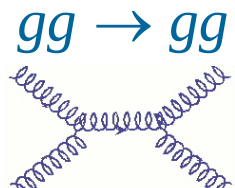
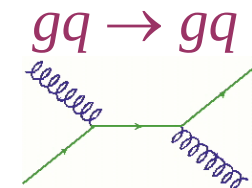
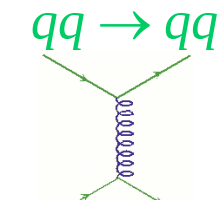


$$gg \rightarrow gg$$


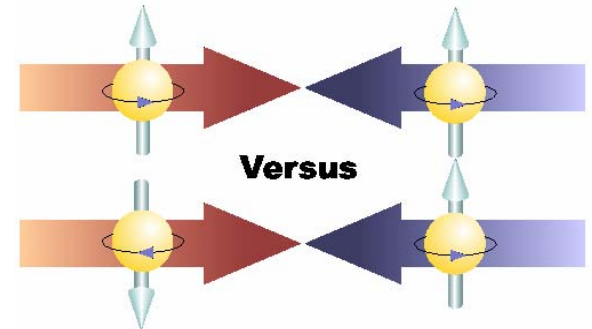
$$\propto \frac{\Delta G}{G} \frac{\Delta G}{G}$$

$$gq \rightarrow gq$$


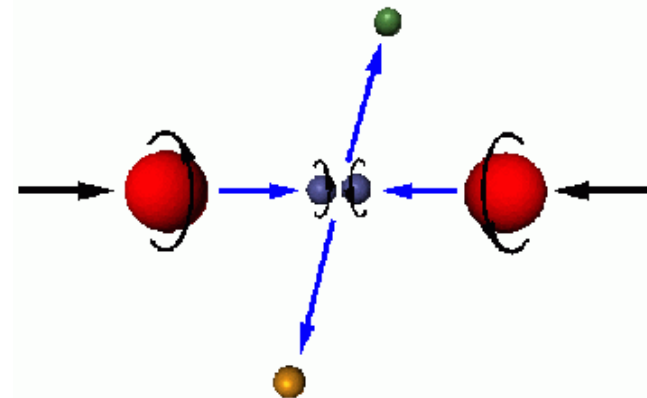
$$\propto \frac{\Delta q}{q} \frac{\Delta G}{G}$$

$$qq \rightarrow qq$$


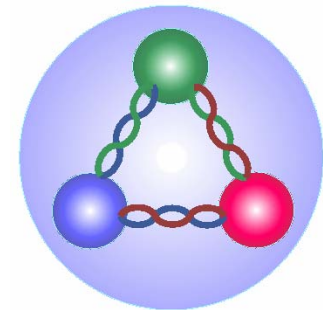
$$\propto \frac{\Delta q}{q} \frac{\Delta q}{q}$$



Proton Spin Physics: Current Status and Forthcoming Results (Experiment)



Christine Aidala
Columbia University



Proton spin physics—where do we stand and what measurements can we expect to see coming out in the next year or two from both the RHIC and DIS communities?



Only possible thanks to the hard work of numerous people at C-AD and the polarimetry teams!



The pp2pp Experiment



RHIC performance in p+p

—Mei Bai

- $P_{\text{achieved}} > P_{\text{projected}}$!
 - great performance of polarized source and injectors
- Successful 110 bunch operation
 - with 1.0×10^{11} protons per bunch.
 - tests with 1.5×10^{11} protons per bunch today!
- Substantial polarization achieved at 205 GeV!
 - Important first step toward $\sqrt{s} = 500$ GeV running

Proton polarimetry at RHIC

—Sandro Bravar

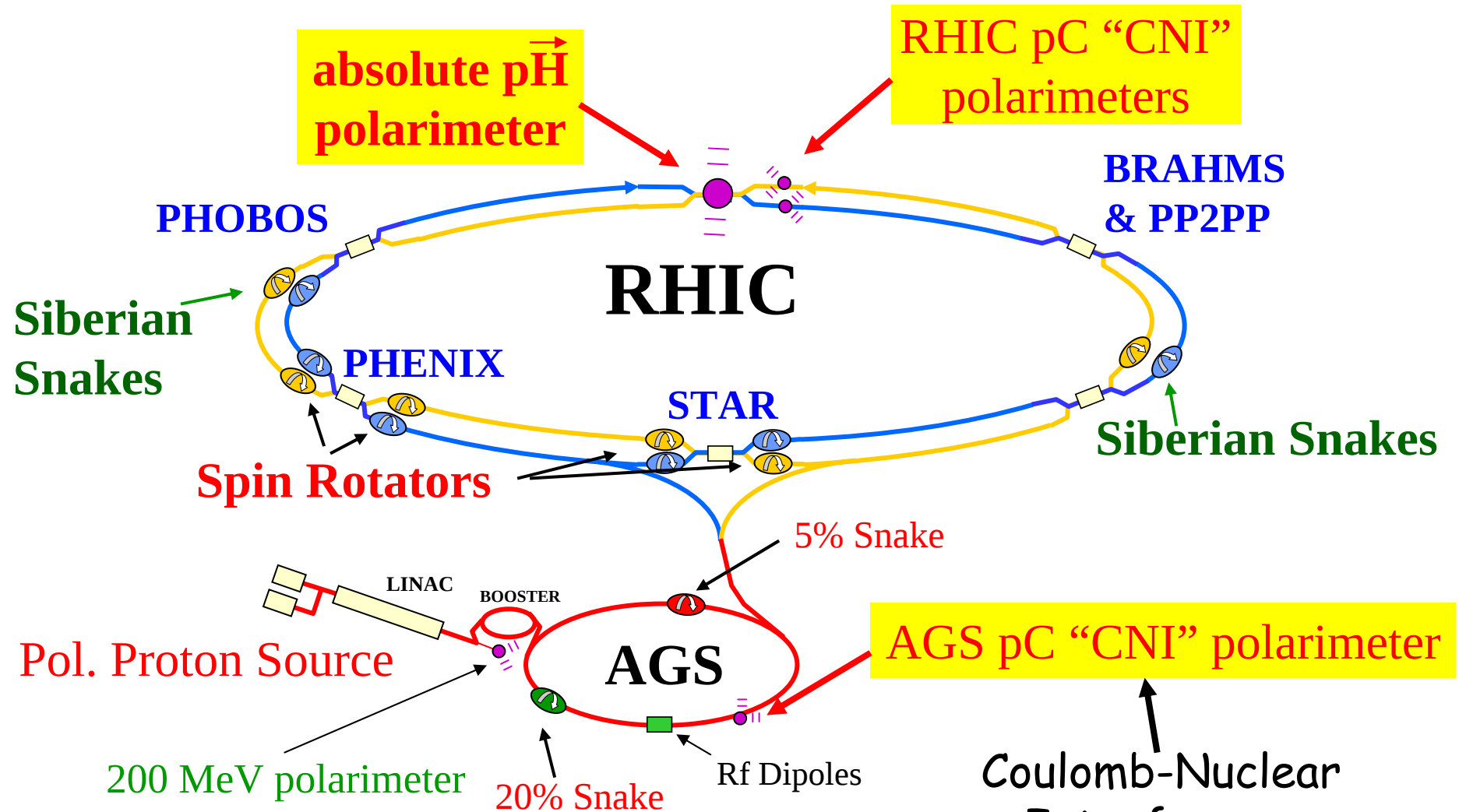
- Provide polarization measurements for RHIC accelerator
- Provide polarization measurements for experiments
- Study polarized elastic scattering

