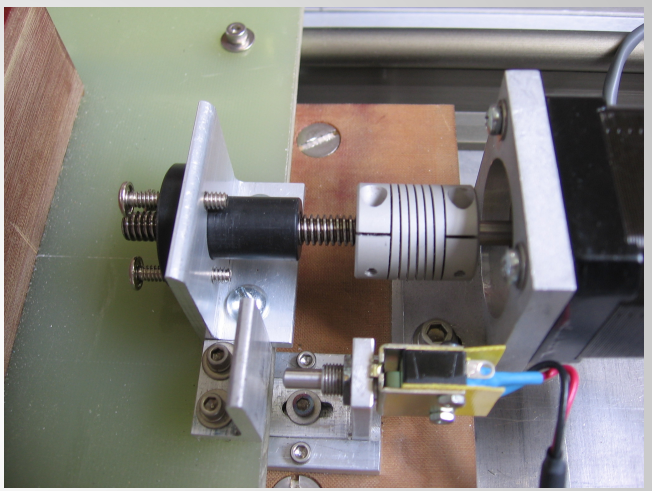
- 6x faster sweep time, from 3seconds to 0.5 seconds
- Improve reliability

Old drive



- Rigid coupling
- 4-40 brass machine thread lead screw
- Brass ball and socket nut

New drive



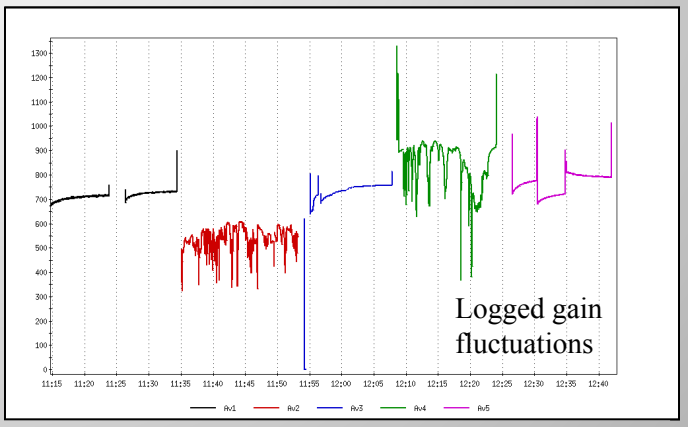
- Flex coupling
- ¼ - 20 acme thread lead screw
- Plastic acme nut

DeSanto

Characterize/Repair Power Amplifiers (5)

- Discovered cause of gain fluctuations (relay contact)
- Documented amplifier variations
- Replaced multiple blown power transistors

