

# Overview of Polarized Proton Commissioning/Polarimeter Status



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RHIC Retreat 2000  
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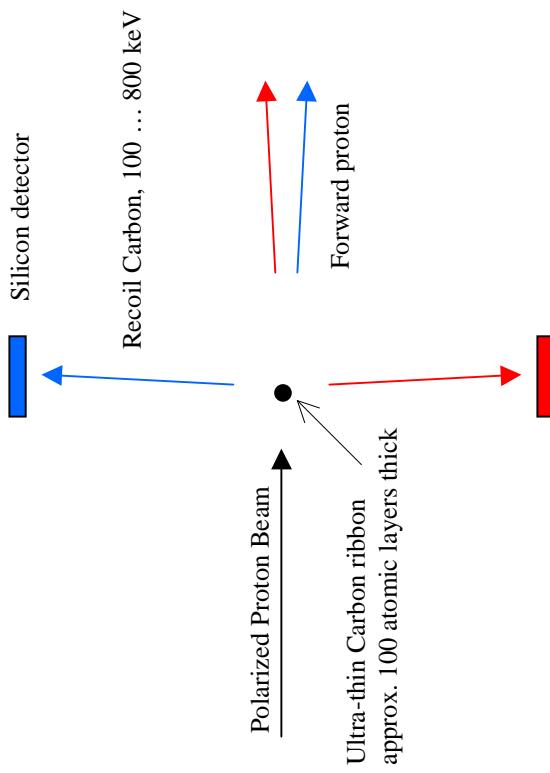
# FY2000 commissioning plan

- June-July 2000: (independent of RHIC operation)
  - New pol. source (OPPIS) commissioned and beam transp. through linac: 65% polarization measured at 200 MeV polarimeter,  
200  $\mu$ A and 300  $\mu$ s beam pulse (4 $\times$ 10<sup>11</sup> polarized protons )
- August 2000: (during RHIC Au stores)
  - Accelerate single bunch (10<sup>11</sup> pol. proton / bunch) in Booster and AGS to  $G\gamma = 46.5$  ( $\gamma = 25.94$ )
  - Commission coupled spin resonance crossing using horizontal rf dipole
- September 2000: (dedicated RHIC operation)
  - Inject 6 bunches (+ - + - + -) into RHIC blue ring with snake off.
  - Commission pC polarimeter and measure vertical polarization
  - Turn on snake and measure radial polarization
  - Accelerate and measure polarization

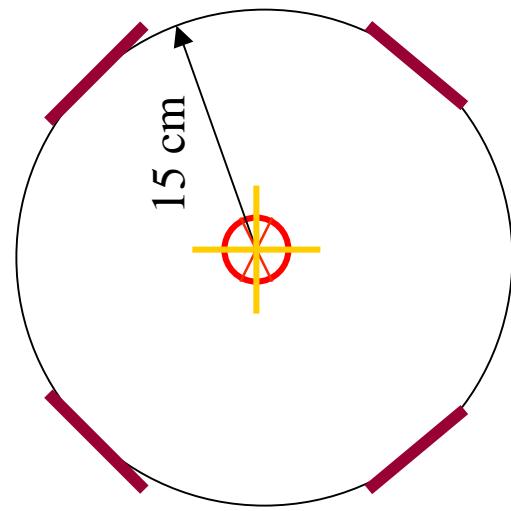


# Principle of CNI

- Forward proton is within the beam
- Detect the carbon recoil instead(Si detector)
- Slow recoil carbon detected between bunch crossings
- Ultra thin ribbon target allows for polarization profile measurement



# Year-One polarimeter



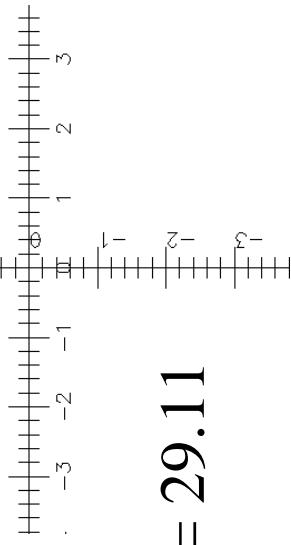
- Thin carbon target  $\sim 5 \mu\text{g}/\text{cm}^2 \times 10\mu\text{m}$ ;
- Horizontal and vertical targets;
- 4 Detectors 12 strips  $\times 2 \text{ mm}$ ;
- Strips in vertical direction;
- Trigger as "or" of all strips;
- DAQ with LeCroy FERA 4300 ADC/TDC;
- 6-bunch mode(+--+--);
- Up to  $3 \cdot 10^{10}$  proton/bunch