$$p^{\uparrow} p^{\uparrow} \rightarrow pp$$

$$p^{\uparrow} C \rightarrow pC$$

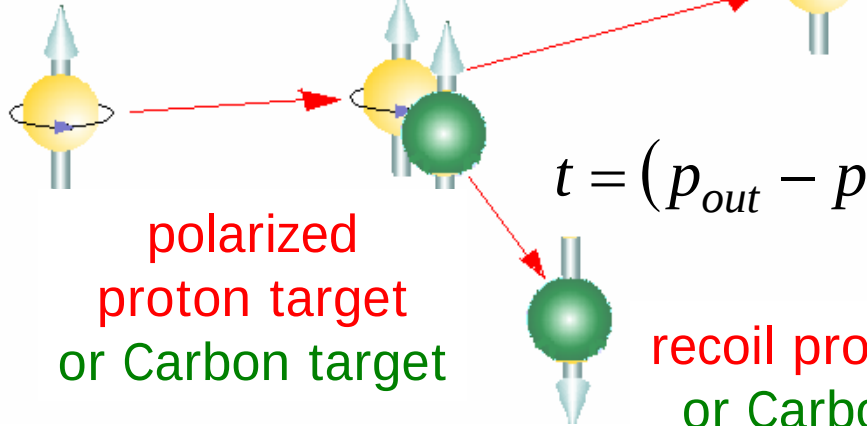
RHIC $p+p$ accelerator complex

The polarimeters are experimental devices



C. Aidala, 2005 Users' Meeting
June 24, 2005

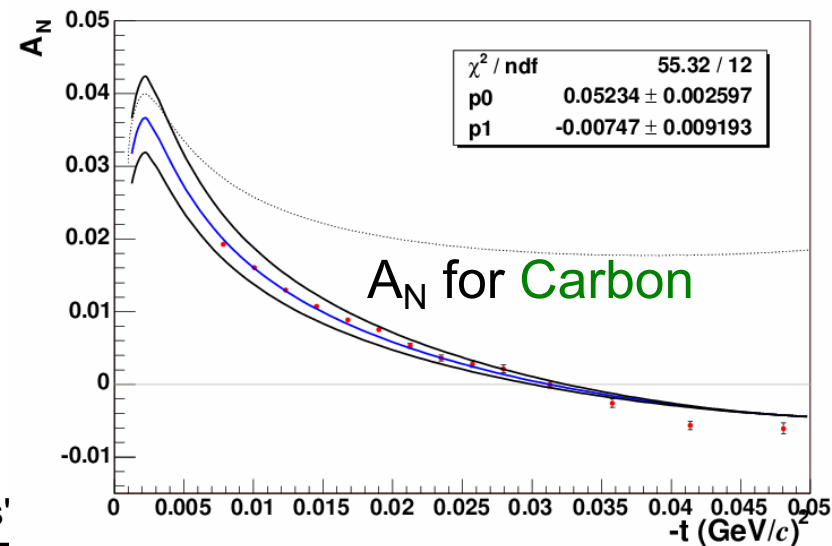
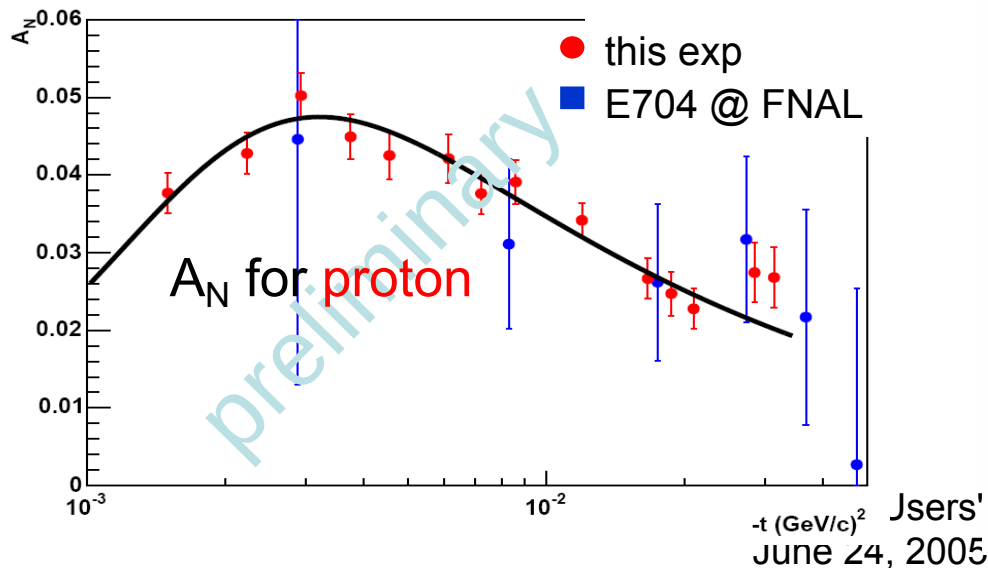
(polarized)
proton beam



