Strategies for RHIC polarization development

M. Bai, T. Roser, C-A Dept

❑ Experience of polarization setup

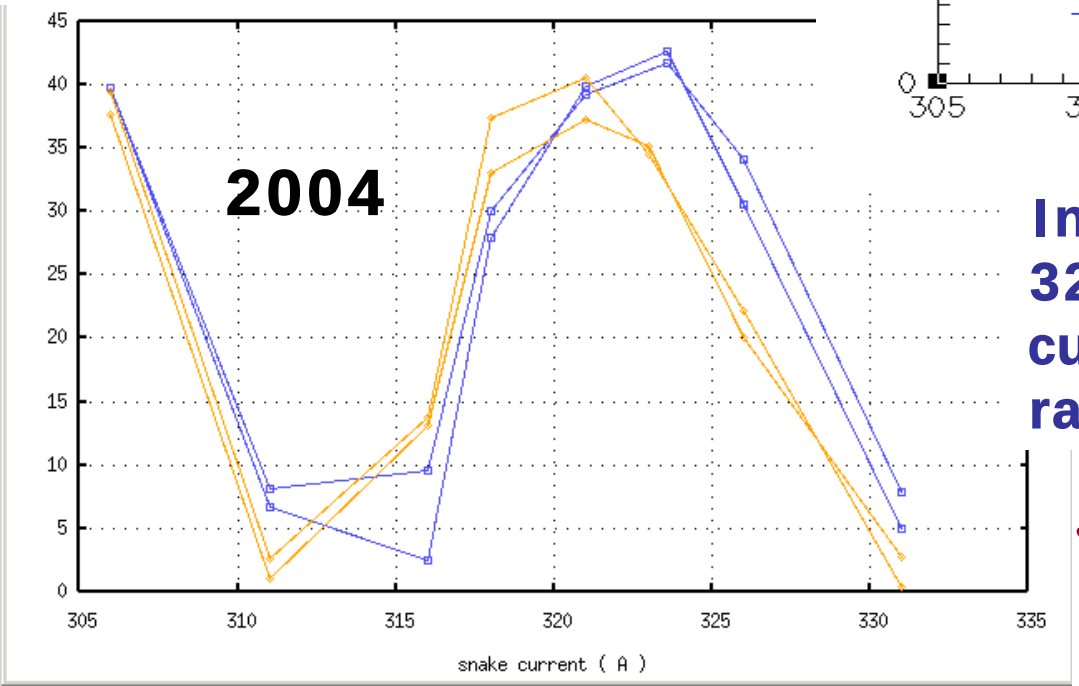
- Orbit setup: < 0.5mm for 100 GeV
- Optics setup: working point in resonance free window
  - Decoupling & Optimize chromaticity
- Optimizing Snake Setting
  - Is snake setting reproducible from year to year?
  - Can we trust snake current scan at injection?
  - Significance of the orbital angle between the two snakes?
- Ramp measurement
  - When shall we have a ramp measurement?
  - Is ramp measurement harmful to the target?
    - So far, no ramp measurement has hurt the targets.

