



*QPT 2025*

*Guilin, China*

# Suppression of elliptic anisotropies inside jets in heavy-ion collisions

Meng-Quan Yang

Collaborated with Wei-Xi Kong, Peng Ru, Ben-Wei Zhang

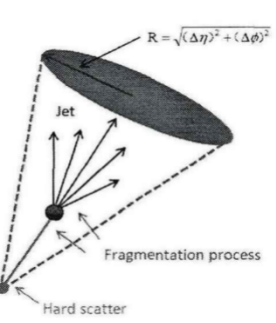
26/10/2025

24-28, October

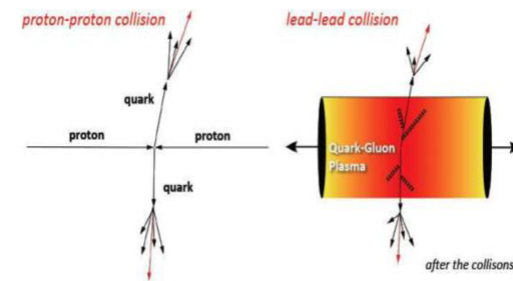


# Outline

- Motivation
- Elliptic anisotropies inside jets in p+p collisions
- Suppression of elliptic anisotropies inside jets in heavy-ion collisions
- Summary