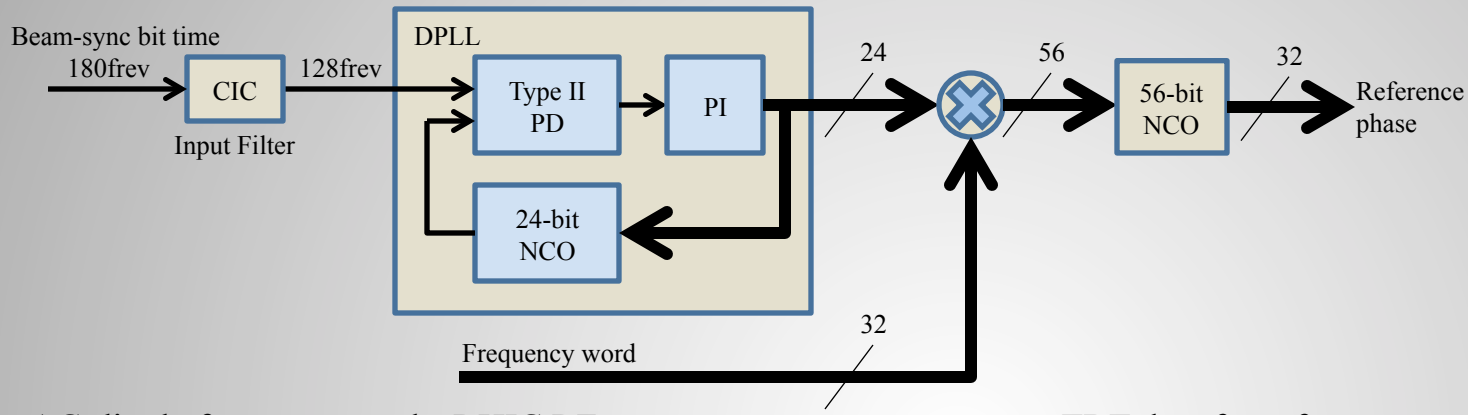
Dawson

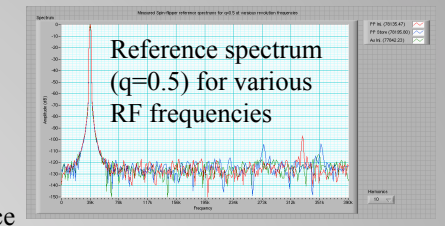


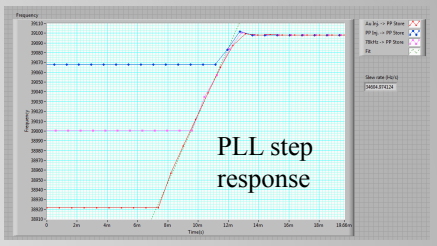
Spin Flipper

FPGA Firmware

Beam-Sync based waveforms



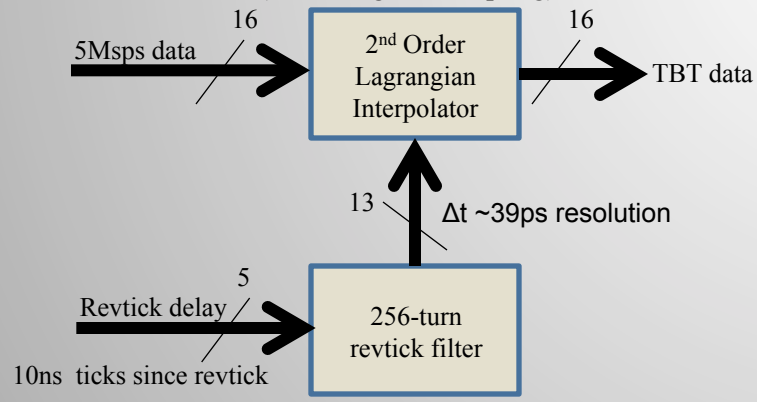




•PLL slew-rate ~34.6kHz/sec

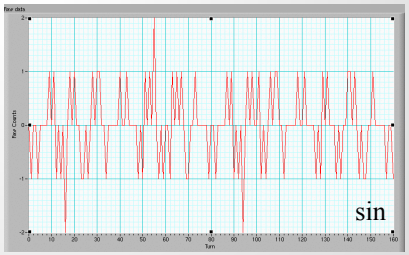
•AC-dipole frequency tracks RHIC RF

Turn-by-turn data acquisition
(Non-integer resampling)

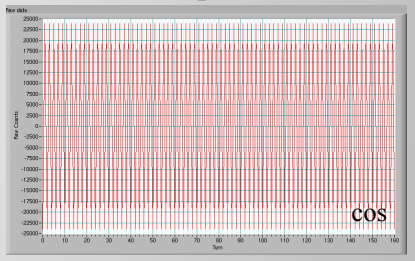


•TBT data to correlate AC-dipole to BPMs and polarimeter
•Higher order interpolator used to maintain resolution

TBT data for reference waveform (q=0.5)

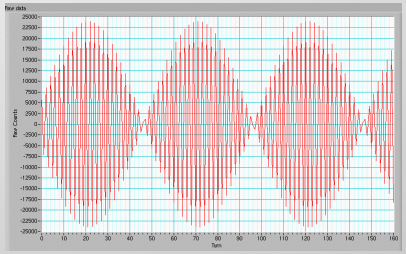


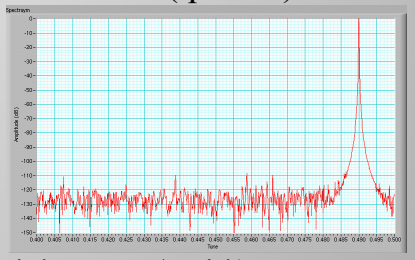
•Sampled at zero
•Cancels within 1-2 counts



•Sampled at min/max

TBT data for reference waveform (q=0.49)