$$t = (p_{out} - p_{in})^2 < 0$$

$$P_B = -\frac{1}{A_N} \cdot \frac{N_{left} - N_{right}}{N_{left} + N_{right}}$$

"Analyzing power"
or transverse
single-spin
asymmetry



Polarimetry summary

- Fast measurements of P_{beam} using CNI polarimeters
 - Few min. (AGS)
 - 10 sec. (RHIC)!
- Polarized hydrogen (proton) gas JET target works beautifully
- Expect $\sim 6 - 8\%$ calibration of pC CNI polarimeters for 2005

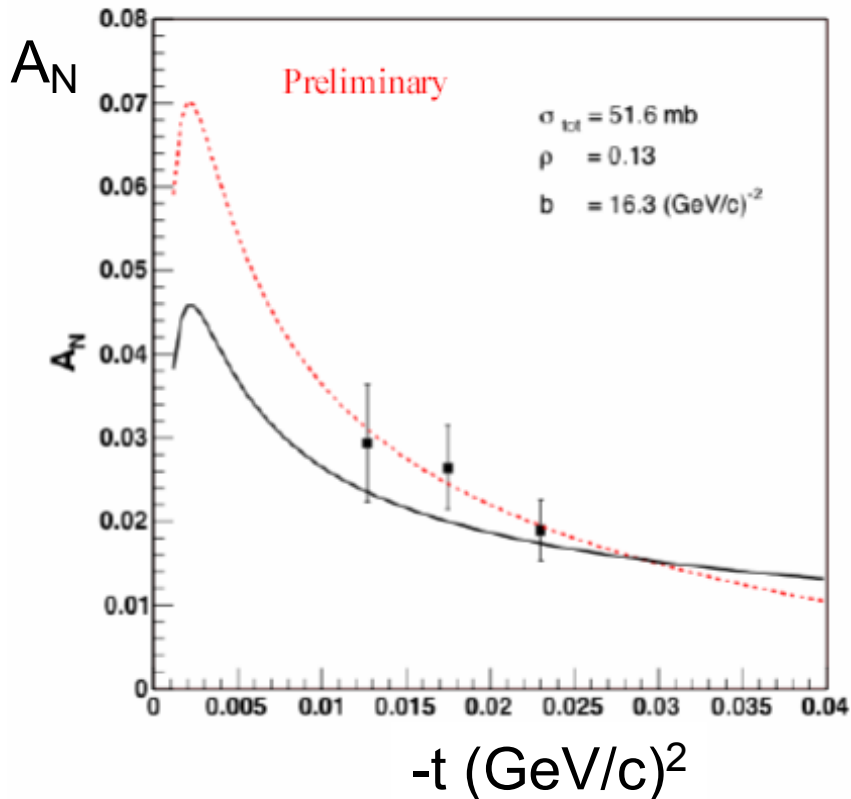
A_N in polarized p+p elastic scattering at RHIC (pp2pp)

—Wlodek Guryn

- Like polarimeters, measuring polarized elastic scattering in the Coulomb-nuclear interference (CNI) region
- Transverse single-spin asymmetry A_N expected due to interference of hadronic “non-flip” amplitude with electromagnetic “spin-flip” amplitude
 - Deviations from calculated CNI asymmetry indicate other contributions, e.g. Reggeon or Pomeron exchange