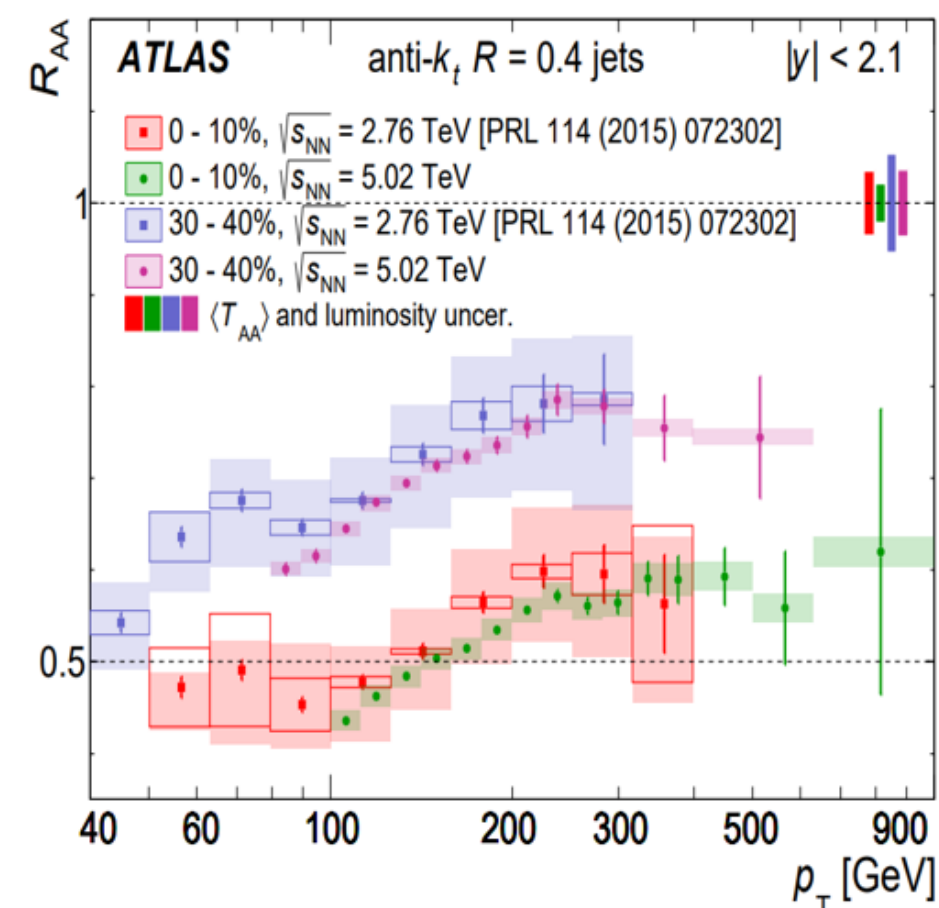


# Motivation

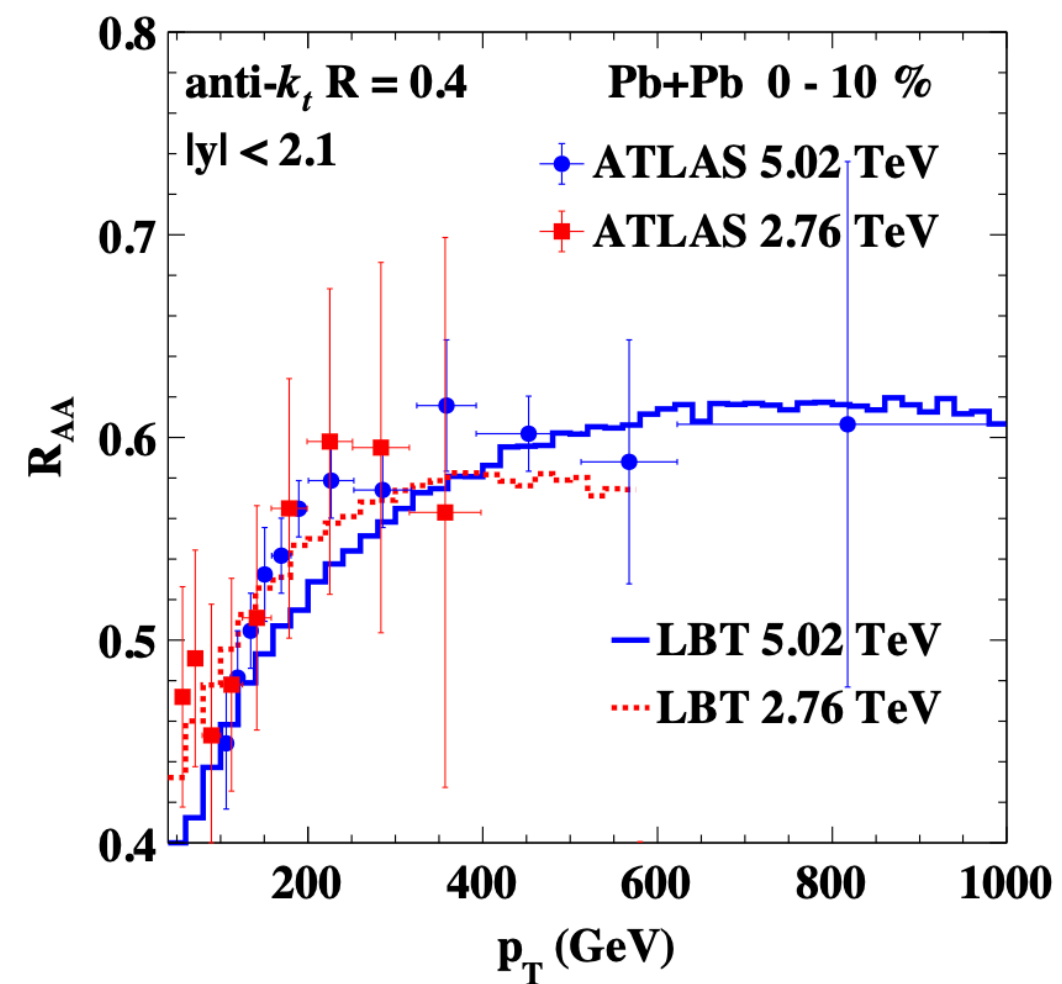


*Phys. Lett. B* 790 (2019) 108

*Phys. Rev. Lett.* 114 (2015) 072302

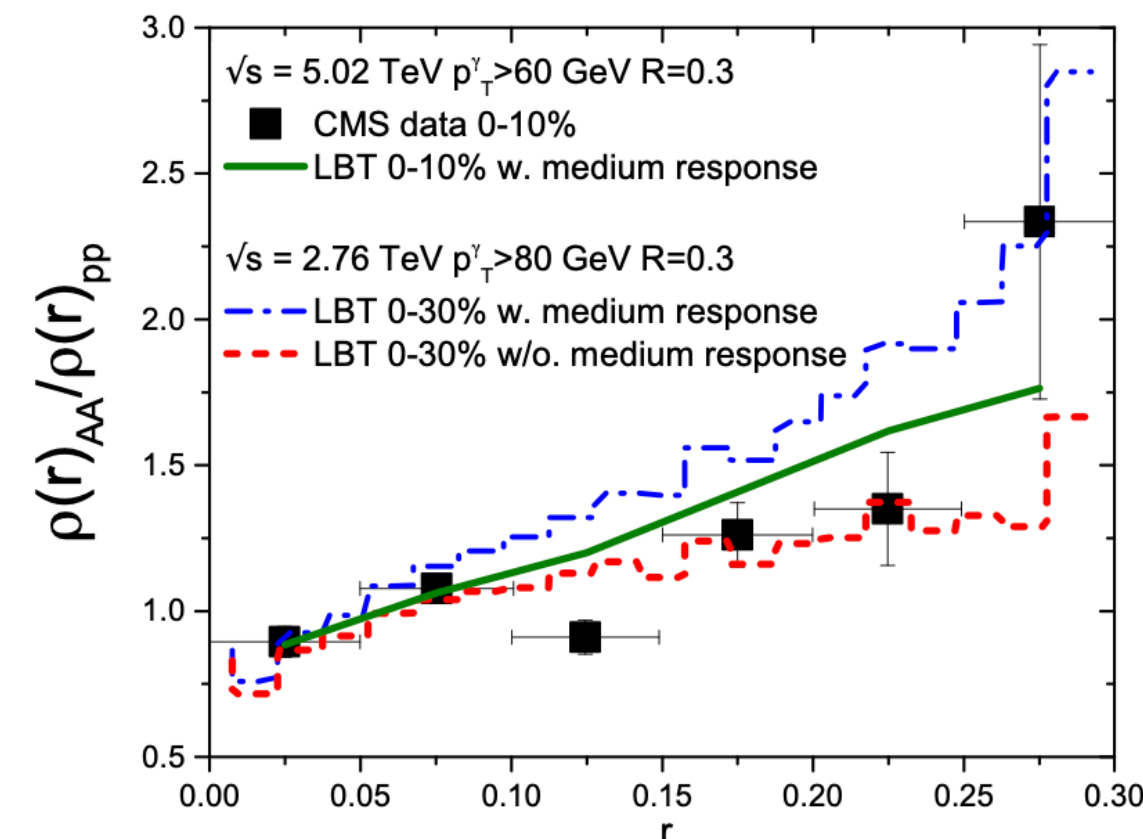


*Phys. Rev. C* 99 (2019) 5



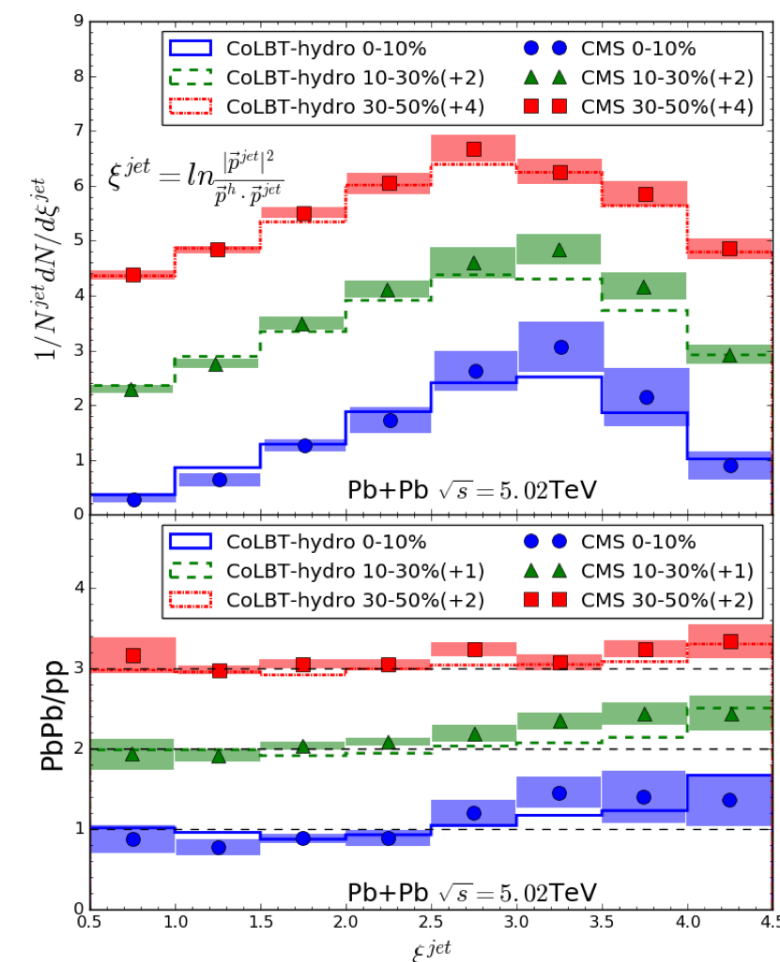
*Phys. Rev. Lett.* 122 (2019) 15

*Rept. Prog. Phys.* 84 (2021) 2



Jet shapes

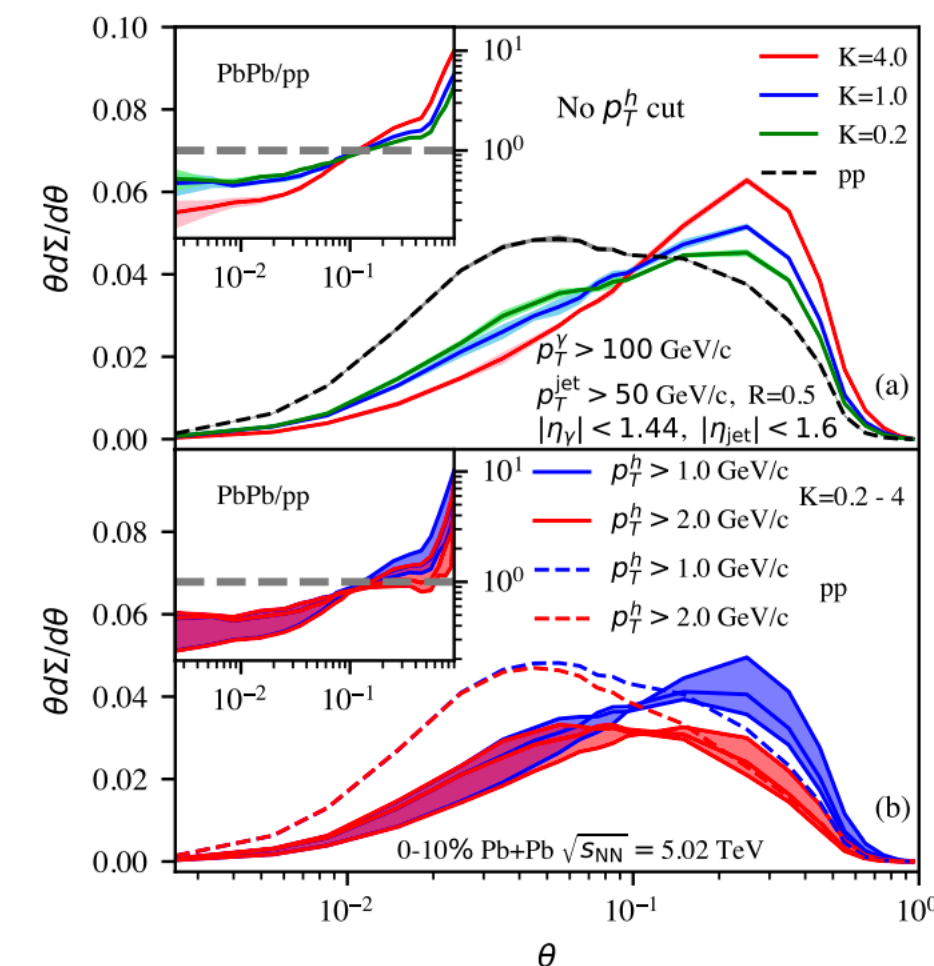
*Phys. Lett. B* 810 (2020)



Jet fragmentation function

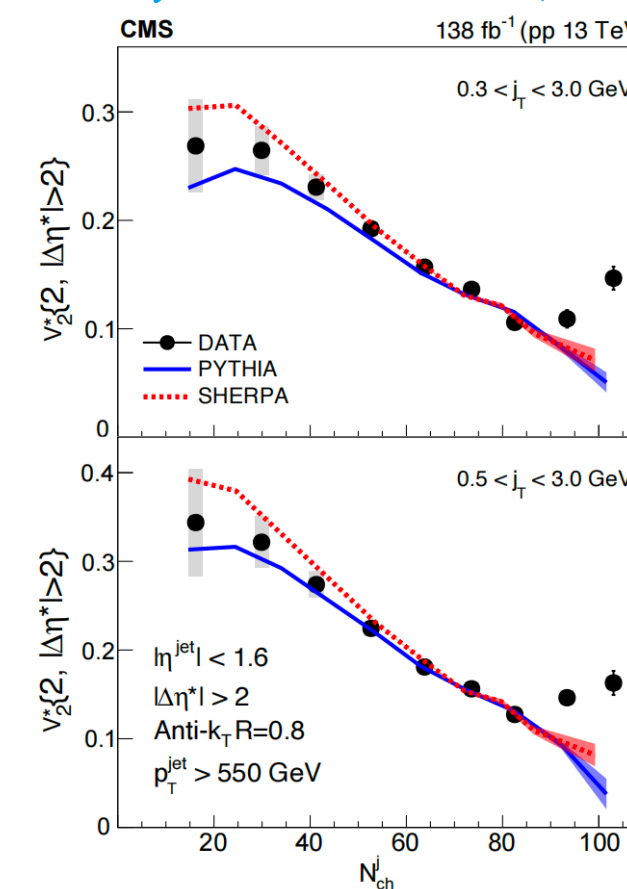
Jet substructure

*Phys. Rev. Lett.* 132 (2024) 1



Energy-energy correlates (EEC)

