Building 510F
P.O. Box 5000
Upton, NY 11973-5000
Phone 631 344-5397
Fax 631 344-5820
vigdor@bnl.gov

managed by Brookhaven Science Associates
for the U.S. Department of Energy

June 13, 2008

Dr. Gulshan Rai
U.S. Department of Energy
Office of Nuclear Physics, SC-26/GTN
1000 Independence Avenue
Washington, DC 20585-1290

Dear Gulshan,

I am herein submitting a report entitled "Plans for the RHIC Spin Physics Program" that is BNL's response to the following recommendation from the 2007 RHIC Science and Technology Review:

- Brookhaven National Laboratory (BNL) should develop and document a detailed plan with milestones that demonstrates the experimental sensitivity for the proposed proton spin measurements between 2008 and 2013 using the anticipated accelerator design capabilities and detector performance as a planning base. This plan should be submitted to DOE NP by May 31, 2008 and presented at the 2008 RHIC S&T Review.

This plan, produced by the RHIC Spin Collaboration in response to a charge from me, and endorsed by the management of both the PHENIX and STAR Collaborations, represents an update of the Spin Plan submitted to DOE in February 2005. It presents a new assessment of detailed goals for the RHIC spin program in the light of recent accomplishments, progress on the design and fabrication of relevant detector upgrades, a new round of more realistic simulations of the PHENIX and STAR detector capabilities, plans for further improvements to p+p collision luminosity and beam polarization, and recent shortfalls in meeting p+p running schedule goals introduced by shortfalls and/or late arrival of RHIC operating budgets in FY2006-2008. The machine improvements planned to enhance luminosity and polarization for the spin program are described only briefly in the attached report, but a more detailed description can be found in the document "RHIC Collider Projections (FY2009 – FY2013)" available at:
http://www.bnl.gov/npp/docs/pac0508_notes/2008-0223_RHIC_collider_projections.pdf

The updated plan addresses measurements relevant to three hadronic physics Performance Milestones included in the recently updated report on Performance Measures for the DOE Nuclear Physics program:

Year	#	Milestone
2013	HP8	Measure flavor-identified q and $\bar{q}$ contributions to the spin of the proton via the longitudinal-spin asymmetry of W production.
2013	HP12 (update of HP1)	Utilize polarized proton collisions at center of mass energies of 200 and 500 GeV, in combination with global QCD analyses, to determine if gluons have appreciable polarization over any range of momentum fraction between 1 and 30% of the momentum of a polarized proton.
2015	HP13 (new)	Test unique QCD predictions for relations between single-transverse spin phenomena in p-p scattering and those observed in deep-inelastic lepton scattering

W production measurements needed to meet milestone HP8 are described in detail in the attached report. Milestone HP12 above represents an update posing a more detailed challenge to follow up on the previous 2008 gluon polarization milestone HP1, which has already been successfully met. HP13 is a new milestone added to reflect the enormous progress made recently in the QCD treatment of transverse spin asymmetries, and the opportunity to provide a stringent experimental test of this treatment via measurements for photon-jet coincidences in polarized proton collisions at RHIC. The bottom line of the attached report is that all three of these milestones should be achievable with RHIC operating budgets that permit 2-species runs each year. In particular, the report is based on a working assumption of an average of 10 physics production weeks per year being available for the spin program over the next several years.

Although the report focuses, as recommended, on the years 2008-13, it also provides a brief insight into some possible measurements in the spin program beyond 2015. It is conceivable that on that time scale RHIC could be working to provide very substantial luminosity improvements for p+p collisions. This opportunity hinges on the possibility that Coherent Electron Cooling (CEC) can be demonstrated to work in a first proof-of-principle test to be carried out over the next five years at RHIC. CEC is a concept that applies Free Electron Laser amplification of density modulations in a high-current electron beam to provide a new, efficient cooling mechanism that is a hybrid between conventional electron cooling and stochastic cooling. We have plans to test the concept at RHIC using the R&D Energy Recovery Linac already under development here. If p+p luminosities can indeed be improved by an order of magnitude via CEC, exciting new possibilities would be opened for the RHIC spin program, including parity violation in hard jet production, W-charm coincidences to probe strange quark polarization in the proton, and transverse spin asymmetry measurements for Drell-Yan dilepton production, among other topics.

In order to keep the length of the report manageable for reviewers, a great deal of the detail regarding simulations and projections for measurements of gluon polarization, sea antiquark polarization and transverse spin asymmetries has been reported separately in three appendices available on the RHIC Spin Discussion page: http://spin.riken.bnl.gov/rsc/ These appendices, the report itself, and other information relevant to the 2008 RHIC S&T Review will all be linked from the following web page:
http://www.bnl.gov/npp/RHICst08_notes.asp

Sincerely,

Steven E. Vigdor
Associate Laboratory Director for Nuclear and Particle Physics
Brookhaven National Laboratory