4/17/02
G. Bunce

Spin Proposal to PHENIX

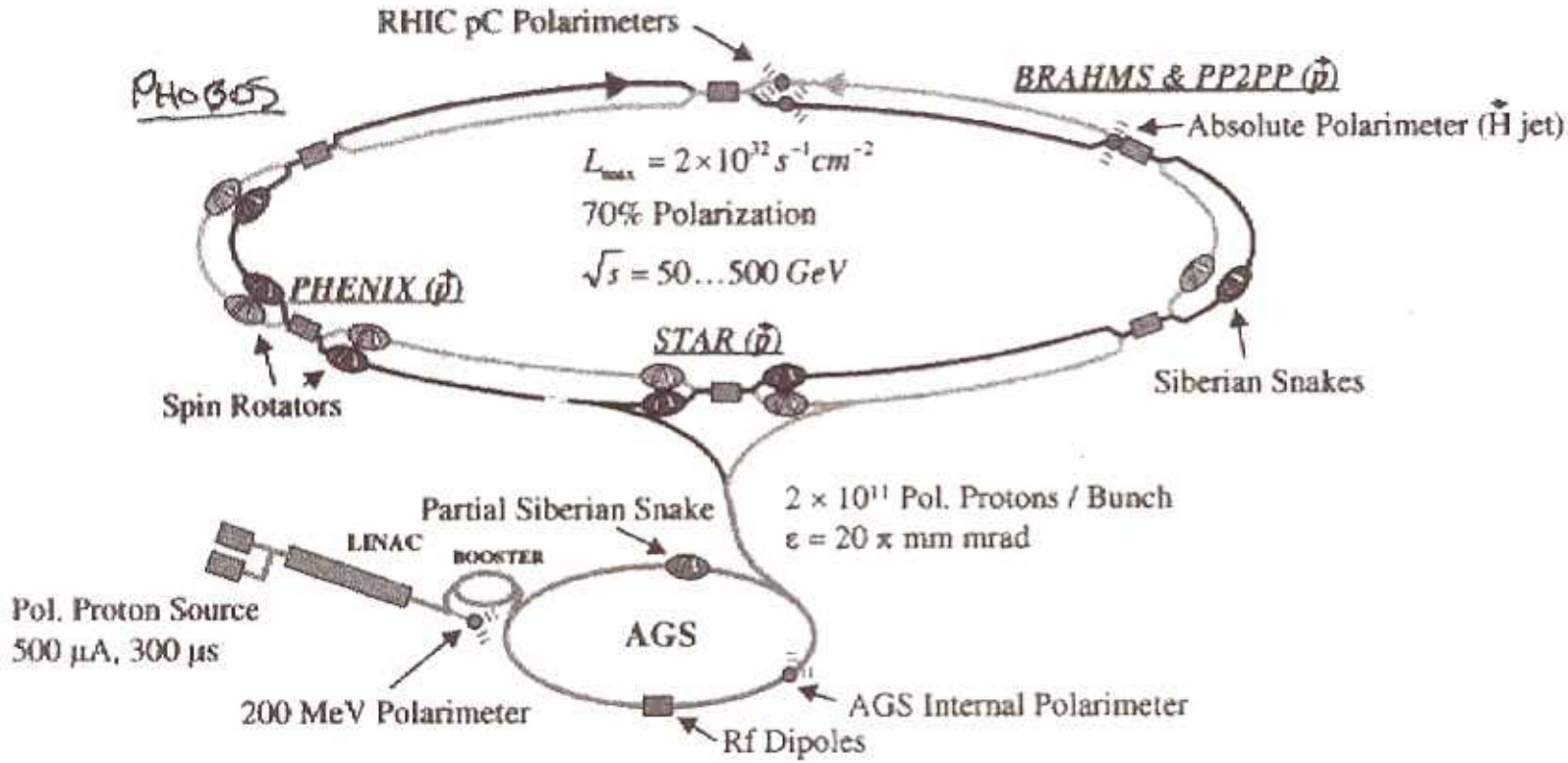
Summary:

- 5 weeks pp spin commissioning
- 3 weeks physics with longitudinal polarization
  - → first serious measurement of gluon polarization
  - → commission and use rotators, long. polarization, x10 luminosity, etc.
    - crucial step on learning curve
- physics run should be contingent on demonstrated $P_{AGS} > 40\%$.

