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

Devika Gunarathne for the STAR Collaboration

Temple University, Philadelphia, PA, USA

Email: devika.gunarathne@temple.edu

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 $W^{\pm} \to e^{\pm} + \nu$ 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 η 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 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 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.