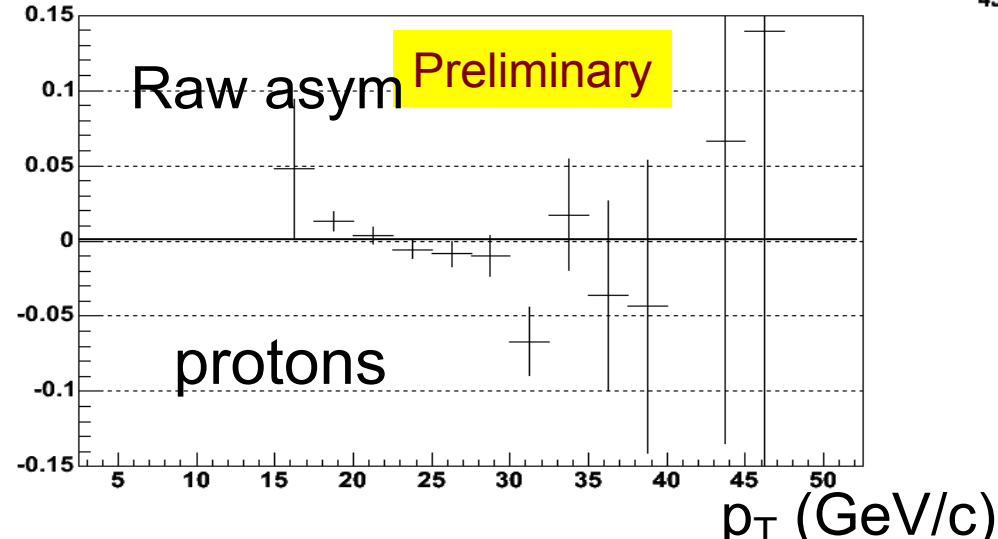
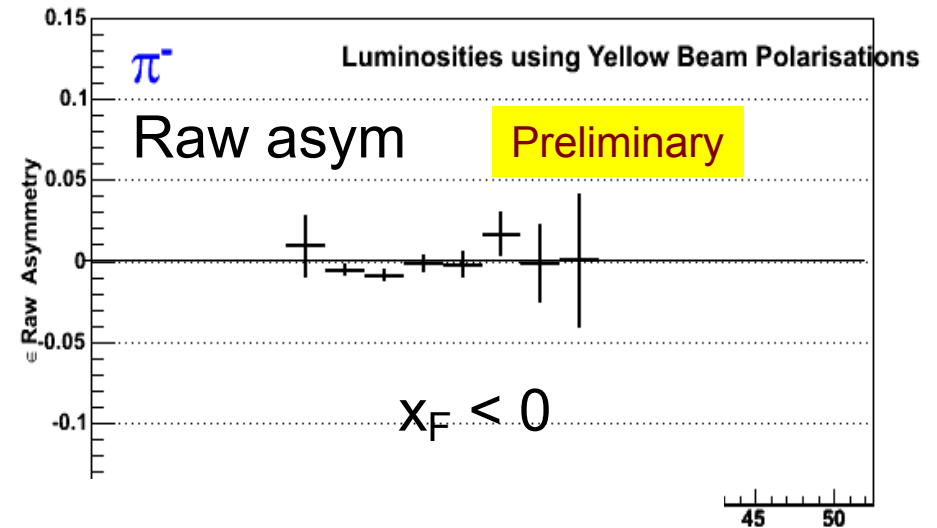
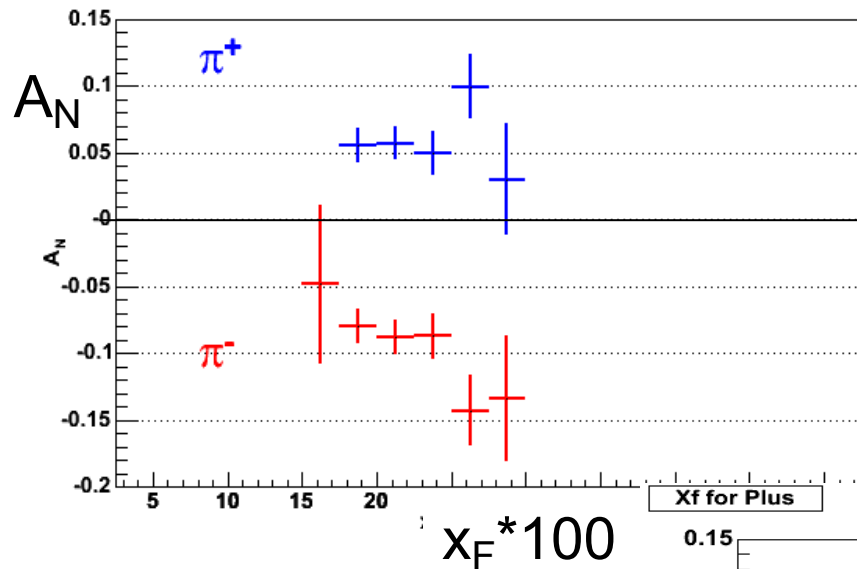


Preliminary (near-final) results



- Large asymmetries (4-5 σ from 0) have been measured
- $\sim 1\sigma$ deviation from CNI curve
- Mapping $\sqrt{s}$ and t dependence and measurement of other asymmetries will shed more light on underlying dynamics

Transverse single-spin asymmetries for π^+ and π^- production (BRAHMS) —Flemming Videbaek



BRAHMS summary

- First preliminary result for single spin asymmetries of π^+ and π^- at 200 GeV for $0.17 < x_F < 0.32$
 - Early Run-05 results confirm Run-04
- A_N for π^+ and π^- have opposite sign, consistent with lower energy results
- A_N at negative x_F for π^+ and π^- consistent with 0 (as found by STAR for π^0)
- Protons have $A_N \sim 0$