*Phys. Rev. Lett.* 133(2024)14



Elliptic anisotropies within jets in p+p collisions

Two-particle correlations

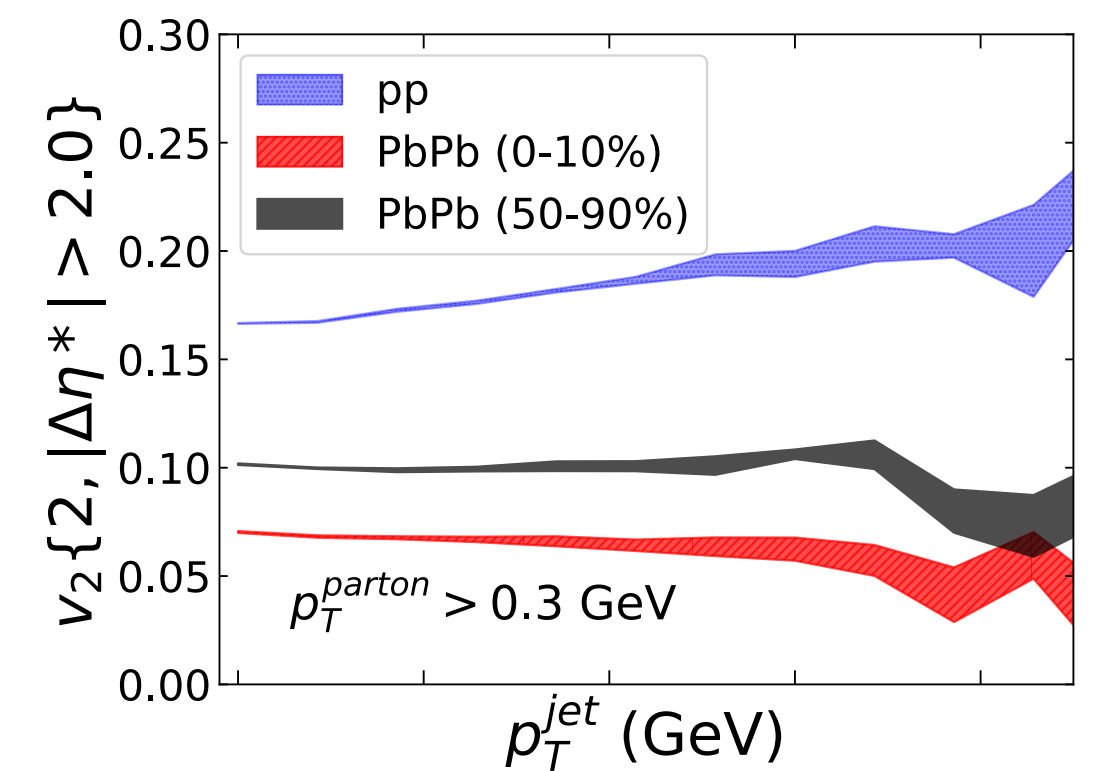
*Phys. Rev. Lett.* 132 (2024) 1

*PhysRevC*.107.064908

*Phys. Rev. Lett.* 133 (2024) 14

*arXiv* : 2401.13137

My work

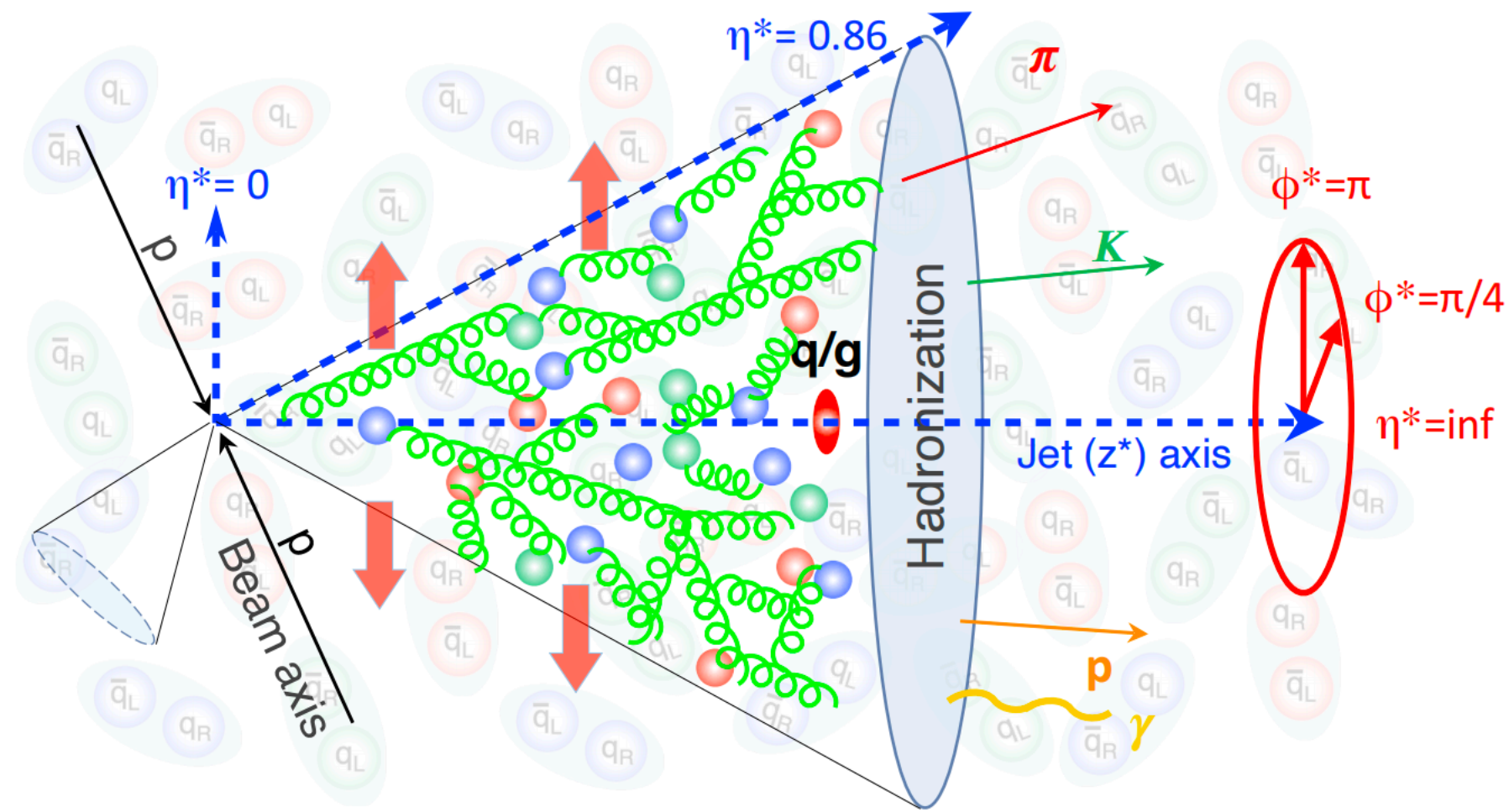


Elliptic anisotropies within jets

Jet suppressions

# Jet systems

Jet frame:  $\vec{p}^* = (j_T, \eta^*, \phi^*)$

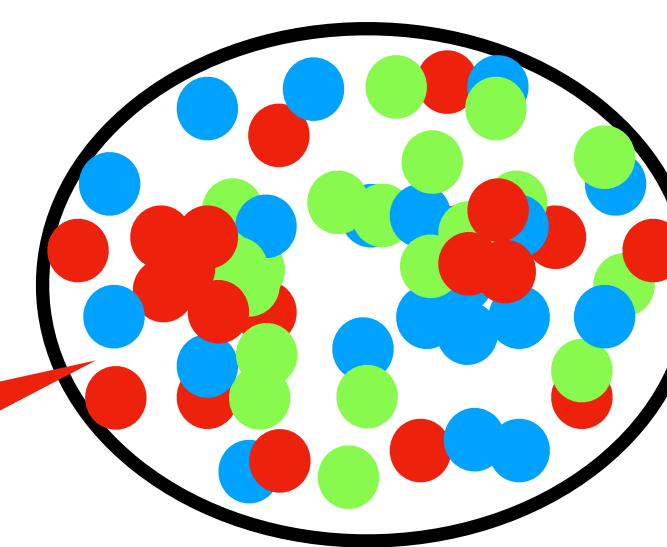
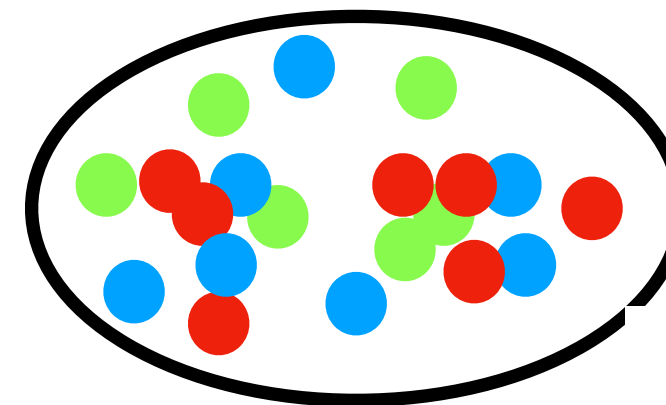
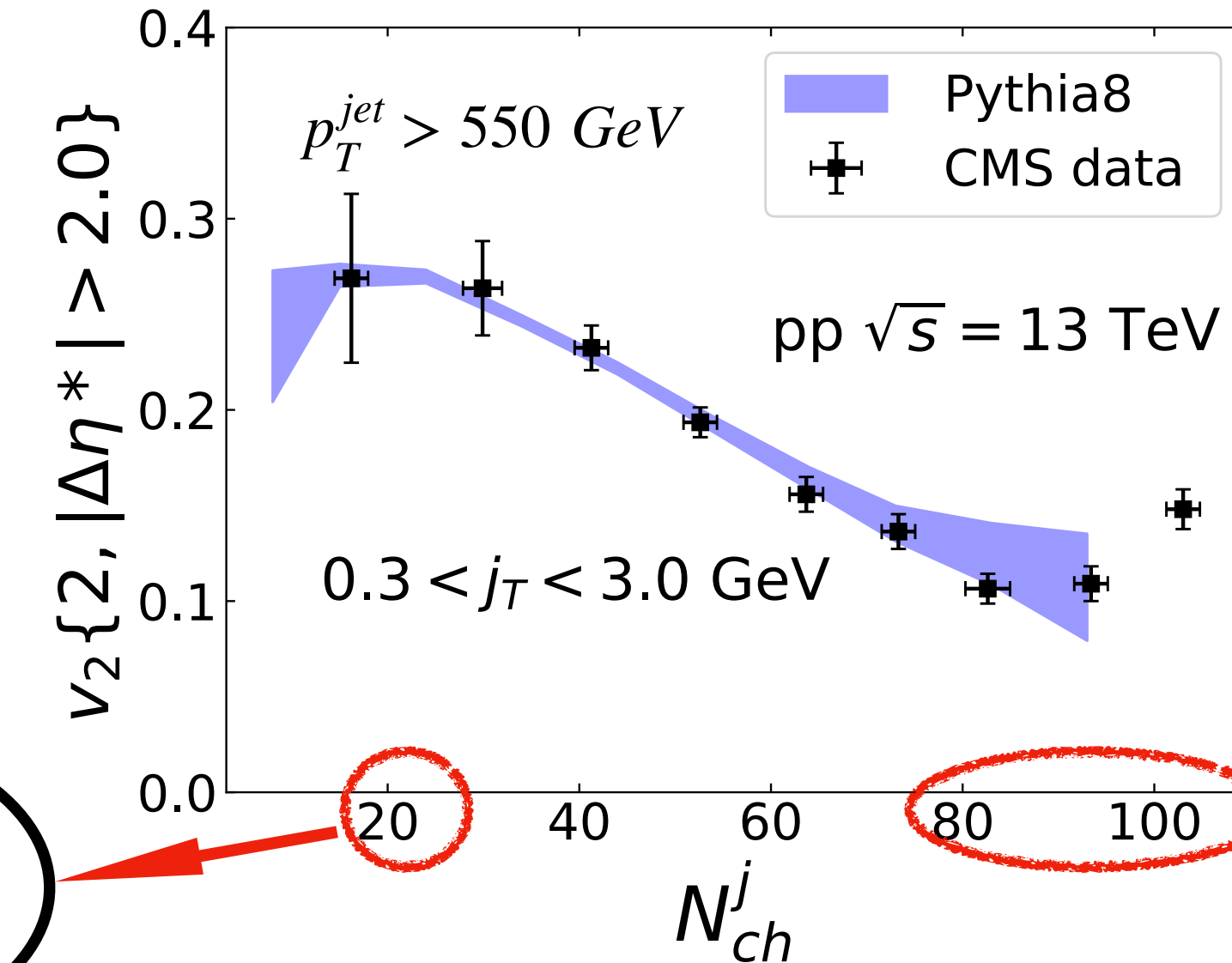


*PhysRevC.107.064908*

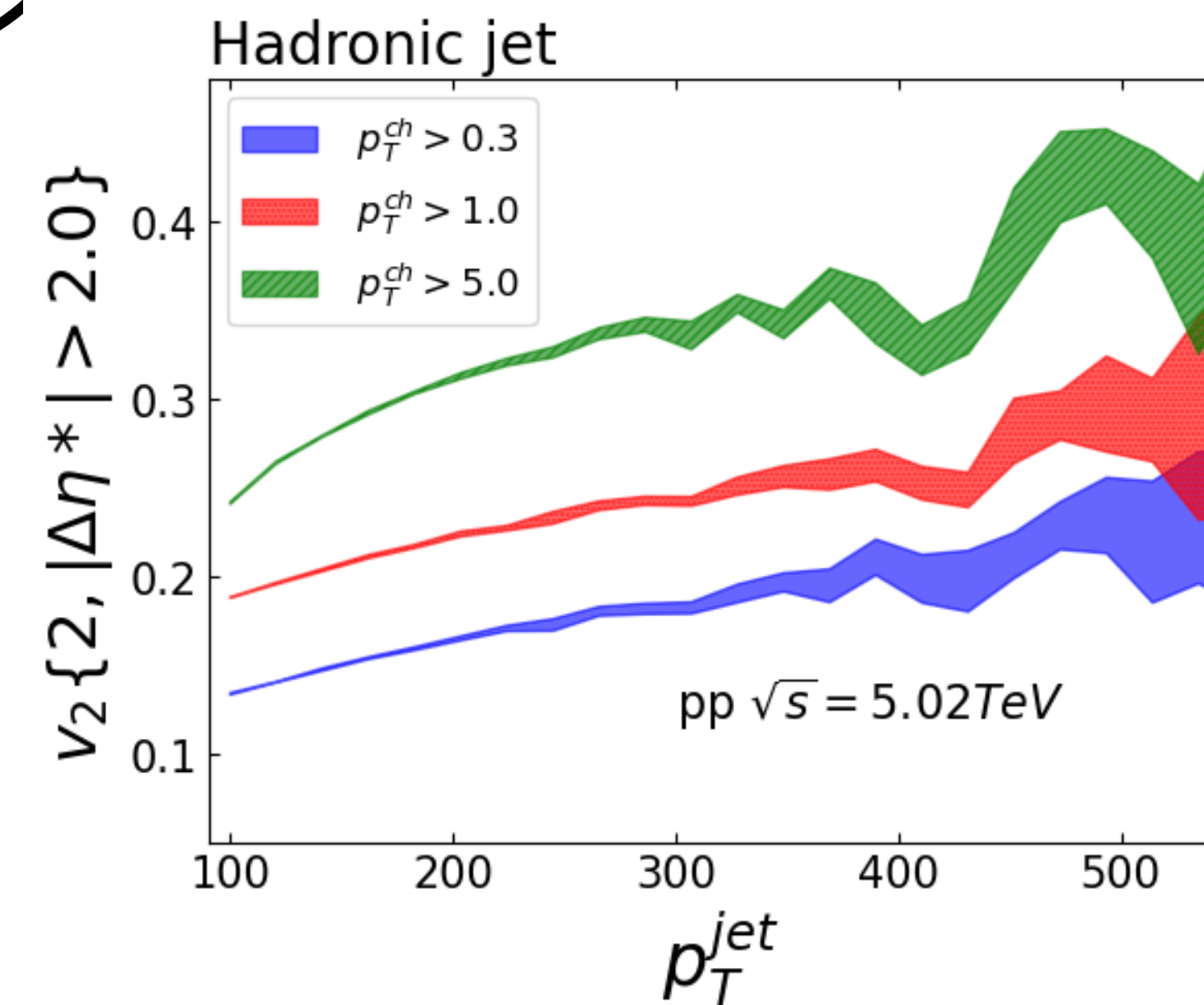
$$\frac{1}{N_{ch}^j} \frac{dN^{pair}}{d\Delta\phi^*} \propto 1 + 2 \sum_{n=1}^{\infty} V_{n\Delta}(j_T^A, j_T^B) \cos(n\Delta\phi^*),$$