Carbon identification by time of flight/energy dependence:

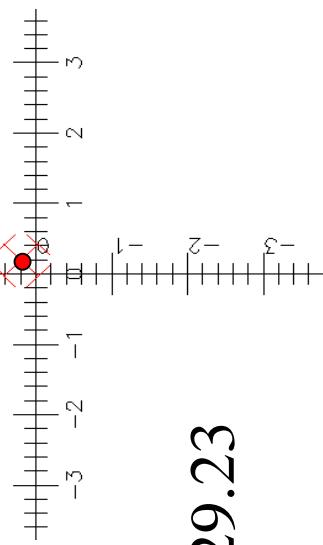
E, keV	T, ns
100	118
200	84
500	53
1000	37

# Pol. proton injection into RHIC

Injection at  $G\gamma = 46.5$  without  
snake: vertical polarization!



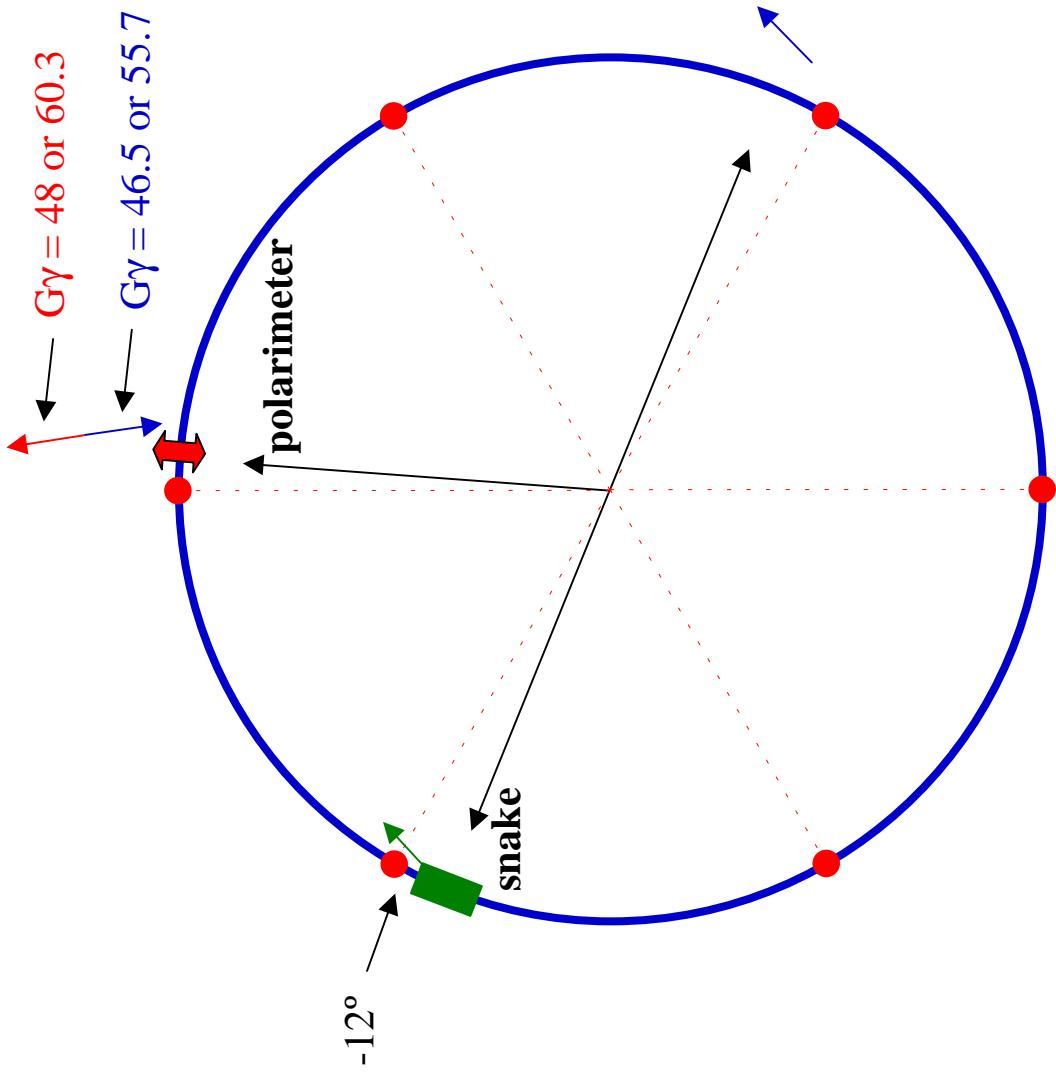
$$v_y = 29.11$$



Sensitive to betatron tune setting

$$v_y = 29.23$$

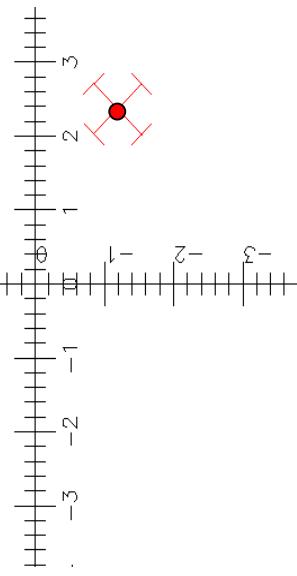
# Stable spin direction with a single Snake



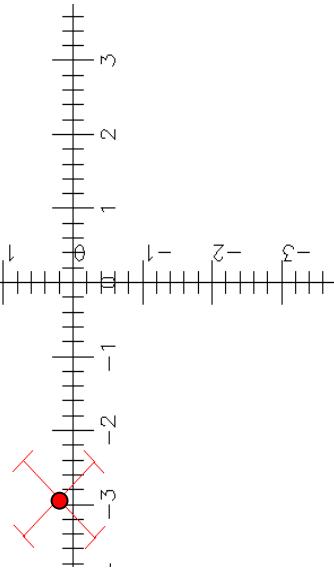
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# Acceleration with single snake