Outline

1. summary
2. 2002 run
3. proposed measurement of $\overrightarrow{\text{gluon}}$ in 2003
4. how does this depend on models? is this a big deal?
5. is this realistic?
6. open discussion

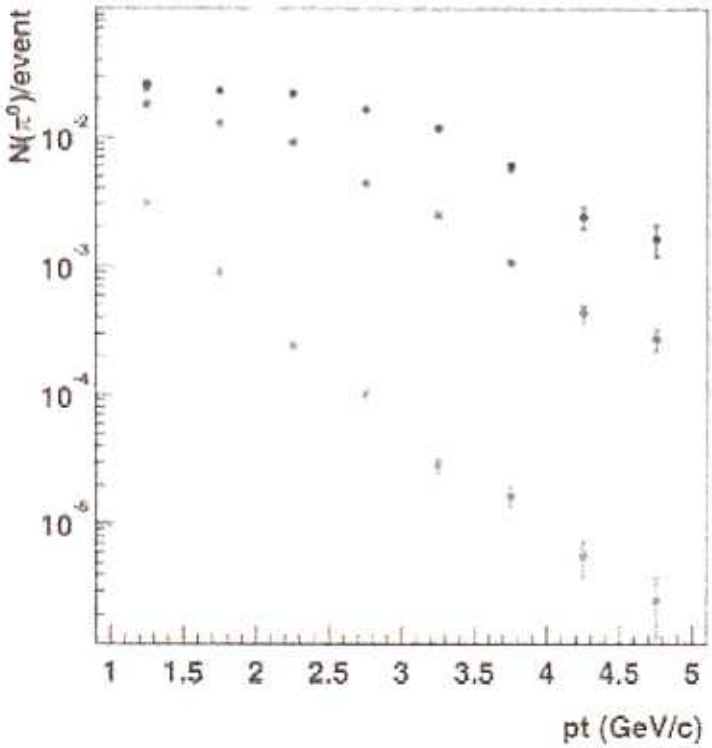
Polarized proton collisions in RHIC



BROOKHAVEN
NATIONAL LABORATORY

