

# Stochastic Cooling, Plans for FY10 Run

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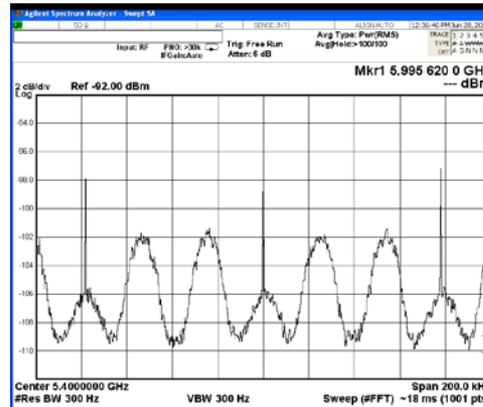
RHIC Retreat  
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# Outline

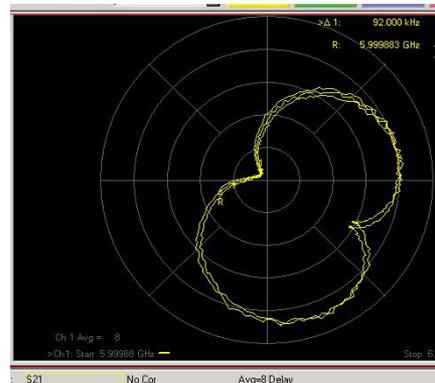
- Results from tests with protons
- Reconfiguration for FY10, Gold operations
- Commissioning plans
- 9 MHz, status and outlook

# Results from Proton run

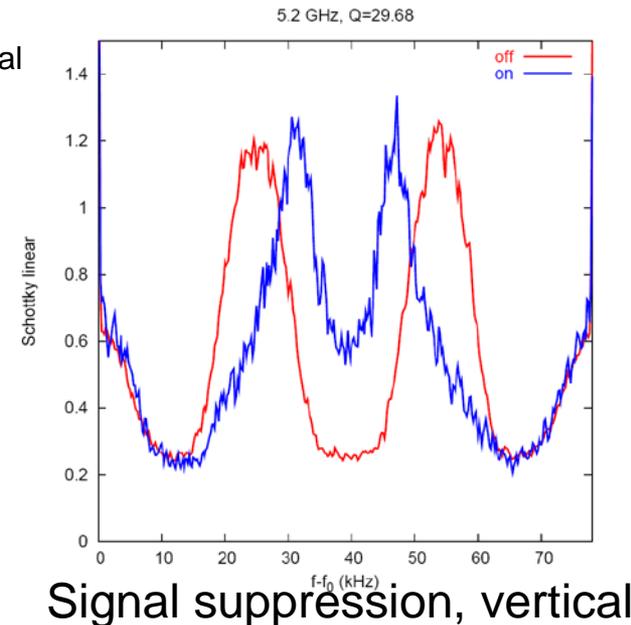
- The first transverse system was installed and tested with protons
  - The first one that was not made from modified Tevatron gear
  - Uses a new mode of operation of the microwave kickers
  - Requires using the pickup in the differential mode, not the sum mode, lower signal-to-noise ratio
- The kicker hardware tested ok with beam
  - Demonstrated by Beam Transfer Function measurement
  - All 16 cavities reliably tune to the correct frequencies, the mechanics work
- The precise pickup to kicker timing was established allowing “**signal suppression**” to be demonstrated (see Mike Blaskiewicz’s talk)
- We were not able to test cooling of a low intensity test bunch (1%) because the signal-to-noise was insufficient from the difference pickup