Jet selection: anti- $k_T$  R=0.8 jets with  $|\eta_{jet}| < 1.6$

*Phys. Lett. B868(2025)139746*



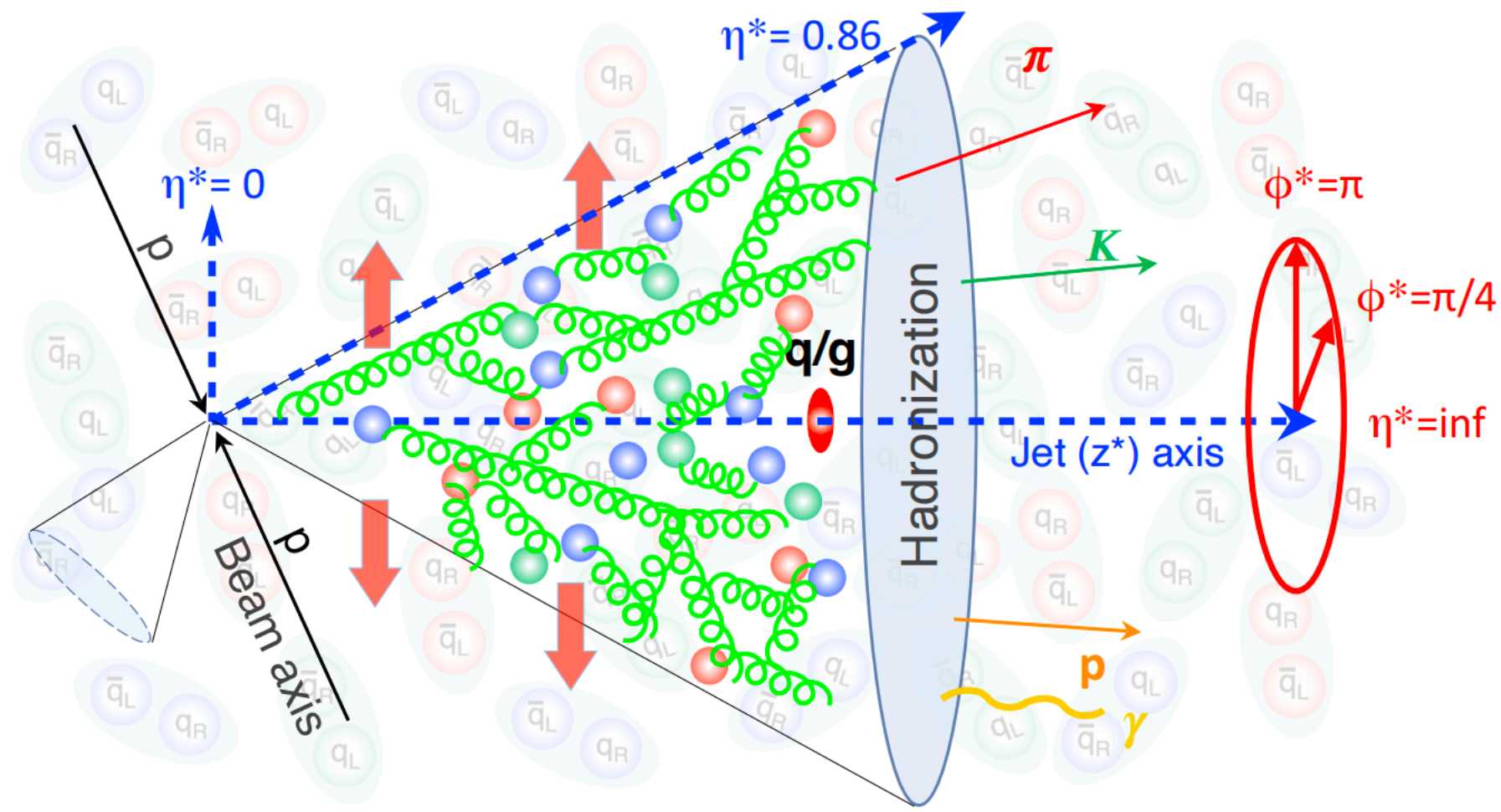
Insignificant





# in-jet $v_2$ in p+p collisions

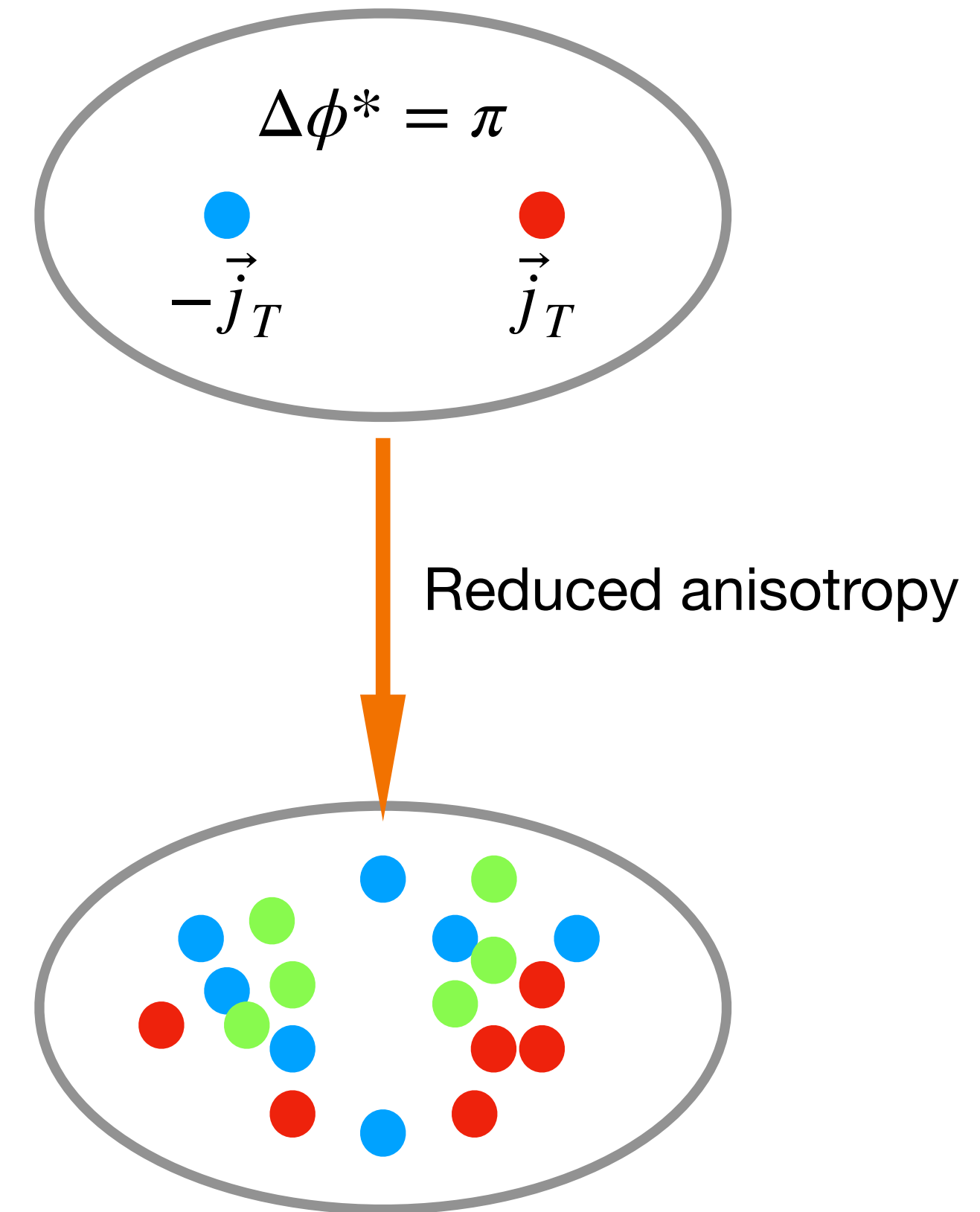
Constituent particle momentum:  $\vec{p}^* = (j_T, \eta^*, \phi^*)$



[PhysRevC.107.064908](#)