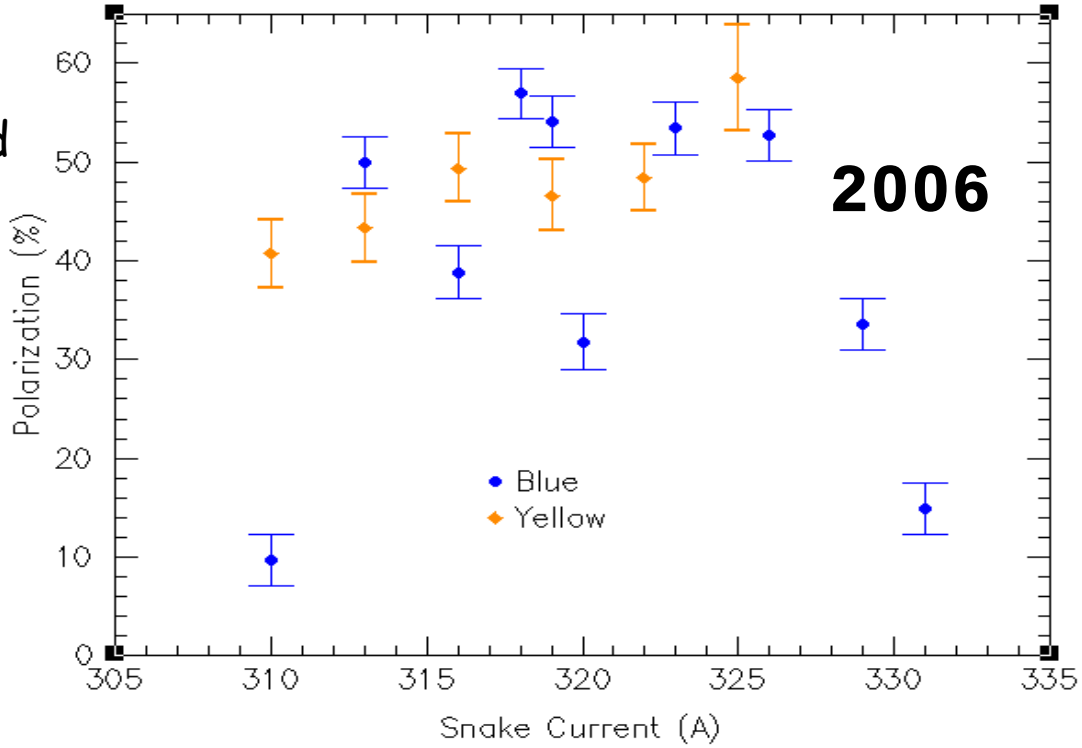
❑ Strategies for RUN 09

Snake current scan at injection

Mei's mistake for 2006 snake scan. The working point was not optimized for the scan. Blue was (074, 0.72) and Yellow was (0.73, 0.71). The Blue polarization loss around 310A is likely due to the coupling.

Both V tunes were set to 0.745 for the 2004 snake scan





In 2006, both currents were at 323A before scan. Left blue current at 318A which was then raised to 322A during week3

Snake current setting is re--producible from year to year

Orbital angle between Blue snakes

$$\Delta Q_s \approx G\gamma \frac{\Delta\theta}{\pi}$$

$$\Delta\theta = (b9\_b7 - b9\_b8) - (b3\_b7 - b3\_b8)$$

		Blue			Yellow		
year	Fill #	Δθ	ΔQs	Measured ΔQs	Δθ	ΔQs	Measured ΔQs
2006	7909 inj	0.55	0.008	--	0.06	0.0009	--
	7909 @gg179	0.43	0.024	--	0.08	0.0045	--
	7909 store	0.43	0.026	--	0.06	0.0036	--
2008	9981 inj	0.31	0.0045	~0.002	--	--	~0.005
	9981@ gg179	0.29	0.016	--	--	--	--
	9981 store	0.31	0.019	~0.005	--	--	~0.020

