

Stochastic Cooling Studies at ATF

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Outline

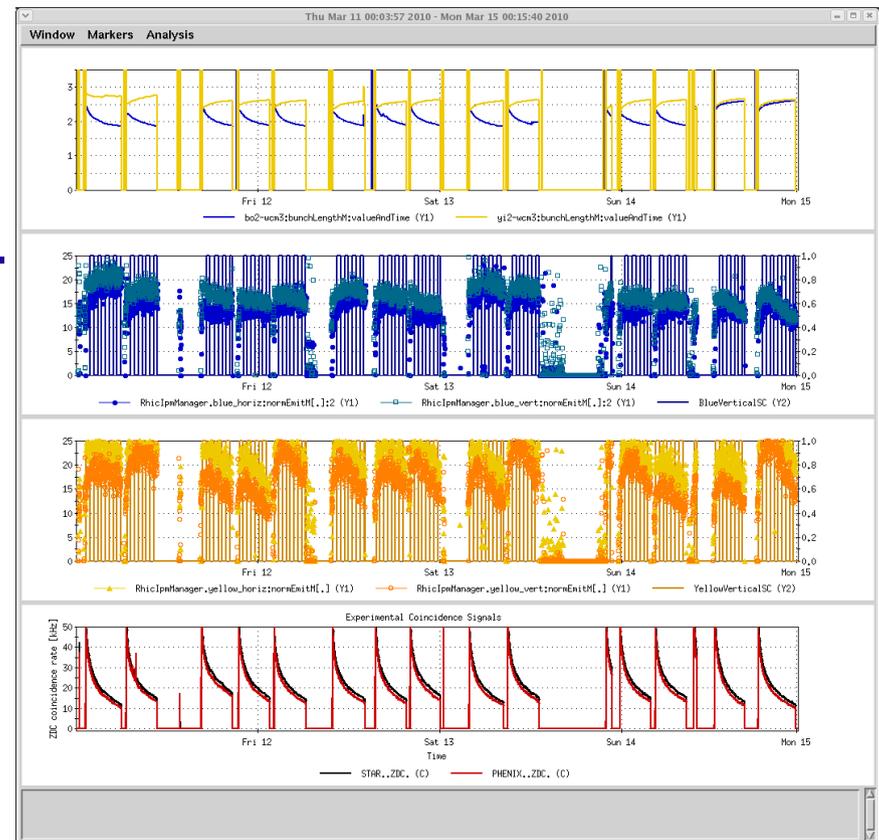
- Overview of Stochastic Cooling at RHIC.
 - Motivation for studies at ATF.
- First test and first results.
- Future plans.

Cooling at RHIC

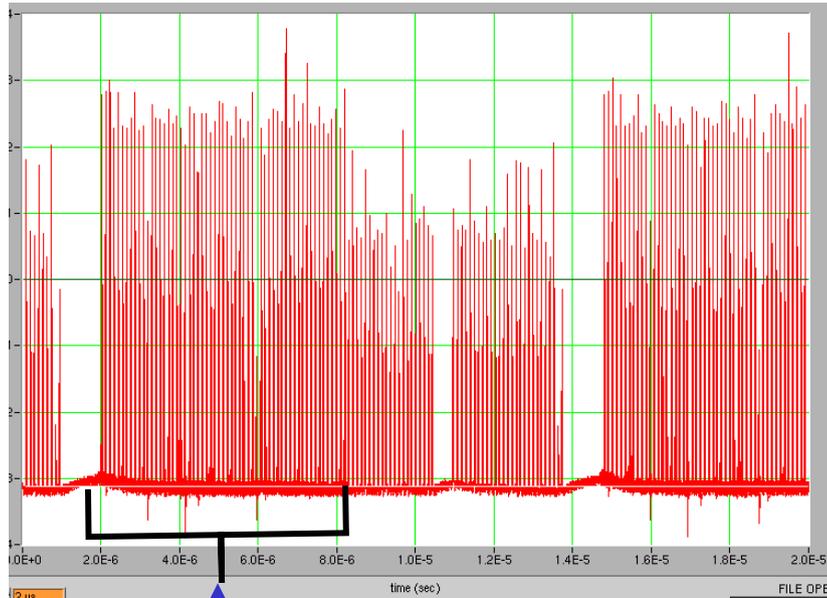
- Stochastic Cooling at RHIC can provide up to a factor of 4 increase in luminosity during high-energy gold runs.

