

Search for large-angle jet deflection using semi-inclusive γ +jet
and π^0 +jet correlations in $p+p$ and Au+Au collisions at

$$\sqrt{s}_{\text{NN}} = 200 \text{ GeV with STAR}$$

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Supported in part by
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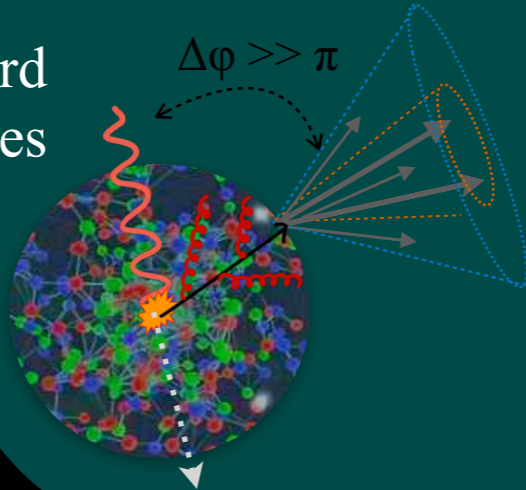
What physics do we try to study in this measurement?

Different physics mechanisms for acoplanarity of γ +jet and π^0 +jet:

- Rutherford Scattering: Energetic parton resolves microstructure of QGP

Large-angle deflection of hard partons off quasi-particles

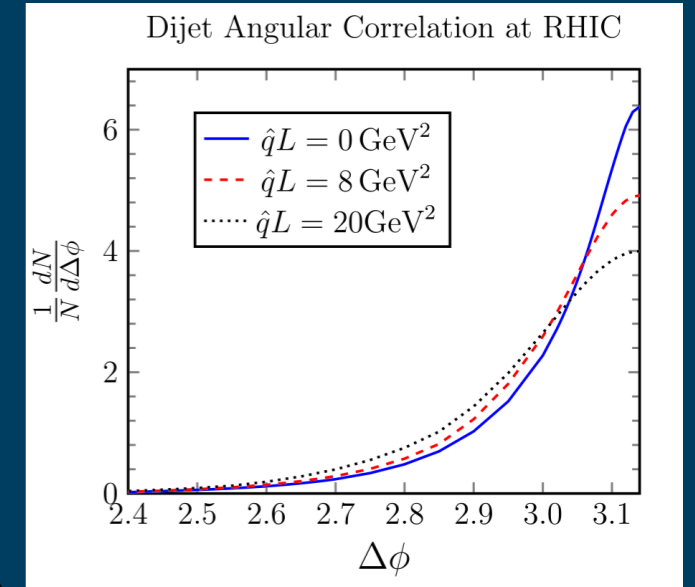
D'Eramo, Rajagopal, Yin, JHEP 01 (2019) 172;
D'Eramo, et. All, JHEP 05 (2013) 031



- Vacuum soft gluon radiation (Sudakov effect at RHIC)

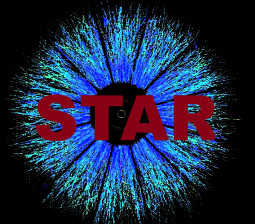
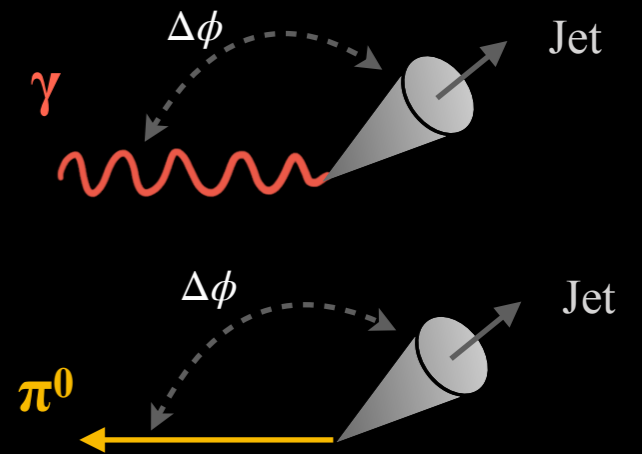
A. Mueller et al,
PLB 763 (2016) 208

- Medium effect: multiple scattering and medium induced gluon radiation



What do we measure in the STAR experiment?