(TBT data taken with synthetic beam-sync/revtick)

Oddo

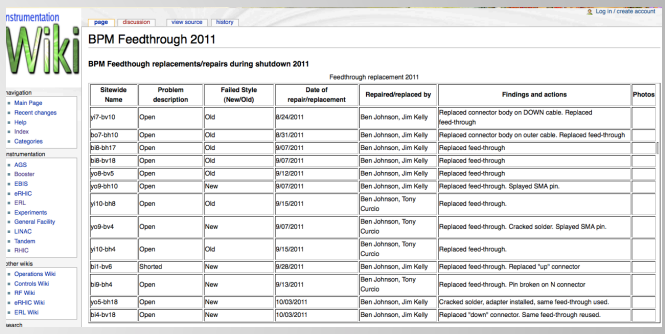
RHIC BPM and 10Hz Global Orbit Feedback

<u>BPM enhancements still in progress include:</u>

- Code changes to prevent position glitches when gain is switched
- Suppressing position measurements during longitudinal (timing) profile scans to prevent bad measurements on dedicated 10 Hz GOFB network
- Distribute status bits for position measurements on dedicated 10 Hz GOFB network
- Feedthrough status: problems are similar to previous years, cracked solder and failing old style feedthroughs.

Feedthrough strategy:

- at a minimum, replace all broken feedthroughs each shutdown
- continue to purchase more feedthroughs each year
- work towards replacing all feedthroughs as labor allows



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BPM Feedthrough 2011

BPM Feedthough replacements/repairs during shutdown 2011

Feedthrough replacement 2011

Sitewide Name	Problem description	Failed Style (New/Old)	Date of repair/replacement	Repaired/replaced by	Findings and actions	Photos
y17-bv10	Open	Old	8/24/2011	Ben Johnson, Jim Kelly	Replaced connector body on DOWN cable. Replaced feed-through	
bo7-bh10	Open	Old	8/31/2011	Ben Johnson, Jim Kelly	Replaced connector body on outer cable. Replaced feed-through	
bi8-bh17	Open	Old	9/07/2011	Ben Johnson, Jim Kelly	Replaced feed-through	
bi8-bv18	Open	Old	9/07/2011	Ben Johnson, Jim Kelly	Replaced feed-through	
yo8-bv5	Open	Old	9/12/2011	Ben Johnson, Jim Kelly	Replaced feed-through	
yo9-bh10	Open	New	9/07/2011	Ben Johnson, Jim Kelly	Replaced feed-through. Splayed SMA pin.	
y10-bh8	Open	Old	9/15/2011	Ben Johnson, Tony Curcio	Replaced feed-through.	
yo9-bv4	Open	New	9/07/2011	Ben Johnson, Tony Curcio	Replaced feed-through. Cracked solder. Splayed SMA pin.	
y10-bh4	Open	Old	9/15/2011	Ben Johnson, Tony Curcio	Replaced feed-through.	
b11-bv6	Shorted	New	9/28/2011	Ben Johnson, Jim Kelly	Replaced feed-through. Replaced "up" connector	
b9-bh4	Open	New	9/13/2011	Ben Johnson, Tony Curcio	Replaced feed-through. Pin broken on N connector	
yo5-bh18	Open	New	10/03/2011	Ben Johnson, Jim Kelly	Cracked solder, adapter installed, same feed-through used.	
bi4-bv18	Open	New	10/03/2011	Ben Johnson, Jim Kelly	Replaced "down" connector. Same feed-through reused.	

<u>10 Hz global orbit feedback system enhancements still in progress include:</u>

- ADO enhancements to provide 1-second reporting of maximum minus minimum BPM position.
  This will provide basic comfort display of 10 Hz feedback performance.
- Improved exception handling of bad BPMs.
- Upgraded On/Off relays for Kepco power supplies.

Michnoff, Hulsart, Cerniglia

RHIC Algorithm Developments

❖**BPM data quality checks**: real time eigenvalue analysis on turn-by-turn data to find faulty BPMs

❖**Online orbit fit**: error localization by comparing difference orbit with fitted orbit (based on selected BPMs ' readings and optical model) (Monday 12/5 meeting talk)

❖**First turn SVD-steering**: correcting beam orbit with Singular Value Decomposition algorithm which uses transport line response matrix

❖**Simultaneous orbit and corrector strength minimization:** Presently the orbit is corrected and the corrector strengths may assume large values. Algorithm will minimize corrector strengths that are working against each other.

