

**Hard Probes 2020**

# **Angular decorrelation of forward dihadrons**

**on the optimal  $p_T$  range to probe gluon saturation**

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G. Giacalone, C. Marquet, M. Matas, S.Y. Wei, in preparation

# Contents

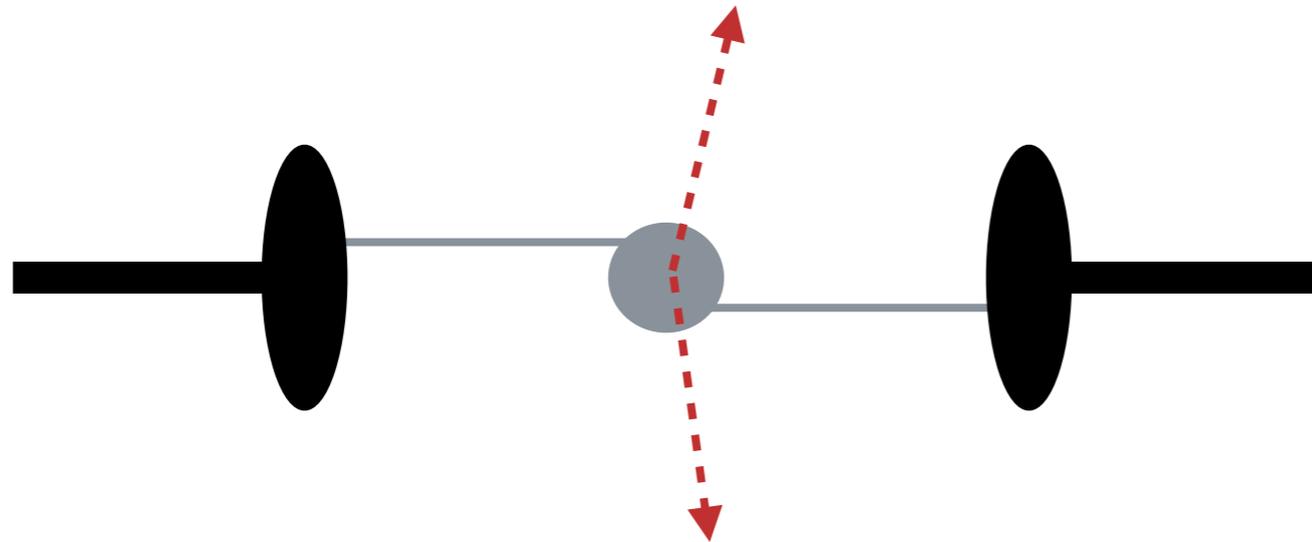
## Introduction

- Observable
- Motivation
- Framework (CGC + Sudakov resummation)