- Azimuthal correlations between trigger particle and recoil jet: $\Delta\phi = \phi_{\text{trig}} - \phi_{\text{jet}}$
- Comparison between γ +jet and π^0 +jet acoplanarity measurements
 - Trigger-bias on vacuum radiation as well as medium response
 - Measurements are done in p+p and Au+Au collisions
- $\sqrt{s} = 200 \text{ GeV } p+p$ collisions: baseline measurement compared with PYTHIA
 - To study vacuum soft gluon radiation
- $\sqrt{s}_{\text{NN}} = 200 \text{ GeV Au+Au}$ collisions: comparison with PYTHIA
 - To study medium effect and/or Rutherford/other scattering mechanisms



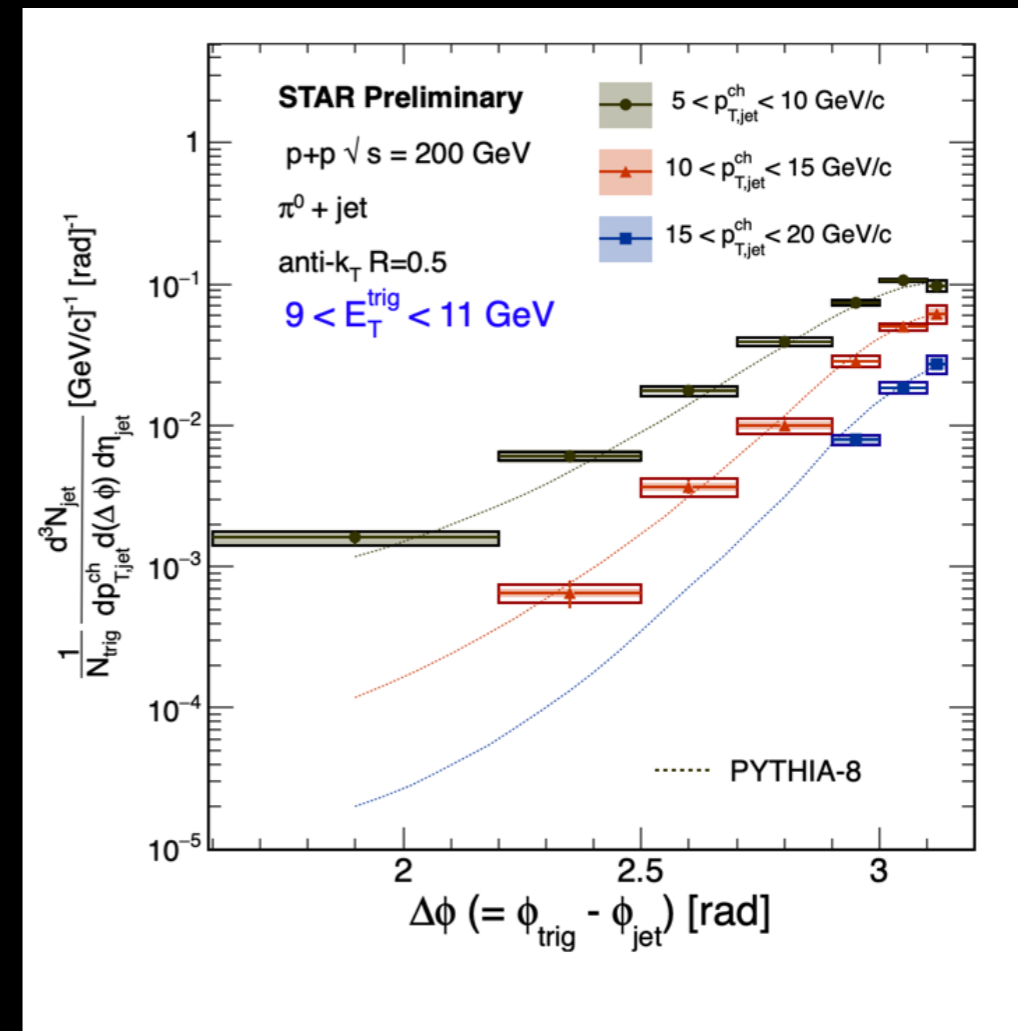
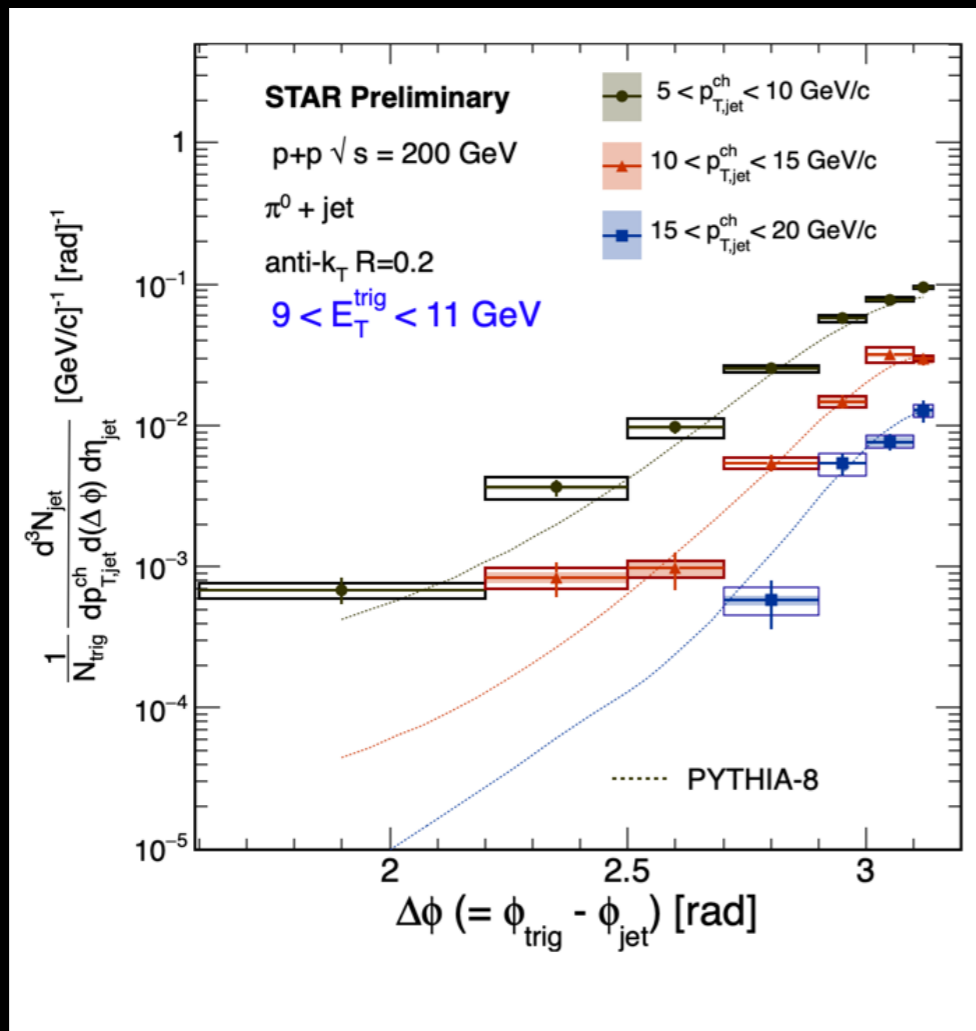
Semi-inclusive π^0 +jet azimuthal correlation in $p+p$ collisions