Vertical pickup with betatron lines and common mode signal



Beam Transfer Function

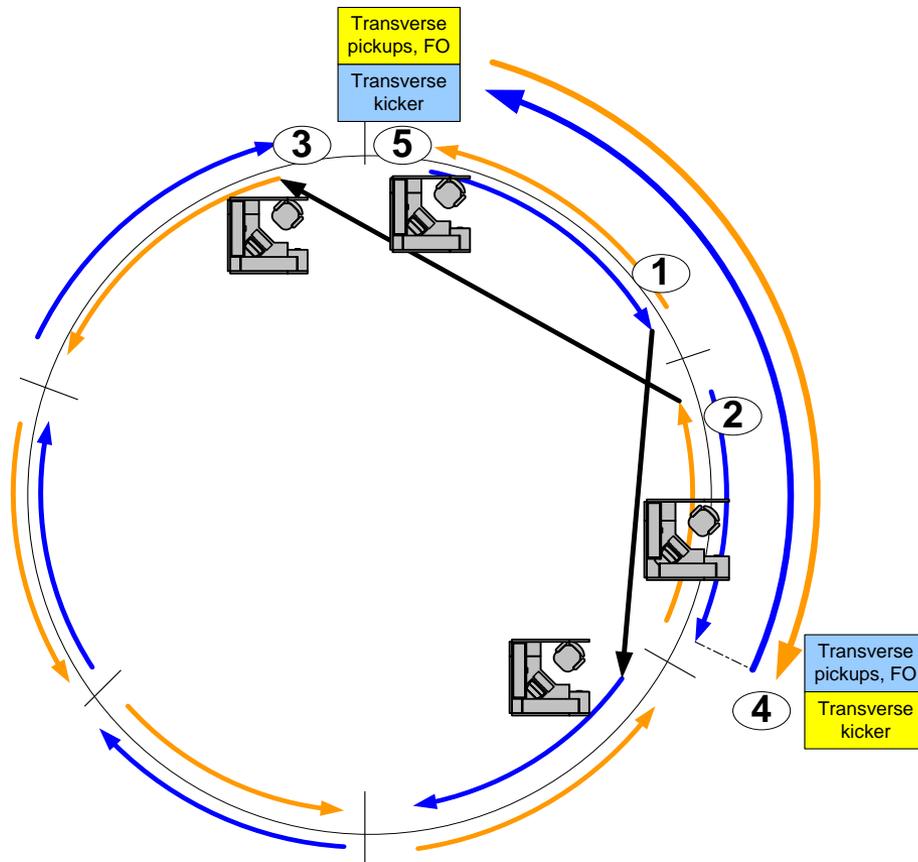


Signal suppression, vertical

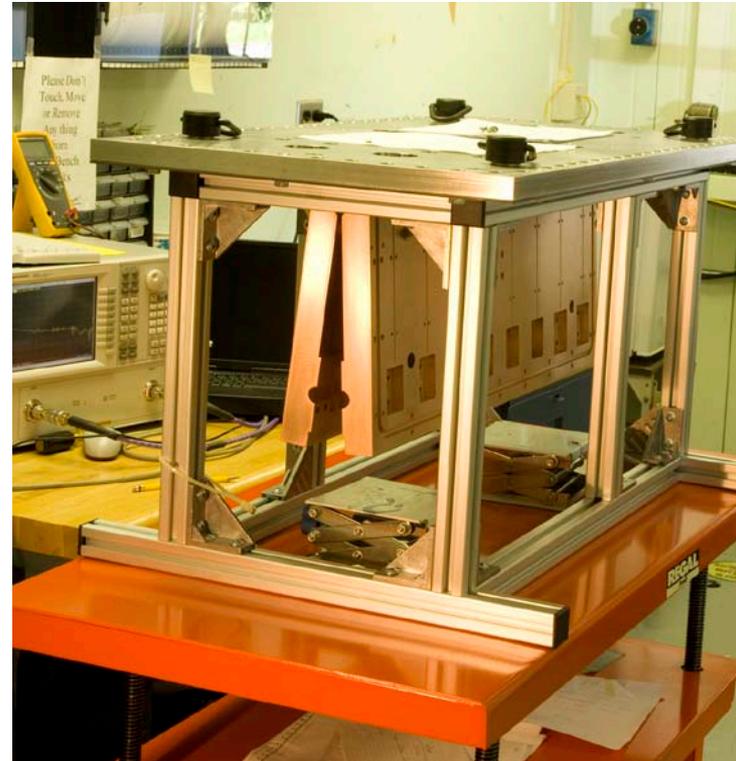
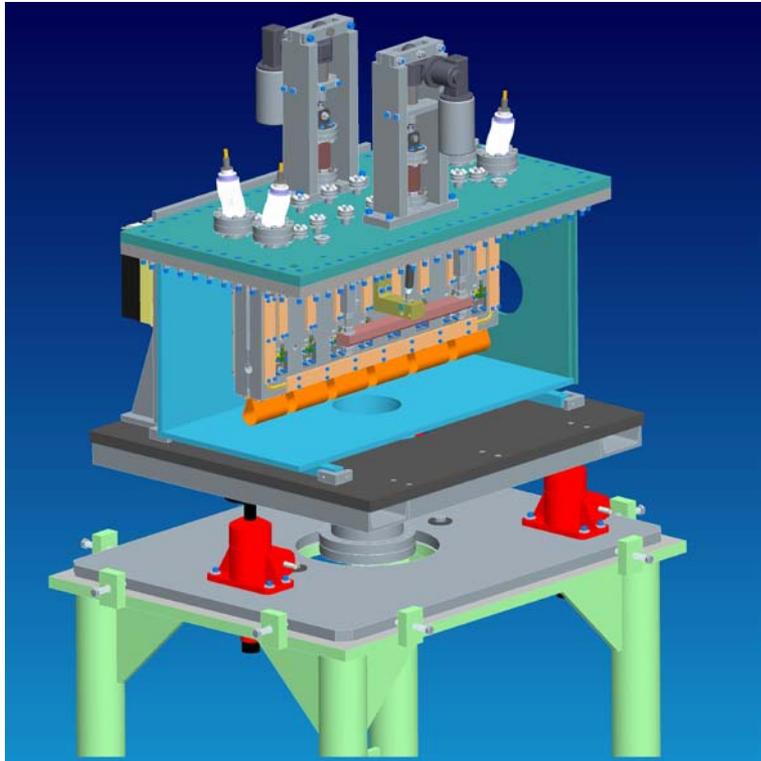
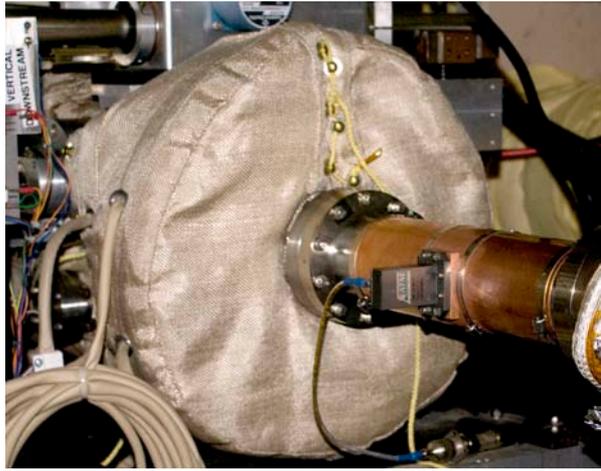
# Reconfiguration for FY10

