Discussion on Beam Polarization for Run 2 Papers

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There are expected to be several papers from the first RHIC spin run, including observed asymmetries (forward π^0 at STAR, very forward neutrons at IP12) and some null results for asymmetries (very forward π^0s at IP12, charged hadrons at mid rapidity at STAR). PHENIX mid rapidity π^0 asymmetries are still being analyzed. To present these results as physics asymmetries, we need to decide on what to use for the beam polarization. We would like to use one approach for all RHIC results.

We have two issues to resolve: what do we use for the absolute beam polarization at 100 GeV, and what systematic error should we assign to the polarimeter measurements?

For the absolute beam polarization, we do not have a measured analyzing power for proton-carbon elastics in the CNI region at 100 GeV. From AGS experiments E950 (J. Tojo et al., PRL 89, 052302 (2002)), and E925 (C.E. Allgower et al., PR D65, 092008 (2002)), we have the analyzing power for a 22 GeV polarized proton beam, for the proton-carbon CNI polarimeter. For the –t range used in the RHIC polarimeters, this is A_N = 0.013 +/- 0.0015. Jungi Tojo will write a RHIC Spin Note that we will use (after reaching an understanding on the approach and error) on the extraction of A_N from the E950 data. (Note that he presented his extraction of the analyzing power for the RHIC polarimeters at two of our RHIC Spin Collaboration meetings in January 2002.)

We discussed presenting asymmetries measured by the experiments with 2 vertical axes. The left axis would give the raw asymmetry, and the right axis A_N, where we use the analyzing power for the polarimeters at 100 GeV = analyzing power at 24 GeV. We state in the paper that the analyzing power has not yet been measured at 100 GeV, and refer to the O. Jinnouchi et al. Spin2002 paper on the RHIC polarimetry.

For the systematic errors for the polarimetry, Osamu has presented several approaches to estimate/measure them. Looking at comparisons between the measurements with the 90° and 45^{0} polarimeter detectors, from various false asymmetry studies, and from a sin ϕ fit to the data from the 6 polarimeter detectors, he finds a systematic error between (0.5 to 1) x $\sigma_{Statistical}$ for each measurement. The measurement statistical error is $\Delta\varepsilon=2 \times 10^{-4}$ for 20 M events. (ε is the raw asymmetry, $\varepsilon=P \times A_N$) For $A_N=.013$, the range of systematic error is ΔP = (0.8 to 1.6) x 10^{-2} per measurement. We propose to use the larger estimate, or $\sigma_{Systematic} = 1 \times \sigma_{Statistical}$ for each measurement. This systematic error adds in quadrature to the statistical error for each measurement. This implies that, after many measurements, the combined statistical and systematic error on the average polarization is greatly reduced. We need to discuss what evidence we have that this systematic error is indeed random, and how we should quote an overall systematic error for the beam polarization, from the measurements. This systematic error is for false asymmetry in the polarimeter measurement, and does not include the systematic error from A_N.

A number of other issues were raised. These included possible pile up or other intensity dependence of the measurement, and whether fill-dependence of false asymmetries is observed. There were 5 fills which showed significant debunching which would affect the time of flight measurement of the polarimeter. Luminosity asymmetries being different for different detectors was mentioned, but this issue may have been addressed with the χ^2 test done for the luminosity of the six detectors for each bunch. This test resulted in identifying several bad bunches which were removed from the analysis. Also a few silicon strips were noisy, and the noise was subtracted based on a measurement in the abort gap. (This also led to the identification of the fills with significant debunching.) Finally, the bunches identified as anomalous have been shown to have anomalous specific luminosity at STAR (see studies by Johanna Kiryluk, Spin 2002 and RHIC Spin Collaboration meetings) and PHENIX (see RSC presentation by Takahiro Kawabata).

We also decided that the Spin2002 polarimeter article (O. Jinnouchi et al.) will present the systematic errors to be used by the

experiments for presentation of their results from the 2002 polarized proton run.