❖**SVD-based orbit control with BPM weighting** (talk by C. Liu)

❖**Global coupling and vertical dispersion correction**: correcting global coupling and vertical dispersion simultaneously using 12 independent skew quad families (C. Liu talk)

❖**Dispersion-free steering**: correcting vertical orbit and dispersion simultaneously with vertical dipole magnets

Minty, Liu, Marusic

RHIC Longitudinal Emittance

Working on getting a more realistic RHIC longitudinal emittance measurement

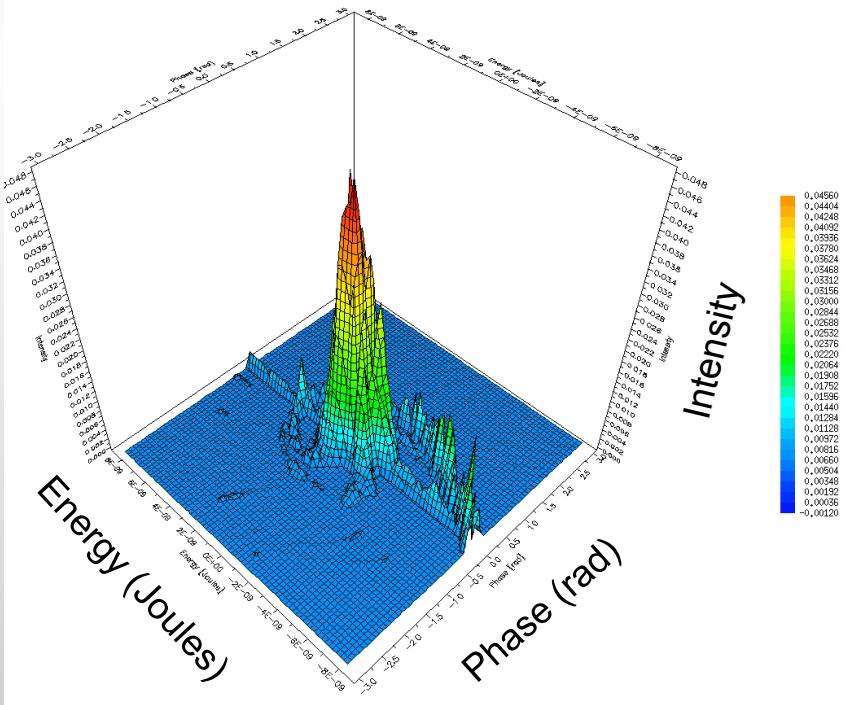
Presently there is a application being developed to perform tomographic reconstruction (offline) of the RHIC bunches already saved into sdds files (as used by wcmview). This will be a testing ground for some ideas for using tomography and some other techniques under developed, to determine the longitudinal emittance when the beams have non-Gaussian distributions. The special cases we are looking at are when the Landau cavities are on and other situations when there are multiple RF harmonics.

The attached picture shows a tomographic reconstruction of a bunch just after transition, from 5 or 6 years ago. The plan is to have a working offline version ready when RHIC starts up, so we can study (offline, of course) longitudinal emittance under different conditions.

Goals:

Develop an online longitudinal emittance calculation that doesn't assume a Gaussian distribution.

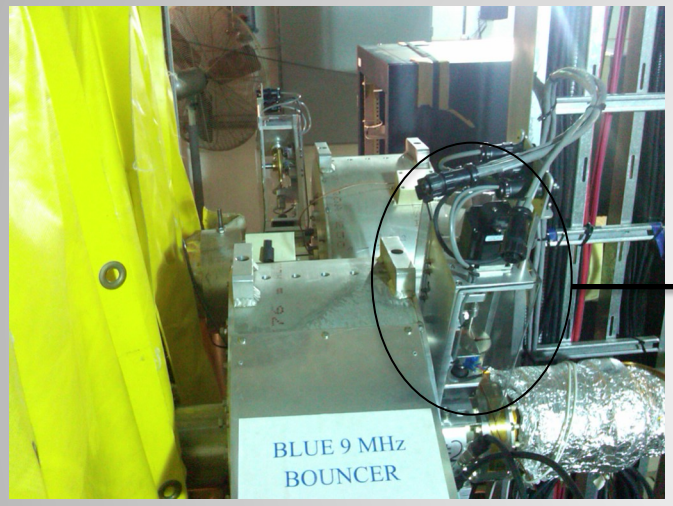
Have online tomographic reconstructions.
This could be done in the AGS and Booster as well, if there are dedicated logged wcm bunch profiles.