Photon Trigger for π0's

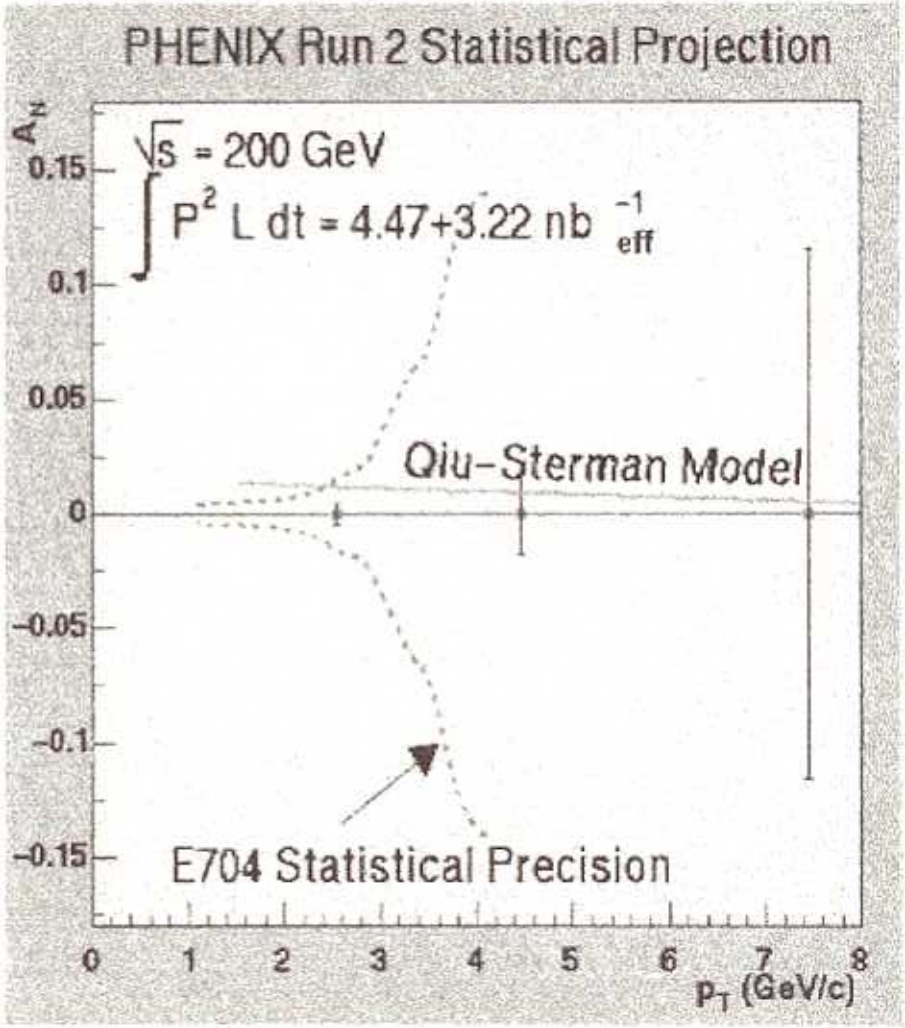
Number of π0's per event



Gamma2
Gamma1
MiniBias

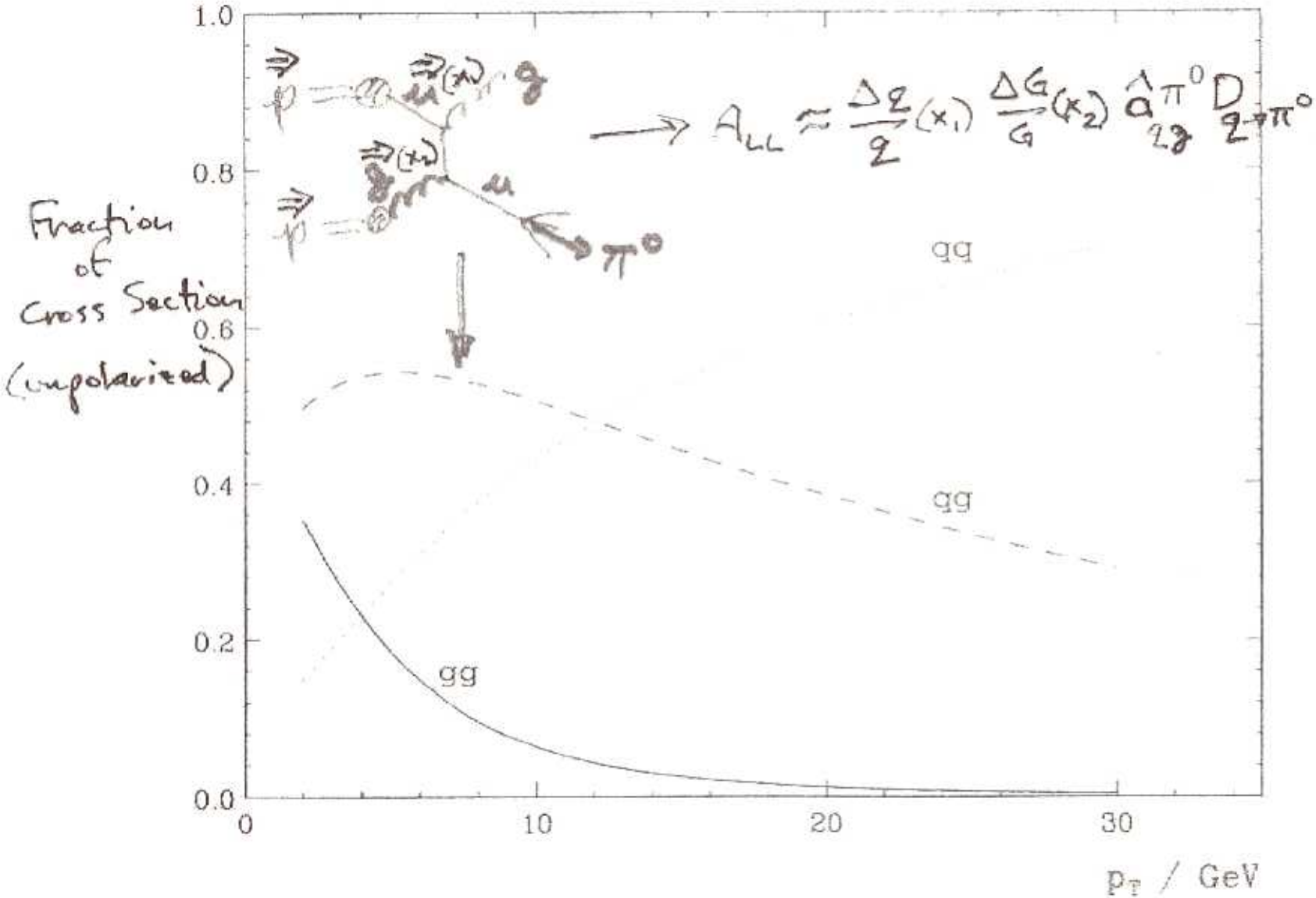
Run2 Statistical Projection

- Statistical Significance of A_N ~ 10x E704
  - Assumption: Analyzing Power for pC CNI is E-indep.