## Numerical Results

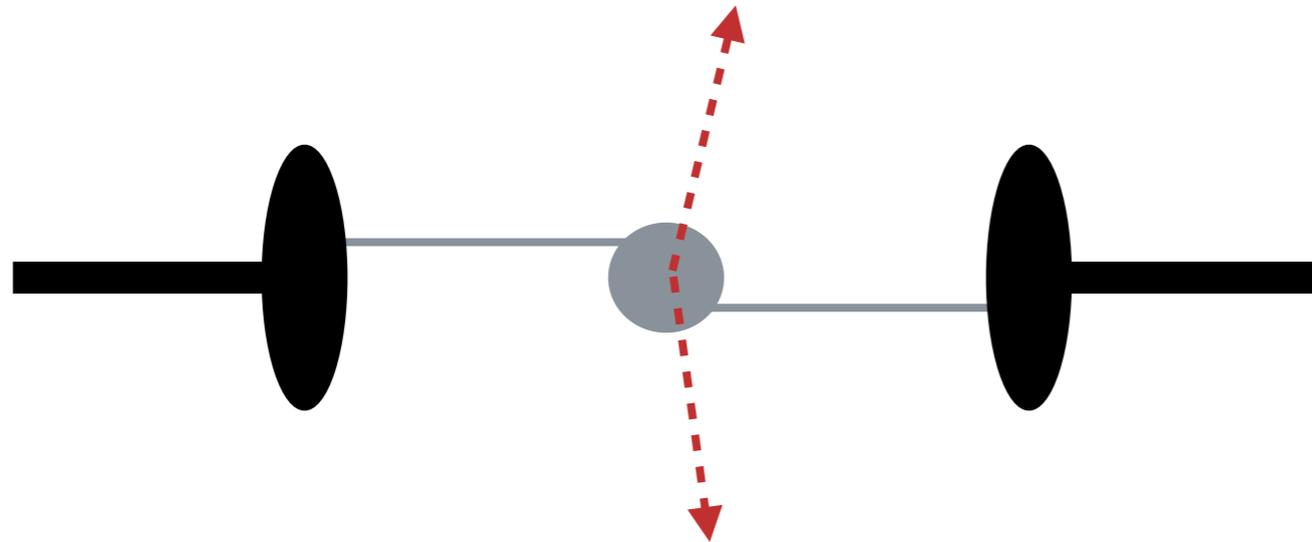
## Summary

## Dihadron/Dijet Angular Correlation



- ☑ Two leading jets
- ☑ Transverse plane
- ☑ Almost back-to-back

## Dihadron/Dijet Angular Correlation



- ✓ Two leading jets
- ✓ Transverse plane
- ✓ Almost back-to-back

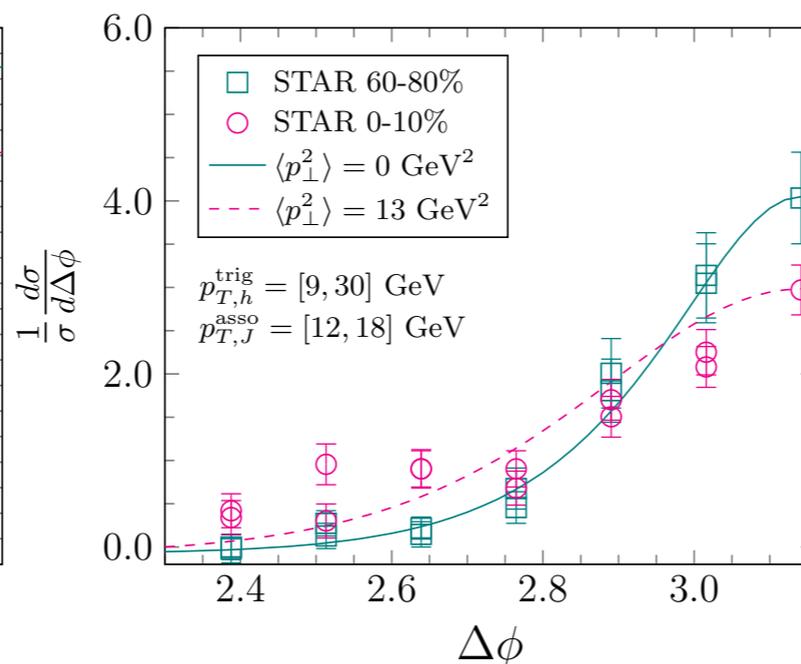
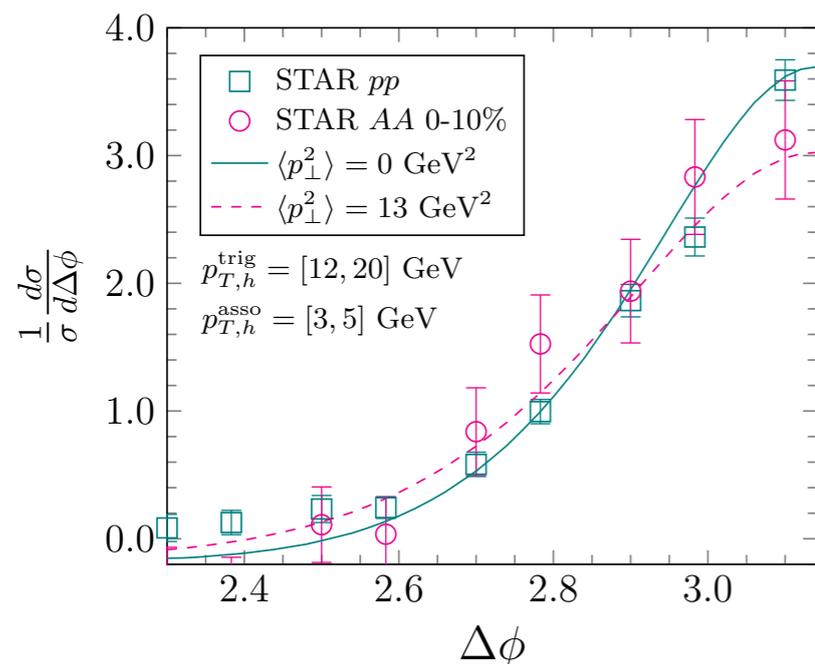
## Motivation?

- ✓ pp & AA collisions: jet-medium interaction

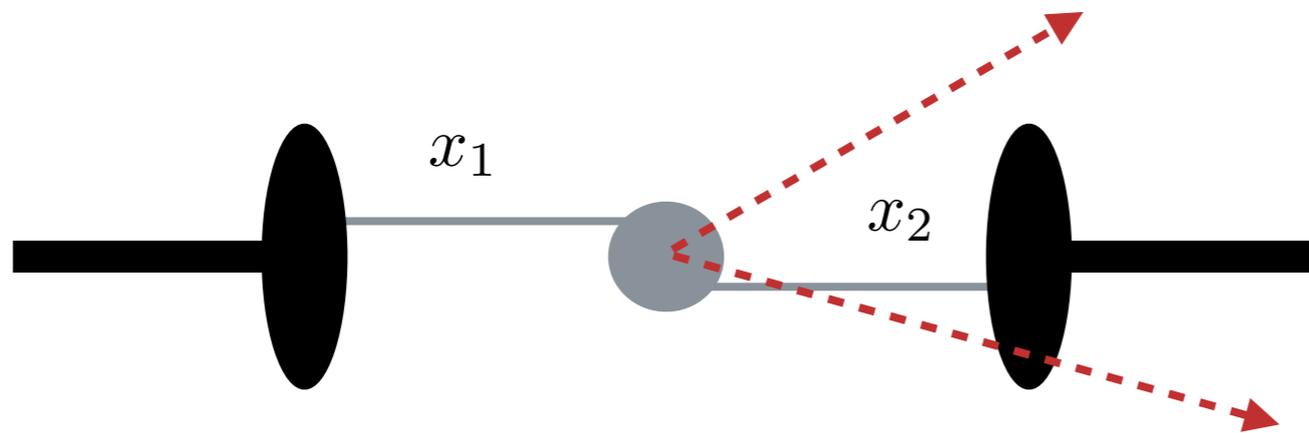
[Mueller, Wu, Xiao, Yuan, 2016](#)

[Chen, Qin, SYW, Xiao, Zhang, 2018](#)

[Jia, SYW, Xiao, Yuan, 2019](#)



