Brookhaven National Laboratory
High Energy and Nuclear Physics
Program Advisory Committee Recommendations

26-27 August 2002

RHIC Heavy Ion Run 3

The four experiments presented a compelling physics case for running RHIC in the d-Au mode as the highest priority during the upcoming Run 3. Data on this reaction are essential in order to isolate and measure the relative contribution of initial state effects (such as shadowing/anti-shadowing/EMC and Cronin effects) from the final state (hydrodynamic flow, jet quenching, etc). The remarkable set of discoveries in Au-Au in Runs 1 and 2 (such as the strong saturating v2 out to 6 Gev, the pattern of suppression of jets, the HBT space-time puzzle, and the anomalous baryon/hyperon excess at high pt) have generated great interest. Only with p-A or d-A can one test whether those signals are true probes of the dense (QCD plasma) matter produced in A-A or originate from other interesting nonlinear initial state effects. One such novel possibility has been proposed based on the so-called color glass condensate model, in which gluon saturation is responsible for several of the signatures. It has been argued that d-A provides a test of this possibility because $x_A \sim 10^{-3}$ to 10^{-4} can be probed at high rapidities.

The importance of d-Au for interpreting future data of J/ψ and open charm was proven by recent NA50 data on p-A at SPS energies that revealed, contrary to the assumption that "conventional" cold nuclear absorption is well understood, there is still much to learn. At RHIC $d+A \rightarrow J/\psi$ measurements are therefore likely to yield new insight into heavy quark production physics and will be an indispensable baseline in the analysis of $A + A \rightarrow J/\psi$ measurements in Run 4.

While the four experiments present different total beam time requests for d-Au at full energy, the PAC recommends 11 weeks with possibly 1 week of that time used at the end to replace the d with an Au beam as a test run to help calibrate the PHENIX north arm for Run 4. The decision to go ahead with this option should be made by the Associate Director based on the integrated luminosity attained after 9-10 weeks, in consultation with the experimental groups.

Given the 5 week dead time between switching beams, the currently funded 24 weeks of operation can only be cost-effectively run in two different modes. After the d-Au, the second run should be to continue to develop the polarized p-p program with 5 weeks of set up and tuning and a 3 week data run. This is also a compelling experiment to enable that important component of the RHIC program to continue commissioning the beams and detectors in preparation for future long polarized p-p runs to measure the gluon spin asymmetry as well as single-spin asymmetries.

Only if an additional 5-8 weeks of RHIC operations funding were obtained for Run 3 should another beam combination be studied. If such additional running were possible then either a

Si-Si or Cu-Cu 1-3 weeks data run at 200 AGeV should be performed as another step in the ongoing RHIC survey experiments. Such short global survey runs will be important to test the limits of systematics observed in the participant number dependence of the observables. Their priority is, however, lower than the specific physics driven runs of d-A and p-p.

The PAC was presented this year with request for beam time extending 2 years and beyond. The next experiment in the Run 4 is recommended to be an extended high luminosity Au-Au run to enable measurements of open and hidden charm and hard probes out to the highest p_t range. Again an 11 week running time for this mode is deemed optimal, with possibly a few weeks spent at the end in an "energy sample" mode at lower 56 AGeV energy. The last 8 weeks is again recommended to be in the polarized p-p mode to advance that part to the developing program.

As RHIC reaches stable high luminosity operations (and detectors are improved), the run modes will naturally focus on rare probes and the polarized proton program. This emphasis does not leave enough running time in the current 24 week/year mode to carry out the needed broader species and energy survey on a rapid time scale. BNL management should continue to press DOE toward a 30+ week RHIC running mode to enable a more full utilization of this facility.

P959R

Proposal 959R would employ a 0.93 GeV/c K^- beam in the D6 beam line. The proposal requests 600 hours of set-up time at 10^{12} ppp and 48 hours of data taking with 30×10^{12} ppp. The objective of the proposal is to determine the K^--nuclear potential that is a critical element in establishing the likelihood of kaon condensation in dense nuclear matter. While a measure of the K^--nucleus potential would be an important addition to our knowledge of dense strongly interacting matter, making a convincing measurement is very challenging. The PAC does not understand how a K orbit in a nucleus can be sufficiently well defined.

This resubmittal did not adequately address most of the reservations (expected width, backgrounds, and interpretation of the result) raised with respect to the original proposal and therefore the PAC views P959R as flawed.

P961R

Rating: legitimate +

The proposers have done a credible job in responding to PAC concerns expressed last year. The use of a lithium target is an important improvement, reducing troublesome backgrounds from decays of undesired single hypernuclei. The PAC is also supportive of the physics motivation. The hyperon-hyperon interaction is poorly constrained. Yet important in its own right and as an ingredient to the high-density equation of state governing neutron star structure.

The statistical improvement over E906, a projected factor of 12, is significant. This factor depends on achieving expected spectrometer improvements.

The Laboratory now faces substantial hurdles in providing beam time, raising the bar for experimental proposals. The PAC would characterize this proposal as legitimate.

P965

AGS P965 requests one week of beam time in the A3 beam line to study the properties of liquid argon time projection chambers to verify that such a detector can be operated with the electric field perpendicular to the magnetic field and to characterize the determination of the sign of electrons or positrons in electromagnetic shower events for tracks with momentum from 1-10 GeV. Liquid argon time projection chambers offer many attractive features for large-scale detectors of neutrino interactions. The ICARUS collaboration has made significant strides in developing this technology in systems without magnetic fields. However, for certain applications in neutrino oscillation studies (i.e., muon decay beams), it is necessary to determine the sign of the charged lepton in the detector following a neutrino interaction. While this is expected to be straightforward for muon tracks, the situation is more difficult in the complicated topology of an electromagnetic shower of an electron event. This measurement would provide the first large scale test of such a TPC in a magnetic field, and confirm that the position resolution can be maintained with an electric field perpendicular to the magnetic field.

The PAC would like to reconsider this proposal after seeing detailed simulations of the expected realistic performance of this TPC for electron shower events. A successful proposal would also need to demonstrate how the proposed experiment is integrated into the world-wide effort to explore this technology.

LoI: Long Baseline Neutrino Program

There is no doubt that the broad subject of neutrino physics is one of the frontiers of physics. The mass differences and mixing angles between the three types of neutrinos and the measurement of CP-violating effects in the lepton sector promise to provide important new physics truly "beyond the standard model."

Accelerator-driven oscillation experiments to study these effects are best done with very long ($\sim$ 1000 km) baselines. The observation in a broad-band beam of several (1-4) nodes of neutrino oscillation would provide many powerful constraints for matter effects, oscillation, and CP-violation.

Although technically feasible, these experiments are challenging in almost all relevant areas– instrumentation, cost, and organization.

Both the interest and complexity of these experiments is increased by the fact that the required massive detectors are important for a wide range of other measurements. Examples include studies of solar neutrinos, neutrino astronomy, and nucleon decay.

The scientific staff at BNL has a long-standing interest and expertise in neutrino physics. The long history extends back to the discovery that ν_e and ν_μ are distinct species. The energy range, geographical location, and high intensity of the AGS make it a most promising source for long baseline experiments. For these reasons, we encourage the Laboratory to study what is possible in this field and to play a leadership role in developing a future neutrino program.