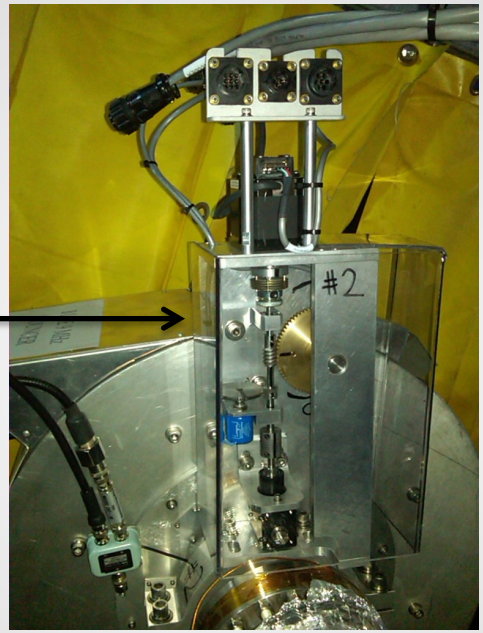
Blaskiewicz, Montag, Brown

9MHz Bouncer & Common Cavities

9MHz Bouncers and Common cavity closed loop tuning via VME & new llrf chassis

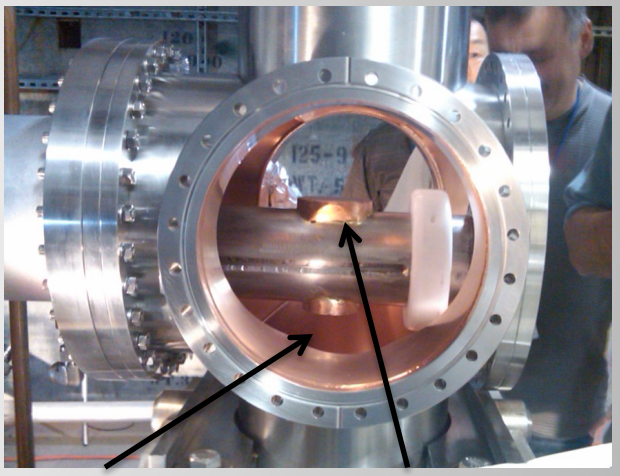


9MHz Bouncer cavities
Sector 3



9MHz Bouncer - Blue
Detail of tuner stage

9MHz Common Cavity
Redesigned, rebuilt



Fixed and variable tuning caps attach to top and bottom stubs.

Zaltsman, DeSanto, VonLintig

Stochastic Cooling

In progress for FY12: Blue Ring

	Pickup	Kicker	electronics	software
Longitudinal	No change	Repair; In-vacuum bearings, leaking feedthrus, Upgrade motors	1.Pilot tone; two frequencies 2. Repair; power amps, +isolators, microwave link	I/Q Lookup tables, Spectrum Analyzer display
Vertical	Upgrade, New motion and vacuum vessel	Repair vacuum leak, upgrade image current bypass straps	Replace LabView with C-code	BTF display and logging
Horizontal	Commission new pickup	New kickers, Two tanks	Install low level, Fiber optic delay cables	Multiplex horizontal and vertical