## Dihadron/Dijet Angular Correlation



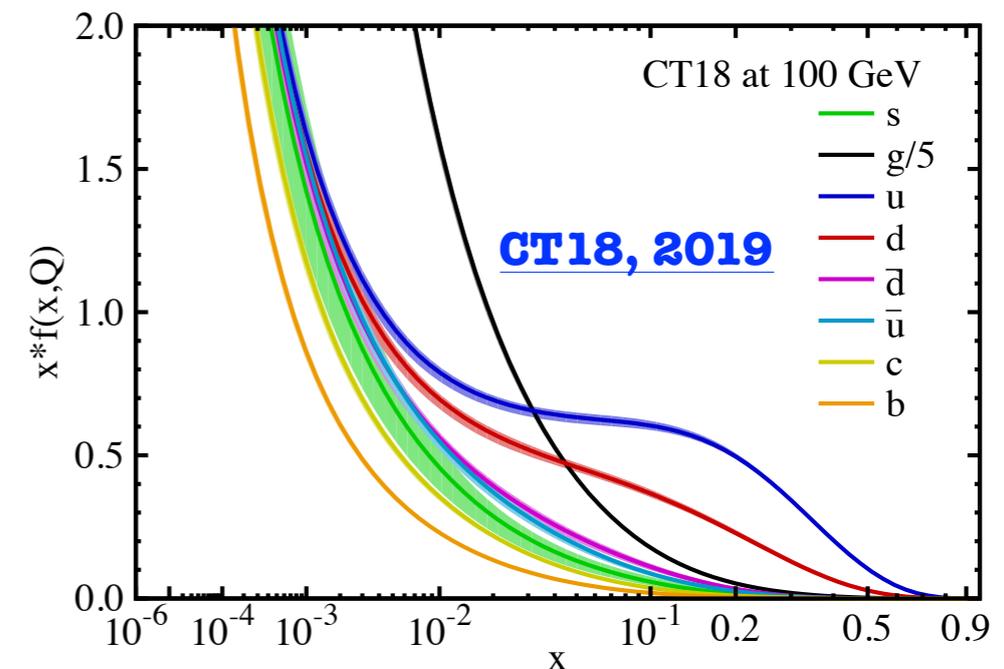
- Two leading jets
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### Motivation?

- pp & AA collisions: jet-medium interaction
- forward pp/pA collisions

$$x_1 = k_T(e^{y_1} + e^{y_2})/\sqrt{s} \gg 0$$

$$x_2 = k_T(e^{-y_1} + e^{-y_2})/\sqrt{s} \ll 1$$



dense-system; gluon saturation;  
non-linear evolution; CGC

## Theoretical Progress

☑ LO dijet/dihadron in CGC

[Marquet, 2007](#)

[Albacete, Marquet, 2010](#)

[Dominguez, Xiao, Yuan, 2010](#)

[Dominguez, Marquet, Xiao, Yuan, 2011](#)

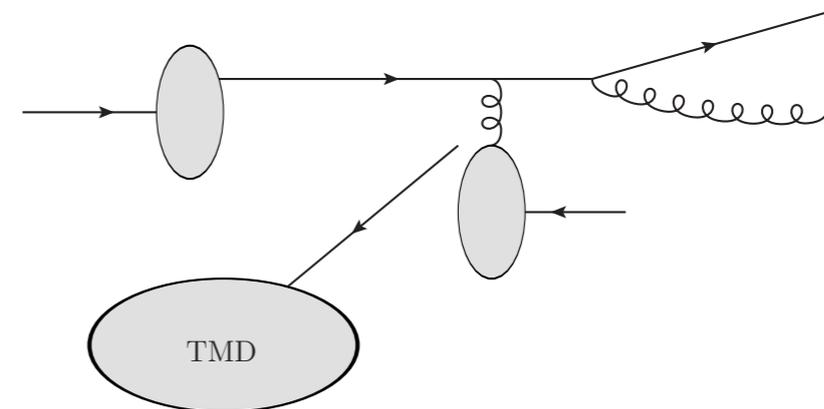
[Stasto, Xiao, Yuan, 2011](#)

[Lappi, Mantysaari, 2012](#)

[Iancu, Laidet, 2013](#)

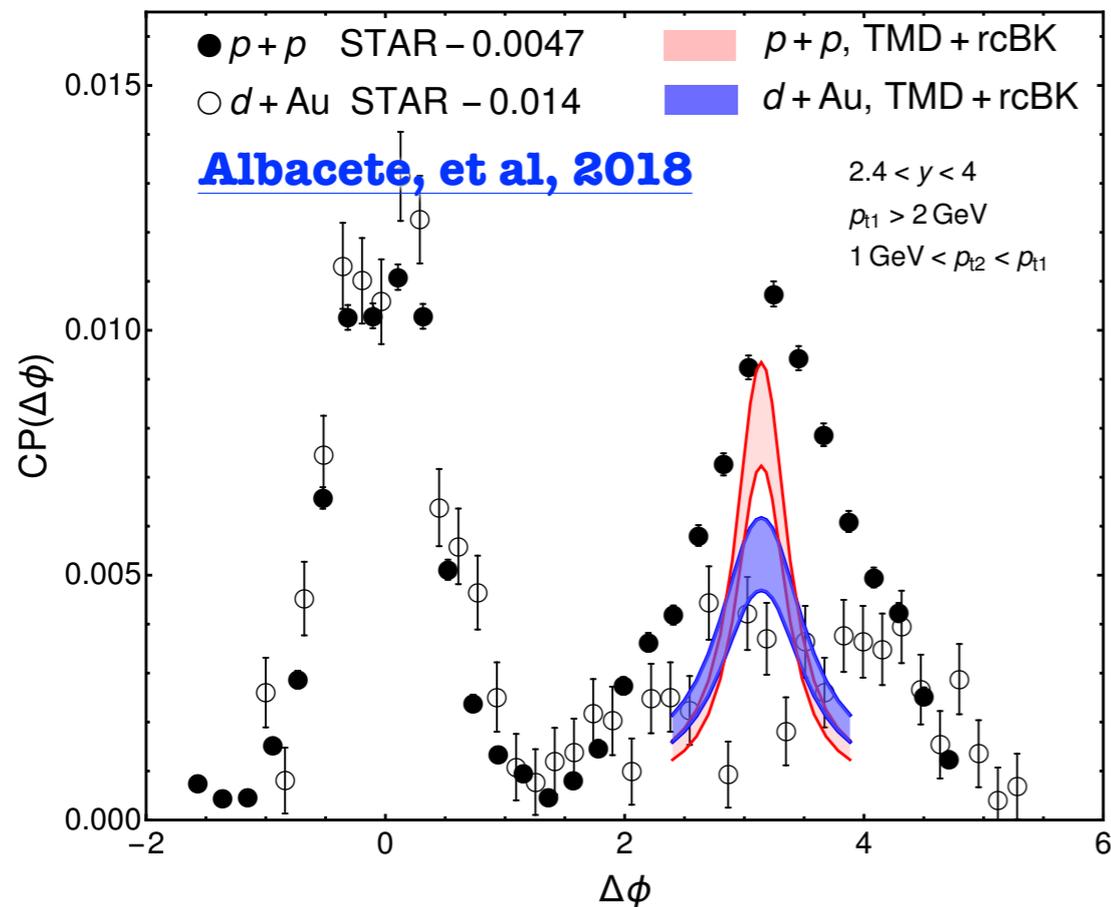
[Albacete, Giacalone, Marquet, Matas, 2018](#)

$$\frac{d\sigma}{d^2p_{T1}d^2p_{T2}} \propto f(x_1) \otimes F(x_2, q_T) \otimes H$$