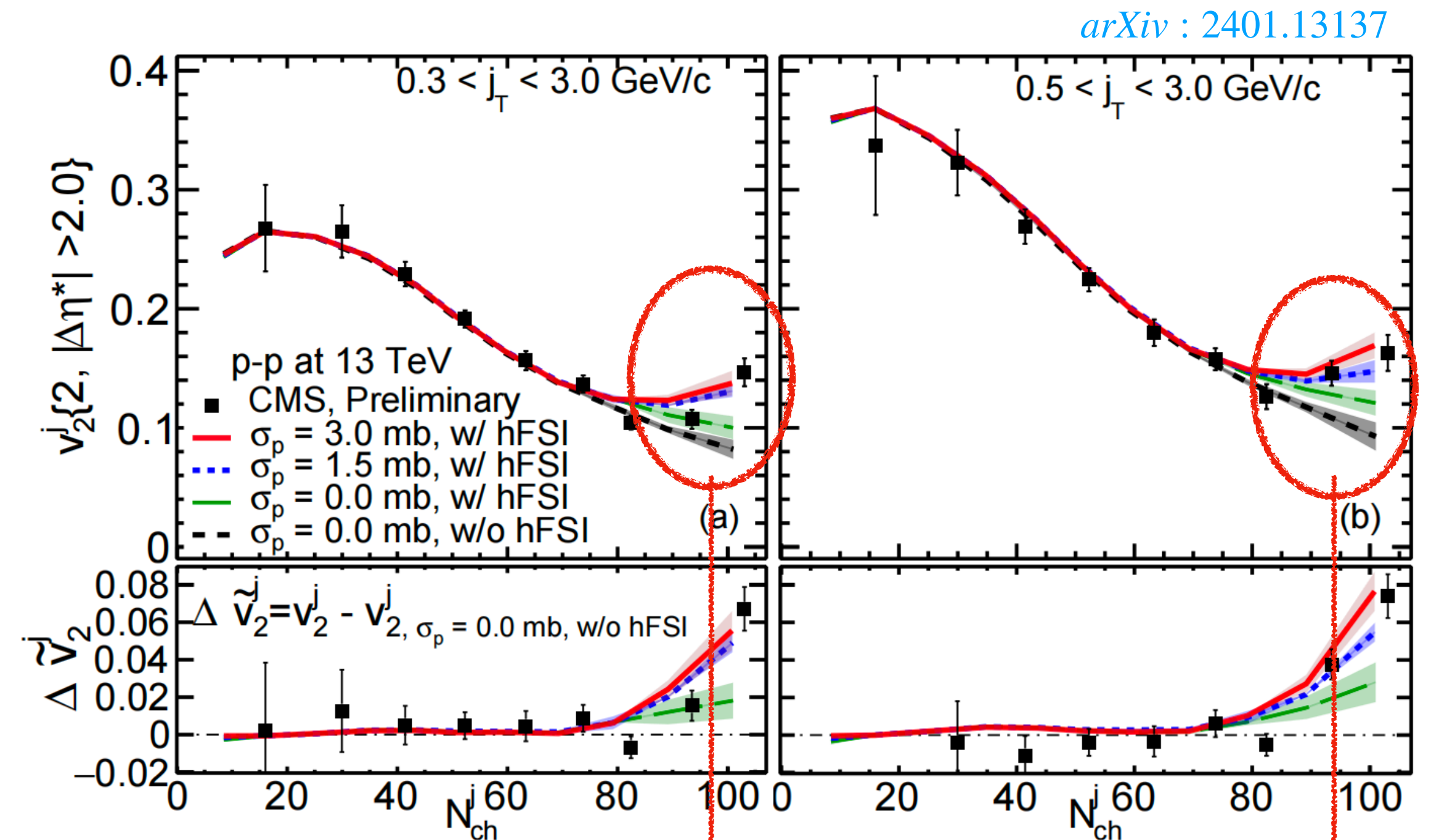
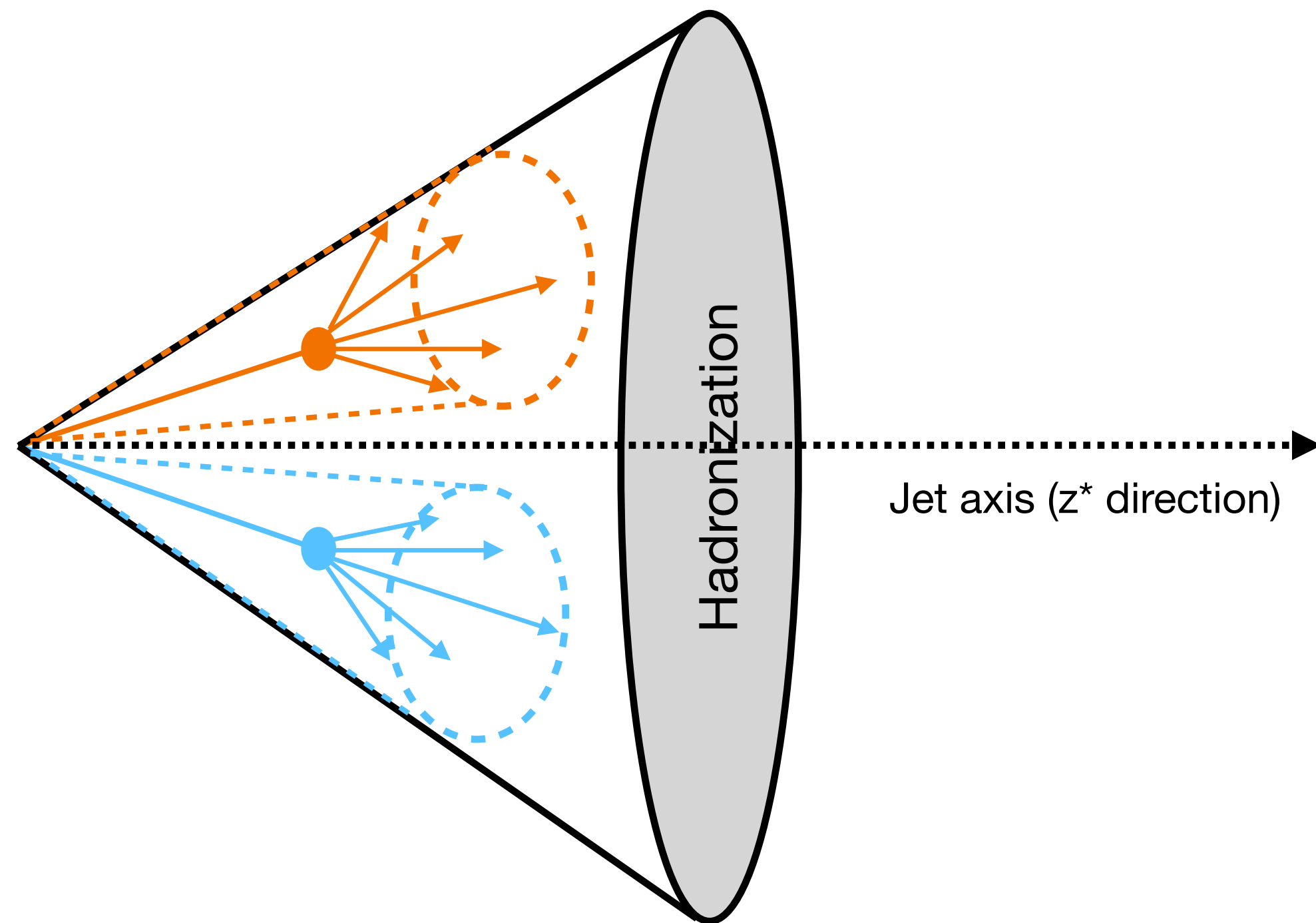
Momentum conservation:  $\sum_i \vec{j}_{T,i} = 0$

Elliptical anisotropy coefficient:  $v_2^2\{2\} = \langle \cos(2\Delta\phi^*) \rangle$





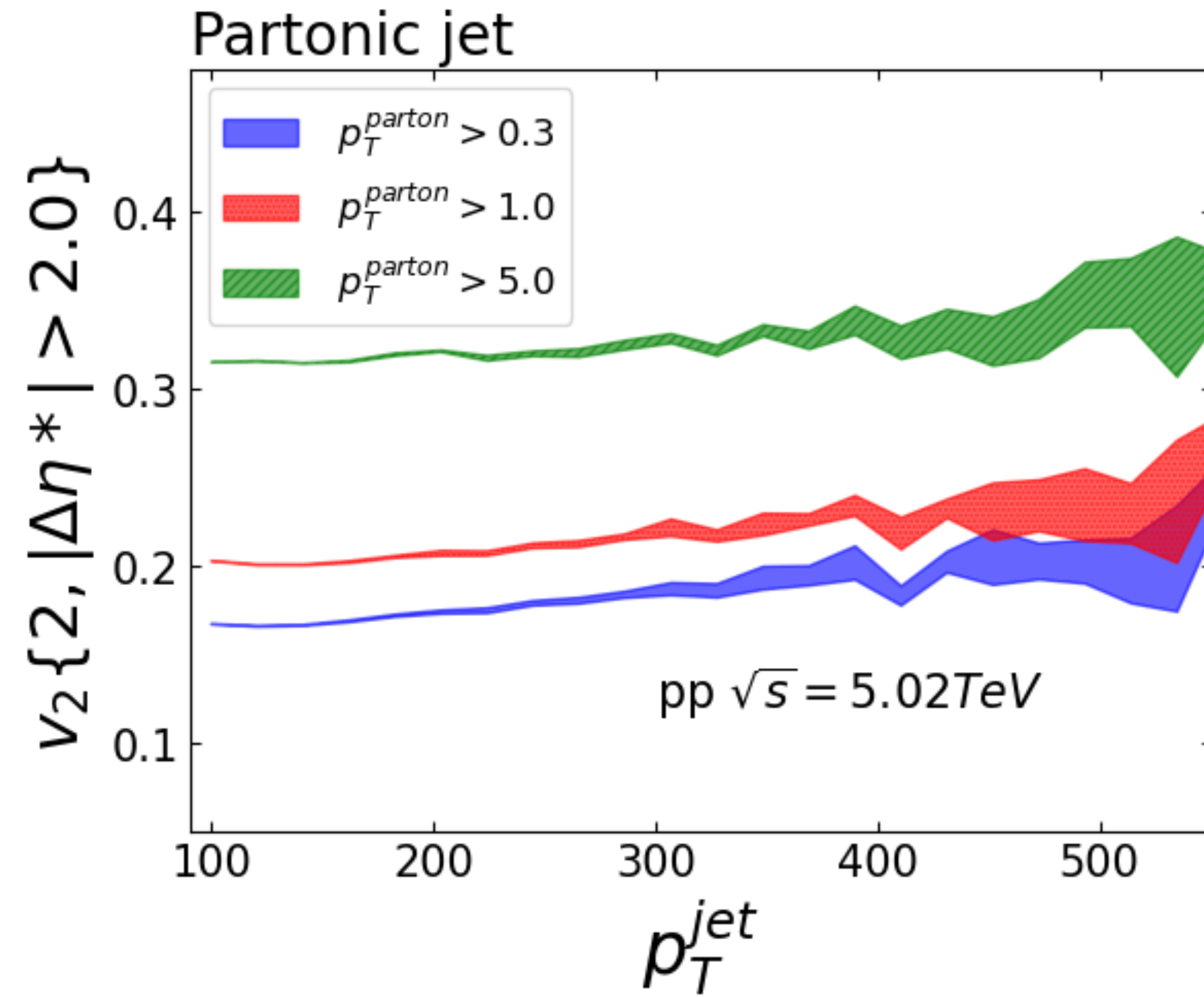
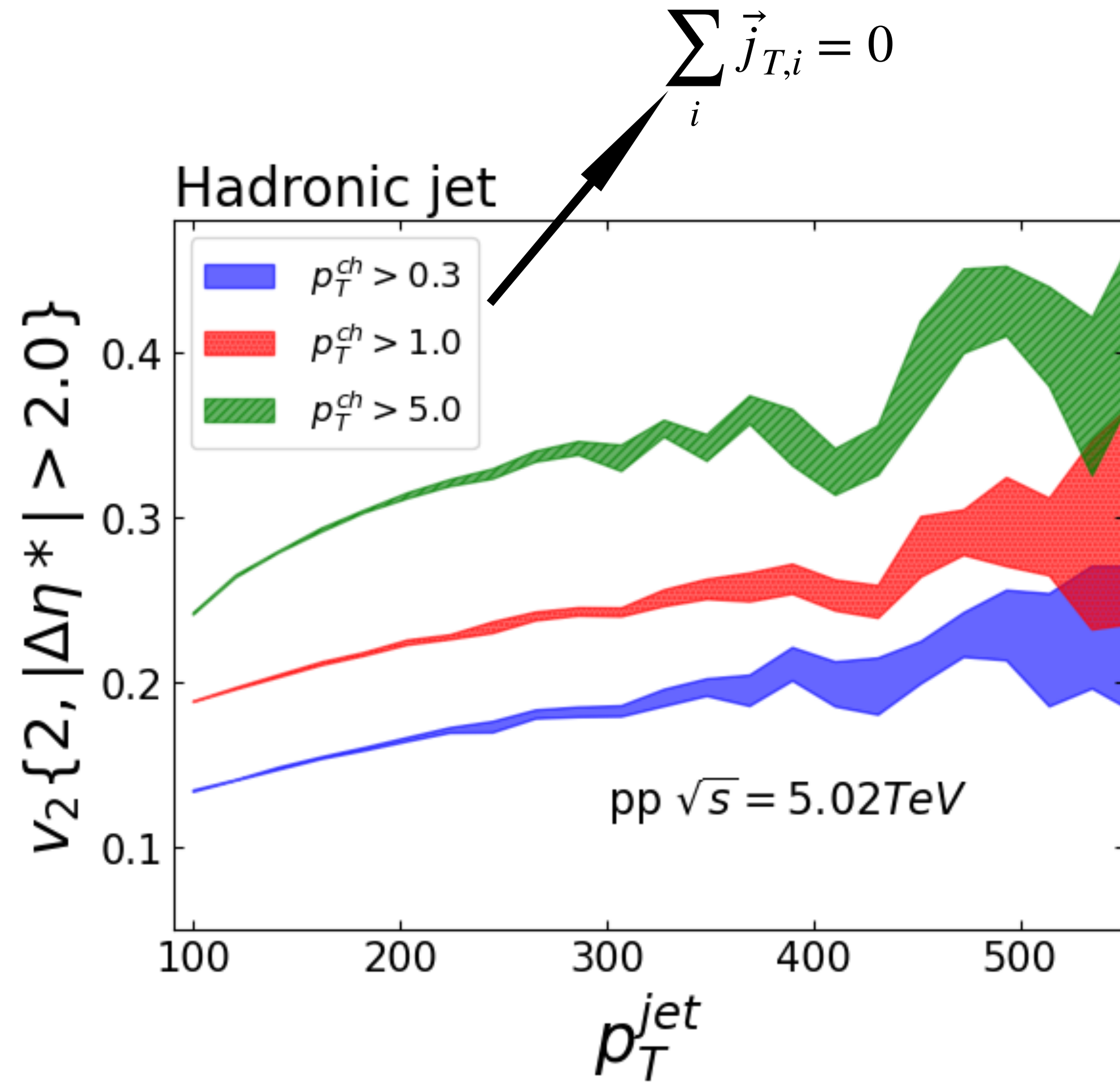
# in-jet $v_2$ in p+p collisions



