W→ μ parity violating asymmetries from the 2013 running period in the PHENIX experiment

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During the 2013 data taking period 277 pb^{-1} of longitudinally polarized proton collision data at a center of mass energy of 510 GeV were accumulated with an average beam polarization of 53% per beam at the PHENIX experiment at RHIC. This data corresponds to the largest data sample available for the polarized W data analysis. In order to access the sea quark polarization in the nucleon real W boson production is an elegant way. The parity violation of the weak interaction directly selects the helicity of the quarks and anti-quarks and the charge of the produced W boson selects the quark and anti-quark flavors. For example the W^- gets produced by a left-handed d quark and a right-handed anti-u quark. While the u and d quark helicities are already reasonably well known the sea quark helicities are only very poorly determined and the question whether the polarized light sea is symmetric or not has been predicted rather differently in various nucleon models. The analysis of W decay muons in the forward and backward muon arm detectors of PHENIX is not as straightforward as at central rapidities as there is no clean W decay signature such as a Jacobian peak at half the W mass. Also a large number of background sources exist such as heavy flavor decay muons and hadrons decaying within the tracking volume mimicking a high momentum muon as previously reported. With the help of kinematically different variables for signal and backgrounds candidate events were pre-selected by a likelihood ratio where only high signal likelihood events were kept. Then the relative signal and background contributions were fit by a maximum unbinned likelihood fit. From those preliminary $pp \rightarrow W^{\pm}X$ cross sections were extracted which turned out to be consistent with NLO predictions, see Fig. 1. After correcting the raw single spin asymmetries for beam polarization and dilution by background the preliminary results[6] for the single spin asymmetries were obtained as seen in Fig. 2. The results are in good agreement with the parameterizations and will eventually be used in future iterations of the global helicity fits to all the existing deep inelastic scattering and proton-proton collision data. The 2013 PHENIX W results are currently being prepared for publication and it is expected to reduce the systematic uncertainties which are dominated by the uncertainties on the signal to background ratio still.

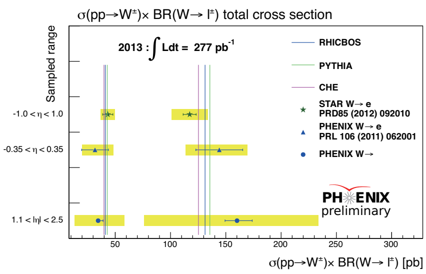

Fig. 1. Total $pp \rightarrow W^{\pm}X \times BR(W \rightarrow l)$ cross sections for forward muon and previously published $W \rightarrow e$ results by PHENIX[1] and STAR[2] as well as predictions by Pythia[3], CHE[4] and RHICBOS[5].

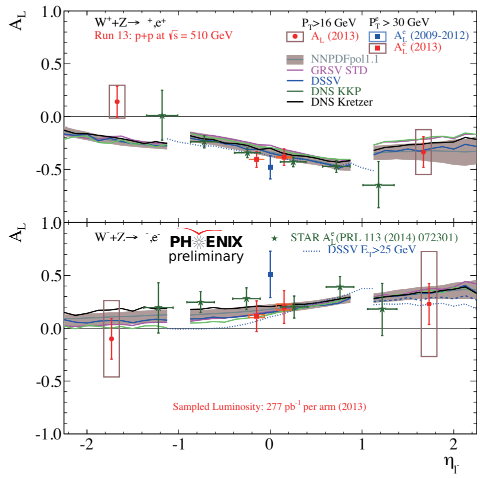

Fig. 2. Single spin asymmetries of W+Z decay leptons as a function of lepton rapidity. The preliminary PHENIX electron and muon results from the 2013 data taking period (red) and the published STAR electron results from 2012 (green)[7] are shown as well as various helicity parameterizations.

References

1) A. Adare *et al.* [PHENIX Collaboration], Phys. Rev. Lett. **106** (2011) 062001
2) L. Adamczyk *et al.* [STAR Collaboration], Phys. Rev. D **85** (2012) 092010
3) T. Sjostrand*et al.* Comput. Phys. Commun. **135** (2001) 238
4) D. de Florian and W. Vogelsang, Phys. Rev. D **81** (2010) 094020
5) P. M. Nadolsky and C. P. Yuan, Nucl. Phys. B **666** (2003) 31
6) F. Giordano [PHENIX Collabortion], to appear in JPCS (Spin 2014 proceedings).
7) L. Adamczyk *et al.* [STAR Collaboration], Phys. Rev. Lett. **113** (2014) 072301

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