

# Run 10: 200 GeV Au-Au

## *Run Coordination/RHIC Setup*

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<http://www.cadops.bnl.gov/AP/RHIC2010/>

# Schedule

- ~~Oct. 1~~ ~~begin FEC/Controls Turn-on~~  
systems are being tested

- ~~Oct. 6~~ ~~Begin Cryo Scrubbing~~

- ~~Nov. 2~~ ~~Begin 45 K waves~~

- Nov. 16 Booster/AGS Setup

- Nov. 16 – 20 RHIC Dry Run

- Dec. 1 4.5 K waves

- Dec. 4 Beam in RHIC (blue)

- Dec. 14 Store devel., physics setup

(conditions:  $\beta^*=60$  cm , intensity =  $1e9$ , # of bunches > 50)

- Dec. 22 Projected Physics Start

# RHIC Run-10 Dry Run Plan

As of:  
October 6, 2009

## RHIC Dry Run (November 16 - 20, 2009)

### Schedule:

Monday, November 16	Infrastructure	meeting 9:00 am in MCR
Tuesday, November 17	Operations & Systems	meeting 9:00 am in MCR
Wednesday, November 18	Systems	meeting 9:00 am in MCR
Thursday, November 19	Instrumentation	meeting 9:00 am in MCR
Friday, November 20	Contingency/Repeats	meeting 9:00 am in MCR

### Please check if:

- your name is assigned to the appropriate system
- your system is listed
- your system has or does not have changes
- all appropriate names are associated with your system
- if you are available that day or need to switch to another day
- if you have enough time

