

**Measurement of  $W^\pm$  single spin asymmetries and  $W$  cross section ratio in polarized  $p + p$  collisions at  $\sqrt{s} = 510$  GeV at STAR**

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The STAR experiment at RHIC has provided significant contributions to our understanding of the structure of the proton. The STAR experiment is well equipped to measure  $W^\pm \rightarrow e^\pm + \nu$  in  $\sqrt{s} = 510$  GeV longitudinally polarized  $p + p$  collisions at mid-rapidity ( $|\eta| < 1$ ). The longitudinal single spin asymmetry in  $W$  production,  $A_L$ , measured as a function of decay positron (electron) pseudo-rapidity  $\eta$  for  $W^+(W^-)$  is sensitive to the individual helicity polarizations of  $u$  and  $\bar{d}$  ( $d$  and  $\bar{u}$ ) quarks. Due to maximal violation of parity during the production,  $W$  bosons couple to left-handed quarks and right-handed anti-quarks and hence offer direct probes of their respective helicity distributions in the nucleon. The published STAR  $A_L$  results (combination of 2011 and 2012 data) have been used by several theoretical analyses suggesting a significant impact in constraining the helicity distributions of  $\bar{u}$ , and  $\bar{d}$  quarks. In 2013 STAR collected a dataset at  $\sqrt{s} = 510$  GeV with a total integrated luminosity of  $\sim 300 \text{ pb}^{-1}$  with an average beam polarization of  $\sim 54\%$ , a figure of merit three times larger than the dataset used by previous analyses. We will report the status of the analysis of the STAR 2013  $W$   $A_L$  along with the future plans for final  $W$   $A_L$  results by combining both STAR 2012 and 2013 data of total integrated luminosity of about  $\sim 400 \text{ pb}^{-1}$ .

$W$  cross section ratio ( $W^+/W^-$ ) measurements at STAR are sensitive to unpolarized  $u$ ,  $d$ ,  $\bar{u}$ , and  $\bar{d}$  quark distributions. At these kinematics, STAR is able to measure the quark distributions near Bjorken- $x$  values of 0.1 at a  $Q^2$  scale set by the  $W$  mass. The increased statistics from the STAR 2013 data collection, will lead to a higher precision measurement of the  $W^+/W^-$  cross section ratio. An update of the  $W$  cross section ratio analysis from the STAR 2011, 2012 and 2013 runs is presented.