Spin tune difference between injection and store

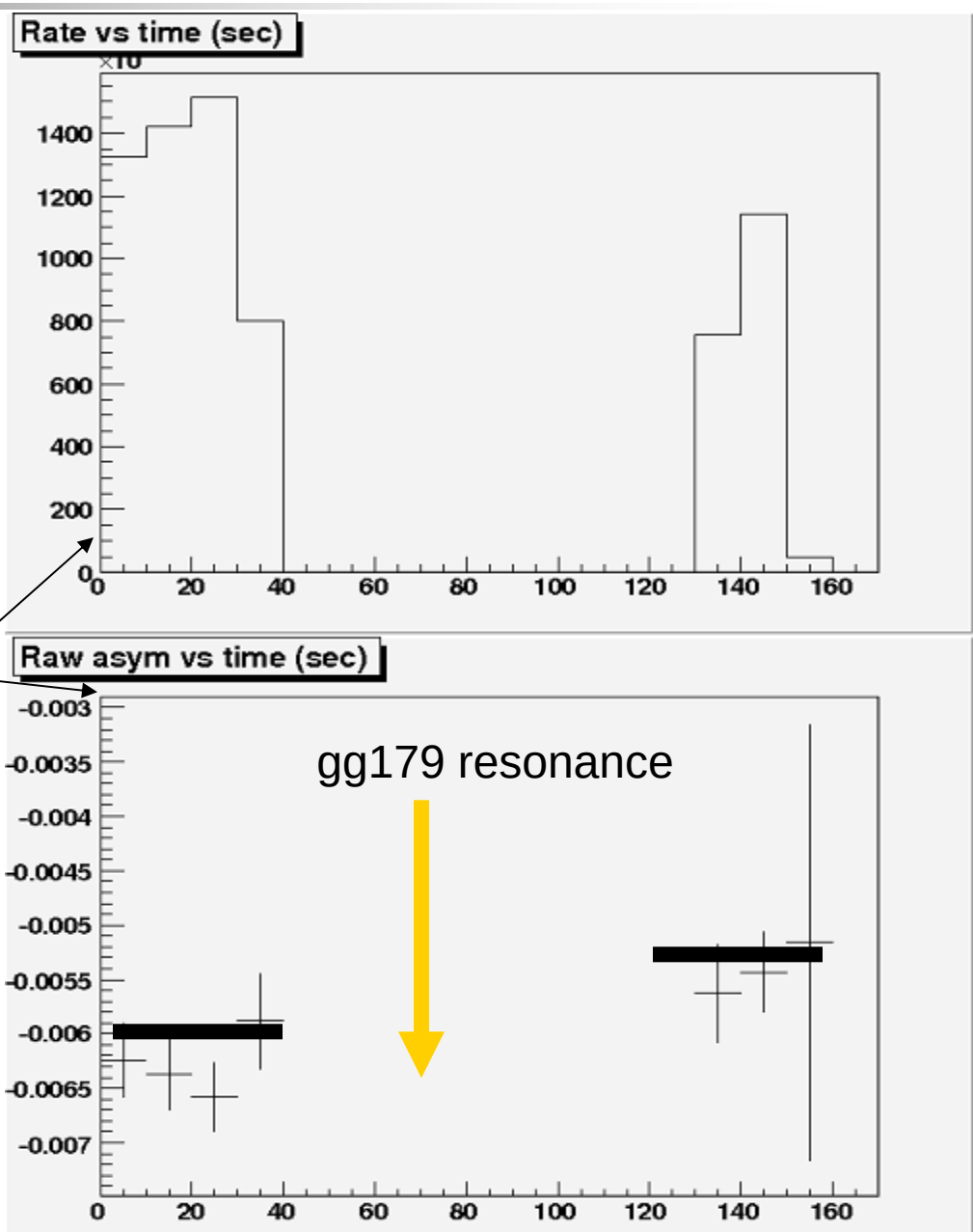
- Current understanding of fixed snake current effect on spin tune for different energy:
  - Tune difference: ~ 0.002 between 23 GeV and 100 GeV
- This is in conflict with observations, esp. in Blue
- Speculation to explain 2008 experimental data
  - For zero orbital angle between snakes, spin tune difference between injection and store for a fixed current is expect to be ~ 0.014, According to Vahid's paper (EPAC 2002), we expect 0.01 spin tune change between injection and store with fixed snake current for the ramp
  - In Blue, the spin tune shift from the orbital angle between snakes compensates the spin tune difference between injection and store
  - In Yellow, significant spin tune difference between injection and store was measured. Estimate zero orbital angle difference to explain.

Polarization ramp measurement

- Mechanism works
- Need deeper memory (1 billion events instead of 80 million). This way, we can take the ramp measurement for the whole ramp.

Step stone: gg63

Target first in the beam at gg63



Plan for shutdown

- Survey and align the two quads on either side of the snakes
- Fix the broken bpms: y9-b8 and y9-b10
- develop a plan to control the orbital angle between snakes
  - minimize the orbital angles between snakes
  - keep this fixed during the ramp as well as from ramp to ramp
- Systematic data mining of the orbital angle between snakes for RUN 06 and RUN 08
  - Difference between blue and yellow
  - Variation through a ramp
  - Variation during the run

Plan with beam

- Orbital angle between snakes scan at injection
  - Place the V tune at 0.745 and measure beam polarization for various orbital angles
  - determine the sign of the spin tune change for a given orbital angle change.
- Spin tune measurement at store
  - Minimum one store
  - first fire the ac dipole at a tune where we expect significant polarization can survive, for example 0.47 as we did in this run
  - Change the orbital angle between snakes with the amount of a spin tune change of ~0.005. measure the polarization. Repeat this step until a depolarization is measured. With the information of how many steps of orbital angle change and the sign of the spin tune change for the orbital angle change as measured at injection, one can then derive the spin tune at store.
- With the spin tune measurements at injection, 100 GeV and 250 GeV, we expect to disentagle the contribution to spin tune from the snake axes and the orbitial angle between snakes.