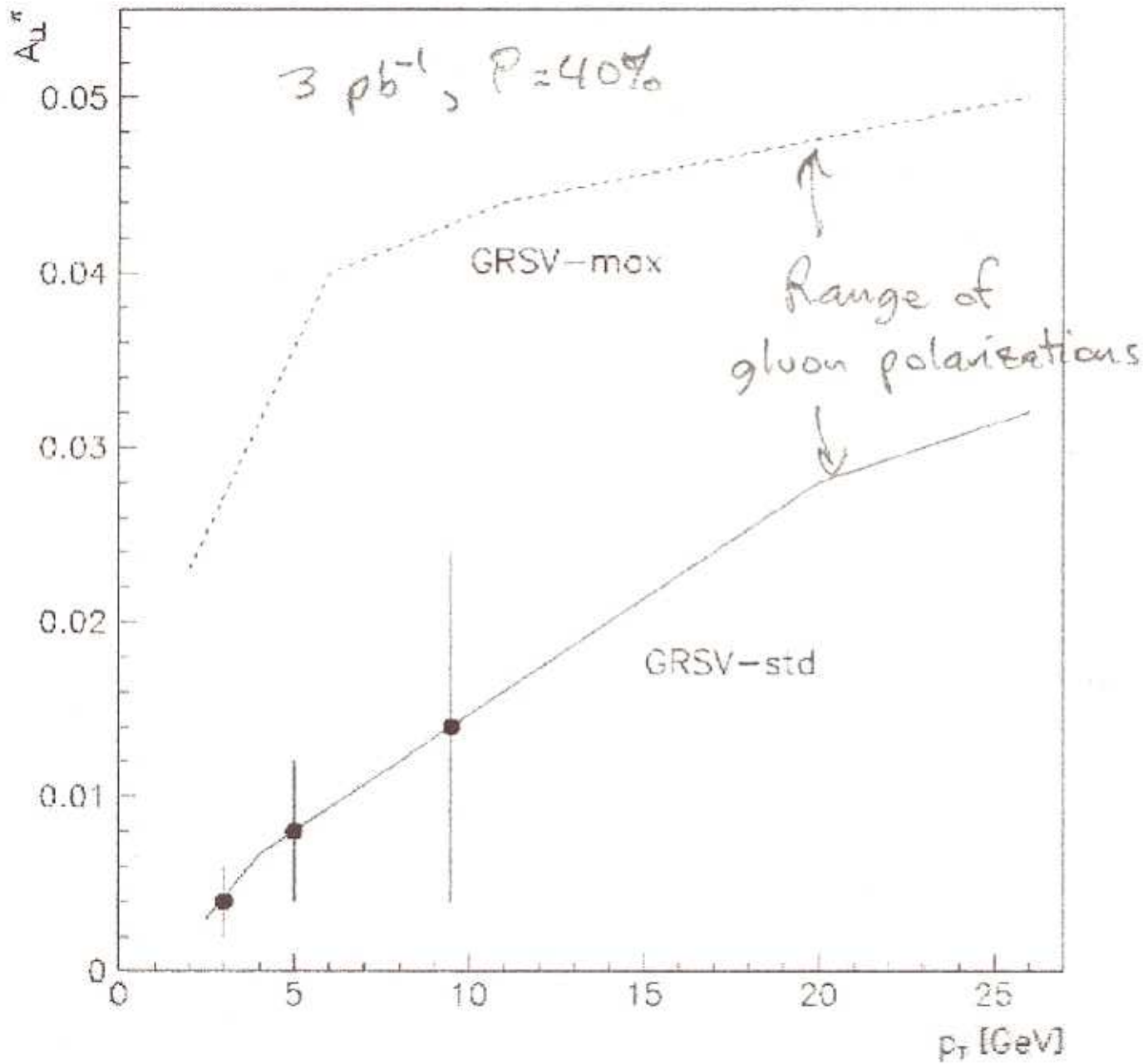


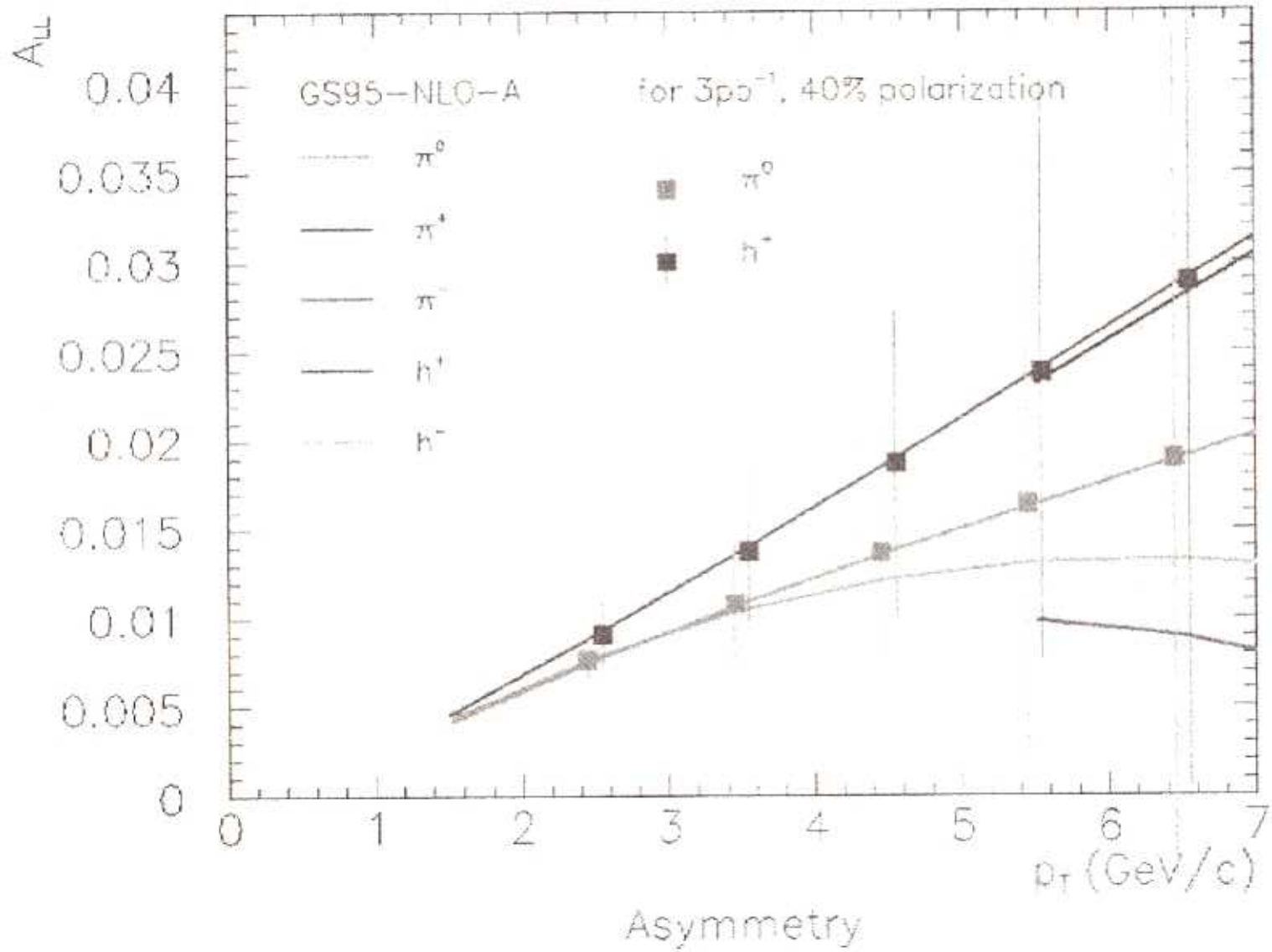
2001: π^0 as a jet surrogate to observe/measure/constrain gluon polarization.