A possible signal of collectivity arising from the rescatterings among the jet particles



# in-jet $v_2$ in p+p collisions





# A simple case with a uniform static medium

**Table 1**

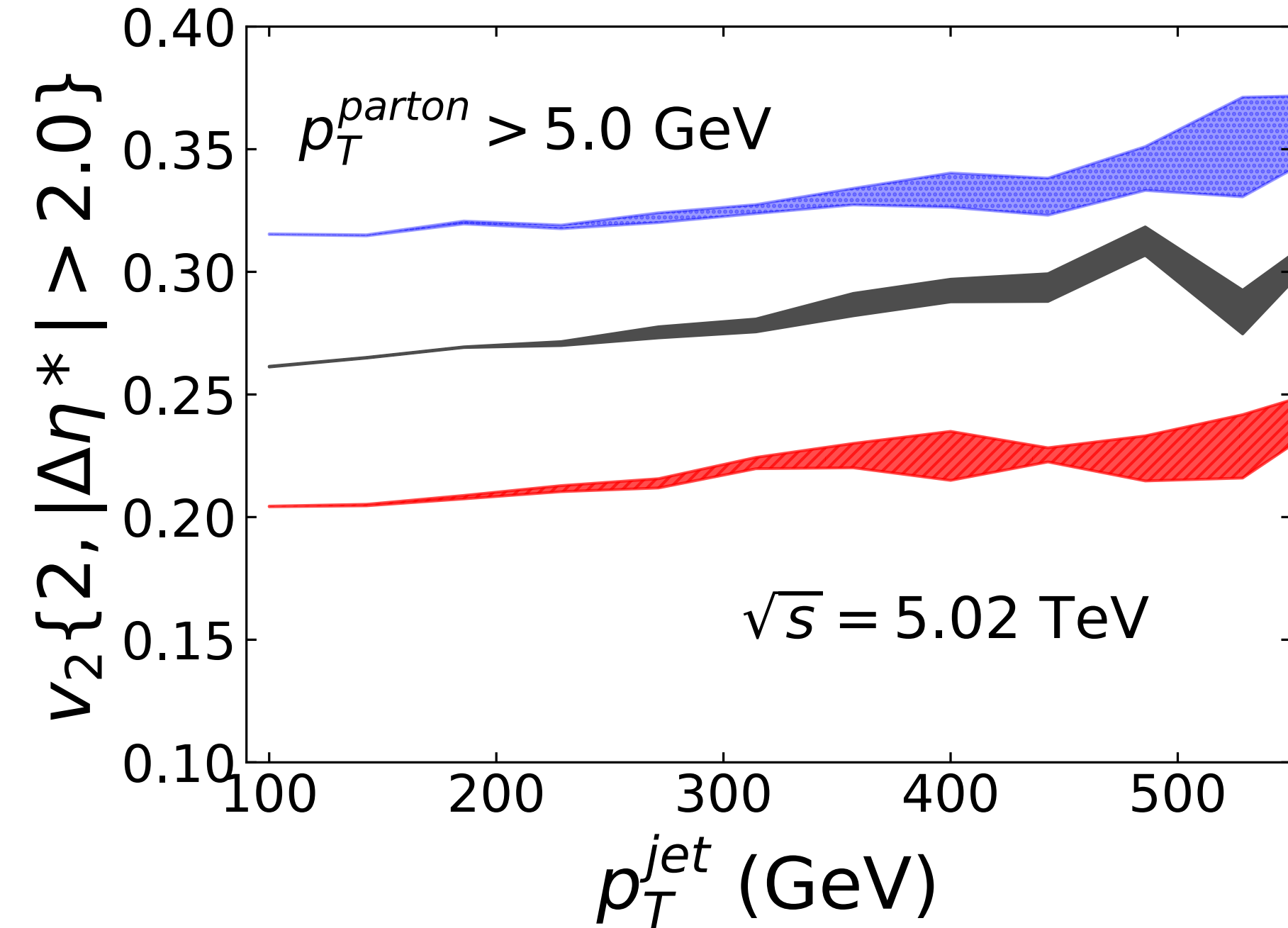
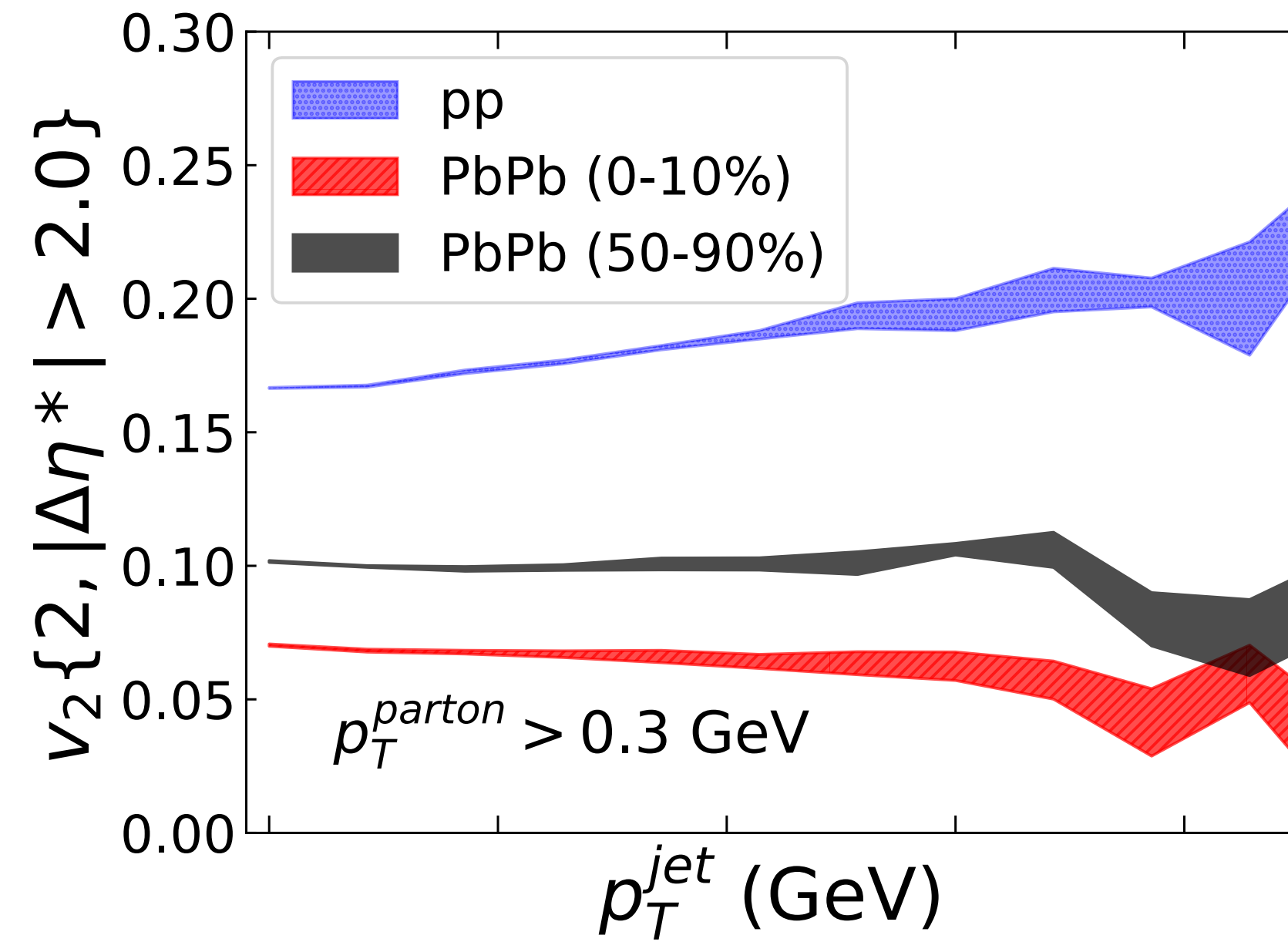
$v_2\{2, |\Delta\eta^*| > 2.0\}$  inside jets for inclusive jet production after propagating through a uniform static medium with different parameters for medium.

| T (GeV)            | Prop. time (fm/c) |      |       | $\alpha_s$ | Scatt. | $\langle v_2 \rangle$ |
|--------------------|-------------------|------|-------|------------|--------|-----------------------|
| <b>A:</b>          | 0.4,              | 1.0, | 0.15, | el.+inel.  |        | 0.126                 |
| <b>B:</b>          | 0.8,              | 1.0, | 0.15, | el.+inel.  |        | 0.096                 |
| <b>C:</b>          | 0.4,              | 5.0, | 0.15, | el.+inel.  |        | 0.039                 |
| <b>D:</b>          | 0.4,              | 1.0, | 0.30, | el.+inel.  |        | 0.092                 |
| <b>E:</b>          | 0.4,              | 1.0, | 0.15, | el. only   |        | 0.147                 |
| No medium ( $pp$ ) |                   |      |       |            |        | 0.169                 |

The modification on in-jet  $v_2$  are found to be sensitive to the medium properties.