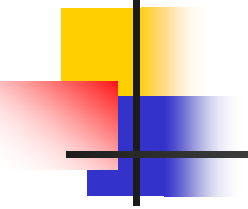
Conclusion

During machine setup

- Non-polarization beam based setup:
  - Orbit & Optics setup Optimizing Snake Setting
- Snake optimization
  - Minimize orbital angle between snakes
  - Snake current scan at injection
  - Spin tune measurement at injection and store
  - Should there be a significant spin tune difference between injection and store with minimized orbital angle between snakes, ramp snake current along the ramp

During machine ramp up

- Ramp measurement
  - Ramp measurement around the end of setup to confirm the setup
- Ramp tune scan
  - During the ramp up period



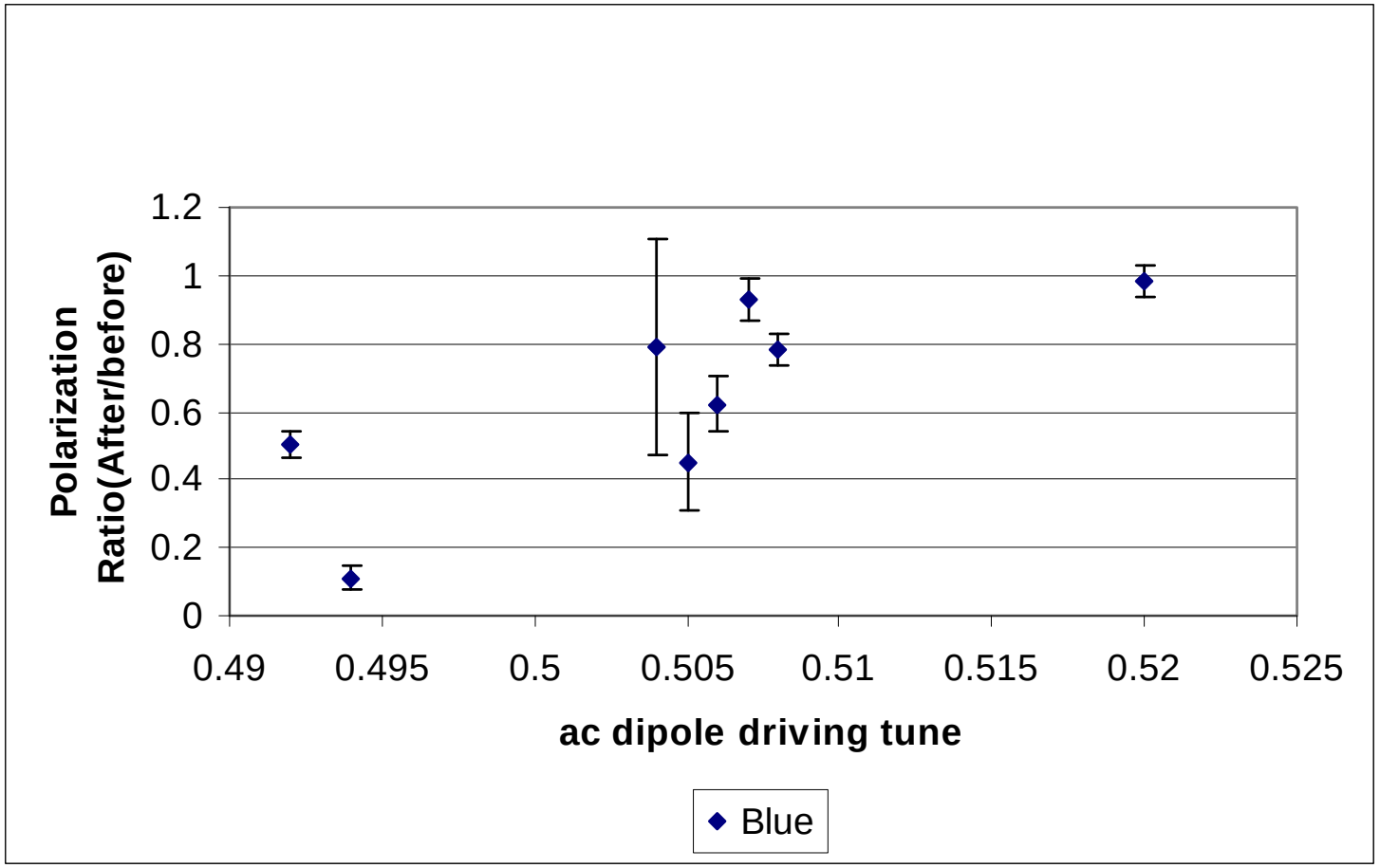