Semi-inclusive π^0 +jet measurement: $\frac{1}{N_{\text{trig}}} \cdot \frac{dN_{\text{jet}}}{d(\Delta\phi)} \Big|_{E_T^{\text{trig}}} = \left(\frac{1}{\sigma^{A+A \rightarrow \text{trig}+\text{jet}}} \cdot \frac{d\sigma^{A+A \rightarrow \text{trig}+\text{jet}}}{d(\Delta\phi)} \right) \Big|_{E_T^{\text{trig}}}$

$R=0.2$

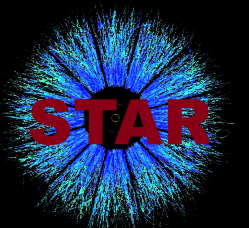
$9 < E_T^{\text{trig}} < 11 \text{ GeV}$

$R=0.5$



$$\Delta\phi = \phi_{\text{trig}} - \phi_{\text{jet}}$$

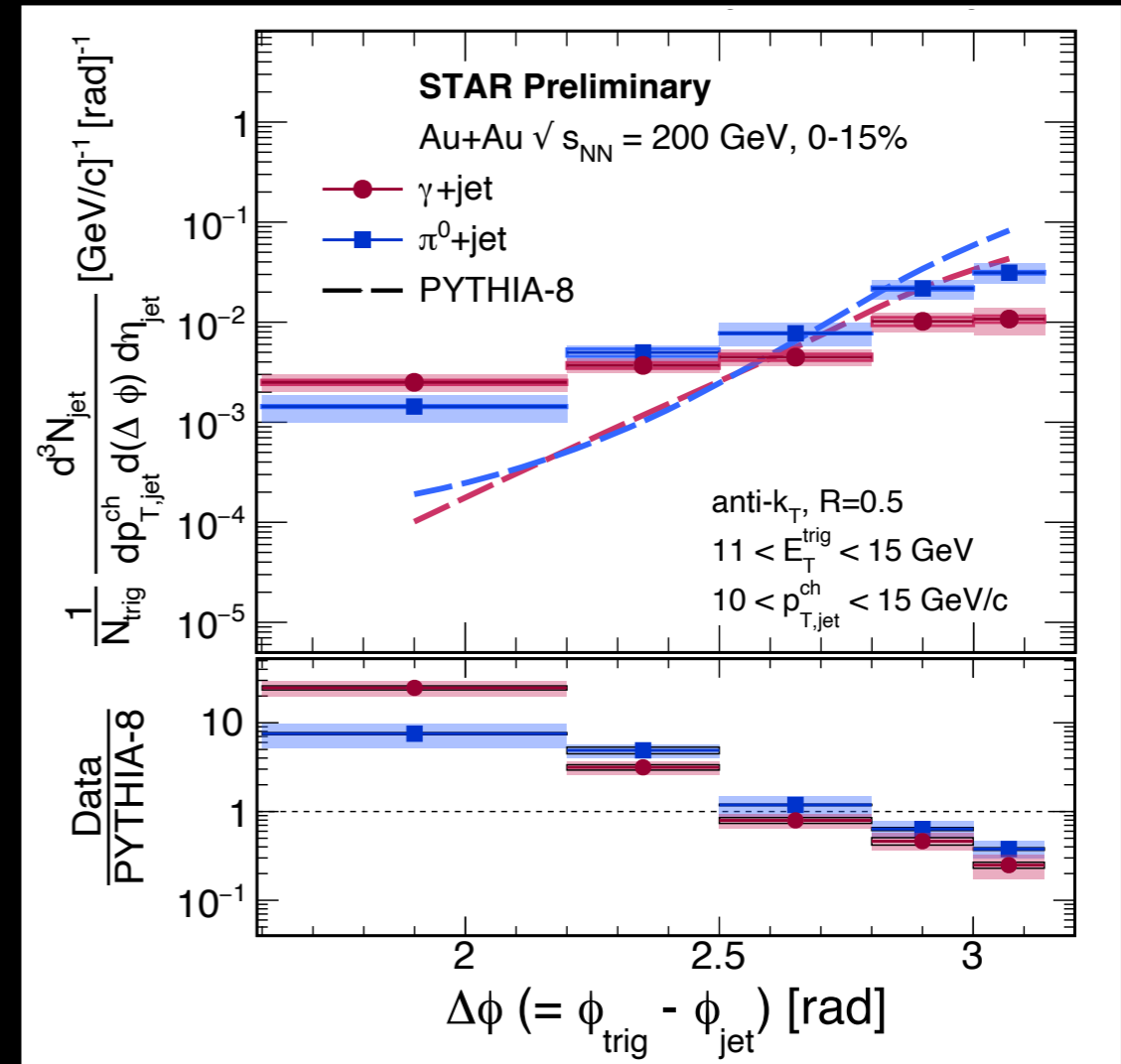
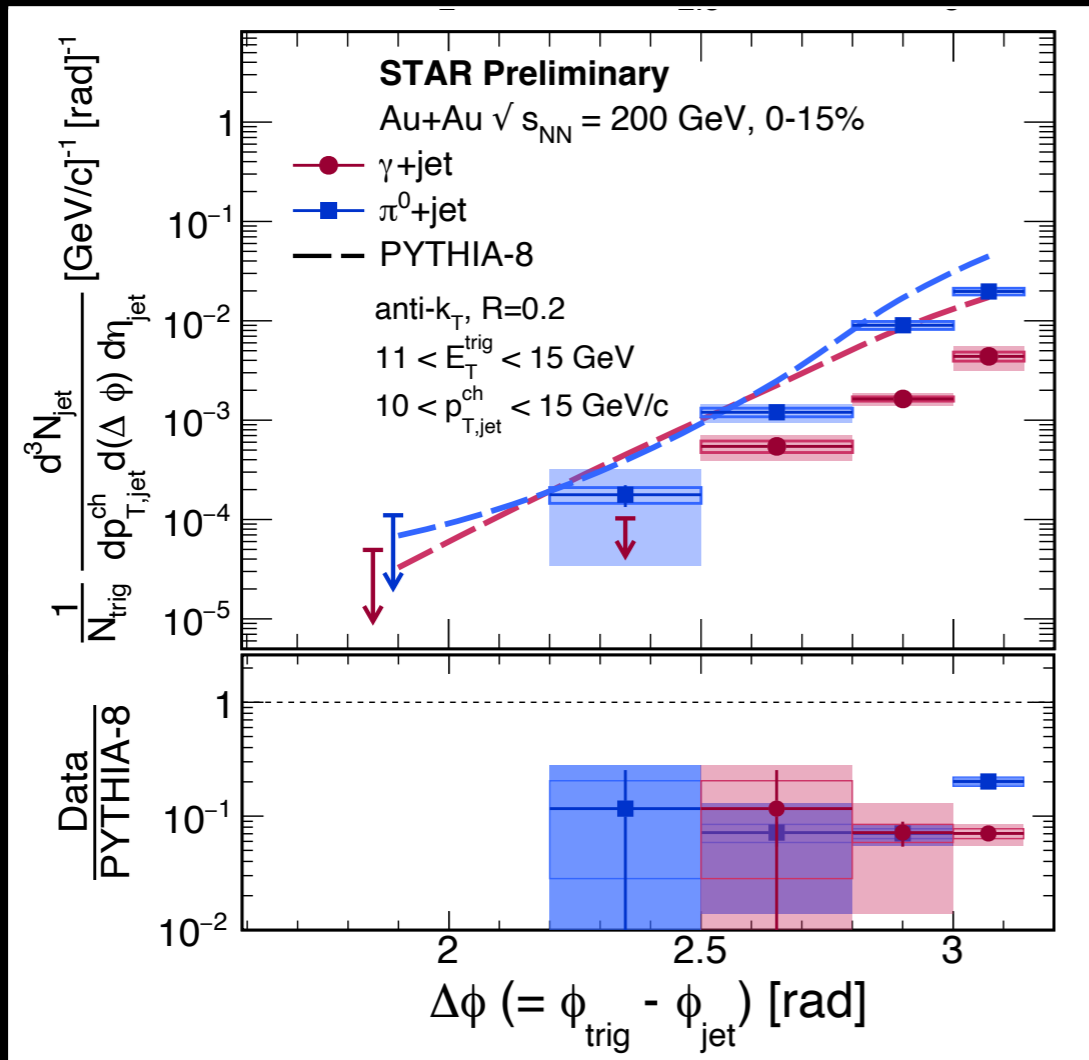
Shape of $p+p$ data comparable with PYTHIA-8



Semi-inclusive γ +jet and π^0 +jet azimuthal correlation in Au+Au collisions

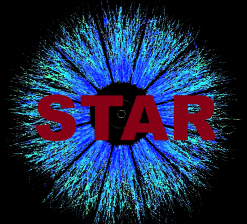
$R=0.2$ $11 < E_T^{\text{trig}} < 15 \text{ GeV}$

$R=0.5$



- Uncorrelated background subtraction:
 Using a Mixed Event method
 STAR: PRC 96 (2017) 024905
- γ/π^0 discrimination
 As done in STAR: PLB 760 (2016) 689
- Insignificant effect of $\Delta\phi$ smearing in Au+Au collisions

Strong evidence for significant medium-induced acoplanarity in the QGP for jets with $R=0.5$



Summary and Outlook

- First γ +jet and π^0 +jet acoplanarity measurements to search for large-angle deflection in both $p+p$ and central Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV are performed.
 - Angular correlation of π^0 +jet in $p+p$ collisions are comparable to PYTHIA-8.
 - In 0-15% central Au+Au collisions, strong evidence for significant medium-induced acoplanarity in the QGP for jets with $R=0.5$ is observed.
- High precision measurement is planned with 2023-2025 data taking with large kinematic coverage and also at forward rapidity.