- $$L = N_B^2 f_B / 4 \epsilon_{x,y} \beta^*$$

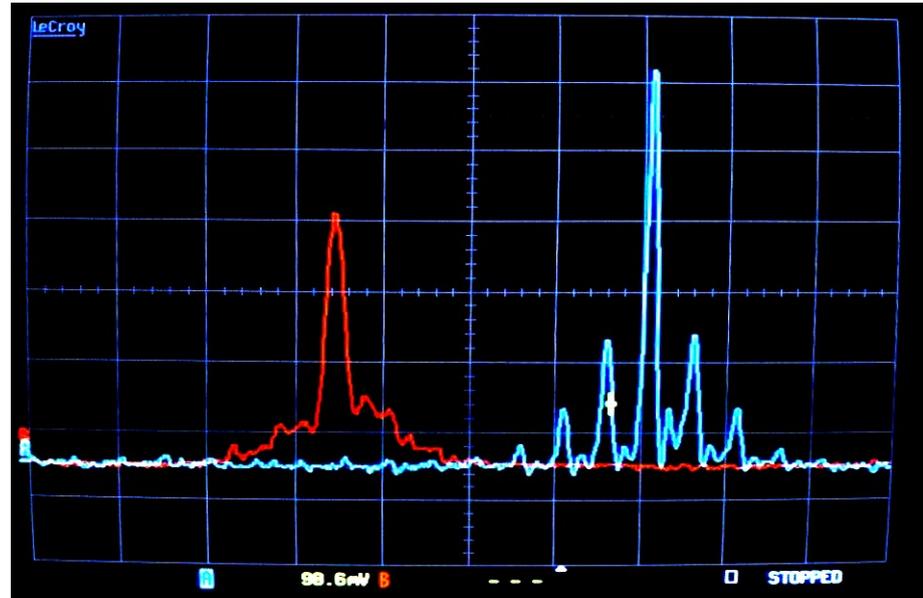
- This is achieved by reducing or reversing emittance ($\epsilon_{x,y}$) growth caused by IBS.



Visible results at RHIC.



Cooling was applied to half of the bunches



The peak current increased (right).

- Longitudinal Cooling reduces the longitudinal emittance.
- Compare cooled and uncooled bunches.

Two Pickup Issues

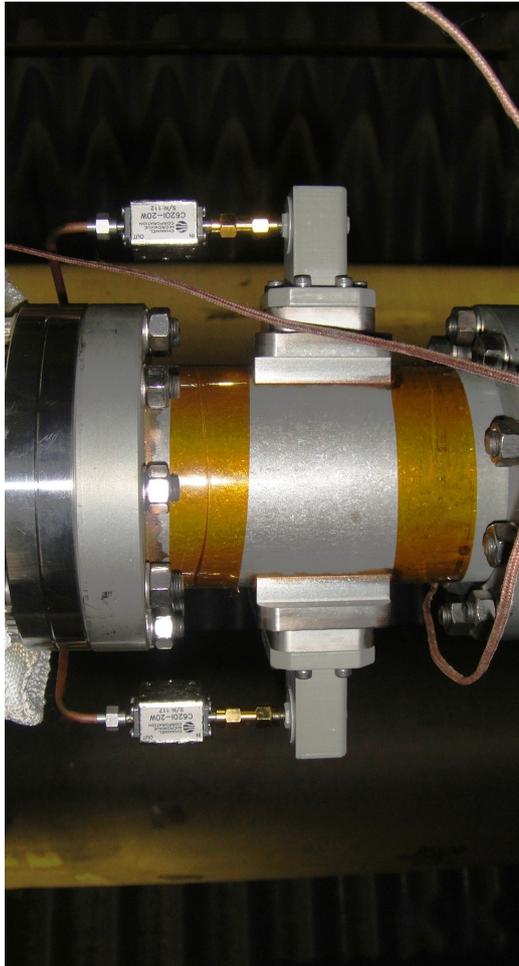
- Transverse pickups close in on the beam to choke off higher-order modes. The motion can cause problems.
- Longitudinal pickups are stationary, but have poor performance.
- We need to design and test new pickups, but how? We can only install once a year in RHIC.



