Polarized Protons at 100 GeV in Run-9

Christoph Montag

RSC Meeting, December 16, 2008

Improvements and plans for Run-9

- Run-9 will start with 250 GeV (Mei).

- Ramps will be identical up to 100 GeV, with squeeze to $\beta^* \approx 2\,\mathrm{m}$.

- Final β^*-squeeze at fixed energy.

- Continuous AGS tuning during 250 GeV run.

- Repair BPMs and re-align RHIC snake regions.

Improvements and plans for Run-9 (cont.)

- New LLRF, 9 MHz cavity, already commissioned during 250 GeV run.

- RF capture, instrumentation timing identical to 250 GeV.

- Start-up at 100 GeV should be faster than species change, somewhat slower than just energy change without β^* adjustment.

Tighter β^*-squeeze

- $\beta^* = 70\,\mathrm{cm}$ was tested during Run-8.

- Luminosity lifetime/beam lifetime at store are still uncertain.

- Tracking studies indicate that $\beta^* = 70\,\mathrm{cm}$ should be feasible. Will try $\beta^* = 50\,\mathrm{cm}$ during APEX if $\beta^* = 70\,\mathrm{cm}$ is successful.

- 40 percent luminosity increase (over Run-6/Run-8) seems realistic.

Nonlinear chromaticity correction

- Idea: Eliminate tune spread from nonlinear chromaticity, then fill up this space by beam-beam.

- Experience with $\beta^* = 70\,\text{cm}$ in Run-8 showed that this is already required for good lifetime.

- HARMON algorithm reduces dynamic aperture.

- Yun Luo developed more gentle correction that leaves second order chromaticity around 500 units and does not affect DA. To be implemented in Model.

- $20 - 30$ percent luminosity increase (?)

9 MHz cavity

- Reduces bunchlength by factor $\sqrt{2}$, or better (at store).

- Shorter bunches (at store) improve hourglass factor.

- Longer bunches on the ramp reduce transverse emittance blow-up due to lower peak current and resulting electron clouds.

- Common cavity will lock bunches on the ramp - avoids long-range beam-beam modulation.

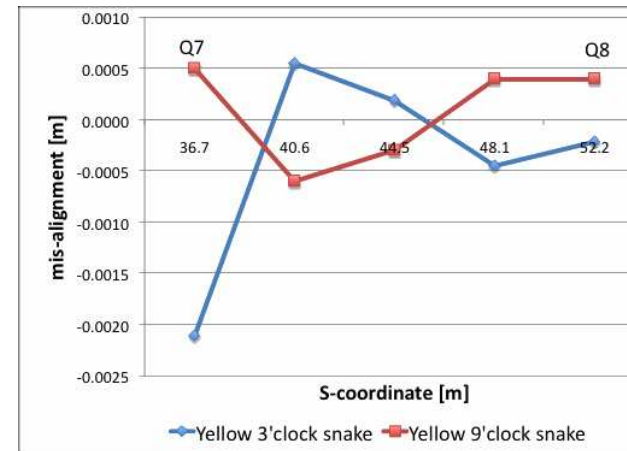- 15 percent luminosity increase.

Polarization
Horizontal snake angle from survey data
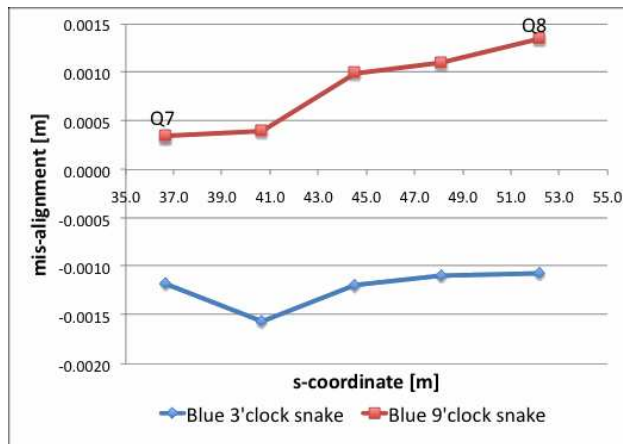
BLUE   YELLOW

$\Delta\Theta = -0.03\,\text{mrad}$ $\Delta\Theta = -0.11\,\text{mrad}$

Resulting spin tune error due to snake orbit angle:

$$\Delta Q_s = G\gamma\frac{\Delta\Theta}{\pi}$$

Consistent with spin tune measurements

Conclusion

- Expect fast start-up after 250 GeV run. Lumi after ≈ 1 week.

- Ramp to 100 GeV identical to 250 GeV ramp, then final squeeze from ≈ 2 m at fixed energy.

- $\beta^* = 0.7$ m at STAR and PHENIX, 7.5 m at other IPs.

- Avg. store luminosity of $40 \cdot 10^{30}$ cm^{-2}sec^{-1} seems realistic.

- Yellow polarization problem seems to be understood (snake orbit angle); BPM repair should have fixed this.