Toward understanding relativistic heavy-ion collisions with the STAR detector at RHIC

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We have advanced the spin-alignment measurement of bottomonium (Upsilon) production. In addition to the measurement in Run-9 p+p collisions at √s=200 GeV, we have performed the measurement for Run-11 p+p collisions at √s=500 GeV.

Upsilon Production Mechanism:

The Run-9 (√s=200 GeV) results were presented in Dr. Cervantes' Ph.D. thesis (2012). Due to the recent discovery of a code error in the acceptance correction to the distribution of Y as a function of cosθ, the final results have changed. However, the Run-11 data (with much more statistics) is fully consistent with the Run-9 result. Figure 1 shows the reconstructed mass from e^+e^- pairs (black) and like-sign pairs (red) from the Run-9 analysis (left panel) and the Run-11 analysis (right panel). The combinatorial background in the √s=500 GeV data is larger than in the 200 GeV data. The blue lines indicate the mass cuts used for the spin-alignment measurement.

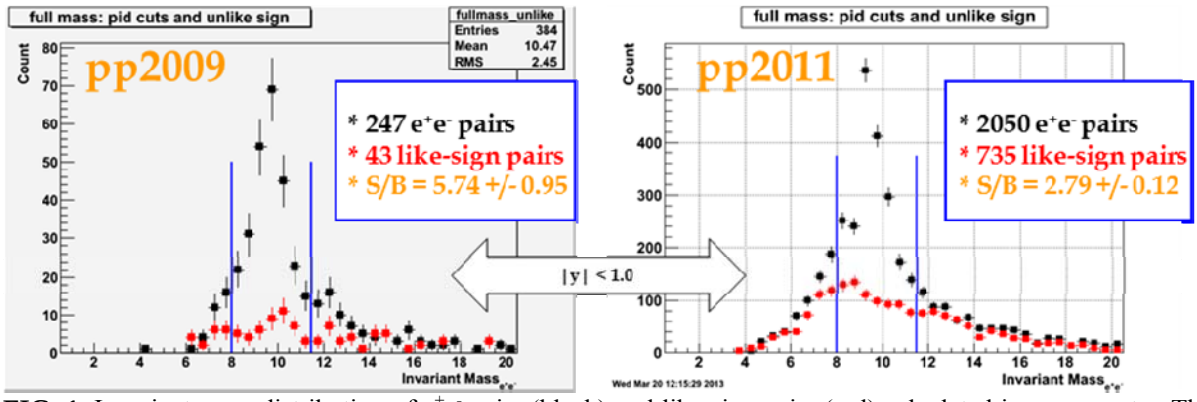

FIG. 1. Invariant mass distribution of e^+e^- pairs (black) and like-sign pairs (red) calculated in p+p events. The blue lines indicate the mass cuts used for the spin-alignment measurement.

The spin alignment measurement is parameterized as $dN/d(\cos\theta)=1+\alpha(\cos^2\theta)$, where θ is the angle between the direction of the decay e^+ momentum, measured in the Upsilon's rest frame with respect to the Upsilon's direction of motion, i.e. the polarization axis. This measurement contributes to the understanding of the production mechanism of heavy quarkonia because different production models (Color Singlet model vs. Color Octet model) predict different values of the polarization α, as a function of Y p_T. The Run-9 result is shown in Fig. 2.