Solution.

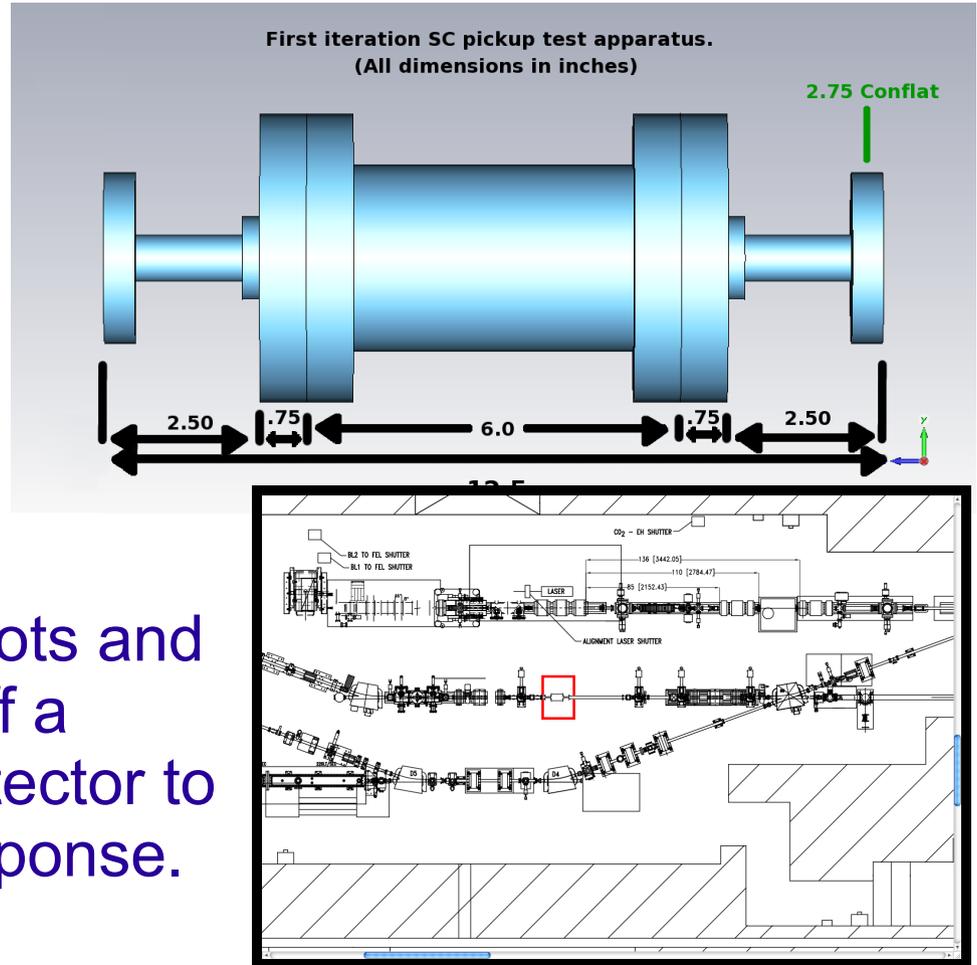
- Model with CST's Microwave Studio.
- Verify with BNL's Accelerator Test Facility.
- This allows many iterations in a (relatively) short timescale and the opportunity to “calibrate” Microwave Studio's predictions.
- ATF's 10ps, 1nC, 70MeV pulse appears as a delta-function to our pickups. The FFT of the signal provides a good analogue to RHIC's pulses.

First Test.



First try was a simple choke down To 1.25" inner diameter pipe.

