

RHIC Retreat Systems Summary

P. Sampson, W. Fischer

PM

Organizers
Chair

Systems

W. Fischer, P. Sampson
J. Tuozzolo

14:00	<u>Main PS: Reliability, Maintenance, and Improvements</u>	C. Schultheiss
14:20	<u>Other PS: Reliability, Maintenance, and Improvements</u>	D. Bruno
14:40	<u>Cryogenics</u>	R. Than
15:00	<u>LLRF Commissioning Plans, L10 Cavity</u>	K. Smith
15:20	<u>BPM's</u>	R. Michnoff
15:40	<u>Instrumentation</u>	T. Russo
<i>16:00 - 16:30</i>	<i>Coffee Break</i>	
16:30	<u>Controls: Software</u>	J. Morris
16:50	<u>Controls: Hardware</u>	C Thiesen
17:10	<u>Access Controls</u>	J. Reich
17:30	<u>Vacuum Systems</u>	M. Mapes
17:50	<u>Pulsed Power Systems</u>	W. Zhang
18:10	Discussion	

Reliability

- 41 Total QLI events, 79 hours of downtime.
- 32 during 250 GeV, 9 during 100 GeV.
 - 26 (63%) events had three causes, 51.9 hours (66%).
 - UPS fan fail caused 10 events, 24.5 hours.
 - Current Limit System caused 6 events, 14.7 hours.
 - 720 Hz Chassis out of lock caused 10 events, 12.7 hours.
 - DCCT
 - DCCT failure caused 3 events, 11.2 hours.
 - Reliability problems.
 - Interchangeability problems.
 - The other 12 events had various causes, 18 hours.
 - Airflow sensor failure, Watlow Controller locked up, Ice Ball

Down Time in Hours Run 9-Run 8-Run7

Main p.s.'s	79	20	52
Quench Detectors	51	4	4
IR p.s.'s - Dynapowers	26	30	63
IR p.s.'s – SCE 300's	18	8	30
IR p.s.'s – SCE 150's	17	10.8	45
Snakes & Rotators	16	1	NU
QPA's (fan warnings)	11	1	8
Current Regulator Cards	9	5	7
Communication Failure QPA's	8	1	14
Sextupole p.s.'s (q10 tree cleaning)	6	6	5
Correctors (3 of 4 swapped on maintenance days)	6	4	7
6000A Quench Switches	0	12	16
Gamma-T's	0	6	0
Housekeeping ps	0	3	0

Cryogenic Systems Run 9

•COOLDOWN

293K to 45K

CRYOPLANT

45K WAVE: 21 DAYS

4K FILL: 6 DAYS

COOLDOWN PREVIOUS

293K TO 90K

LN2 , 4 WEEKS

90K TO 4K WAVE, 10 DAYS

The Plan For Run 10

K. Smith, LLRF

• RHIC LLRF

- Start RHIC with new LLRF System ready to fully commission.
- Integrate quad mode damping from the start.
 - One example of the flexibility of the new system.
 - "Readily expandable, flexible, obsolescence resistant, ready spares. Example: Once new system is stable, new quad mode damper functionality is readily subsumed and current "external" implementation goes away." (RHIC Retreat 2008)
- Begin commissioning of "Cavity Controllers" during the Au run.
 - Provide independent drive for each cavity, eliminate existing IQ modulators.
 - In the fullness of time add tuning loop, phase and amplitude stabilization, monitoring ...
- This remains a commissioning effort and we will need machine time.

• Blue Injection, Timing Setup, Injection Correction, Capture	1 x 12 Hrs
- Testing and debugging of BTB Phase Detector	
• Blue Acceleration, Transition Crossing, Store Cogging Testing, Rebucket Testing	2 x 12 Hrs
- Testing and debugging of BTB Phase Detector, Feedback DSP, DAC Firmware	
• Yellow Injection, Timing Setup, Injection Correction, Capture	1 x 12 Hrs
- Ditto Blue.	
• Yellow Acceleration, RTR Synchro, Transition Crossing	1 x 12 Hrs
- RTR Synchro loop moves from analog to digital	
• Collision Cogging, Rebucketing	1 x 12 Hrs
- Rebucket gymnastic is a new implementation, simpler in hardware.	
• Quad mode damping	1 x 8 Hrs
- Completely new implementation, embedded in new hardware (firmware)	

- EBIS LLRF (Cavity Controllers)
 - Provide RF drive and tuning control for 5 systems.
- ERL LLRF (Cavity Controllers)
 - Provide phase locked RF drive for 5-cell and gun.