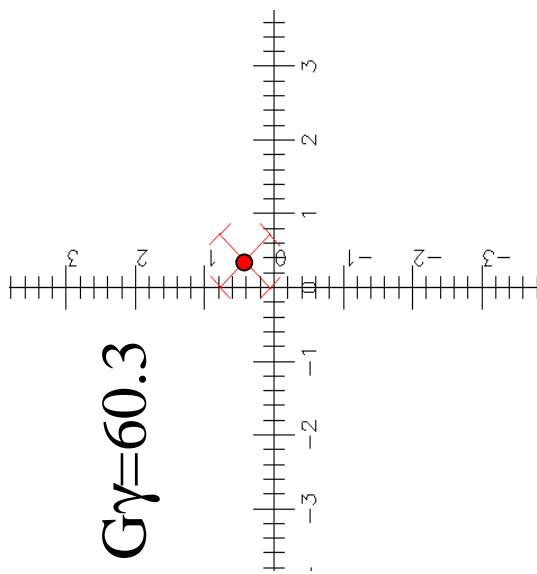
$G\gamma=46.5$



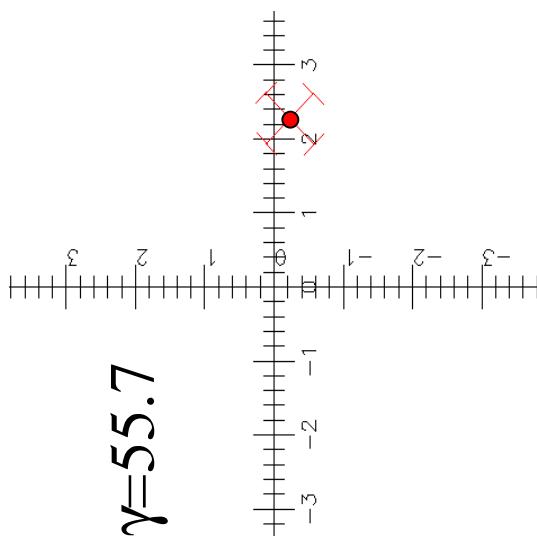
$G\gamma=48.0$



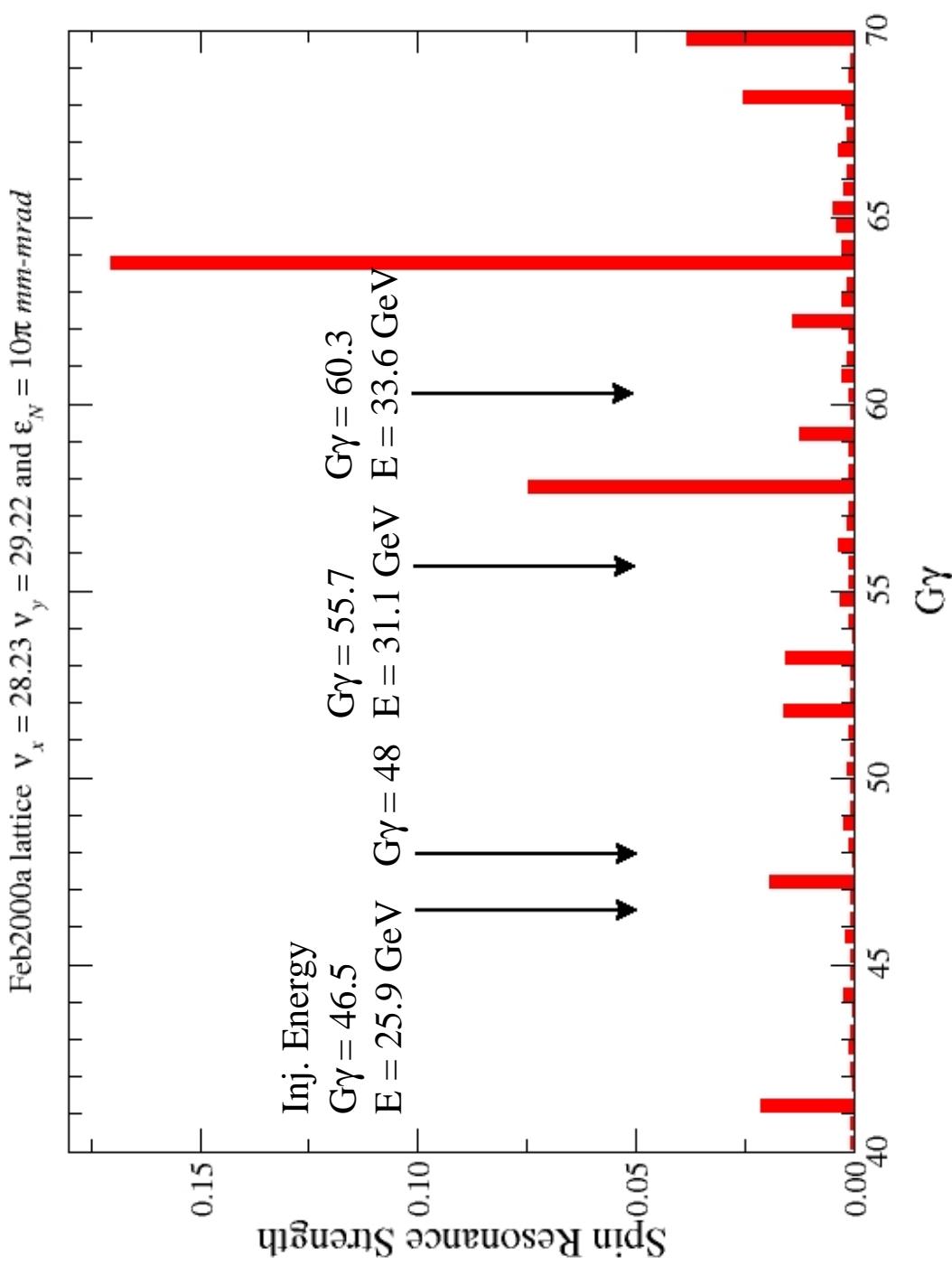
$G\gamma=60.3$



