1 Introduction & Motivations

- **Middle Rapidity**
  - large-$x$
  - collinear factorization + Sudakov resummation (parton shower)

- **Forward Rapidity**
  - small-$x$: $x_2 = (k_t e^{-y} + k_x e^{-y})/\sqrt{s} < 0.01$
  - intrinsic TMD can no longer be neglected
  - probing saturation physics

2 Formalism

- **leading order**: arXiv:1009.2141, 1101.0715

$$\frac{d\sigma}{dy_1d\phi_1d^3p_{T1}d^3p_{T2}} = \sum_{\text{channels}} \int \frac{dz_1}{2\pi} \int \frac{dz_2}{2\pi} \int \frac{d^2h_1}{(2\pi)^2} e^{-S_{\text{sud}}}
D_{h_1}(z_1, \mu_0)D_{h_2}(z_2, \mu_0)x_1f_1(x_1, \mu_0)
\sum_{\alpha} H^{(\alpha)}(z)f^{(\alpha)}(x_2, b_\perp)$$

- **small-$x$, TMD**: Fourier transform of $F^{(\alpha)}(x_2, b_\perp)$
- **$S_{\text{sud}}$**: Sudakov factor that resums logarithms such as $\ln^2 Q^2/q_1^2$ that come from multiple soft gluon radiation

3 Numerical Results

We compared with the STAR data: forward: arXiv:1008.3989; forward angular correlations in both $pp$ and $dAu$ collisions, where both the small-$x$ work allows to describe the forward dihadron angular correlation in $pp$ collisions, the difference between angular correlations the $pp$ and $pAu$ collisions, and therefore provide robust predictions. This would allow us to systematically study the signature of gluon saturation at RHIC.

4 Summary

we have carried out a comprehensive study of forward rapidity dihadron angular correlations in both $pp$ and $dAu$ ($pA$) collisions at RHIC, by using the small-$x$ formalism with parton shower effects. This new framework allows to describe the forward dihadron angular correlation in $pp$ collisions, where both the small-$x$ effect and the Sudakov effect are important. By incorporating the parton shower effect, a very good agreement with all the available data is obtained. Using the results in $pp$ collisions as the baseline, we can reliably study the saturation effect which accounts for the difference between angular correlations the $pp$ and $pAu$ collisions, and therefore provide robust predictions. This would allow us to systematically study the signature of gluon saturation at RHIC.