Polarized Hadroproduction of Open Heavy Quarks in NLO QCD at RHIC and JHF

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We present the first complete next-to-leading order QCD calculation of the polarized hadroproduction of open heavy flavors [1]. This reaction is now being studied experimentally in polarized pp collisions at the BNL RHIC in order to constrain the polarized gluon density Δg. Predictions for RHIC based on the currently available helicity density function (HDF) sets are presented for both charm and bottom production at $\sqrt{S} = 200$ and 500 GeV. In these predictions hadronization and the PHENIX detector acceptance for leptons from heavy meson decays are treated in a novel way by using "efficiencies" for bins in transverse momentum p_T and pseudo-rapidity η of the heavy quark. Thus the ability of RHIC to distinguish different HDF sets is demonstrated clearly by taking into account the actual experimental setup in a realistic manner.

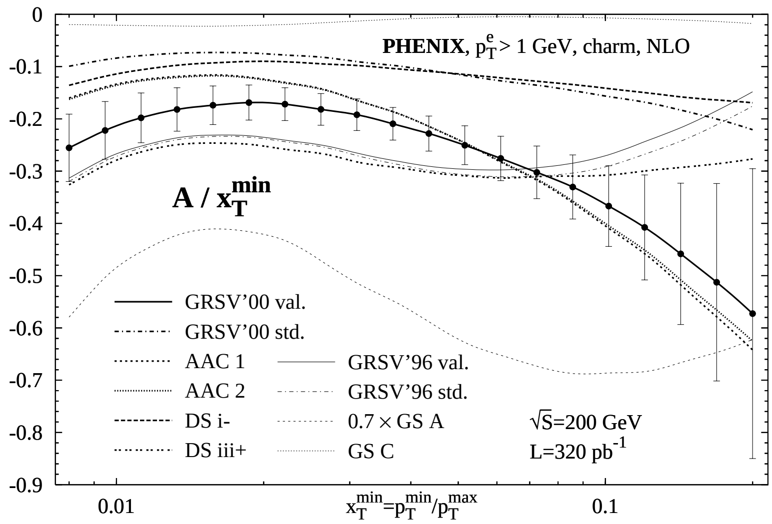

Figure 1: Spin asymmetry $A = \Delta\sigma/\sigma$ for $p_T \geq x_T^{\min} p_T^{\max}$.

We also display predictions for the production of open charm, polarized and unpolarized, at the JHF. The high intensity proton beam makes the JHF a "charm factory" with very impressive statistics for our reaction even with polarized beam and target. We show that the JHF can constrain the HDF sets strongly in the large x region. In spite of having the same $\sqrt{S}$ as *photo*production at COMPASS, the larger values of x probed at the JHF will make these experiments complementary. Furthermore the unpolarized production of open charm will yield measurements unprecedented in accuracy in an energy range that has not been covered by previous experiments. The statistical error of the JHF measurements quickly becomes smaller than the theoretical uncertainty stemming from the *unpolarized* parton distribution functions at large x.

It is demonstrated that the dependence on unphysical renormalization and factorization scales is strongly reduced beyond the leading order. The remaining theoretical uncertainties are briefly discussed. In particular it is pointed out that at JHF the very high statistics for the unpolarized process can be used to eliminate most of the theoretical uncertainties for a polarized measurement.

References

[1] I. Bojak and M. Stratmann, `hep-ph/0112276`, to be published in Phys. Rev. **D**.