Research Plan for Spin Physics at RHIC

Abstract

In this report we present the research plan for the RHIC spin program. The report covers 1) the science of the RHIC spin program in a world-wide context; 2) the collider performance requirements for the RHIC spin program; 3) the detector upgrades required, including timelines; 4) time evolution of the spin program.

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1 Summary (Gerry)

In this document we have described the RHIC spin research plan, responding to the request by the Department of Energy Office of Nuclear Physics. We were requested to cover 1) the science, 2) the requirements for the accelerator, 3) the resources that are needed and timelines, and 4) the impact of a constant effort budget to the program.

1) The science is presented in section 2. Here we have emphasized measuring gluon polarization and anti-quark polarization in the proton. RHIC will provide the first sensitive measurements of each. We believe this is an exciting program, which addresses the structure of matter.

2) The accelerator requirements are presented in section 3. We are well along in reaching the polarization requirement of 70%, and anticipate reaching this goal in 2006, for 200 GeV running. To reach this goal for 500 GeV running will require releveling the machine, which is planned. Reaching the luminosity goal will be challenging. We must store 2×10^{11} polarized protons in 110 rf bunches in each RHIC ring and collide them. Limits of betatron tune shift and of electron cloud formation will be tested. For the physics sensitivities presented, we have used a luminosity of 2/3 of the calculated maximum.

3) The required experiment resources are presented in section 4. The PHENIX and STAR detectors are complete for the gluon polarization program. Both need improvements to be ready for the W physics program. These are described in the section. For a "technically driven" program, where the improvements are funded and completed as proposed, the PHENIX detector will be ready for W physics in 2009, and the STAR detector in 2010.

There are also important planned upgrades for the heavy ion and spin programs that greatly extend the range of spin physics, and these are also described in section 4.

4) The impact of a constant effort budget is presented in section 5, where we compare the two plans, as requested in the charge to the RHIC Spinplan Group:

"I ask that you consider two RHIC Spin running scenarios: 1) 5 spin physics data taking weeks per year (averaged over two years using the combined fiscal year concept); 2) 10 spin physics data taking weeks per year. These two scenarios will give appropriate indications of the physic goals that can be met over a period of years without involving the Group in difficult funding and cost scenarios that are not central to the calculation of physics accomplishments over time." (Appendix A)

The plan with 10 spin physics weeks per year, the technically driven plan, completes the gluon polarization measurements and the W physics measurements by 2012.

The plan with 5 spin physics weeks per year completes this program in 2019 or later. With this plan RHIC runs 25% of the year on average (we assume 10 spin physics weeks per two year cycle).