HERMES: Outlook to 2007

—Naomi Makins

Run 1: 1995 - 2000

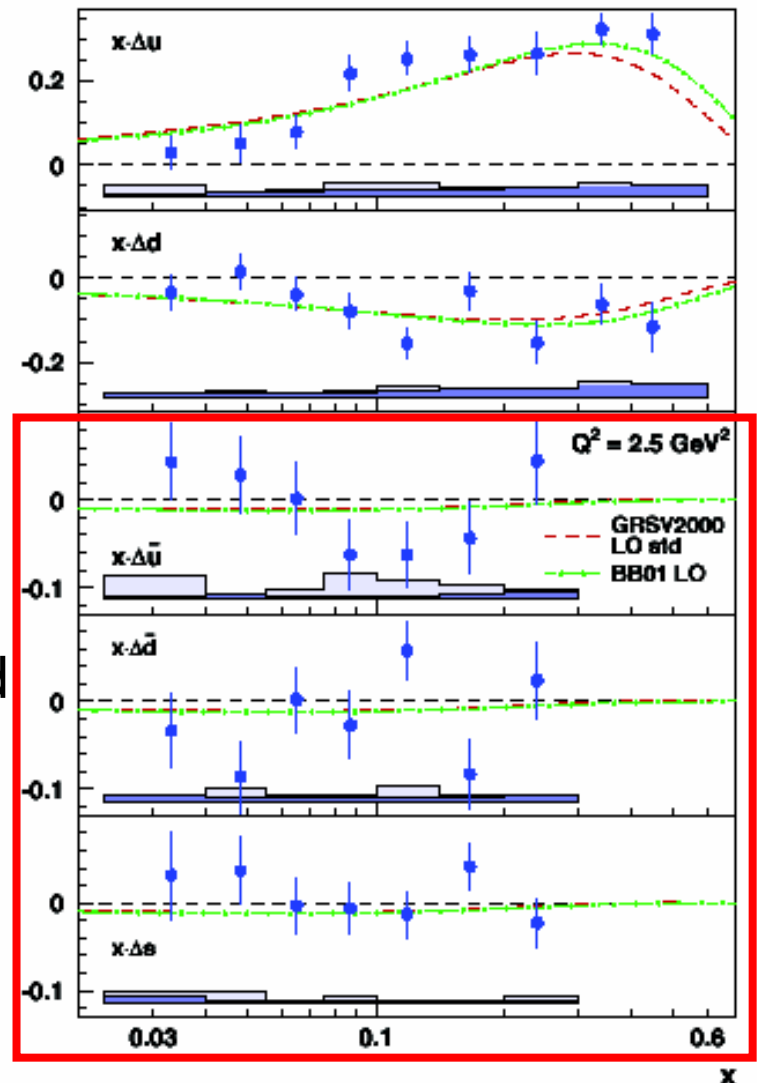
longitudinal targets

*focus on **quark polarization***

Final HERMES Δq measurement
from semi-inclusive DIS

First 5-flavor fit to Δq !