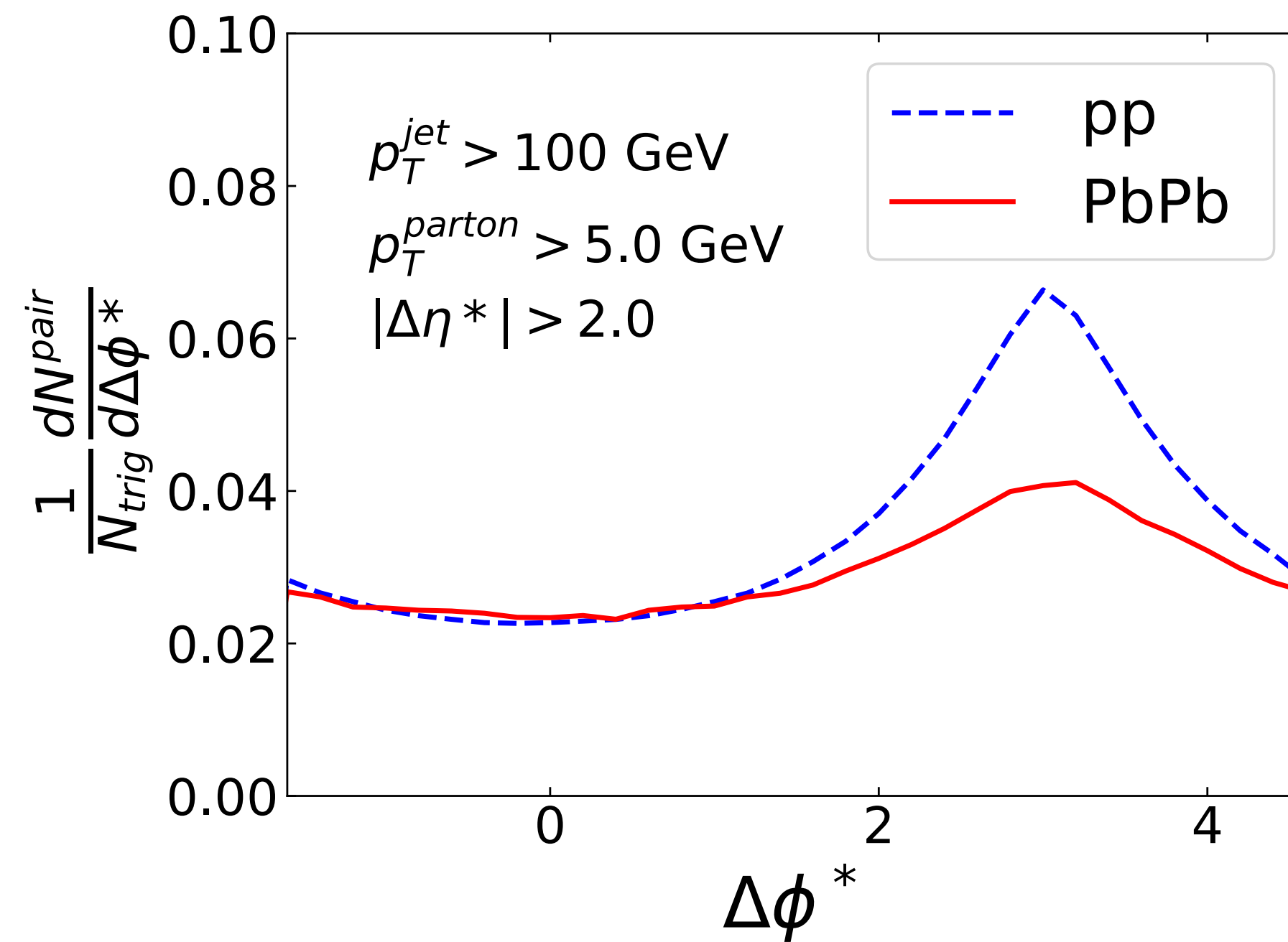
# Medium modifications in A+A collisions



A significant suppression of the in-jet  $v_2$ , which becomes stronger in more central collisions.



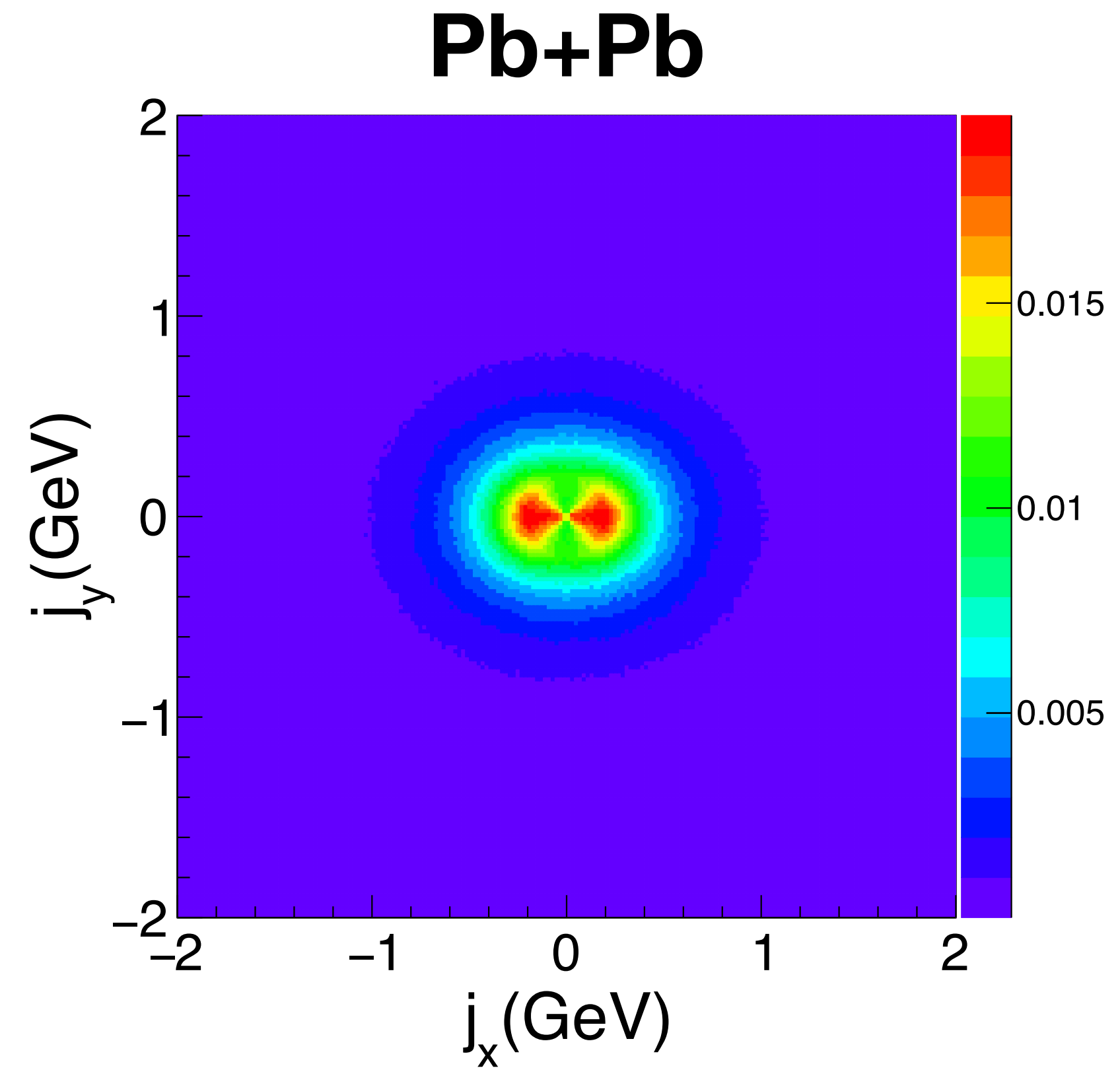
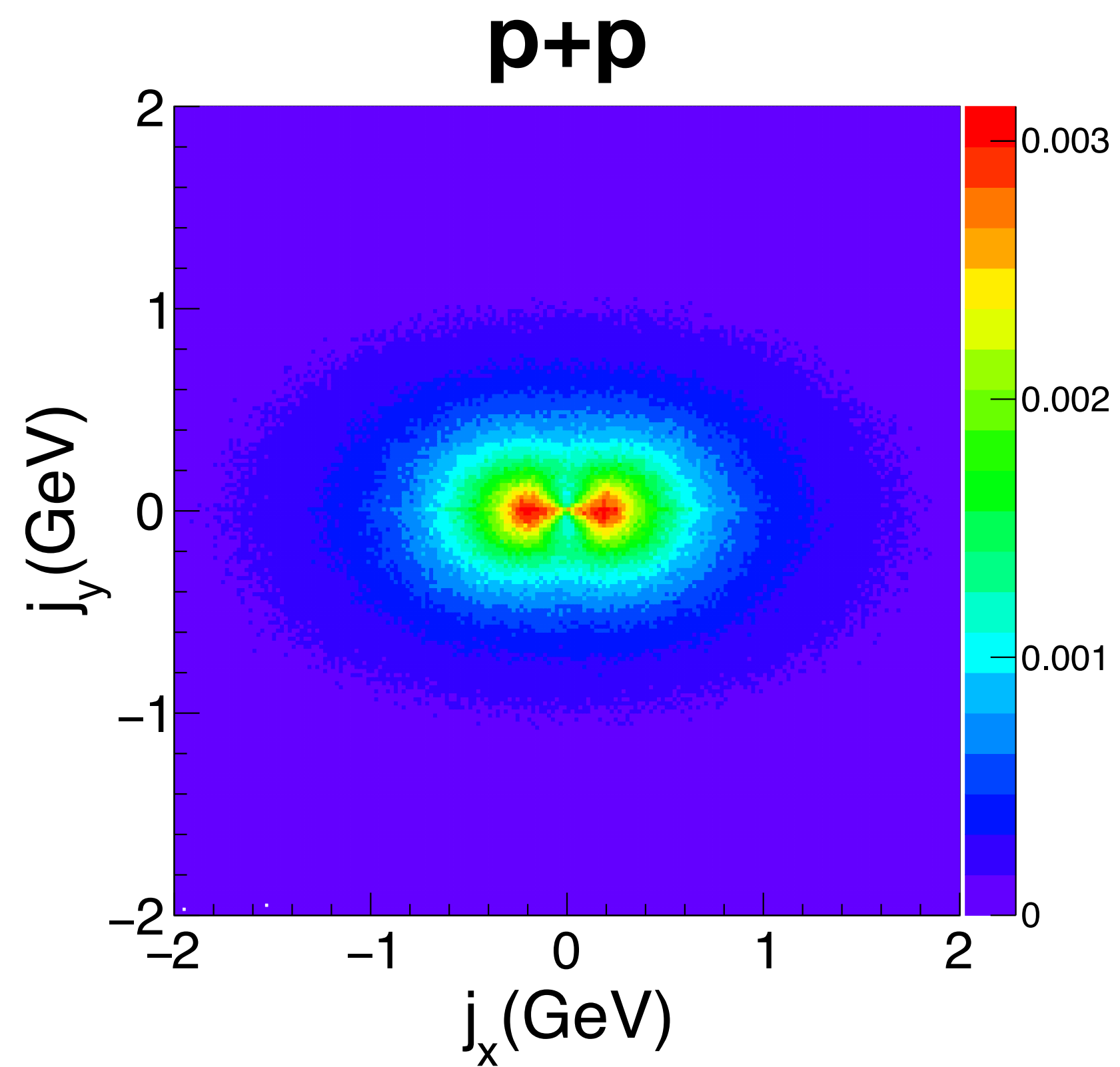
# Medium modifications in A+A collisions



An obvious de-correlation in azimuthal angular distribution in AA collisions.