Stochastic Cooling

In progress for FY12: Yellow Ring

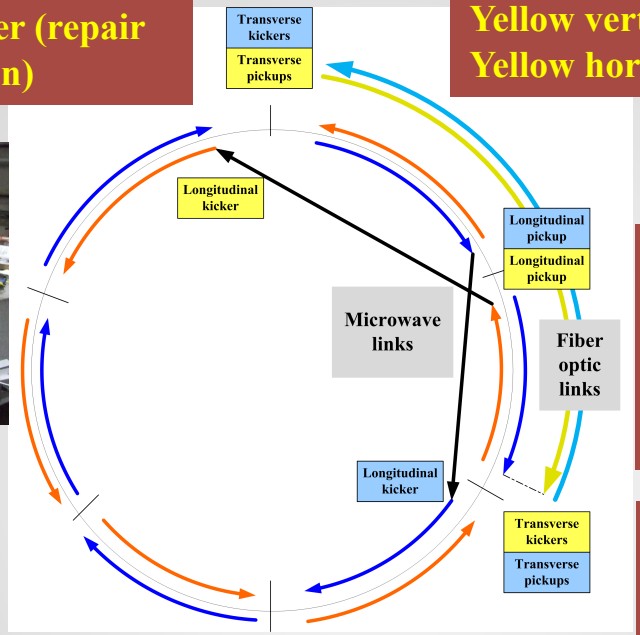
	Pickup	Kicker	electronics	software
Longitudinal	No change	Repair; Bad coax cable in vacuum, Upgrade motors	1.Pilot tone; Two frequencies 2. Repair; Power amps, +isolators microwave link	I/Q Lookup tables, Spectrum Analyzer display
Vertical	Upgrade, New motion and vacuum vessel	Upgrade “inserted” switch	Replace LabView with C-code	BTF display and logging
Horizontal	New pickup	New kickers, Two tanks	Install low level, Fiber optic delay cables	Multiplex horizontal and vertical

Stochastic Cooling

Capability for 6 planes of cooling this run.
Horiz, Vert, & Long, in both B & Y rings.

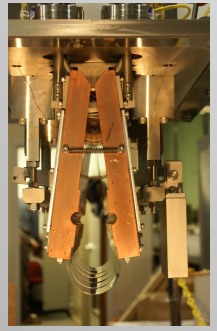
Sector 11:
Yellow longitudinal kicker (repair bad coax, upgrade motion)

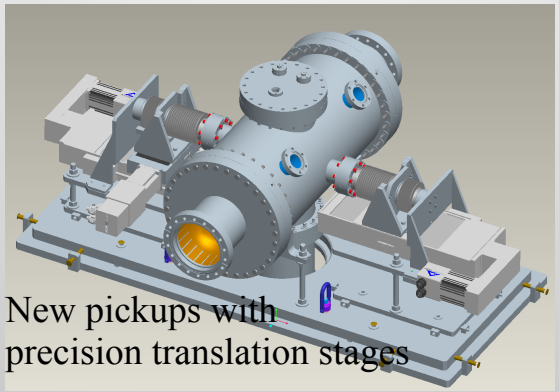
Sector 12:
blue vertical kicker (repair leaks)
blue horizontal kicker (new)
Yellow vertical pickup (replacement)
Yellow horizontal pickup (new)



Sector 3:
Blue vertical pickup (replacement)
Blue horizontal pickup installed last year
Yellow horizontal kicker (new)
Yellow vertical kicker (minor mechanical)

Sector 4:
Blue longitudinal kicker (refurbished, upgrade motion)





K. Mernick, M. Brennan

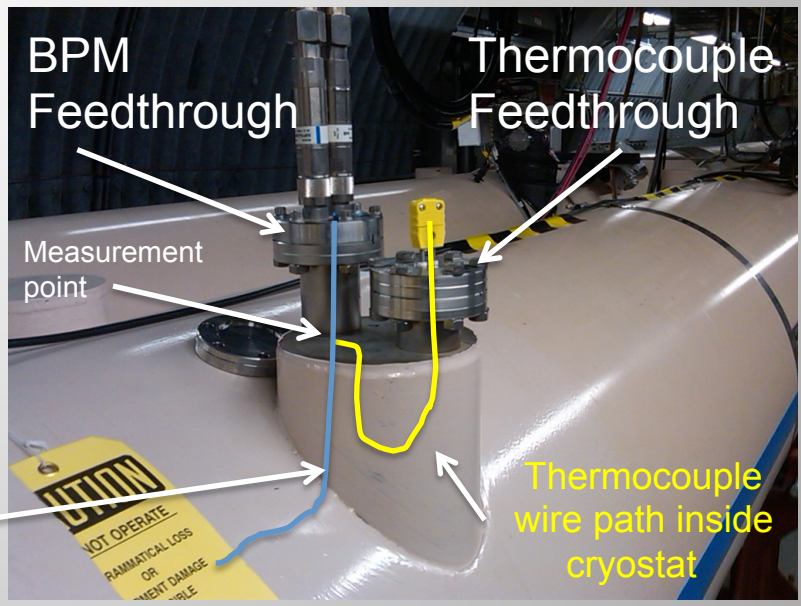
RHIC: Preparations for High Current

50W 6dB attenuators were purchased to replace all the existing 5W DX BPM attenuators. Monitoring attenuator temperature at 6 a O'clock BPM.