$\sqrt{s} = 200$



Phenix π^0 for 2003




A_{LL}
GS95−NLO−A
for 3pb^{-1}, 40% polarization
π^0
π^+
π^-
h^+
h^-
π^0
h^-
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
1
2
3
4
5
6
7
p_T (GeV/c)

Asymmetry

How model-dependent is this?

From Werner Vogelsang (on web):

→ fragmentation function differences largely cancel in asymmetry

→ unpol. parton distributions – variations have little effect on asymmetry

→ evidence that pQCD fits data for colliders down to $p_T = 2$

→ NLO: stable for jet pd. cross sections, in process for π

→ π^+, π^-, π^0 all measure $\Delta G/G$

→ frag. functions: e^+e^- LEP + pol. PDFs: pol. DIS (SMC, SLAC) } strong data base

→ γ vs. jets vs. π – all 3 will give exciting information

∴ it is a big deal!

Realism?

① AGS polarization

- Westinghouse → Siemens
  - → spin resonance strength × $\frac{1}{2}$
- source 70% → 80% +
- new RHIC-type polarimeter for AGS
  - → 30x faster pol. measurement
    - much quicker learning curve
    - reliability before filling RHIC

$\boxed{P_{AGS} > 40\% \text{ is likely.}}$

② $P_{RHIC}(100\ \text{GeV}) = P_{AGS}$?