## Theoretical Progress

☑ LO dijet/dihadron in CGC



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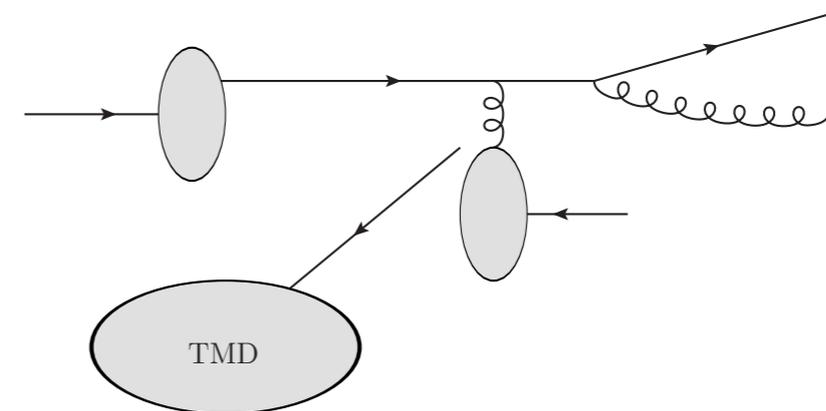
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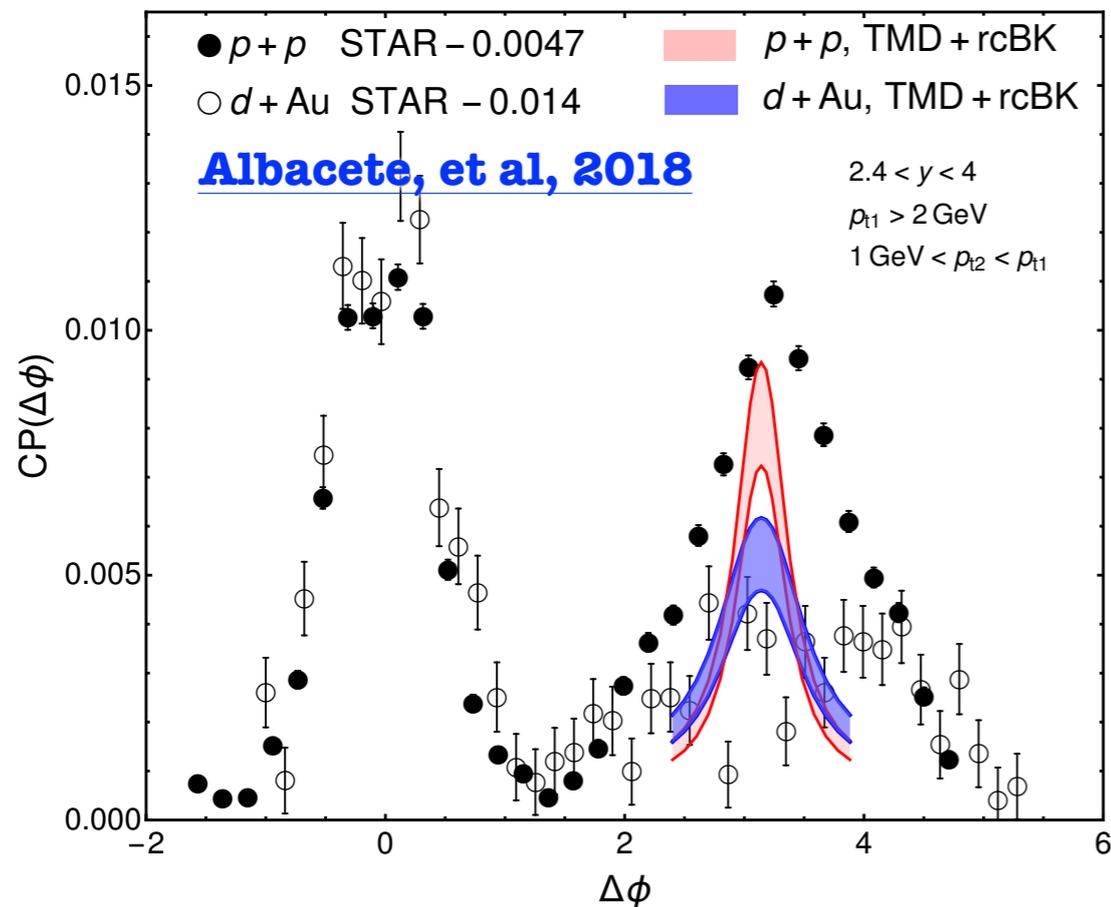
[Albacete, Giacalone, Marquet, Matas, 2018](#)