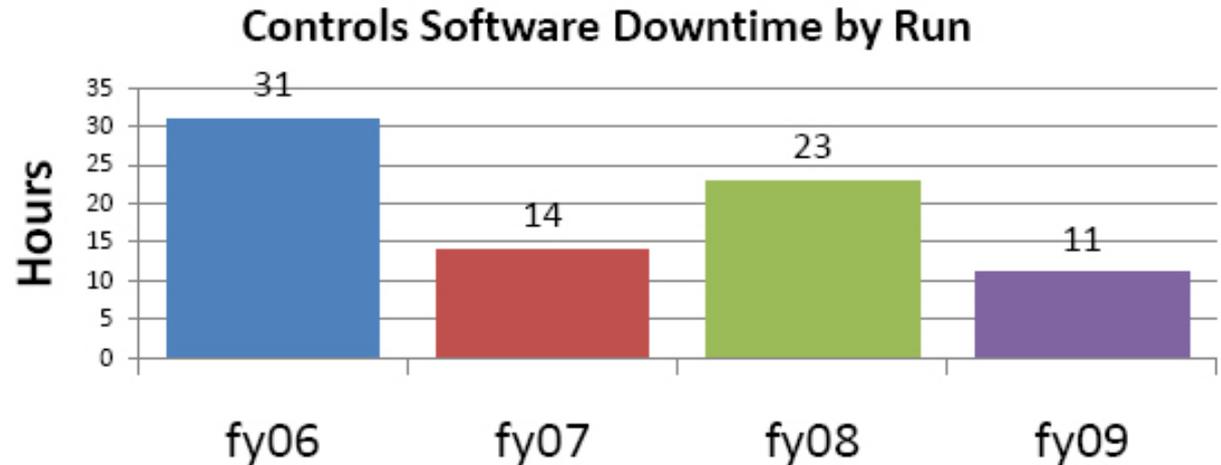
The Best Year Ever

- Improved data reliability due to data quality checks
 - Bad data are flagged and not used
 - Enhancements in DSP code, ADO, Manager, Applications
- Improved uptime due to 1394 firewire protocol rewrite
 - Error checking, retry on failure, staggered data delivery (R. Hulsart)
- Improved data quality due to new continuous average orbit calculation
 - Variations of measurements decreased from ~ 100 to ~ 10 microns
- Fewer holes in data sets due to:
 - correction of timestamp problems (slow and fast)
 - auto-gain implementation

BBQ Hardware and Software Modifications

- Hardware basic topology “fixed” for the entire run.
- Numerous repairs and additions (~70 so far):
<http://www.cadops.bnl.gov/RHIC/Instrumentation/bbq/index.html>
- Examples: repair of RF connections in the ring, re-arranging racks
- Test points were added to provide useful insight into the circuit during operation – without disconnecting any cables.
- Addition of Michiko’s DSA’s connected to the differential output provide online beam spectrum all the time.
- Added calibrated readbacks for kicker current for repeatability – we are trying to reduce “arbitrary units”.
- We are attempting to calibrate the sensitivity of the BBQ by exciting the beam with the AC dipole and comparing with million turn BPM data. Best data so far shows them within 50%. Spectra are identical.....
- The system is now used by the MCR operators reliably
- We still have a lot of work to do – trying to resolve phase jumps, mains harmonics.....

Reliability



Strategies

- Fault tolerance in infrastructure
- Investigation and repair of SW bugs
- System monitoring / notification of failures
- Scheduled testing/release of SW
- SW release procedures with log of changes
- Availability of fallback software versions
- Operator troubleshooting knowledge/tools
- Responsive call list (sufficient staff)

Some Tasks Prior To Next Run

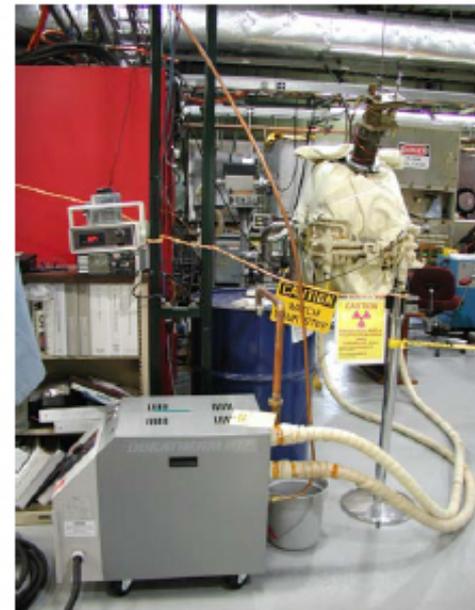
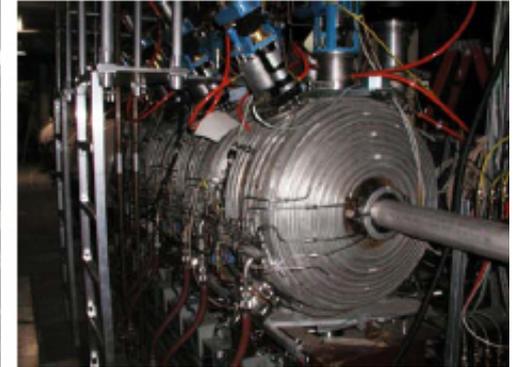
- Continue MRAM Upgrades in Alcoves
 - 50 To 75 Units
- Retrofit Alcove BPMs With Vicor Supplies
- Upgrade Fiber Equipment
- Replace Old Datacon Equipment
- Continue EBIS Installation And Testing
- Investigate Better Ways To Diagnose Problems