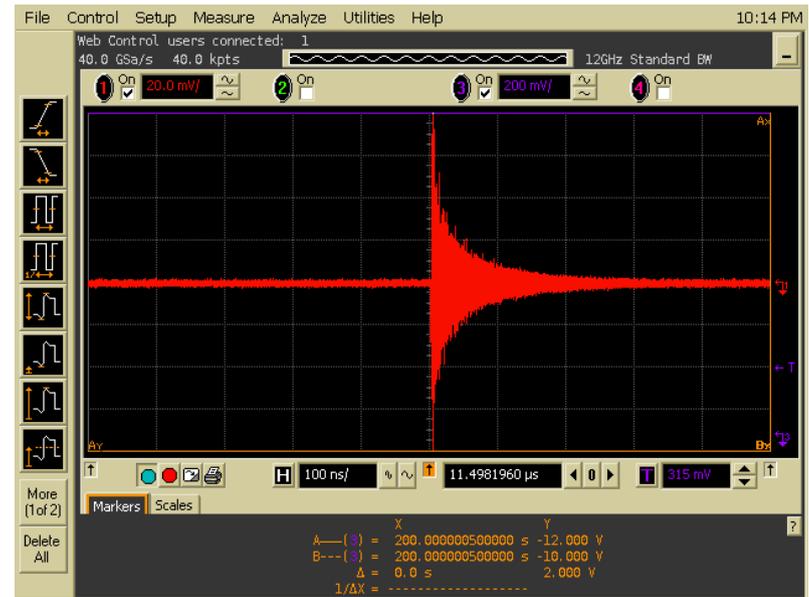
We took shots and triggered off a stripline detector to see the response.



Results.



Stripline sampled at 40Gs/s,
12GHz analogue bandwidth.

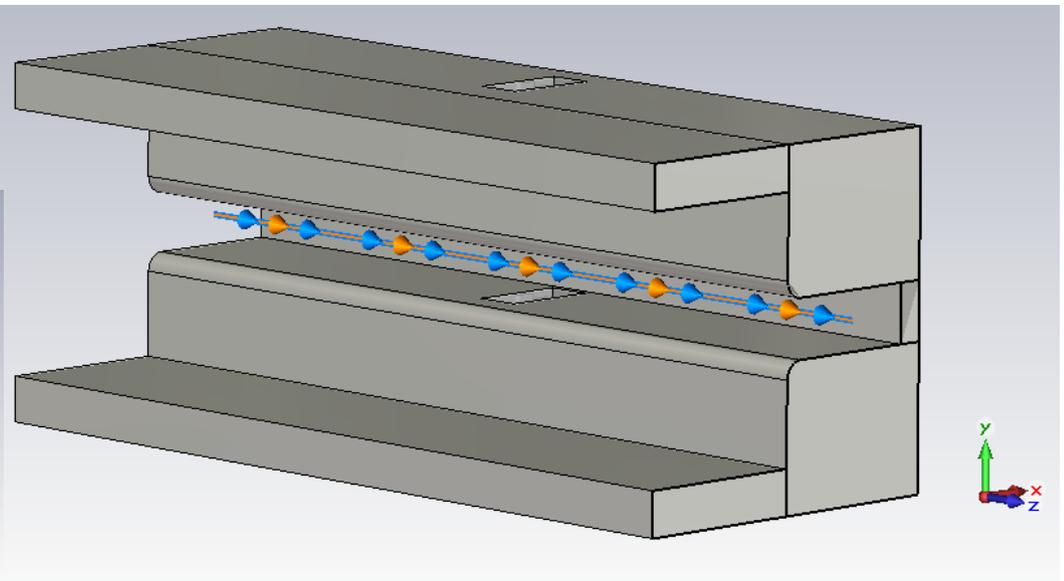
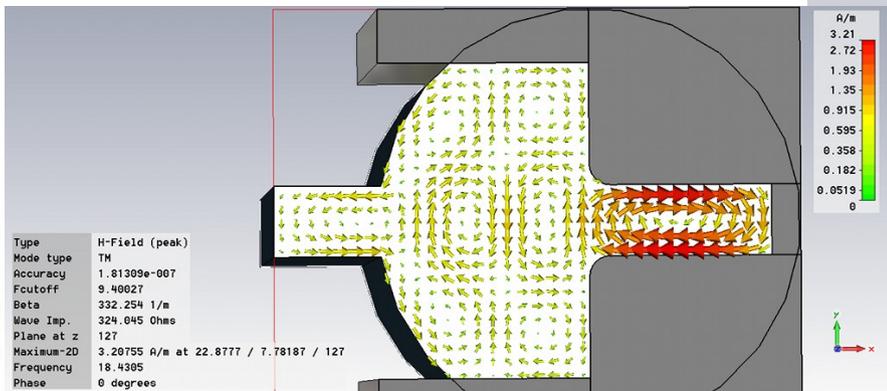


Waveguide pickup, same
setup.