Backup slides

Orbital angle between snakes

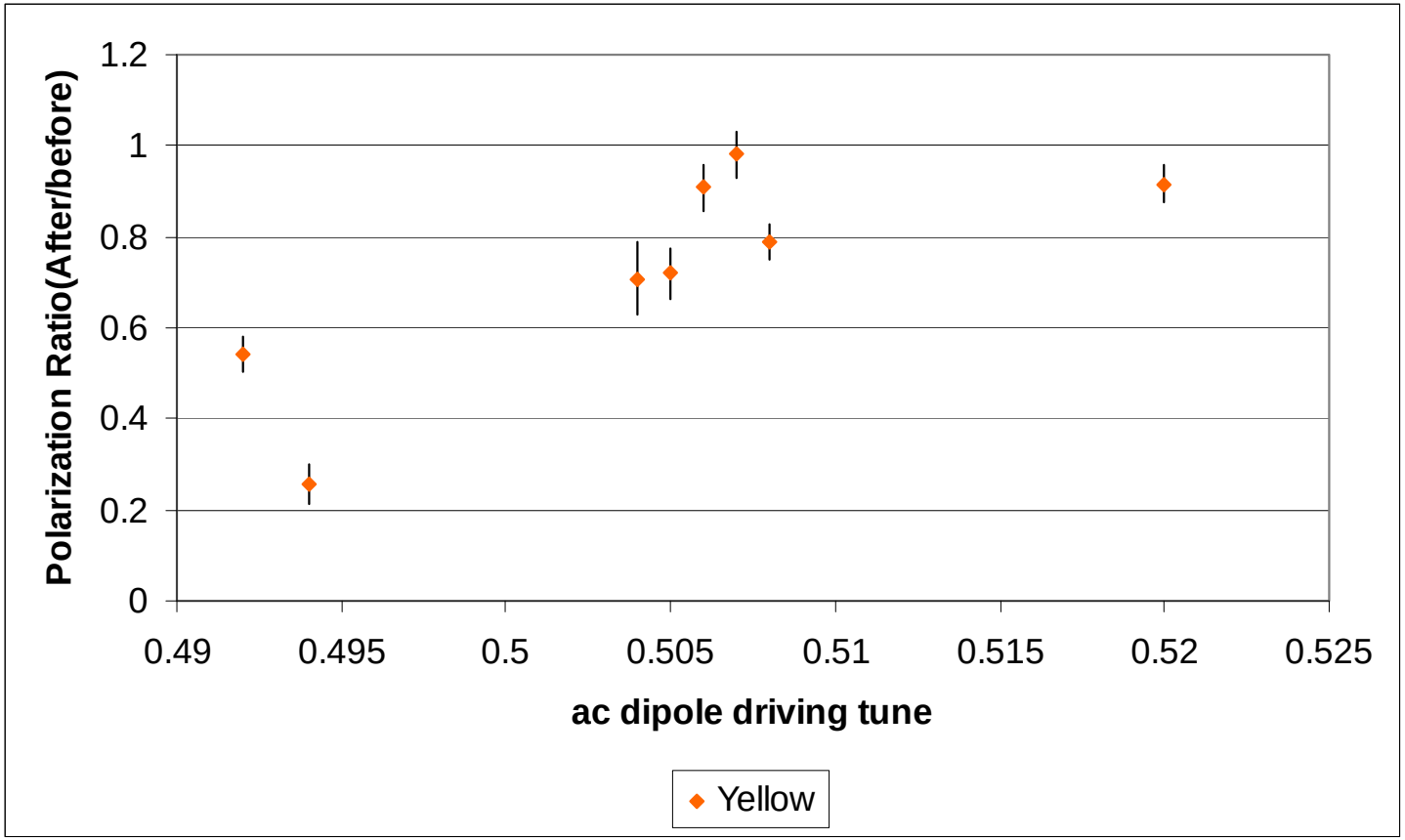
No data from y9-b8. This bpm was disable for run 08 due to bad feed through. The number here is my wild guess based on the bpm in the mid of the snake

Fill #	9'clk[mrad]	3'clk[mrad]	9'clk[mrad]	3'clk[mrad]
7909 inj	0.16	-0.39	-0.01	-0.07
7909 @gg179	0.13	-0.30	-0.06	-0.14
7909 store	0.13	-0.30	-0.08	-0.14
9981 inj	0.04	-0.27	N/A	-0.10
9981@ gg179	-0.02	-0.31	N/A	-0.11
9981store	0.03	-0.28	N/A	-0.11

AC Dipole scan at injection in 2008



AC Dipole scan at injection in 2008



AC dipole tune scan at store 2008

- Blue spin tune at 100 GeV: ~ 0.505
- Yellow spin tune at 100 GeV: ~ 0.52