$G\gamma=55.7$



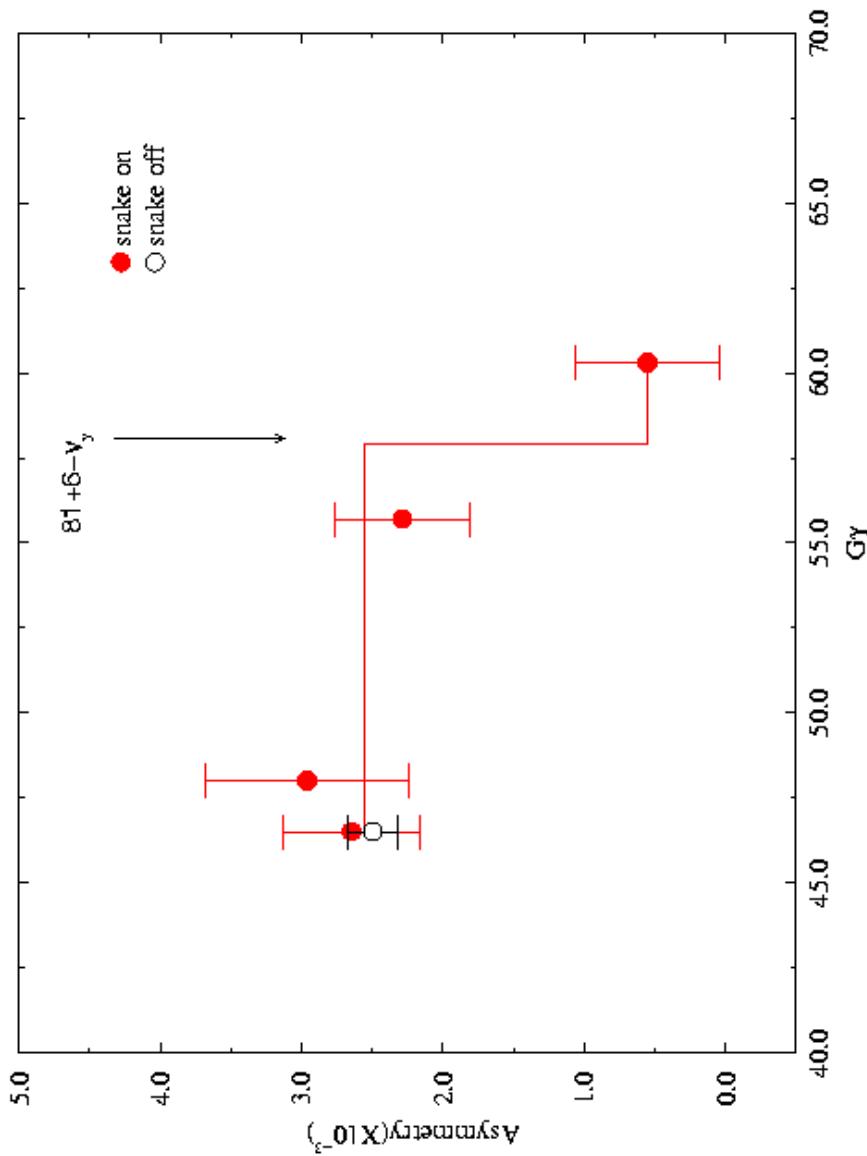
# Spin resonances in RHIC (w/o Snakes)



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# Asymmetries in RHIC (Preliminary)

RHIC Asymmetries (Preliminary)



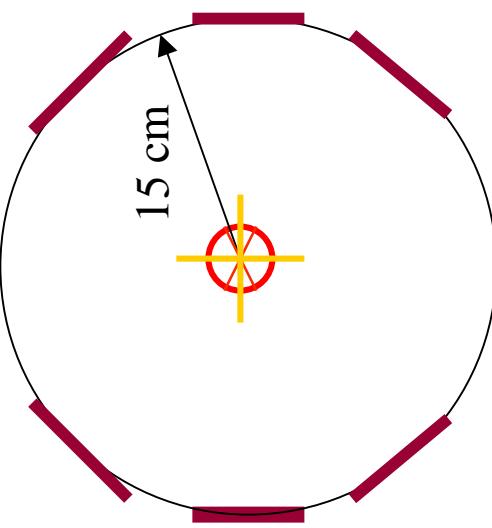
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## Polarization in RHIC

