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.

- \[ L = N^2 \frac{f_B}{B} \frac{1}{4\epsilon_{x,y} \beta^*} \]

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

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

Cooling was applied to half of the bunches

The peak current increased (right).
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. Agreement with Microwave Studio predictions is encouraging.

Waveguide pickup, same setup.

Stochastic Cooling Group, BNL C-AD
ATF Users' Meeting, 10/6/10
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.