SUMMARY

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for
RHIC Spin Collaboration Meeting XI
RIKEN BNL Research Center

Since its inception, the RHIC Spin Collaboration (RSC) has held semi-regular meetings each year to discuss the physics possibilities and the operational details of the program. Having collected our first data sample of polarized proton-proton collisions in Run02 of RHIC, we are now in the process of examining the performance of both the accelerator and the experiments. From this evaluation, we not only aim to formulate a consensus plan for polarized proton-proton during Run03 of RHIC but also to look more forward into the future to ensure the success of the spin program.

In the fifth meeting of this series (which took place at BNL on July 29, 2002), we focused on the former since the beam-use requests from the experiments were due in early August. Accordingly, we had presentations on three of the critical issues for spin running in RHIC Run-03:

- RHIC polarization issues,
- Commissioning of the new spin rotators, and
- Absolute luminosity.

Following these presentations, we had an open discussion about the beam use proposal. In addition, there was a presentation on a proposal to measure the analysing powers of the CNI polarimeter at AGS energies.

To open the meeting, Osamu Jinnouchi presented an update on the offline analysis of the CNI polarimeter data from Run-02. Following up on the work presented in the May meeting, Osamu showed that the increase in the noise was caused by the gain drop in the silicon. Instead of cutting the noisy strips in his analysis, he performed a background subtraction by using the counts observed for "abort gap" bunches as a measure for this noise. In the yellow beam, he showed that the polarization exhibits a bunch-to-bunch dependence – specifically, the polarization of up bunches go up with bunch number, whereas the down bunches go down. At this time, this trend is not understood.

Vahid Ranjbar then presented his results on depolarization in RHIC during ramping. In RHIC, the intrinsic, imperfection, and coupled resonances have no effect because the two Siberian snakes keep the tune at 1/2, independent of energy. However, the snakes give rise to so-called snake resonances. During the ramp to 100 GeV, there are three such resonances – Q_y at 3/16, 3/14, and 1/4 – which need to be avoided while ramping. During Run-02, the vertical tune was kept well above the 3/16 resonances, but did come close to the 3/14 and 1/4 resonances. These resonanaces were slightly displaced from their nominal values because, as seen by the survey, the machine was not as flat as it was initially thought. In particular, there was a sizeable dip (~ 5 mm) at IP12. From plots of the polarization versus the tune separation from the 3/14 and from the 1/4 resonance points, it's clear that both resonances were affecting the beam polarization. The 3/14 looked like the more frequent problem during the run. This fact may explain the observation (as presented by Dave Underwood in the June meeting) that the CNI analyzing power at flattop energy appeared to differ at the 20% level from the value at injection energy. For the next year, the new knowledge of the alignment of the machine will be propagated into the tune calculation and thus this situation will likely be avoided.

As suggested by Vahid, the polarization would be better retained if we could control the tune on the ramp. Such control is possible when the tune feedback system (commonly referred to as the phase-lock loop or PLL system) is operating during the ramp. Peter Cameron presented a report on the commissioning and the performance of this system during Run-02. In this system, one bunch is given a nudge with each revolution of the beam and, via an rf pickup, the response of the beam is measured. The beam tune can then be computed from this information. To control the tune, the measurement is fed back to the magnet control system to tweak the current in correction coils so that the tune remains unchanged during the ramp. During Run-02, the system suffered from several problems: locking onto satellite bunches instead of the main bunches, the control system was not quite mature enough for non-experts to operate the system, and the feedback circuit was a bit too simple. Nevertheless, the system – when operated by an expert – was often able to control and stabilize the tune as the Au beams were being ramped. For proton-proton running, however, there were initially several failures of the system. Subsequently, these failures have been attributed to chromoticity broadening. But, at the time, the system was not studied further because of other demands on the commissioning effort. It is expected that the various problems will be surmounted by the beginning of Run-03 so that the system can be routinely operated throughout the run. The operation of this system is also required for performing the downramp.

In Run-03, both PHENIX and STAR will have spin rotators installed and operational around their IPs. As part of the commissioning for Run-03, these rotators need to be calibrated. Thus, there needs to be a means to measure the transverse component of the polarization at the interaction points. For PHENIX,[1] Abhay Desphande presented the results for the measurements which were performed at IP12 in Run-02 in the hopes of locating a process with both a sufficient rate and a non-zero analyzing power to provide a feasible method for doing local polarimetry. In this effort, forward production of neutral particles (neutrons, photons, and neutral pions) were studied with an electromagnetic calorimeter and a hadron calorimeter positioned behind the DX magnet on the blue and yellow beam, respectively. At this time, the analysis shows a large (on the order of 10%) analyzing power for neutrons, no analyzing power for pions, and at most a small analyzing power for photons. PHENIX plans to use the neutrons to determine the orientation of the polarization vector by adding shower maximum detectors to the existing zero-degree calorimeters (ZDC).