No significant sea polarization observed



C. Aidala, 2005 Users
June 24, 2006

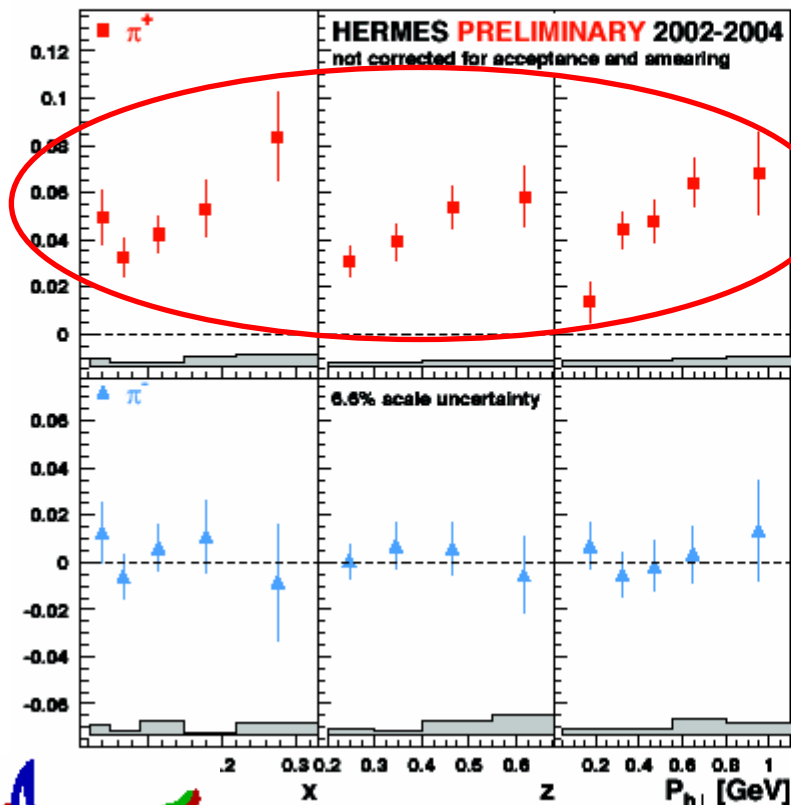
Run 2a: 2002 - 2005

transverse target

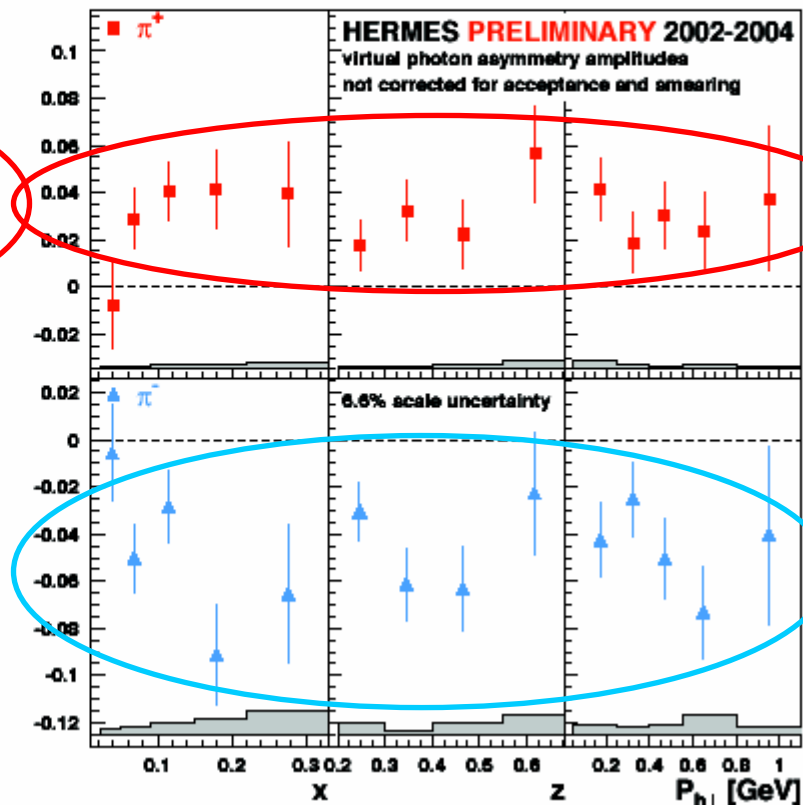
focus on **transversity**

Statistics will double by end of 2005

Sivers Moments for $\pi^+ \pi^-$



Collins Moments for $\pi^+ \pi^-$



COMPASS experiment status and results

—Katarzyna Kowalik

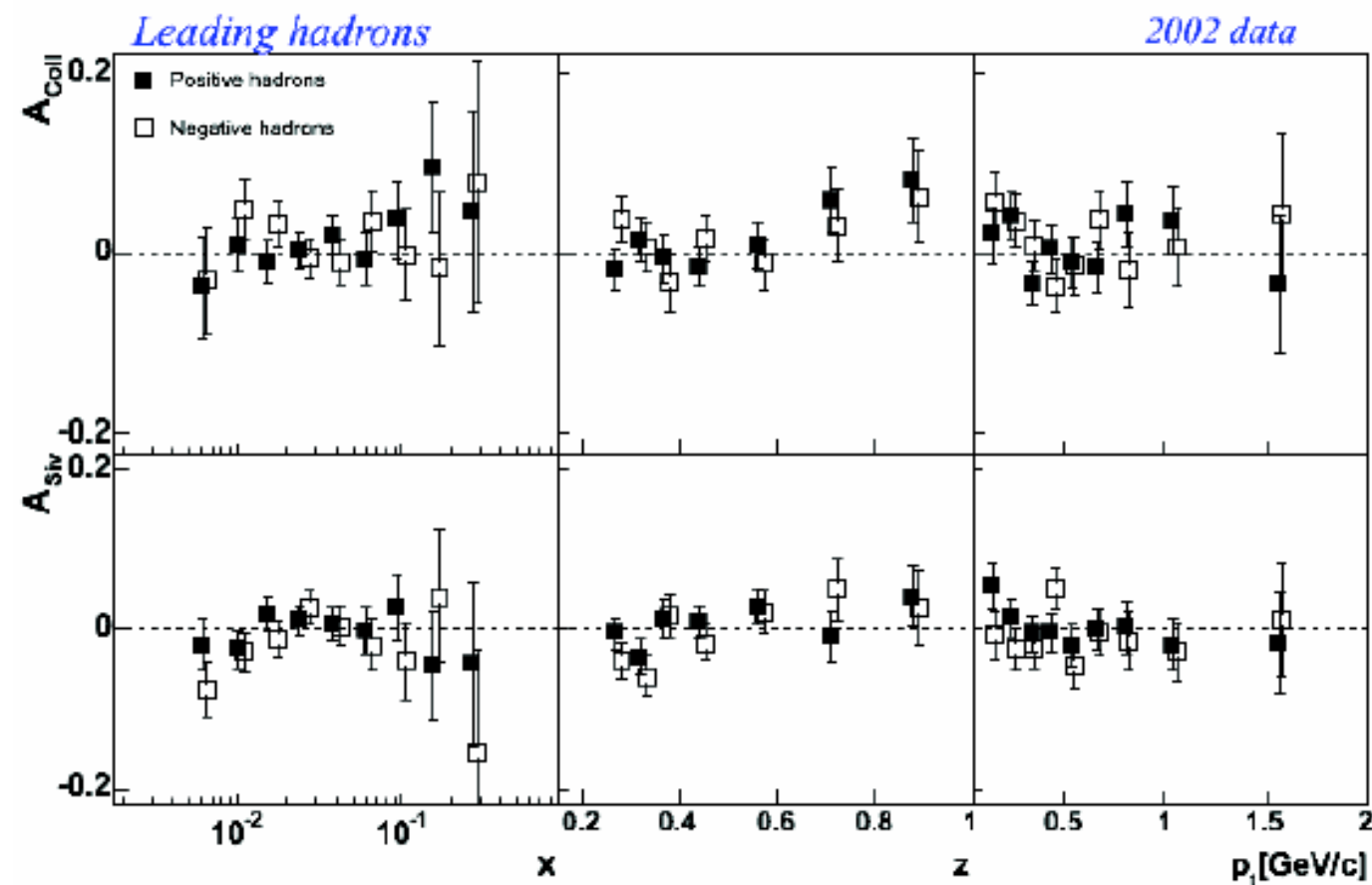
Muon beam 2002-03

- Transverse spin structure: Sivers and Collins asymmetries
- Longitudinal structure: g_1^d and gluon polarization

