The STAR collaboration will be upgrading its forward detection capabilities in the final years of RHIC running before RHIC transitions into the Electron Ion Collider (EIC). STAR intends to utilize this time to explore a kinematic region yet unexplored in Cold QCD that will complement the EIC program. The upgrade will utilize excellent charged particle tracking and electromagnetic and hadronic calorimetry in the forward region of STAR (2.5 < \eta < 4). The planned RHIC runs of transversely polarized \( p+p \) at \( s = 200 \text{ GeV} \) and \( 510 \text{ GeV} \) together with the STAR forward upgrade (fSTAR), allows to make precise measurements of transverse momentum dependent distribution functions (TMD).

This poster outlines prospects for key measurements for the RHIC run 2022 and beyond, as well as reporting on the progress of the STAR forward upgrade.

**Abstract**

The measurement of TMDs at high \( Q^2 \) and low \( x \) requires transversely polarized proton-proton collisions available only at RHIC!

**fSTAR Design**

*Pseudorapidity Coverage 2.5 < \eta < 4.0*

**Forward Calorimeter System**

- Split into two halves (North/South)
- ~ 7m from STAR Interaction Region
- Misses above and below beam pipe
- Use existing detector as preshower

**Hadronic Calorimeter**

- Steel/Sc Sandwich
- \( \approx 60\%/\sqrt{E} \)
- 10x10 cm\(^2\) lateral, \( \approx 4.5 \lambda \)

**EM Calorimeter**

- Pb/Sc Sandwich (from PHENIX)
- \( \approx 10\%/\sqrt{E} \)
- 5x5 cm\(^2\) lateral, 18 \( X_0 \)

**fSTAR Construction**

- EM Calorimeter installed Oct. 2019
- Hadron Calorimeter installed January 2021

**Forward Tracking System**

- Each layer has 12 inner and outer modules
- Full 2\( \pi \) coverage
- Status: Module production

3 Layers Silicon Microstrip Sensors

- Status: Module production

4 Layers small-strip Thin Gap Chambers

- Double sided layers
- Position Resolution: \( \approx 100 \mu m \)
- Roughly 2\( \pi \) coverage
- Status: Module production

**Probing Transverse Momentum Dependent PDFs**

The measurement of TMDs at high \( Q^2 \) and low \( x \) requires transversely polarized proton-proton collisions available only at RHIC!

**STAR forward upgrade will accomplish this with a new tracking system along with electromagnetic and hadronic calorimetry**

**Upgrade in forward pseudorapidity allows for new \( x \) and \( Q^2 \) coverage**

**Net quark transverse polarization in a transversely polarized proton**

**Collins Fragmentation Function**

Collins can be measured from azimuthal distribution of hadrons in jets

**Chiral Odd so must couple to another chiral odd function**

**Need good hadron, photon, and \( \pi^0 \) identification!**