Following Abhay's presentation, Waldo Mackay closed the morning session with a status report on the installation of the spin rotators and a first look at the commissioning plan for them. The installation of the rotators in the RHIC ring is on schedule and presently well past the halfway point. The main tasks which remain are the cabling of the magnets to the cooling system, the magnet power supplies, and the quench circuits. Both tasks are expected to be finished on schedule. The commissioning plan is to take some data at the experiments first with the spin rotators off so that the performance of the local polarimeters can be verified. Then, Waldo would turn on the rotators so that, in principle, the spin would be aligned radially. A measurement by the local polarimeters at STAR and PHENIX would then verify the orientation of the polarization. From this point onwards, the commissioning effort would depend upon what is learned. Once the spin rotators have been commissioned, their setting will be set during physics running from measurements of the deflection of the beam made by

[1]The STAR local polarimeter effort was discussed by Les Bland during the May RSC meeting.

beam position monitors situated at the center of each rotator.

The afternoon session was opened by Angelika Drees with a presentation of the analysis of the data from the van der Meer/vernier scans performed with protons during Run-02. To compute the luminosity from machine parameters alone, the most difficult property to determine is the transverse size of the overlap between the two beams at the interaction point (IP). At RHIC, this overlap size can be directly measured using van der Meer or vernier scans. In these scans, one of the beams is systematically moved across the other beam along one axis. By monitoring the collision rates using the experiment's min-bias trigger and measuring the positions of the two beams using the beam position monitors, the width of the overlap is measured along one axis. The width of the overlap region along the orthogonal axis is then determined by repeating the scan with displacements along this axis. In her presentation, Angelika showed that the ZDC cross section was, within statistics, the same at PHENIX and STAR in the fills for which scans were done at both IRs. She also presented the preliminary cross section results from the BBC counters at PHENIX.

Since the geometry of the detectors at each IP imposes an event configuration cut on the cross section, it is necessary to investigate the extent to which the experiments understand such effects. This effort provides a means to estimate the systematic error in the luminosity measurement. Yuji Goto presented a status report on the PHENIX efforts to study this issue.[2] Since PHENIX imposes a vertex cut in its trigger counters, the effective luminosity is smaller than the machine luminosity. The correction for this effect was estimated from data which had been collected without this cut. In addition, the limited acceptance of the trigger counters ($3.0 < \eta < 3.9$) biases the cross section measurement done via the van der Meer scan. This effect was estimated using a PYTHIA Monte Carlo. At present, the analysis results in a cross section of 40 mb, somewhat smaller than the inelastic cross section predicted in PYTHIA (42 mb). However, for this analysis, we presently estimate that the error is between 10 and 20%. In the upcoming month, we plan to finalize the error estimate and investigate the agreement of PYTHIA with our measured data. Yuji also showed the measured π° p_t spectra released by PHENIX for QM. The agreement of the perturbative QCD (pQCD) calculation with these data is remarkable and thus supports the use of pQCD for interpreting our future longitudinal asymmetry measurements.

Likewise, STAR has worked to understand the infleuence of their detector geometry on the luminosity measurement. Les Bland provided an update on the status of this analysis. STAR, like PHENIX, needs to estimate the acceptance bias of their trigger counters. They, like PHENIX, are using a PYTHIA Monte Carlo to generate the events. They then use a simplified response functions for their detectors to complete the simulation. Les showed that, in this simulation, although the hit distributions for each counter agree qualitatively with data, they tend to fall more rapidly at low and high multiciplicity than the data does. These differences are likely arising from from the simplified response function and the neglection secondaries in the Monte Carlo. He then summarized the status of the forward π° detector analysis which they are presently finalizing.[3]

For the pp2pp experiment, Ron Gill presented a progress report on their absolute lumi-

[2]The complete discussion of this analysis (including final results) was presented by Sergei Belikov during the October meeting.

[3]For details of the goals of this work, see Les Bland's talk during the May meeting.

nosity analysis. In pp2pp, the luminosity is monitored using the count rate in their inelastic detectors. Positioned at ± 20 m from the IP, these detectors cover the pseudo-rapidity range (η) from 2.5 to 5.5 using four sets of quadrant-segmented scintillator paddles. Since each set is separated from the other by ~ 2 m in z, a crude TOF measurement can be done to determine the direction of the particles which pass through the counters. This measurement can discriminate between beam-gas or beam-scraping events and beam-beam events. By using information from only one side of the IP, they hope to reduce the bias of the trigger on their data selection. During their dedicated fill in Run-02, however, pp2pp had set up their trigger so that it required a coincidence between the set of counters on each side of the IP. From these data, Ron reported that a single side measurement could separate the beam-beam events from the other background events. He used these events, along with a cross section estimate from PYTHIA, to determine a luminosity at pp2pp.

To close off the presentations, Rob Hobb talked about the goals and plans for a possible measurement of the CNI analyzing powers at several energy points over the range which the AGS operates. From the E950 experiment, this analyzing power is only known at one energy – namely 22 GeV which is near the transfer energy to RHIC – but with an error of $\sim 30\%$. To make the most use of the CNI polarimeter presently being installed in the AGS, it would be best not only to improve the precision of this result but also to know the analyzing power at or near all of the spin resonances in the AGS. Without a dedicated experiment, it will only be possible to cross check the CNI analysing power with the "standard" AGS polarimeter at low energy in the AGS, leaving room for uncertainty over the mid-range of energy. So, to fill this gap in our knowledge, Rob presented a proposal to install a jet experiment on one of the AGS exit lines and, similar to the jet target effort underway at RHIC, make a measurement of the analyzing power of the AGS.

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