DX BPMs: new offsets to be implemented (based on Peter Thieberger's analyses, presented at the RHIC Retreat)

While with existing new DX BPM survey data have not yet been able to rationalize measurements, alternate approach (Online Orbit Fit, presented by C. Liu at this week's RHIC weekly meeting) shows promise in determining these based on measurements with beam.

BPM "cold cable" temperature monitoring installations at 4 locations (bi4-bh5 & bh9, bi12-bh5, bi1-bh5) in support of the RHIC Luminosity upgrade (with higher beam intensities and shorter bunches)

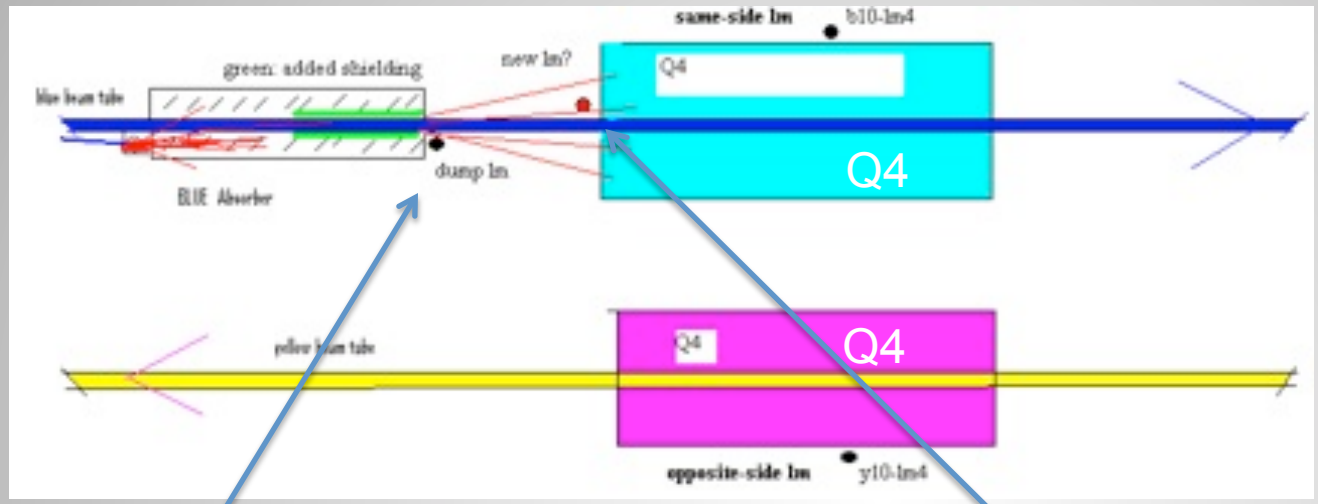


BPM cable path inside cryostat

Thieberger, Mahler

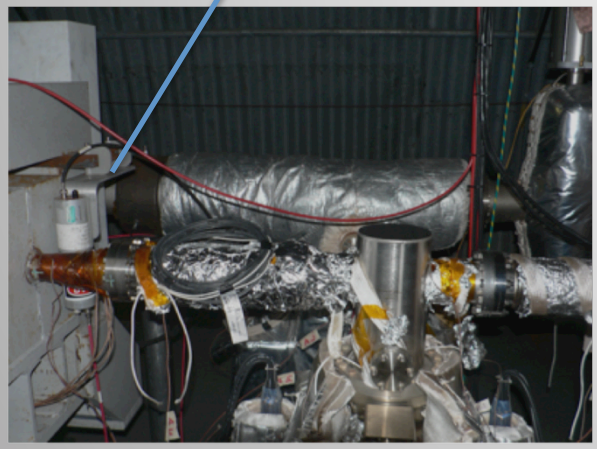
RHIC Dump Diagnostics

New BLM detectors, RHIC & SNS Style upstream sector 10 Q4.