Agreement with Microwave Studio predictions is encouraging.

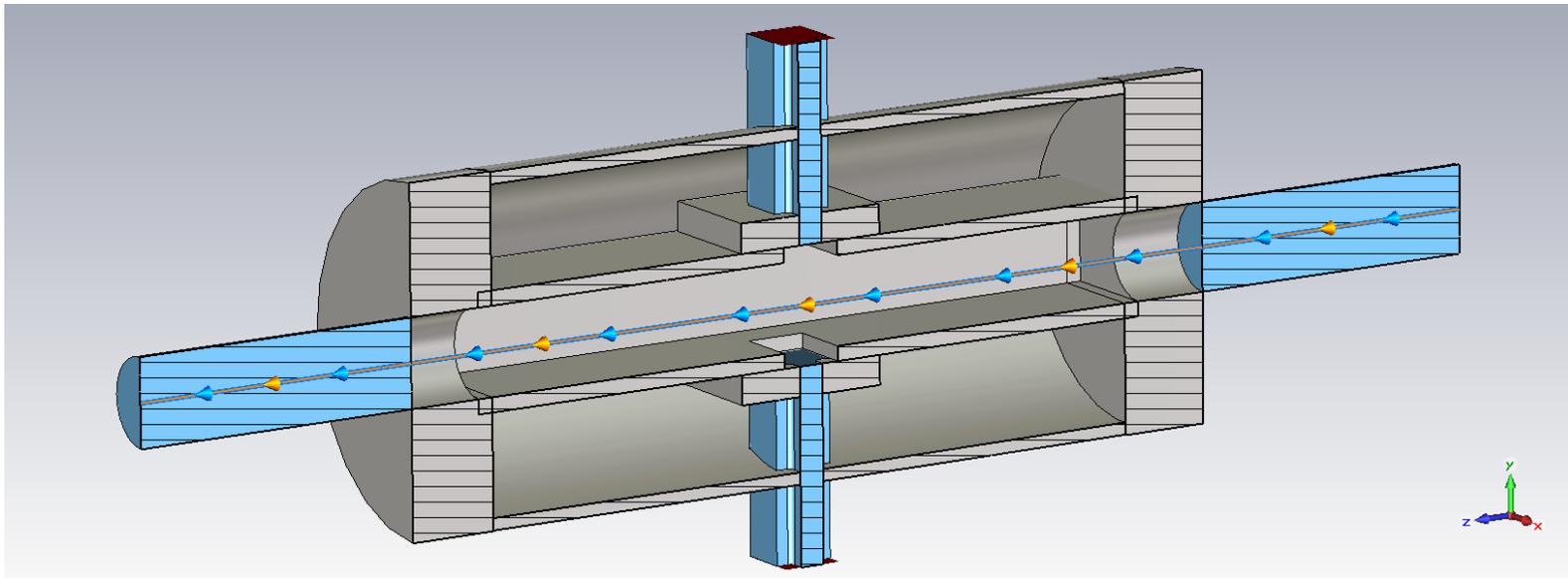
Future plans

- We need to choke off higher order modes. Our pickups operate up to 9GHz, so that is the lower limit.
- Results from Microwave Studio suggest that the following design gives 9.4GHz as the lowest resonant mode that will couple to the waveguide.



Design for next ATF Test

- In RHIC we have to concern ourselves with moving the beam or moving the pickup.
- At ATF, there is no change in beamsize, so we do not need to worry about that complication at the first pass.



Summary

- ATF has been demonstrated as a good environment for testing and verification purposes for Stochastic Cooling.
- With this facility, many years of research and design work can be reduced to iterations over a few short months.
- Tests that would once have been abandoned can now be attempted.
- Devices can be checked before being committed to installation into RHIC.