Hadron beam as of 2004



Collins and Sivers asymmetries for leading hadrons

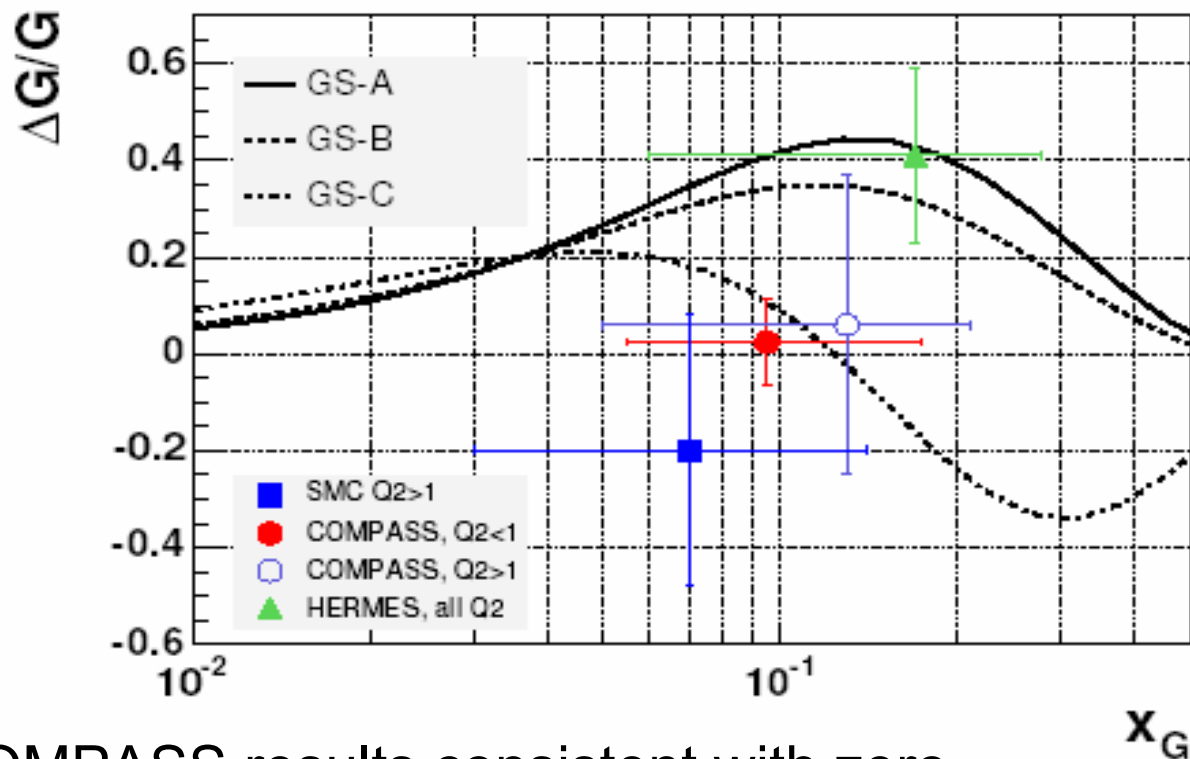


COMPASS

asymmetries
consistent with zero

Marginal Collins effect
seen at large z

Gluon polarization from high- p_T hadron pairs



- COMPASS results consistent with zero
- Most precise measurement of $\Delta G/G$ for low Q^2
- Will also measure gluon pol. via open charm—expect results this summer

PHENIX Run-05 p+p analysis

—Kensuke Okada

Cross section

C π^0 , Charged pion
Direct photon
 η
Single electron, J/ψ

M J/ψ

A_N

C Charged hadron, π^0
Jet correlation (kT)

L Neutron asymmetry
(200, 400 GeV)

Persists!

A_{LL}

(A_{TT})

C π^0 , Charged pion
Direct photon
 η , Λ
Jet

M J/ψ

Single electron

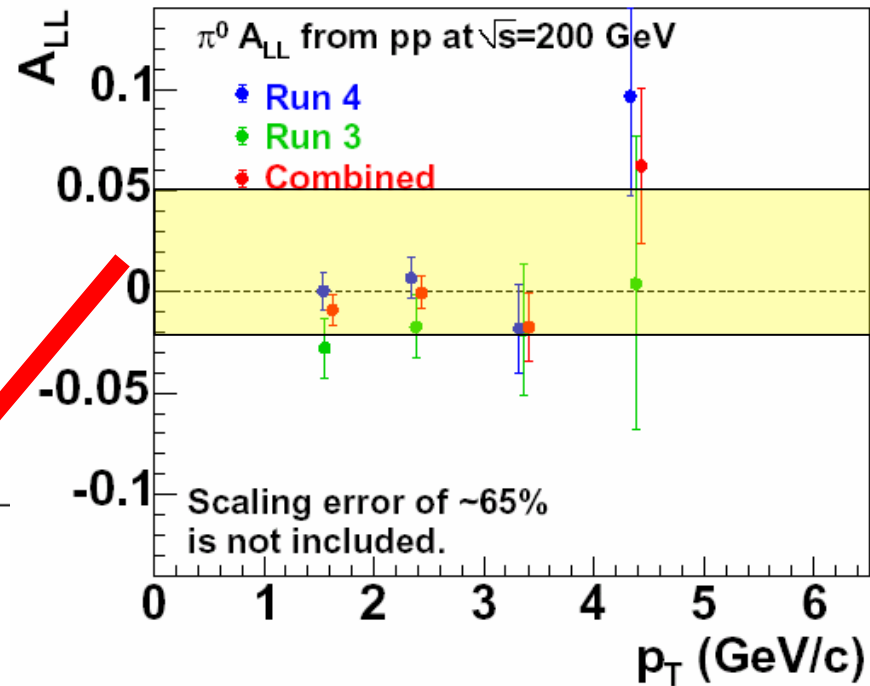
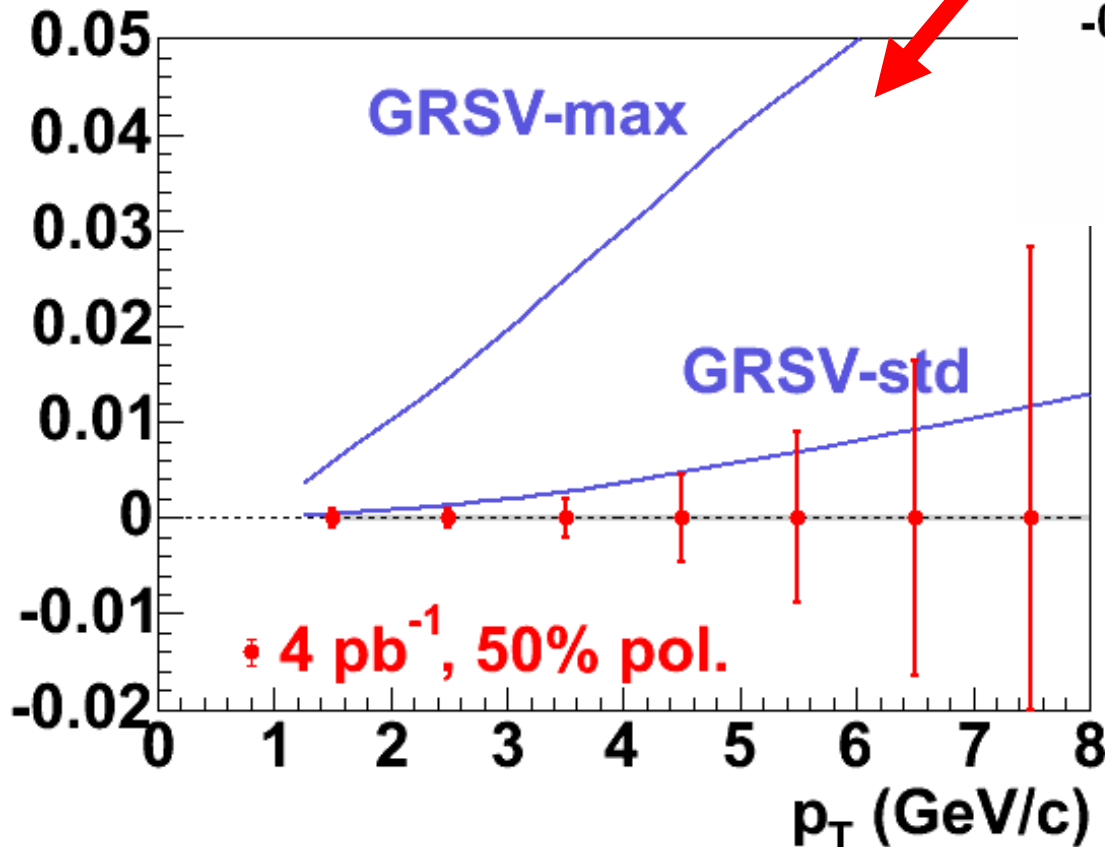