- 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

# “Musical Chairs” (no quiz!)



1. New pickup, Blue longitudinal
2. New pickup, Yellow longitudinal
3. Microwave link, upgraded kicker (9 GHz), new low-level enclosure
4. New pickup, Blue vertical (from 1.)
5. New kicker, Blue vertical



# 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

# 9 MHz, The situation and outlook

- Quick review: purpose and principle of operation
  - The purpose is **to make short bunches** during store without suffering transverse emittance growth due to electron cloud during ramping
  - The principle is to keep the bunches **long without increasing the longitudinal emittance**
  - The way to long bunches is low rf frequency (9 MHz)
  - The way to low longitudinal emittance is low rf voltage (~ 20 kV)
- What went wrong? 1. the power supply glitch, 2. emittance growth at injection
  1. The fix for the power supply glitch is straightforward. We need a bouncer cavity in each ring to compensate for the differences in the dipole between Blue and Yellow mains.
  2. We found that high intensity bunches went unstable at injection when captured in the 9 MHz. The growth rate was on the order of a few minutes. Too fast to fill even one ring.
  3. We could stabilize the bunches with the Landau cavities but at the expense of emittance growth. Then we not only didn't get short bunches we didn't even have enough bucket area to accelerate at max B-dot. 80% transmission.

# 9 MHz, Where to go from here?

- We need to study prospects for damping the bunch instability
  - A Landau cavity would work but our existing cavities have too much voltage (beam loading sets the minimum)
  - We need a new dedicated cavity, but what frequency and voltage are optimum?
- Another approach is to build a active damper
  - Such a damper would (could) have other benefits, for ions at transition, for example
  - What modes need to be damped? Dipole, quadrupole, up to 200 MHz?
  - The technology is an open question
- The subject needs further study. I don't have specific proposal.
- P.S. We will have to do better at making lower longitudinal emittance for protons in the Injectors.

# Conclusions

- This run will have stochastic cooling in two planes for both rings
- The hardware is getting a major reconfiguration this shutdown
- Commissioning can start when we have stable stored beam and will take three weeks (guess!) to start cooling
- 9 MHz remains a work in progress. Stabilizing bunch shape oscillations is the essential challenge ( and opportunity ) for progress in making short bunches