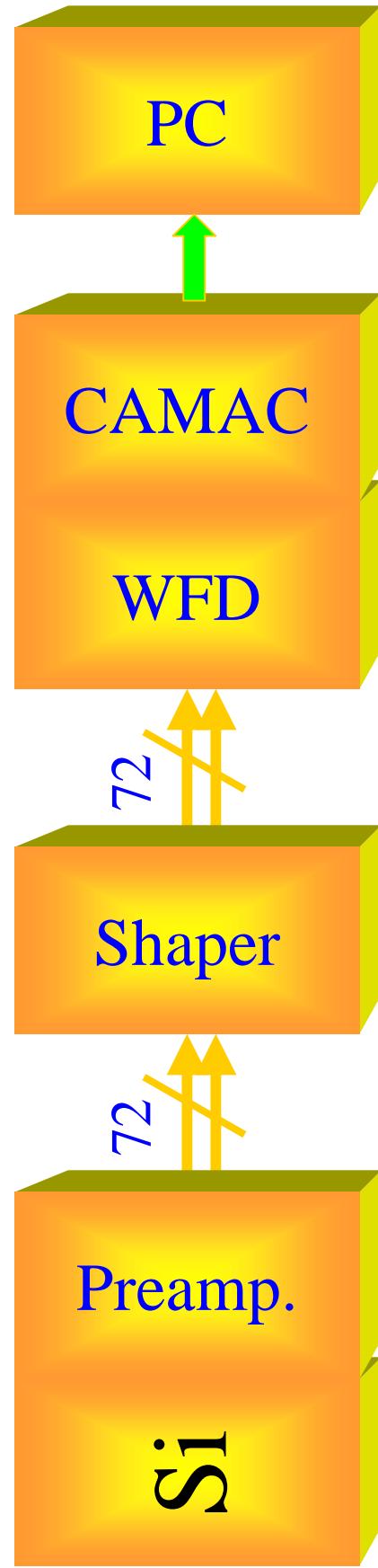
- The polarization injected from AGS is estimated as  $(33 \pm 1)\%$  (statistical error only).
- The polarization measured in RHIC is estimated as  $(19 \pm 1)\%$  (statistical error only).
- It is not a surprise, given the no-snake injection condition and not well-calibrated injection field in RHIC. In addition, we did not explore the tune space.



# RHIC Polarimeter



- 6 Detectors 12 strips  $\times$  2 mm;
- Strips in horizontal direction;
- 72 independent self triggered channels with wave form digitizers (WFD);
- zero dead time;
- large load  $\sim$  1 event/bunch crossing;
- WFD allows to measure both time and amplitude of the signal.



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# Polarized proton status and plans

- FY2000 run:

- Single Siberian snake and pC polarimeter installed in blue ring
- New polarized proton source:  $\sim 10^{12}$  pol. protons/pulse
- Goal: Accelerate polarized beam in blue ring

- FY2001 run:

- All four Snakes (Snake year next year!) and pC polarimeters installed in blue and yellow rings (scheduled in the end of January, 2001)
- New DAQ system using Wave Form Digitizer (WFD) to handle higher data rate(scheduled in February-March, 2001)
- Goal:  $100 \text{ GeV} \times 100 \text{ GeV}$  collision with long. pol. at interaction regions
  - Accelerate with two Snakes
  - Collide beams with one Snake per ring for longitudinal polarization
- Polarization:  $\geq 50\%$ 
  - $10^{11}$  protons per bunch; 60 bunches;  $b^* = 2 \text{ m}$ ;  $L = 5 \times 10^{30} \text{ cm}^{-2} \text{ s}^{-1}$
  - Integrated luminosity per week :  $1.5 \text{ (pb)}^{-1}$  (50% availability)
  - Accelerate polarized beam to 250 GeV



# Summary

- Very successful first RHIC spin commissioning run:
  - RHIC Blue Polarimeter commissioned
  - Single Siberian snake works
- With two snakes per ring and improved tune and orbit control during acceleration expect to preserve full beam polarization to 100 GeV
- Collisions of polarized protons are planned for FY 2001