C : with Central arm
M : with Muon arm
L : with Local calorimeter

$\pi^0 A_{LL}$ for Δg measurement

$\pi^0 A_{LL}$

SPIN2004 Y.Fukao



PHENIX Run-05 summary

- $\sim 4 \text{ pb}^{-1}$ recorded with longitudinal polarization, $P \sim 50\%$
 - **210 times** Run-03 double-spin asym. figure of merit (P^4L)
 - $\pi^0 A_{LL}$ will be greatly improved!
 - Other A_{LL} first measurements will be possible
- 0.16 pb^{-1} recorded with transverse polarization
 - Limit on A_{TT} contamination to A_{LL}
 - Improved A_N measurements—9x more than Run-02 FOM (P^2L)
- Will measure variety of production cross sections
- Other probes will give hints for future measurements

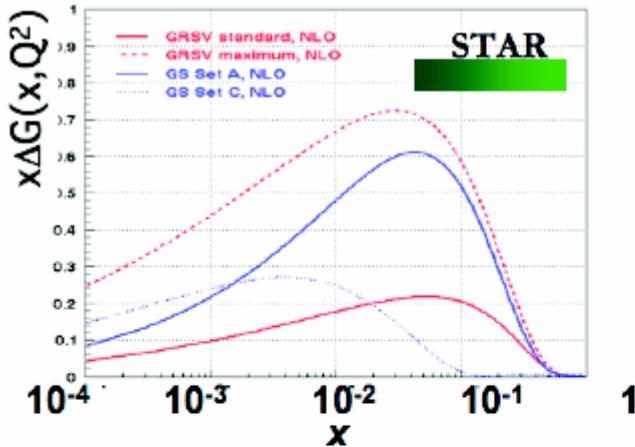
STAR Spin: Progress and near-term prospects

—Ernst Sichtermann

- Lead-scintillator Endcap EM calorimeter complete for 2005!
 - $1 < |\eta| < 2$
- Barrel EM calorimeter fully installed, half instrumented for **triggering**
- Will allow measurement of π^0 A_{LL} over a **wide range in η** from 2005 data set
 - Anticipate precision to discriminate among several possibilities for Δg
- Ultimately measure prompt photon asymmetries as well



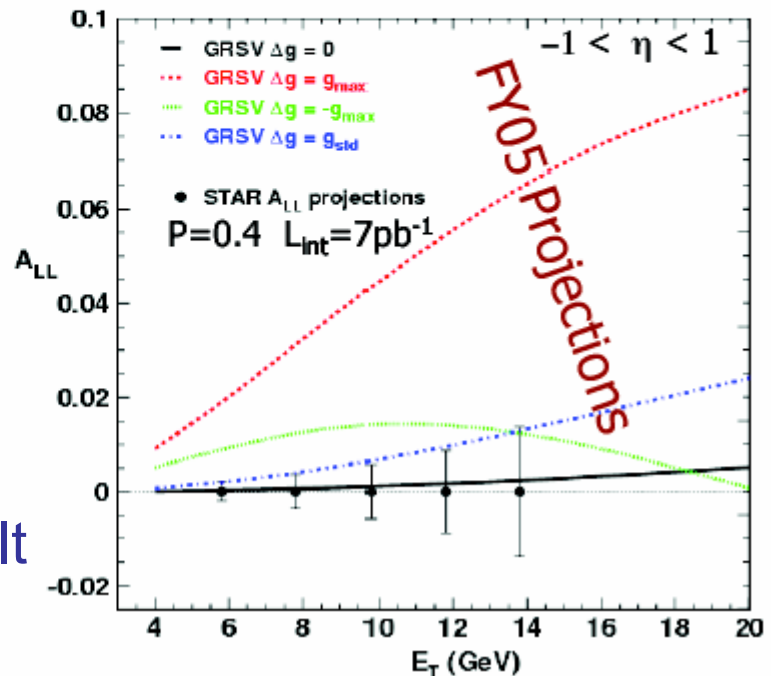
Inclusive jets: near-term prospects



Kinematic Coverage, although still limited, where ΔG is sizable

Potential to *discriminate* between several of the expectations based on DIS parametrizations (not all of which are equally probable).

Preliminary Run-03/04 jet result expected in a few months



Concluding remarks

- Nucleon spin structure is a thriving community!
- The wealth of data from the latest RHIC run will greatly improve on some previous measurements and enable several new ones
- Complementary (and sometimes competitive!) efforts by the DIS and RHIC experiments are gradually disentangling both the longitudinal and transverse spin structure of the proton

Thanks to Peter Steinberg and the Users' Center for facilitating the organization of a successful workshop!