- at 10% level, needs study, commissioning
- yes at 20% level

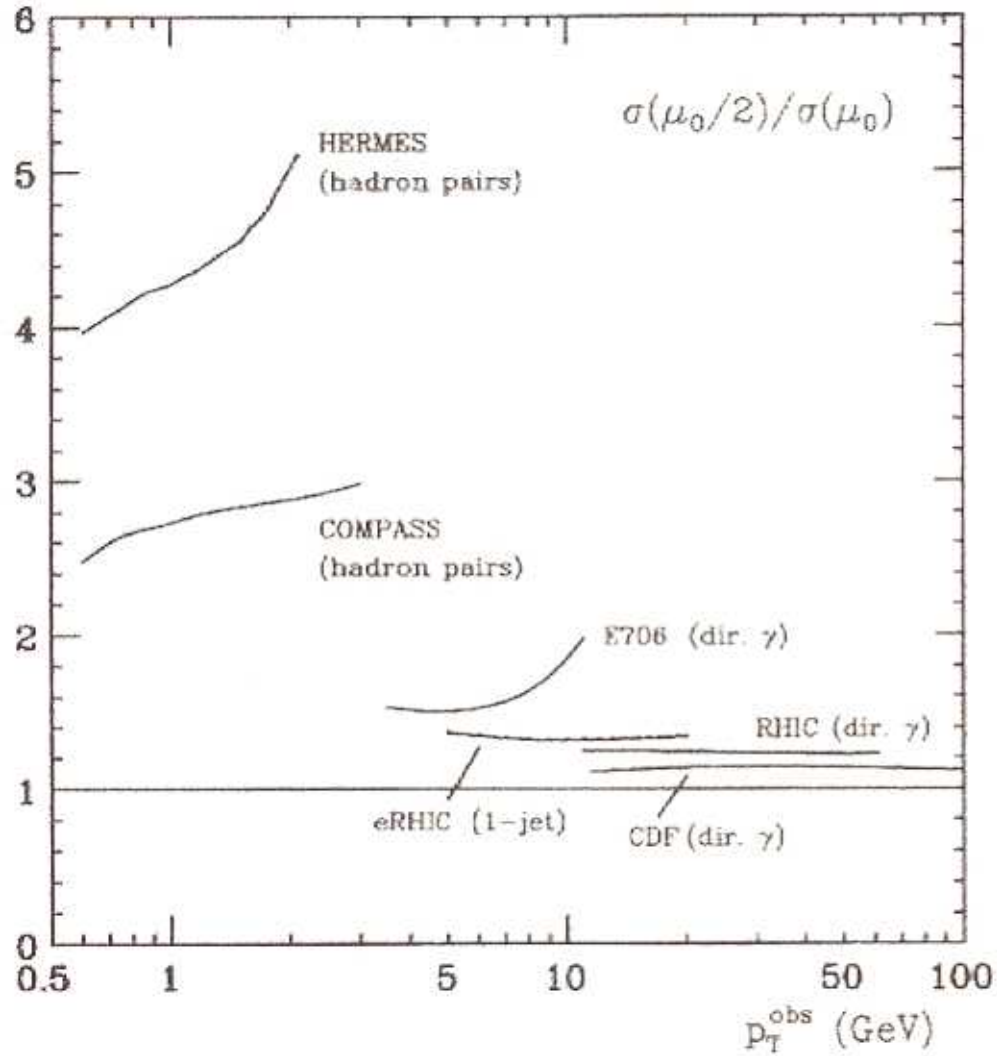
③ luminosity vs. 2002:

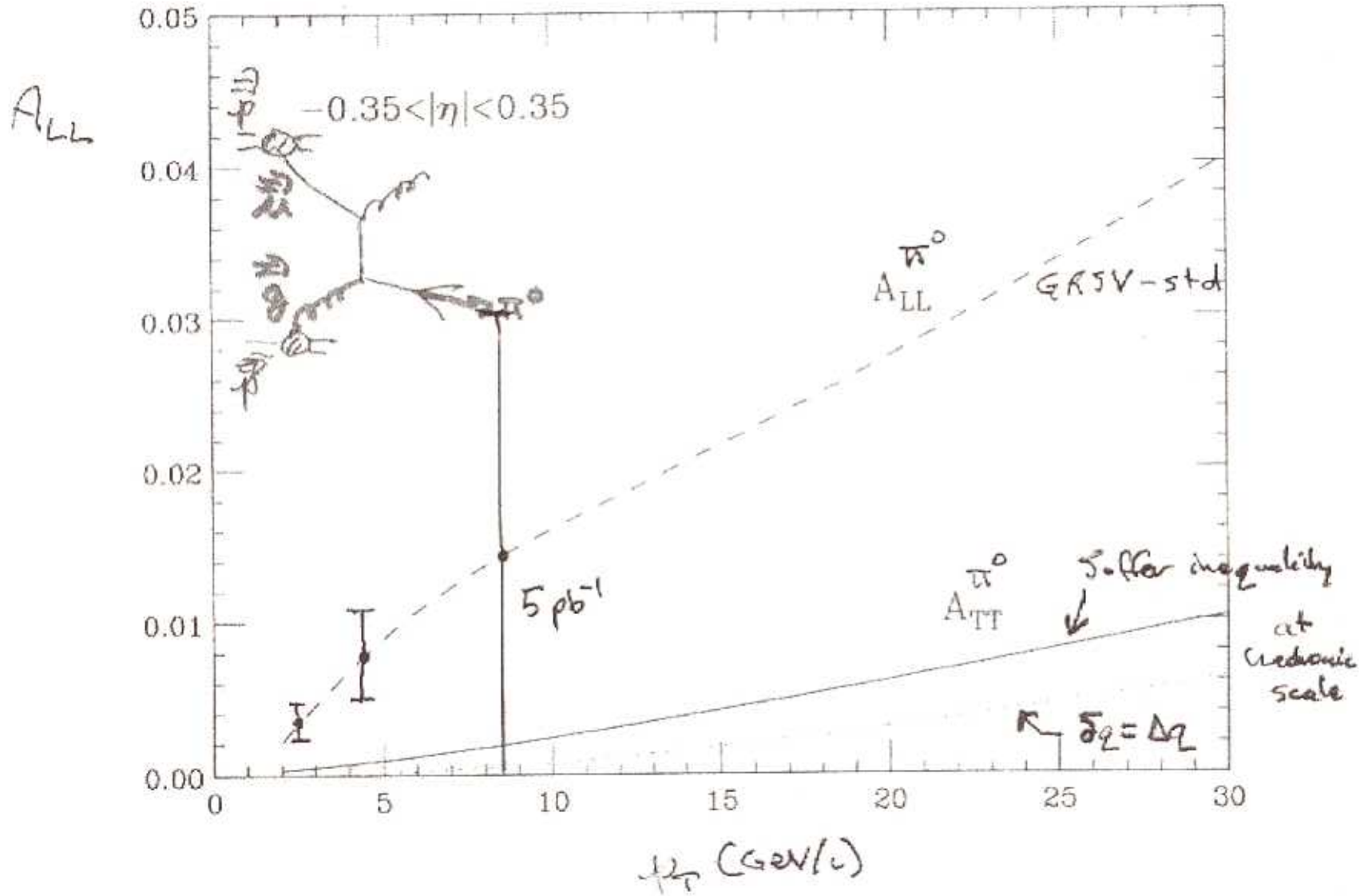
$$\text{intensity}^2 \times 1/\beta^* \times N_{\text{bundles}} \approx 10$$
$$1.5 \times 3 \times 2$$

Roser: 2.8 pb^{-1}/wk → 1 pb^{-1}/wk PHENIX

Some points for open discussion:

- on the measurement
  - on its impact
- on the realism
- on the spin group, on the investment, the people, the learning curve
- on the realism of the alternatives
- on possible schedules


$\sigma(\mu_0/2)/\sigma(\mu_0)$
HERMES
(hadron pairs)
COMPASS
(hadron pairs)
E706 (dir. γ)
RHIC (dir. γ)
eRHIC (1-jet)
CDF (dir. γ)
0
1
2
3
4
5
6
0.5
1
5
10
50
100
p_T^{obs} (GeV)

2003: Probing Gluon Polarization with jets → π^0, $\pi^{+,-}$

$\sqrt{s} = 200$