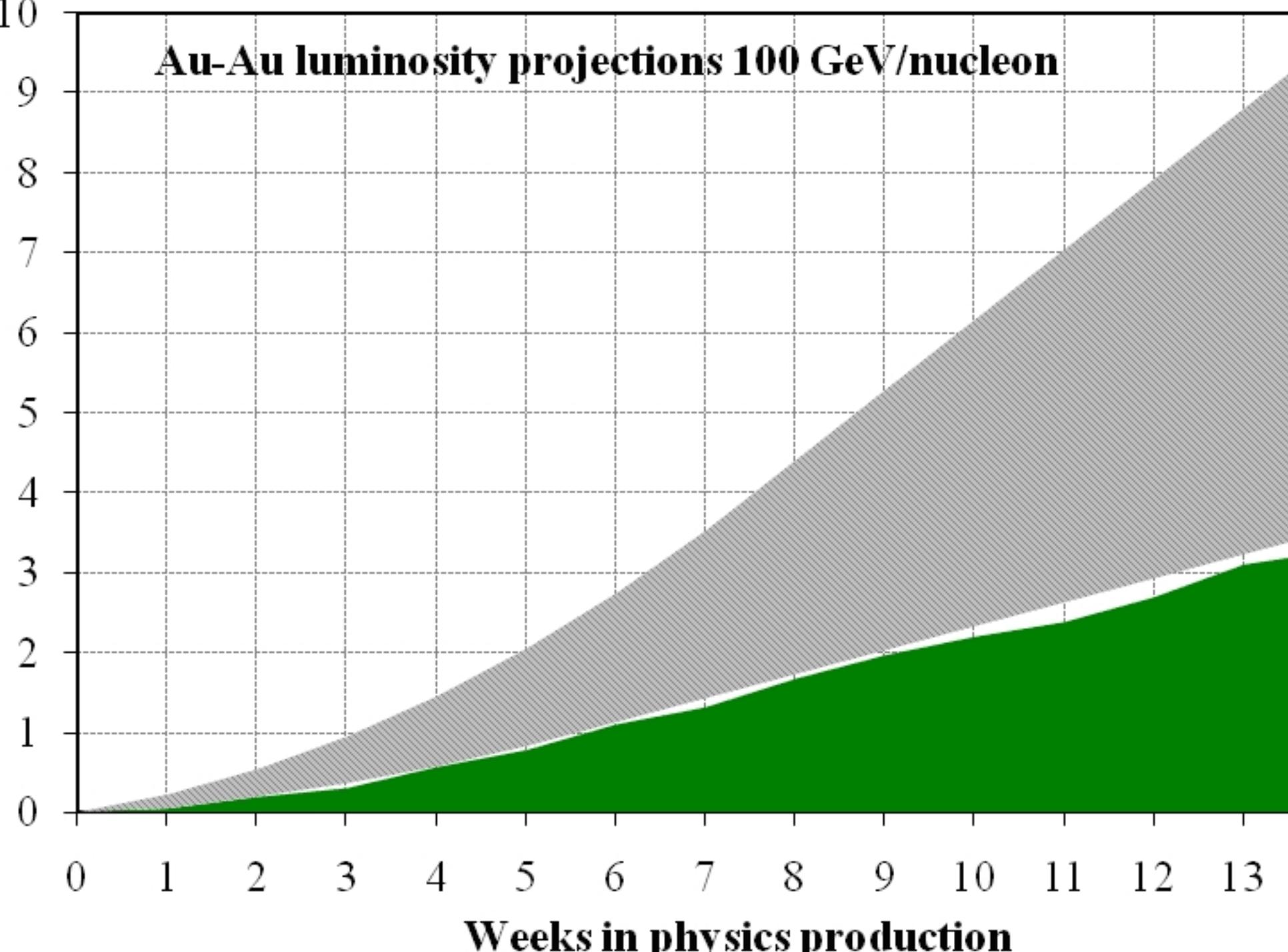
### Pre-Dry Run Plans

**October 1-9, FEC's, Servers, MCR Consoles, Permit link, event link's, remote scopes and other systems turn on.**

During October all systems listed below will be brought on and tested individually, by the responsible contacts, as given below. Final check and testing will be performed during the dry run. By that time all systems will have been tested at least once, and any problems will have been fixed.

# Run 10 Au-Au Goals

No of bunches	= 103
Ions/bunch [ $10^9$ ]	= 1.1 (>1.2)
$\beta^*$ [m]	= 0.6 m
Emittance[mm]	= 17-35 (smaller?)
$L_{\text{peak}}$ [ $\text{cm}^{-2}\text{s}^{-1}$ ]	= $44 \times 10^{26}$
$L_{\text{store avg}}$ [ $\text{cm}^{-2}\text{s}^{-1}$ ]	= $27 \times 10^{26}$
$L_{\text{week}}$	= 0.9 nb $^{-1}$
Time in Store	= 60 %



# Commissioning Items

- Transition crossing at different times (with IBS Suppression lattice, both rings) and Radial Feedback (yellow)
- New LLRF (+ Quad mode damper at transition)
- Ramp/Global Orbit Feedback (slow feedback)
- **Stochastic cooling** (once there are steady stores)
- Reach lower  $\beta^*$  values ( 60 cm, 50 cm in APEX)
- Slow  $\xi$  jump at transition (no backlash after jump)

# Split GammaT's Ramp – Au101

- Gamma jumps occur 1.3 sec apart, yellow first
- Both rings with IBS suppression lattices
- At store:  $\beta^* = 0.6\text{m}$  at IP6 and IP8, 4.0m elsewhere
- Crossing angles at 2mrad for IP10, IP12, IP2 and IP4
- Ramp Time is 380 sec, set by Sext. Ramp limits
- Backup = Au100, gamma jumps at same time

# Lattice

- Injection
  - ♦  $\beta^*$  all 10 m (possibly 7.5 m)
  - ♦  $B\rho = 81.1138 \text{ Tm}$
- Ramp
  - ♦ Start with separate  $\gamma_{\text{tr}}$  ramp
  - ♦ Start  $\beta^*$  squeeze just after transition
  - ♦  $\beta^* = 5 \text{ m}$  during transition
- Store
  - ♦  $\beta^* = 0.6 \text{ m}$  at IR 6 & 8
  - ♦  $\beta^* = 4 \text{ m}$  at all others
  - ♦ 2 mRad crossing angle at 4 m IR's
  - ♦ Working points (fractional) the same as in Run 7

# Beam Development

- Main focus – *Stochastic cooling*
- Others:
  - ♦ Gamma-tr instabilities = limits intensity to 1.1
    - Chromaticity
    - $dp/p$
    - E-cloud?
  - ♦ Orbit feedback systems (slow, fast) when ready
  - ♦ Reducing long. Emittance (how far ?)
  - ♦ Injection matching
- *Maximizing collision rates/minimizing backgrounds*

# Reminders from RHIC Retreat

# Stochastic Cooling

Mike Brennan & Mike Blaskiewicz

# Reconfiguration for FY10

- Up to now we have only cooled **one** of the six possible phase space planes (Yellow longitudinal)
  - The Blue longitudinal systems has only seen deuterons and protons
  - For **FY10** we will have systems for cooling **4 planes** (longitudinal and vertical in both rings)
    - We expect some cooling to be transferred from vertical to horizontal via betatron coupling
    - Cooling in the transverse plane will make longitudinal cooling more difficult because smaller emittance enhances IBS
    - See Blaskiewicz talk for luminosity projections
- Therefore even the Yellow longitudinal system will be new this year
  - To go beyond halo cooling we jettison the two-turn filter
  - Add another **microwave link** to cut the chord
  - Extend the **frequency range to 9 GHz** (like Blue)
- We have to build another original kicker machine for Blue vertical
  - Same microwave cavities as Yellow vertical but new **concept for the opening mechanism**
  - A new concept is called for so that we can efficiently build kickers for the horizontal cooling system
  - This effort is underway thanks to the **stimulus funding**
- We have also run out of Tevatron pickups
  - The longitudinal systems (Blue and Yellow) will use a new concept
  - Longitudinal is easier, therefore no motion in vacuum is required
  - The new concept is based on commercial waveguide-to-coax transitions
  - Tested this year at Blue pickup