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LO dijet/dihadron in CGC



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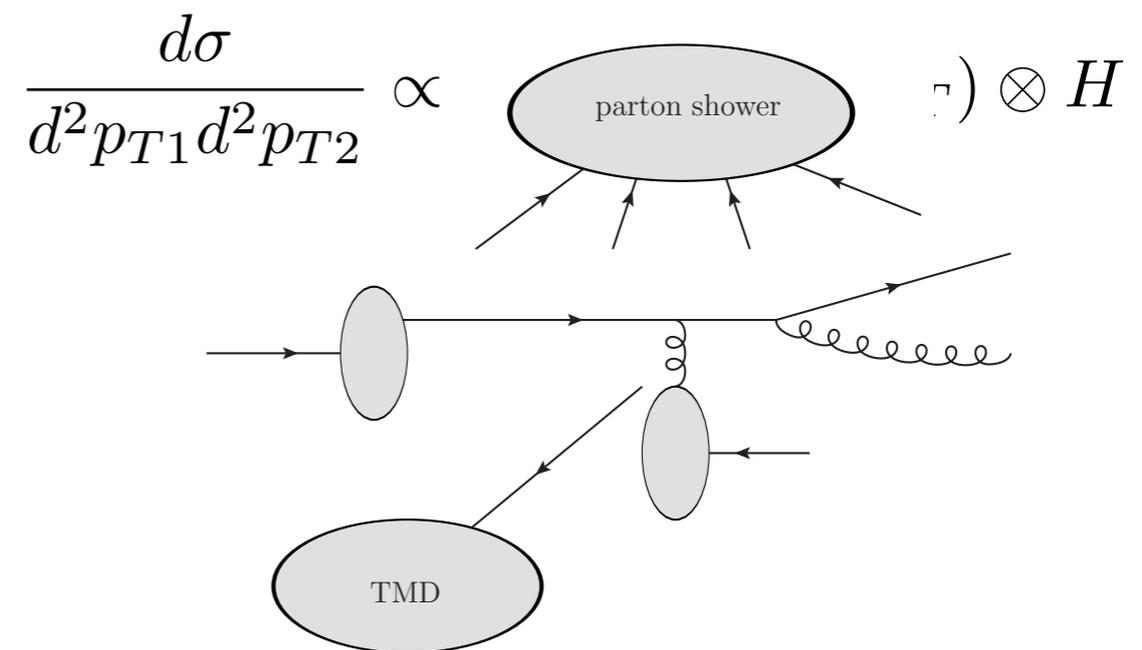
[Dominguez, Marquet, Xiao, Yuan, 2011](#)

[Stasto, Xiao, Yuan, 2011](#)

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## Theoretical Progress

LO dijet/dihadron in CGC

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[Lappi, Mantysaari, 2012](#)

[Iancu, Laidet, 2013](#)

[Albacete, Giacalone, Marquet, Matas, 2018](#)

Sudakov logs and small- $x$  logs factorize

CGC + Sudakov Resummation

[Mueller, Xiao, Yuan, 2012](#)

[Stasto, SYW, Xiao, Yuan, 2018](#)

[Marquet, SYW, Xiao, 2019](#)

## CGC + Sudakov Resummation

LO

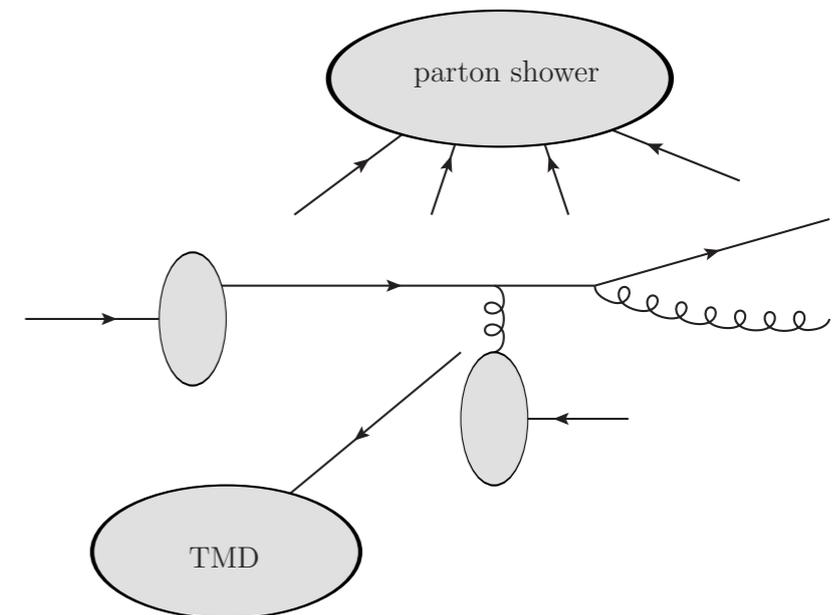
$$\frac{d\sigma}{d^2p_{T1}d^2p_{T2}} \propto \int \frac{d^2b_{\perp}}{(2\pi)^2} e^{-i\vec{q}_T \cdot \vec{b}_{\perp}} f(x_1) \otimes F(x_2, b_{\perp}) \otimes H \otimes e^{-S_{\text{Sudakov}}(Q, b_{\perp})}$$