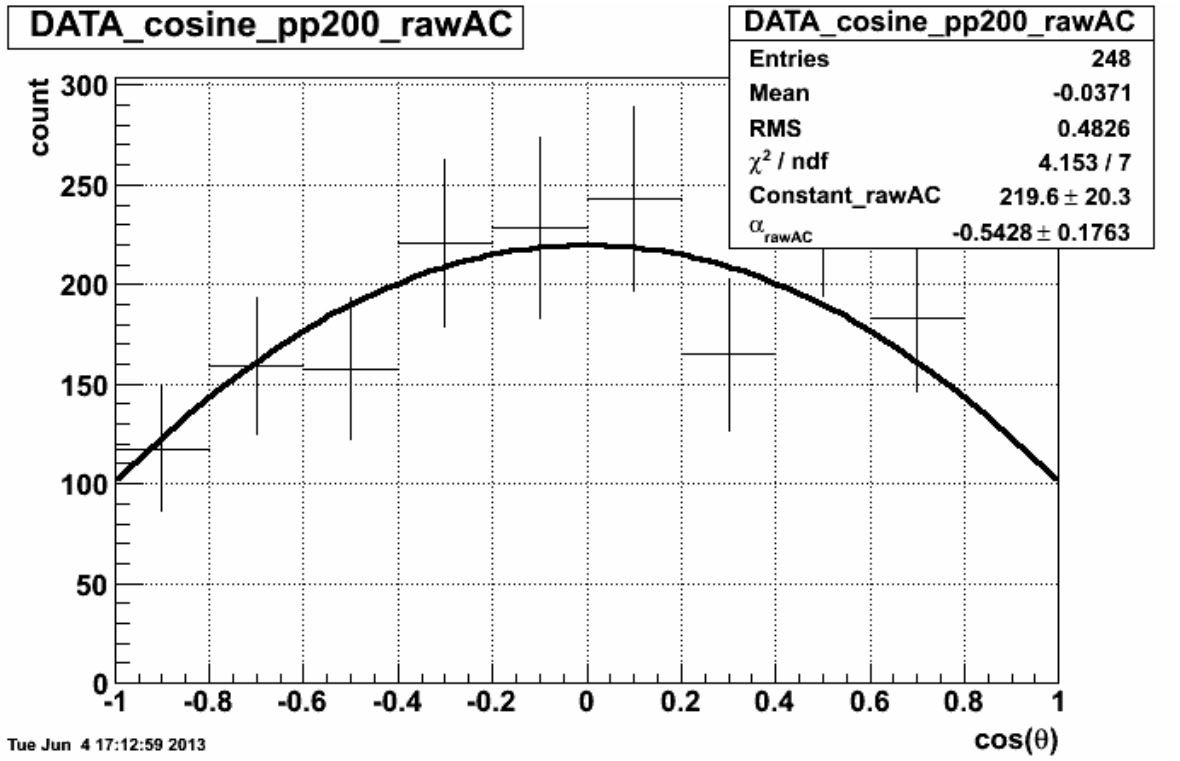

FIG. 2. Acceptance-corrected (Run-9) spin-alignment measurement dN/d(cosθ), in √s=200 GeV p+p collisions, fit with function $C[1+\alpha(\cos^2\theta)]$.

The polarization was found to be longitudinal, with a value of -0.54±0.18. The combinatorial background is small, as seen in Fig.1 (left), and flat in cosθ, and has not been subtracted. The Drell-Yan background, also still included in the measurement is estimated to contribute ~20% from a line-shape analysis.

In the Run-11 data set, the statistics are larger, and we are able to subtract the background by analyzing the invariant mass distribution (for like-sign and unlike-sign pairs) in each bin of cos(θ). A preliminary result of the dN/d(cosθ) distribution is shown in Fig. 3.

The polarization was again found to be longitudinal with a fit value of -0.53±0.18. The acceptance correction, the background subtraction, and the systematics of the result are currently being studied and finalized.

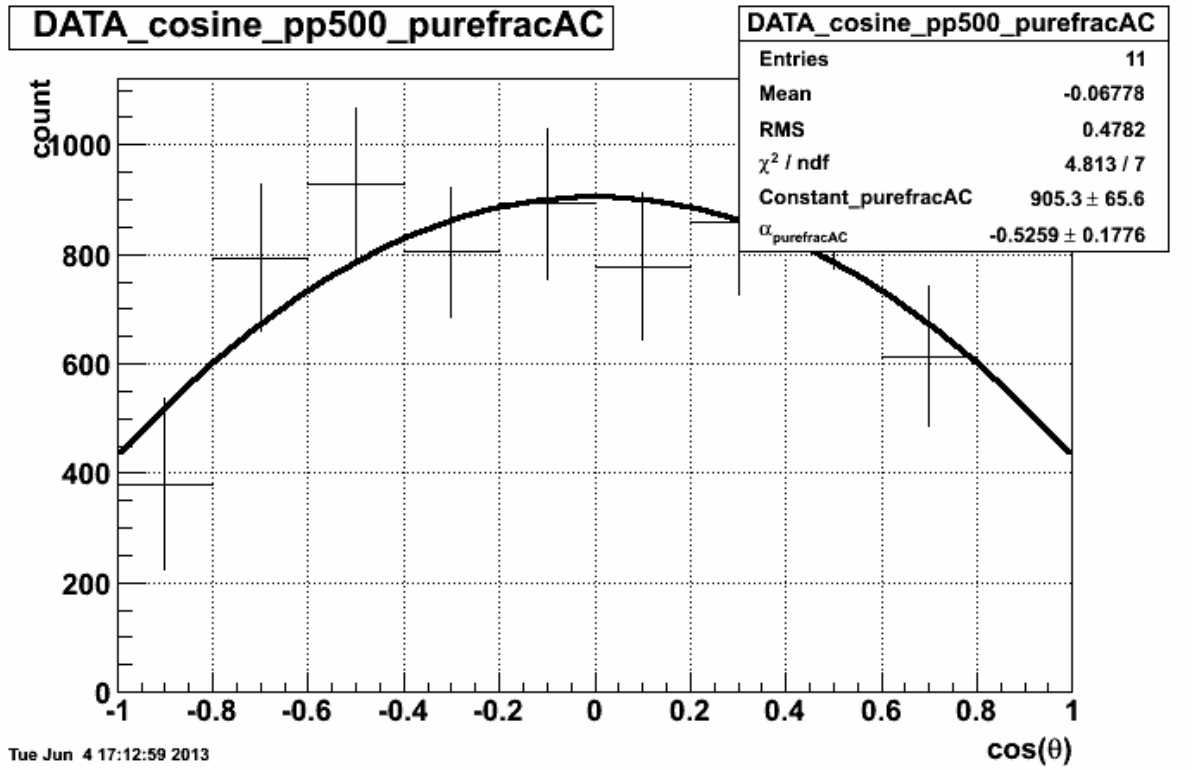

FIG. 3. Acceptance-corrected (Run-11) spin-alignment measurement dN/d(cosθ), in √s=500 GeV p+p collisions, fit with function $C[1+\alpha(\cos^2\theta)]$. The background (combinatorial and Drell-Yan) has been subtracted for this data set.