Future prospects of di-jet production at forward rapidity constraining $\Delta g(x)$ at low $x$ in polarized $p+p$ collisions at RHIC
Results / Status - Gluon polarization program

Impact on $\Delta g$ from RHIC data

- DSSV: Original global analysis incl. first RHIC results (Run 5/6)
- DSSV*: New COMPASS inclusive and semi-inclusive results in addition to Run 5/6 RHIC updates
- DSSV - NEW FIT: Strong impact on $\Delta g(x)$ with RHIC run 9 results $\Rightarrow$ Positive for $x > 0.05$

"...better small-x probes are badly needed."


Bernd Surrow
RHIC Gluon polarization - Correlation Measurements

Correlation measurements provide access to partonic kinematics through Di-Jet/Hadron production and Photon-Jet production:

\[ x_1(2) = \frac{1}{\sqrt{s}} \left( p_{T3} e^{\eta_3(-\eta_3)} + p_{T4} e^{\eta_4(-\eta_4)} \right) \]

Bjorken x-coverage:

\[ \eta_3 + \eta_4 = \ln \frac{x_1}{x_2} \]

\[ M = \sqrt{s} \sqrt{x_1 x_2} \]

\[ x_2 \text{ vs. } (\eta_3, \eta_4) \text{ M}_{\text{inv}} = 20 \text{ GeV} \quad \sqrt{s}=500 \text{ GeV} \]
Future prospects - Gluon polarization program

$A_{LL}$ projections / Central

Cone alg. (R=0.7) / $E_T > 5\text{GeV}$ $E_T > 8\text{GeV}$
Delivered Luminosity = 1000pb$^{-1}$
Polarization = 60%

- (EAST / EAST)
- (EAST / WEST)
- (WEST / WEST)
- (EAST / EEMC)
- (WEST / EEMC)
- (EEMC / EEMC)
Future prospects - Gluon polarization program

**Kinematic coverage - Simulations / Forward**

- **(EAST / FCS)**
  - $0.8 < \eta_3 (4) < 0 / 2.8 < \eta_4 (3) < 3.7$
- **(WEST / FCS)**
  - $0 < \eta_3 (4) < 0.8 / 2.8 < \eta_4 (3) < 3.7$
- **(EEMC / FCS)**
  - $1.2 < \eta_3 (4) < 1.8 / 2.8 < \eta_4 (3) < 3.7$
- **(FCS / FCS)**
  - $2.8 < \eta_3 (4) < 3.7 / 2.8 < \eta_4 (3) < 3.7$
Future prospects - Gluon polarization program

\[ A_{LL} \text{ projections / Forward} \]

\[ \delta R = 5 \times 10^{-4} \]

Delivered Luminosity = 1000pb⁻¹
Polarization = 60%

\[ (EAST / FCS) \]

\[ (WEST / FCS) \]

\[ (EEMC / FCS) \]

\[ (FCS / FCS) \]
Status: Gluon polarization program:
- First Di-Jet measurement opens the path to constrain the shape of $\Delta g$
- Run 9 results: Precise $A_{LL}$ measurement suggesting non-zero $\Delta G$

New global analysis by DSSV:
- Non-zero $\Delta g(x)$ for $x > 0.05$
- Larger uncertainties for $x < 0.05$, i.e. below current RHIC kinematic region!

Run 14 STAR BUR request:
- 6 weeks with $L_{\text{delivered}} = 75\text{pb}^{-1}$ and 60%

Forward jet production:
- Extend jet measurements at forward rapidity probing $\Delta g(x)$ as low as $10^{-3}$ in $x$
- Good control of sys. uncertainties important (Assume ~ 1 long RHIC run!)
- Additional probes to be studied: $\pi^0$-jet correlations!
- Important step prior to a future Electron-Ion Collider (EIC) ~2025!