Suggested Improvements and upcoming projects

- Replace and upgrade all Problematic gates ~ 15 more
- Replace LINAC, BOOSTER, AGS relay based safety systems with more modern safety PLC's which will provide better safety and reliability and a faster MTTR and much more efficient Re-Certification(Less time required) due to significantly better diagnostics.
- Replace all sensors and final elements with much more reliable and safety rated components(switches, contactors, etc)
- Devote dedicated resources(2 Techs, 1 Eng) to check and perform ECN on all required QA-A1 drawings(Hundreds) for errors, omissions. Big job. Known for many years, we must address this deficiency now.
- MCR Gate Video system upgrade to digital systems and large flat panel displays.
- NSRL OPLESS Access
- VTF, SBH
- Re-Certification streamlining
- Upgrade entire RHIC/U line PASS with Safety rated plc's and components(discreet/no monitored current loop circuits/no more human servos)
~ 2013???

RHIC RF BAKEOUT

- Major upgrade since RF region was never baked before
- Bake Common and Storage Cavity sections @ 150°C
- Bakeout Temp limited by aluminum diamond seals
- Hot water Heating Unit used instead of conventional heating jackets saving ~\$100K
- HW Unit delivered a ramp rate of 100 C/hr. Limit in ring to 50 C/hr
- HW heating unit use hot water at a supply temp of 150°C @ 90 PSIG to keep water from boiling
- Cavity baked with HOM, tuner and window installed using metal diamond seals.



RHIC BEAM ABORT KICKER SYSTEM PERFORMANCE

Yellow Ring

#1	#2	#3	#4	#5	TIME	DATE	VOLTAGE	BEFORE PREFIRE	ACTIVITY
			1		17:22	2/26/2009	26kV	IN RAMP @ SLOPE, CLOSE TO TOP	
0	0	0	1	0					

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Blue Ring

#1	#2	#3	#4	#5	TIME	DATE	VOLTAGE	BEFORE PREFIRE	ACTIVITY
1					15:09	2/16/2009	22kV	Ramp	
1					22:06	2/19/2009	27kV	FLAT TOP ~10 MINUTES	
			1		0:36	2/25/2009	27kV	FLAT TOP ~200 MINUTES	
		1			4:38	2/28/2009	20kV	Ramp	No beam
			1		17:07	3/6/2009	27kV	FLAT TOP ~22 MINUTES	
			1		18:04	3/6/2009	27kV	FLAT TOP ~6 MINUTES	PEAK VOLTAGE REDUCED BY 10%
			1		21:07	3/6/2009	24kV	FLAT TOP ~35 MINUTES	CONDITIONED. 4 TIMES @ 28kV. #4 RESERVOIR VOLTAGE REDUCED.
			1		16:18	3/10/2009	12kV	IN RAMP @ SLOP	Lowered Voltage. Changed the B#4 large 5uF capacitor on March 12.
				1	13:44	3/27/2009	27KV	FLAT TOP ~35 MINUTES	
			1		12:14	6/20/2009	10kV	FLAT TOP ~90 MINUTES	#4 REDUNDANT TRIGGER MODULE WAS REPLACED.
2	0	1	6	1					

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RHIC Retreat Systems Summary

- Time in store (55±5)% since 2004 (somewhat lower 2006/07)
- Contributions from systems change from year to year
- Review of trends reveal reliability improvements on systems where specific problems have been focused on- BPMs, low voltage PS...
- End of life issues are becoming more prevalent – Experimental Air conditioning, MMPS UPS, ACS components
- Old problem categories are reappearing on the radar, perhaps due to work on parallel systems- i.e. power supply fan replacement last year may have sparked the rash of QPA faults this year by disturbing old wiring
- Shutdown in VERY ambitious – MANY Vacuum bakes, MMPS, component, upgrades, installations, new systems EBIS etc...
- There is a great need to set priorities, timetables and schedules are critical
- Efficient commissioning is critical during startup- MMPS, RF etc.