$$\frac{\alpha_s^n}{q_T^2} \ln^{2n-1} \frac{Q^2}{q_T^2}$$

$$q_T \ll Q$$

## Physical Interpretation of Sudakov R.

- ☑ Multiple SOFT gluon radiation
- ☑ Parton shower

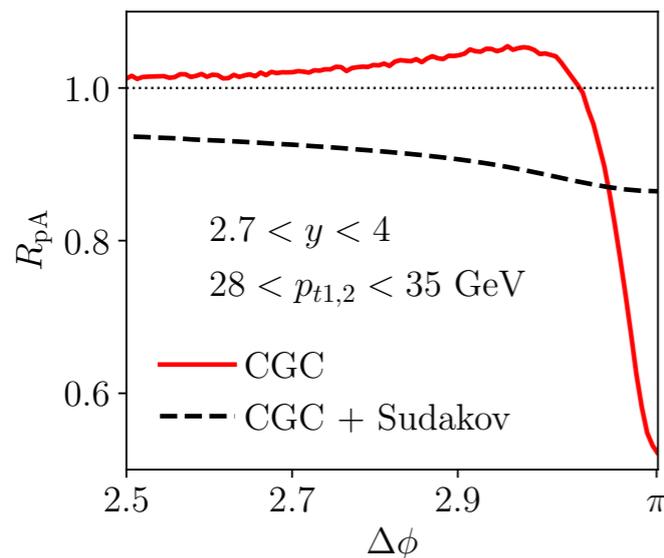
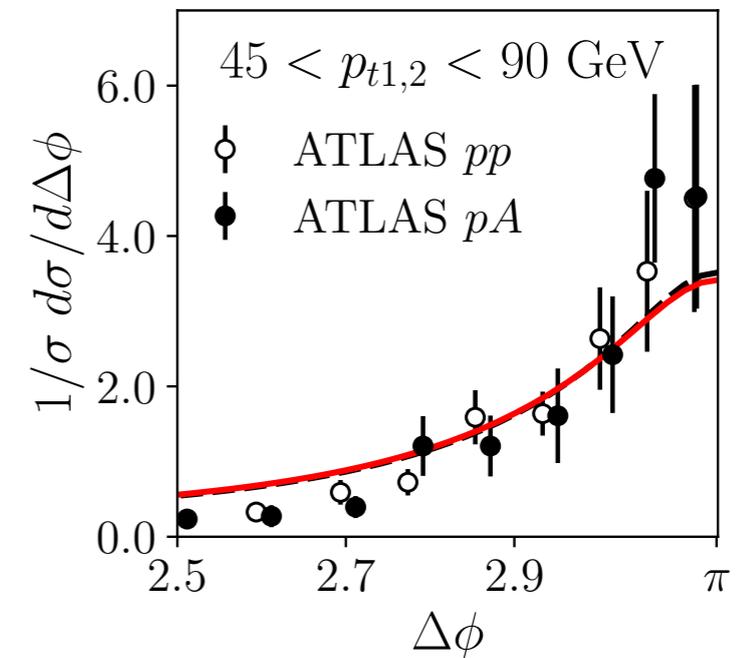
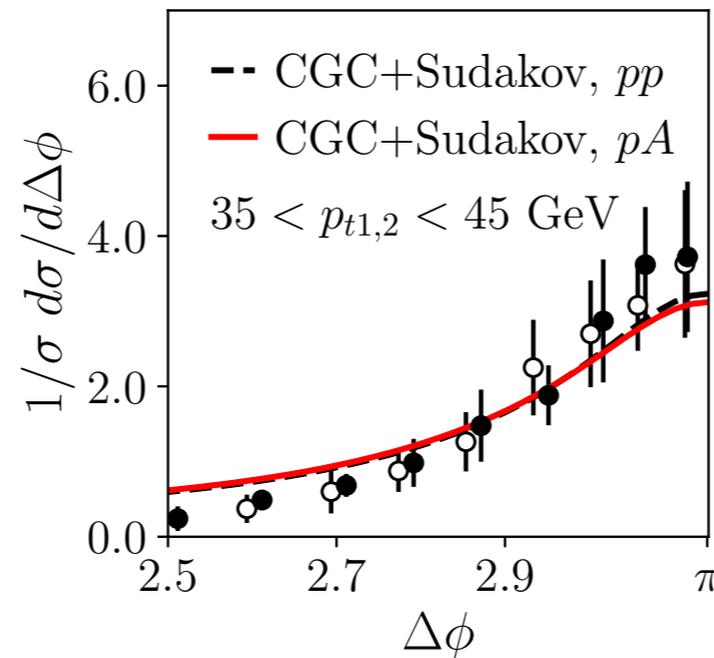
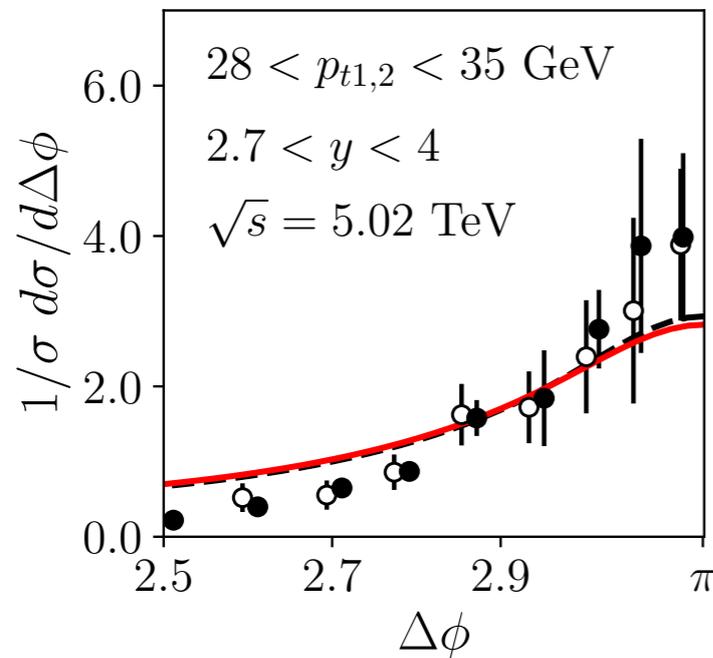


Monte Carlo method approach:

[Hameren, Kotko, Kutak, Sapeta, 2019](#)

