

Research Plan for Spin Physics at RHIC

Abstract

1 Executive Summary

Briefly describe the physics case/highlights of the RHIC Spin program, the detector and accelerator capabilities and their development, and the plans over the next few years.

2 The case for RHIC Spin

2.1 Introduction: what we know so far, what else we would like to learn, and why

- initial information on spin structure of the nucleon, spin “crisis” & spin sum rule
- motivation for studies of gluon polarization Δg and for further studies of quark polarization
- parton angular momenta
- transverse-spin asymmetries, transversity, parton correlations, parton transverse momentum & spin, and what they tell us about the nucleon
- physics of elastic scattering
- wider context of nucleon spin structure
- why polarized pp scattering to answer these questions ? What can it probe ? Complementarity to DIS
(leads into next section)

2.2 Unpolarized pp scattering (Werner, Stefan)

- Introduction: lay out ideas, how do we describe inelastic pp scattering?
 - pQCD, collinear factorization (and beyond), lowest and higher orders etc.
 - (perhaps:) uncertainties
 - π^0 , γ measurements from RHIC
- robust understanding of probes used for spin structure
- fractions of subprocesses (midrapidity & forward)
 - from that, identify the probes that are most sensitive to gluons etc.

2.3 Probing longitudinal spin structure of the nucleon

- pQCD with spin, subprocess analyzing power (**Marco**)
 - gluon: π , jet, γ , γ +jet, $Q\bar{Q}$... (**Steve, Yuji, Hal, Les**)
 - what are the key predictions for Δg processes? (**Werner, Marco+...**)
- show spin asymmetries A_{LL} for π^0 , jet, γ and their dependence on Δg . Use for example currently estimated uncertainty on Δg from DIS and give estimates of how precise measurements need to be “at least” in order to obtain a significant improvement. This will provide the “minimum requirements”. Discuss relevance of “correlation observables” such as jet+photon, pion+pion, etc. Discuss development with time.

- (anti)quarks, W (**Naohito, Bernd**)
- this should include in particular a discussion of importance of 500 GeV running.

2.4 Transverse spin structure

- why it is different from longitudinal (**Jianwei**)
- history, previous A_N measurements, planned measurements (**Les, Matthias, Akio**)
- assess what requirements would be for key measurements here, and how they would compare to longitudinal running.

2.5 “What else is going on in the world”

- briefly discuss current efforts in DIS and their expected results & timelines (**Ernst, Akio**)

2.6 Elastic scattering (**Larry, Elliot, George, Sandro**)

2.7 Future plans/ideas at RHIC

- $W + c$ (**Yuji ?**)
- physics beyond the Standard Model? (**Vladimir**)
- other opportunities possibly offered by high-luminosity running (and/or a new detector)
- opportunities with polarized beams in p+heavy-ion physics (**Les**)

2.8 Connection to eRHIC (**Abhay**)

3 Accelerator–present & future (Wolfram, Mei)

- successes so far
- expected development in polarization and luminosity over next few years
- polarimetry (**Gerry, Sandro**)
- expectations with 10, 5 physics week scenarios
- long-term perspective (RHIC II, new ideas for luminosity etc.)

4 Experiments

4.1 Phenix (Matthias)

- present status & issues to solve
- priorities
- planned upgrades and developments
- required resources

4.2 Star (Steve)

- present status & issues to solve
- priorities
- planned upgrades and developments
- required resources

4.3 Other experiments

- Brahms (**Flemming**)
- New detector
- eRHIC detector
- pp2pp (**Wlodek**)
- jet (**Sandro**)

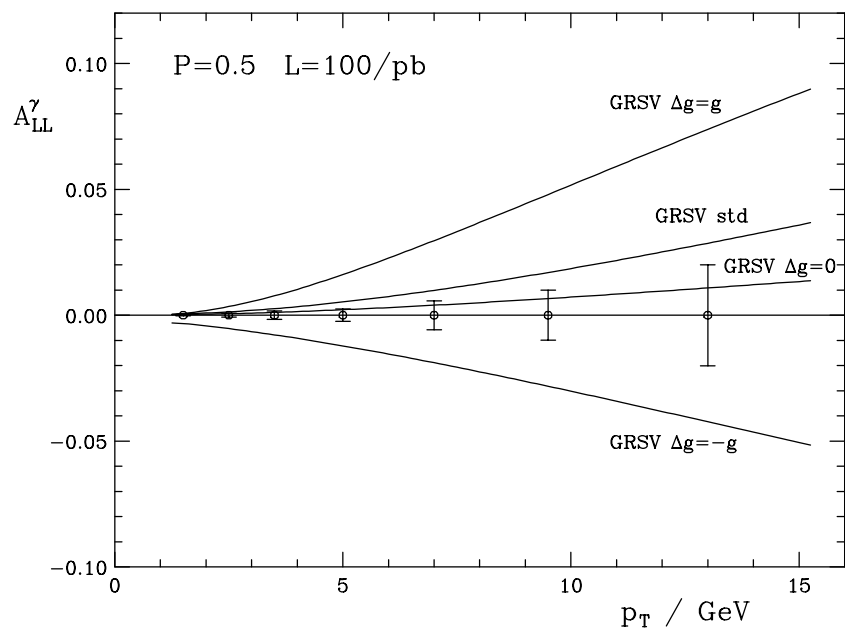


Figure 1: Spin asymmetry A_{LL} for prompt photon production for various gluon polarizations. Expected error bars are for $P = 50\%$ and $\mathcal{L} = 100/\text{pb}$. Phenix acceptance.

5 Spin plan schedule (Gerry)

5.1 5 physics weeks

5.2 10 physics weeks

6 Summary (Gerry)

Acknowledgments

References