# Commissioning Plans

1. Initial checkout of pickups and microwave links
  - Beam at injection with reasonable lifetime
  - Some ring access likely (pickup electronics)
2. Real checkout needs beam at store
  - Need small beam size to close devices to small aperture
  - Rebucketed beam to get 5 ns bunches
  - Need reliable BPMs at Q4s
  - Set up software to read PIN diodes
3. Precise adjustment of pickup-to-kicker delays needs beam at store (six bunches is hard to see the gap)
4. We need to establish reference BTFs for each cavity (4 x16 ) for all four planes
  - One plane per shift is optimistic
  - The interaction between planes is something new. It likely will require iterating these reference BTFs
  - Commission the software that stabilizes these BTFs
5. Testing and refining TAPE sequences will be on-going as other systems come on line
  - rebucketing
  - Collimation
  - Orbit correction
  - Backgrounds/vacuum
  - We want to switch on cooling as early as possible in a store
6. Ring access will require some priority during commissioning (!)
7. A WILD GUESS.....we would have all four systems running three weeks after we have stable beam at store

# From my notes

- initial check out of pickups and microwave links as soon as there is beam, but can't close the pickups at injection.
- real checkout occurs when there is steady beam at store.
- Key dry run activity, testing the tape sequences
- expect all four systems will be running (not optimized) three weeks after steady stores.
- *Need stable beam during the day shift*

# New RHIC LLRF

Kevin Smith

(with slight format editing by K.Brown)

# The Plan For Run 10

- 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 ...

# LLRF Commissioning plan

	Post Retreat Clarification Edit	
	Conservative	Optimistic
<ul style="list-style-type: none"> <li>This (LLRF) remains a commissioning effort and we will need machine time                             <ul style="list-style-type: none"> <li>Blue Injection, Timing Setup, Injection Correction, Capture                                     <ul style="list-style-type: none"> <li>Testing and debugging of BTB Phase Detector</li> </ul> </li> </ul> </li> </ul>	1 x 12 Hrs	1 x 12 Hrs
<ul style="list-style-type: none"> <li>Blue Acceleration, Transition Crossing, Store Cogging Testing, Rebucket Testing                             <ul style="list-style-type: none"> <li>Testing and debugging of BTB Phase Detector, Feedback DSP, DAC Firmware</li> </ul> </li> </ul>	2 x 12 Hrs	1 x 12 Hrs
<ul style="list-style-type: none"> <li>Yellow Injection, Timing Setup, Injection Correction, Capture                             <ul style="list-style-type: none"> <li>Ditto Blue.</li> </ul> </li> </ul>	1 x 12 Hrs	0.5 x 12 Hrs
<ul style="list-style-type: none"> <li>Yellow Acceleration, RTR Synchro, Transition Crossing                             <ul style="list-style-type: none"> <li>RTR Synchro loop moves from analog to digital</li> </ul> </li> </ul>	1 x 12 Hrs	0.5 x 12 Hrs
<ul style="list-style-type: none"> <li>Collision Cogging, Rebucketing                             <ul style="list-style-type: none"> <li>Rebucket gymnastic is a new implementation, simpler in hardware.</li> </ul> </li> </ul>	1 x 12 Hrs	1 x 12 Hrs
<ul style="list-style-type: none"> <li>Quad mode damping                             <ul style="list-style-type: none"> <li>Completely new implementation, embedded in new hardware (firmware)</li> </ul> </li> </ul>	1 x 8 Hrs	1 x 8 Hrs
	80 Hours	56 Hours

Note: Original estimate for the Run 9 Start-Up commissioning was 96 Hours = 8 x 12 Hrs. See Dejan's Meeting, 12/22/2008.

We actually took less than 20 hours in the two Run 9 commissioning development days. So the benefit of those days has been realized both in terms of the upgrade effort proper, and in required commissioning time.

# Transition Christoph Montag

# Improvements to Transition Crossing

- Chromaticity jump
  - ♦ Using RHIC's 8 sextupoles families, chromaticity jump can be modified
  - ♦ Tested at in injection during Run-8
- Longitudinal quadrupole oscillations
  - ♦ Longitudinal quad mode damper in LLRF
- Radial feedback in Yellow
  - ♦ Yellow RF is tied to Blue master and cannot compensate for small field errors (radial offsets)
  - ♦ Adjust Yellow dipole field instead, based on BPMs
- Different  $\gamma_t$  in the two rings
- Alternative method to separate  $\gamma_t$  – new idea, to be further investigated

# Summary

- Startup schedule is aggressive
  - ♦ Commissioning new ramp
  - ♦ Commissioning new LLRF
- Once there are steady stores
  - ♦ Stochastic cooling has priority during days (potentially useful time for experiments)
  - ♦ Beam development in evenings
- 9 am meeting every day (M-F) in LCR
- 3 pm meeting every day (S-S) in MCR CR (w/ shift leaders, mcr staff, exper. Invited)