## Forward dijet angular correlation

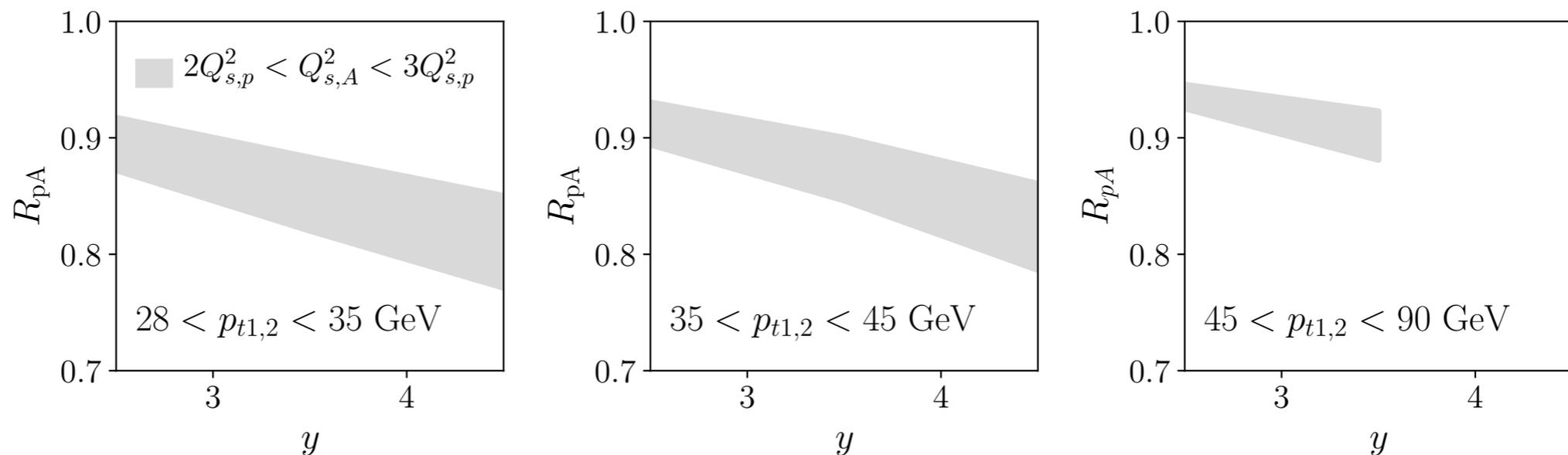
$$Q_{sA}^2 \sim 2(3)Q_{sp}^2$$



- Almost no difference between  $pp$  and  $pA$
- Sudakov factor dominate

[ATLAS, 1901.10440](#)

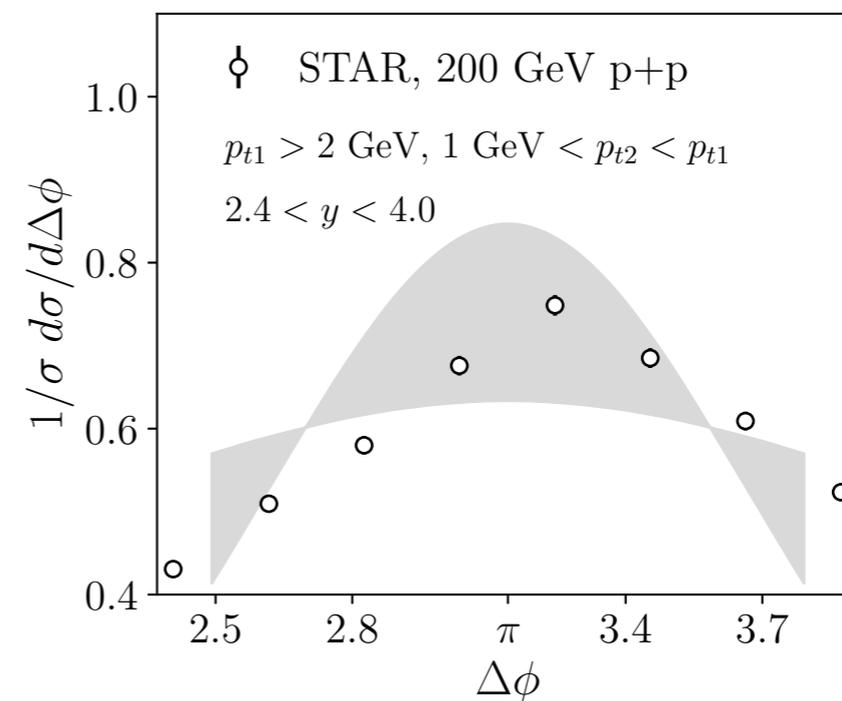
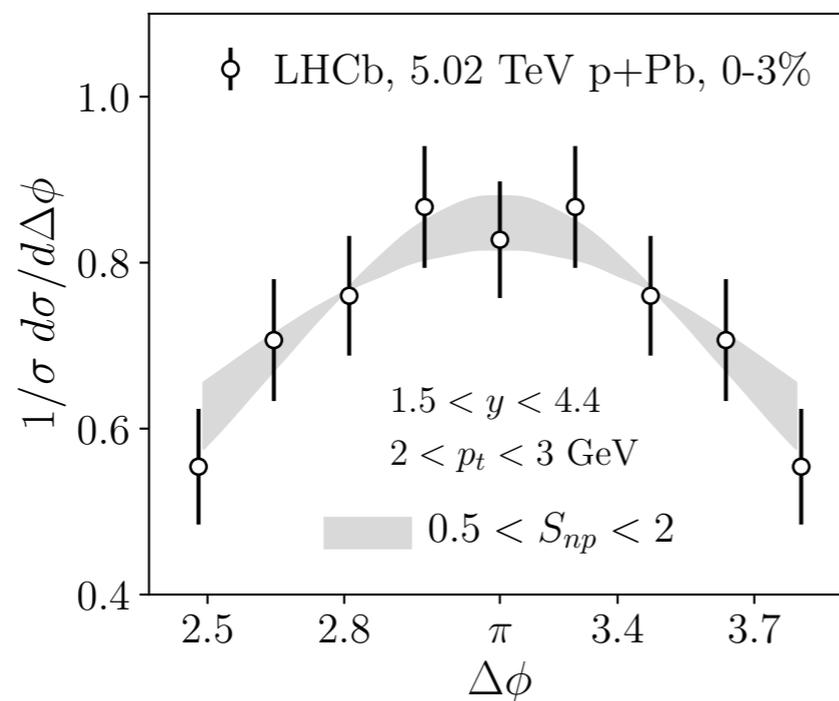
## Nuclear Modification Factor



