

**Measurement of  $W^\pm$  single spin asymmetries ( $A_L$ ) and  $W$  cross section ratio ( $W^+/W^-$ ) 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 been contributing to understand the structure of the proton to a great extent. The STAR experiment is well equipped to measure  $W^\pm \rightarrow e^\pm + \nu$  in  $\sqrt{s} = 510$  GeV of longitudinally polarized  $p + p$  collisions at mid-rapidity ( $|\eta| < 1$ ).  $W$  single-spin asymmetry,  $A_L$ , measured as a function of decay lepton (positron) pseudo-rapidity  $\eta$  for  $W^+(W^-)$  are sensitive to the individual helicity polarizations of  $u / d$  quarks and anti-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 anti- $u$  and anti- $d$  quarks. In 2013 the STAR experiment has collected a large sample of data at  $\sqrt{s} = 510$  GeV resulting total integrated luminosity of  $\sim 300 \text{ pb}^{-1}$  which is more than 3 times larger than the previous years, with an average beam polarization of  $\sim 54\%$ , comparable to run 2012. The preliminary results of the STAR 2013  $W A_L$  analysis will be presented along with the future plans for final  $W A_L$  results by combing both STAR 2012 and 2013 data of total integrated luminosity of about  $\sim 400 \text{ pb}^{-1}$ .  $W$  cross section ratio ( $W^+/W^-$ ) measurement at STAR is 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. The increased statistics will lead to a higher precision measurement of the  $W^+/W^-$  cross section ratio as well as allow for a measurement of its  $\eta$  dependence at mid-rapidity. An update of the  $W$  cross section ratio analysis from the STAR 2011, 2012 and 2013 runs is presented.