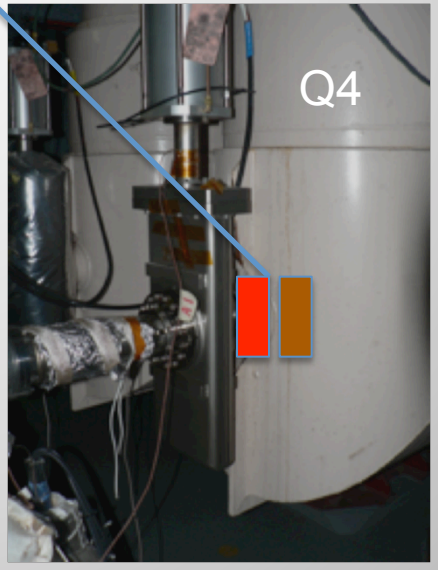


Reason:
Try to determine how close a dump had come to quenching a magnet.

Improve chances of getting a non-saturated signal by moving the BLM & using also an SNS BLM (~3-5X's) better saturation response.



Position of existing BLM downstream of 10 O'clock dump Shield/absorber



Future position of new RHIC & SNS BLM's near the blue beam tube in front of the Q4 cryostat.

P Thieberger & L. Ahrens

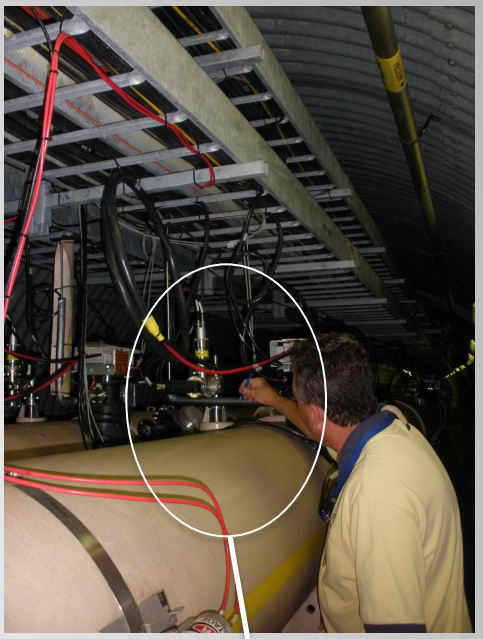
RHIC Dump Diagnostics

Dump Pressure Transducer

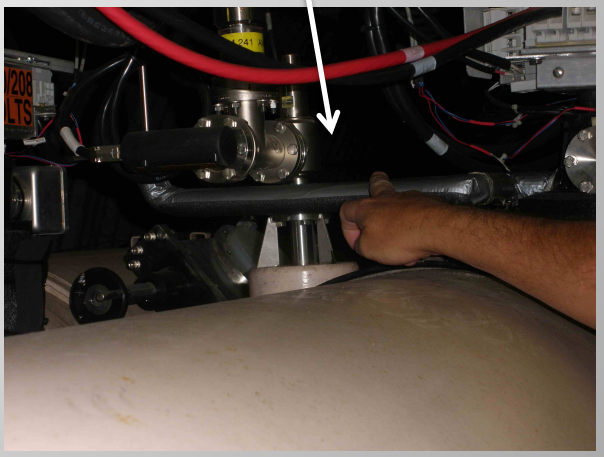
Try to detect increase in LHe at the sector 9 beam dump.

New pressure transducer installed at 9Q4 since this one quenched most frequently.

Typical LHe at ~4 atmospheres. Transducer full scale 100psia, 300Hz response time.



Insert tee & attach transducer to this cryo pipe



The idea is to see if there is a small increase in LHe pressure correlated with dumping the beam even without a quench. There is certainly always some energy deposited in that area when the beam is dumped. The question is if we will see a corresponding spike in the LHe pressure.

High sensitivity and low noise are more important than extreme speed. If we see such a spike we may use its height to predict how close to a quench we are. In other words, if we get to an intensity that causes many dump quenches, the largest spike without a quench would be the limit. The effectiveness of any additional countermeasures we may be able to implement would then be easy to see in a quantitative way as a reduction in the size of the spike.

Thieberger, Ahrens, Tallerico