☑  $R_{pA} < 1$

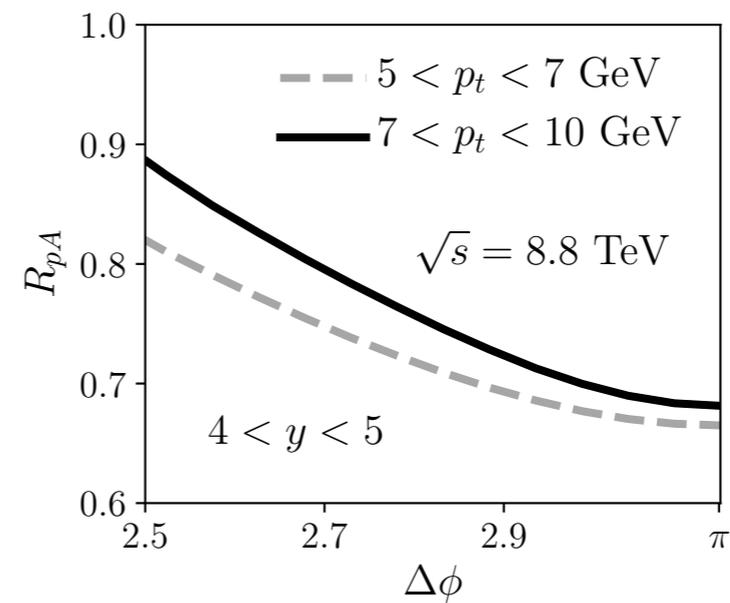
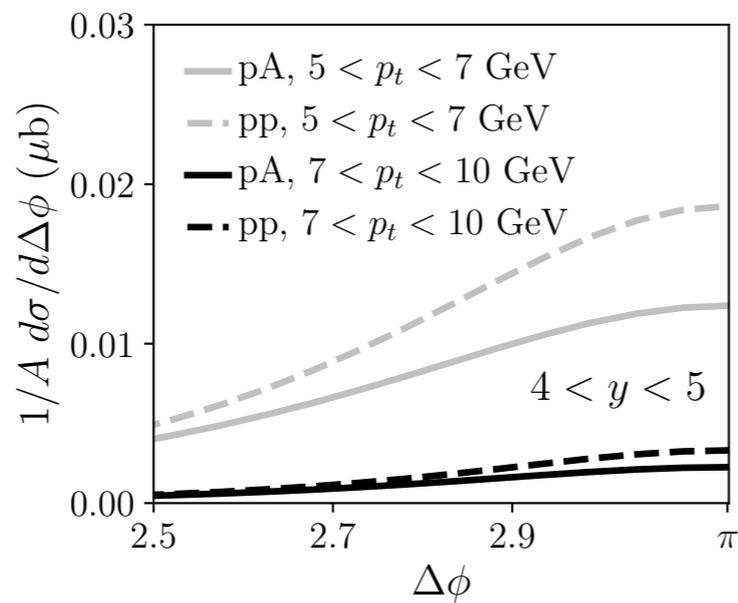
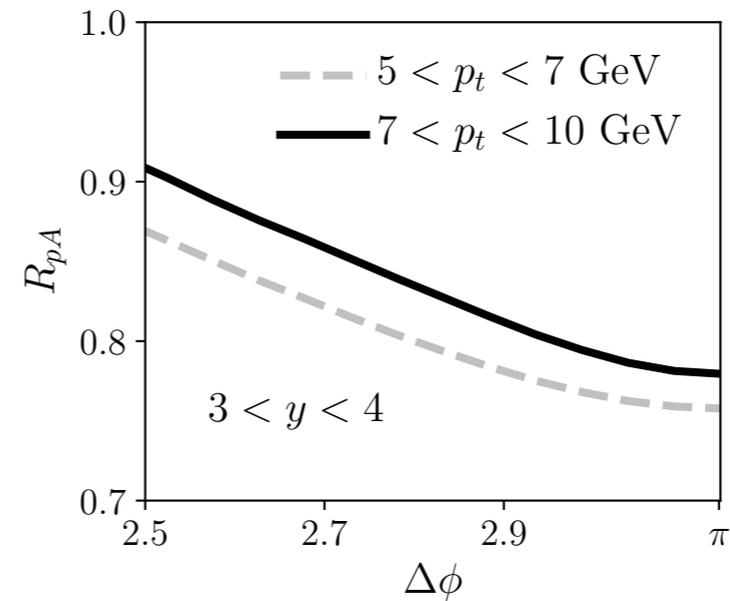
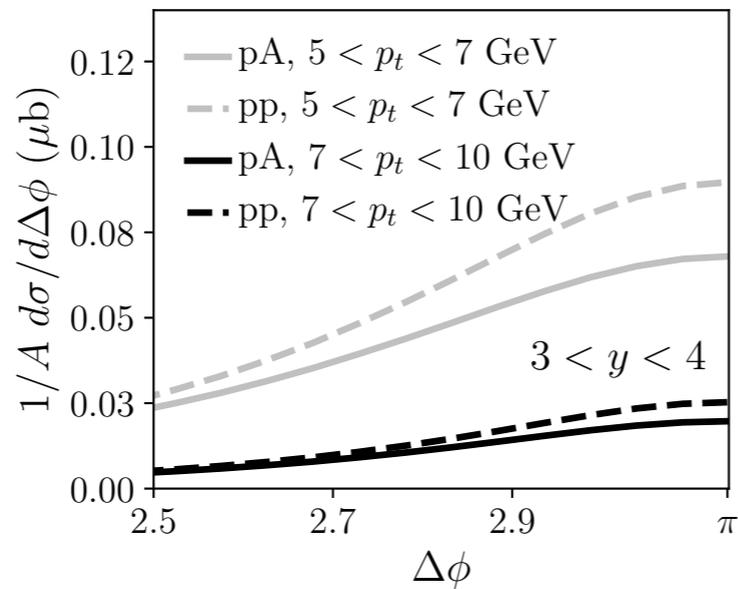
☑ Forward rapidity: larger gluon density; stronger saturation effect

## Forward dihadron angular correlation



Non-perturbative effect

## The optimal $p_T$ range to probe gluon saturation



- ☑ To describe the exp. data, we have to incorporate Sudakov resummation into the CGC framework.
- ☑ Angular decorrelation effect can be observed at moderate  $p_T$  range.

**THANKS FOR YOUR ATTENTION!**

The End