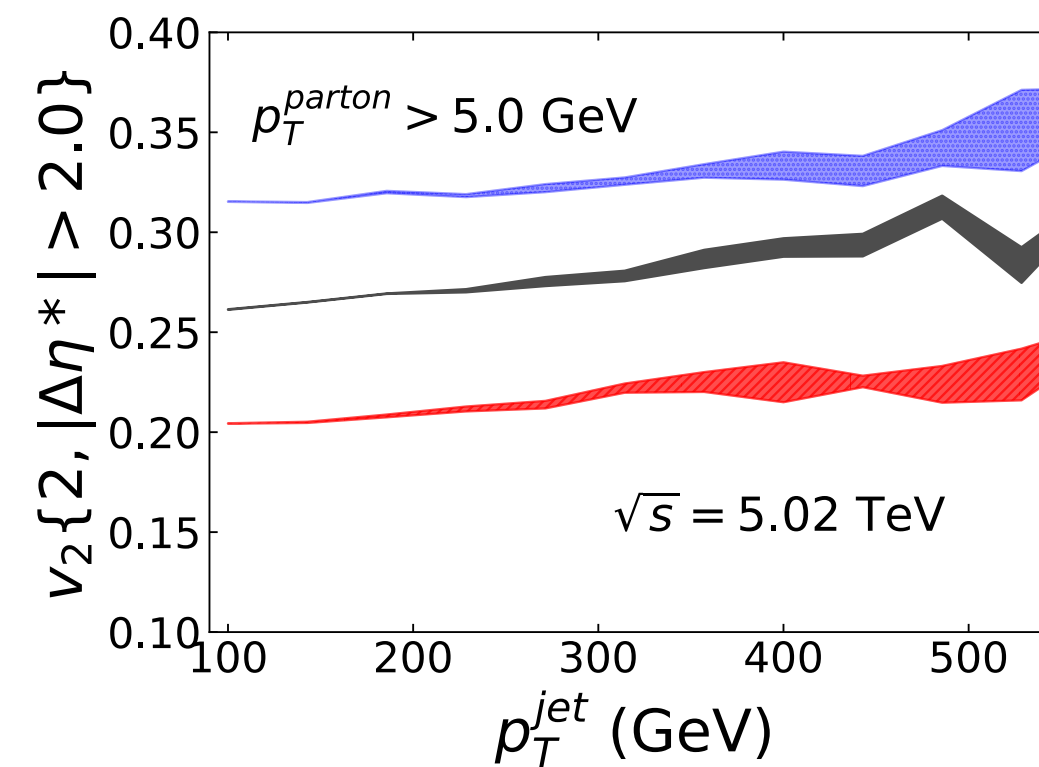
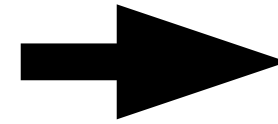
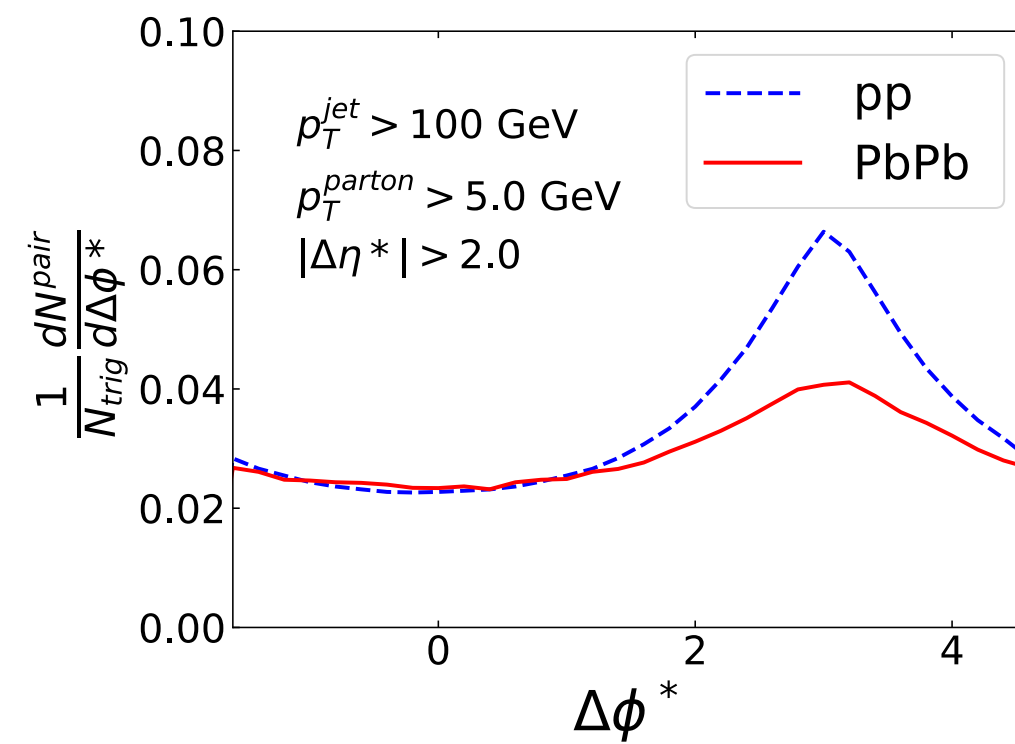


# Medium modifications in A+A collisions

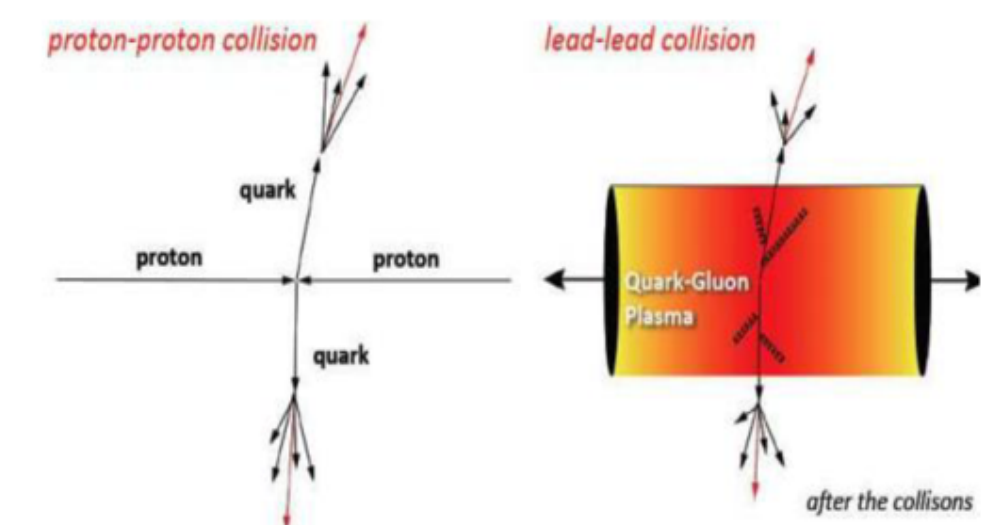
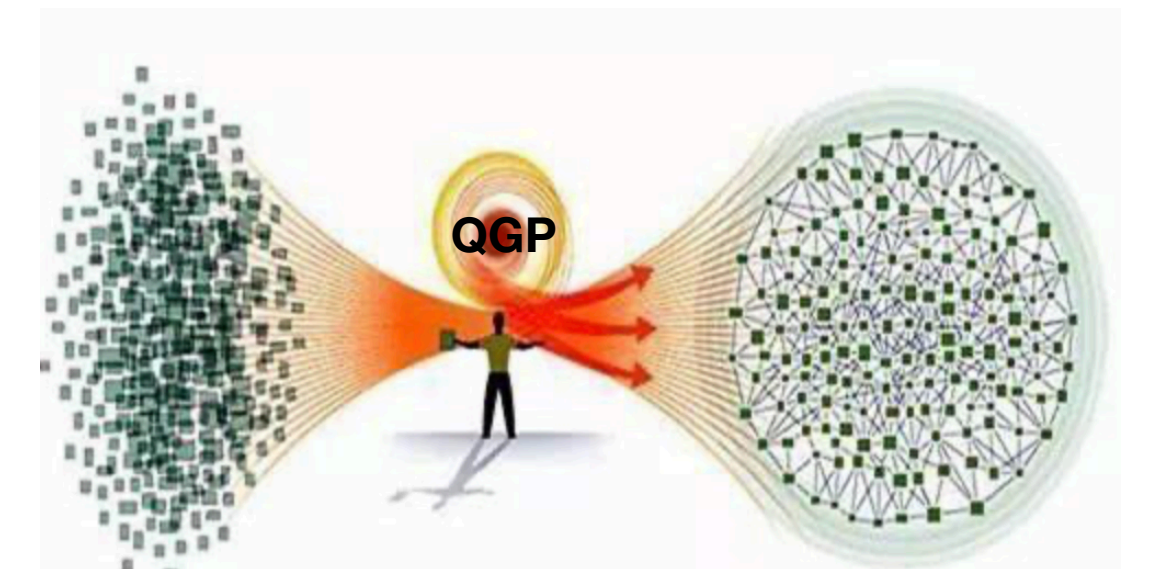




# Summary



- (1) An obvious azimuthal de-correlation inside jets is observed in AA collisions compared to pp collisions due to jet-medium interactions. which results in significant suppressions of the in-jet  $v_2$ .
- (2) The jets propagating in thermal media may become more disordered than that in vacuum.
- (3) The measurement of such observables may provide new resolution power of the jets as a microscope of the structures of QCD matters.



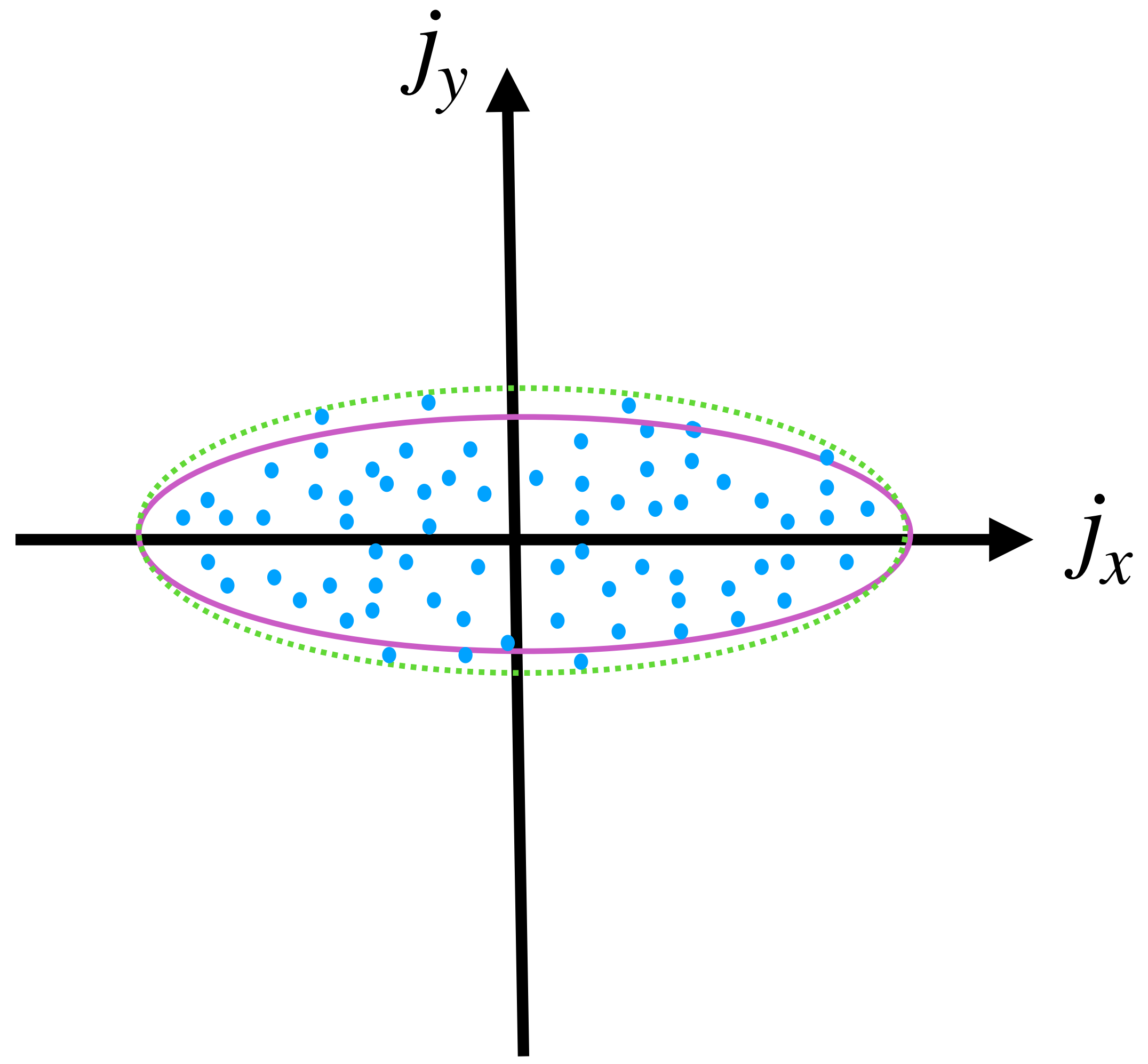
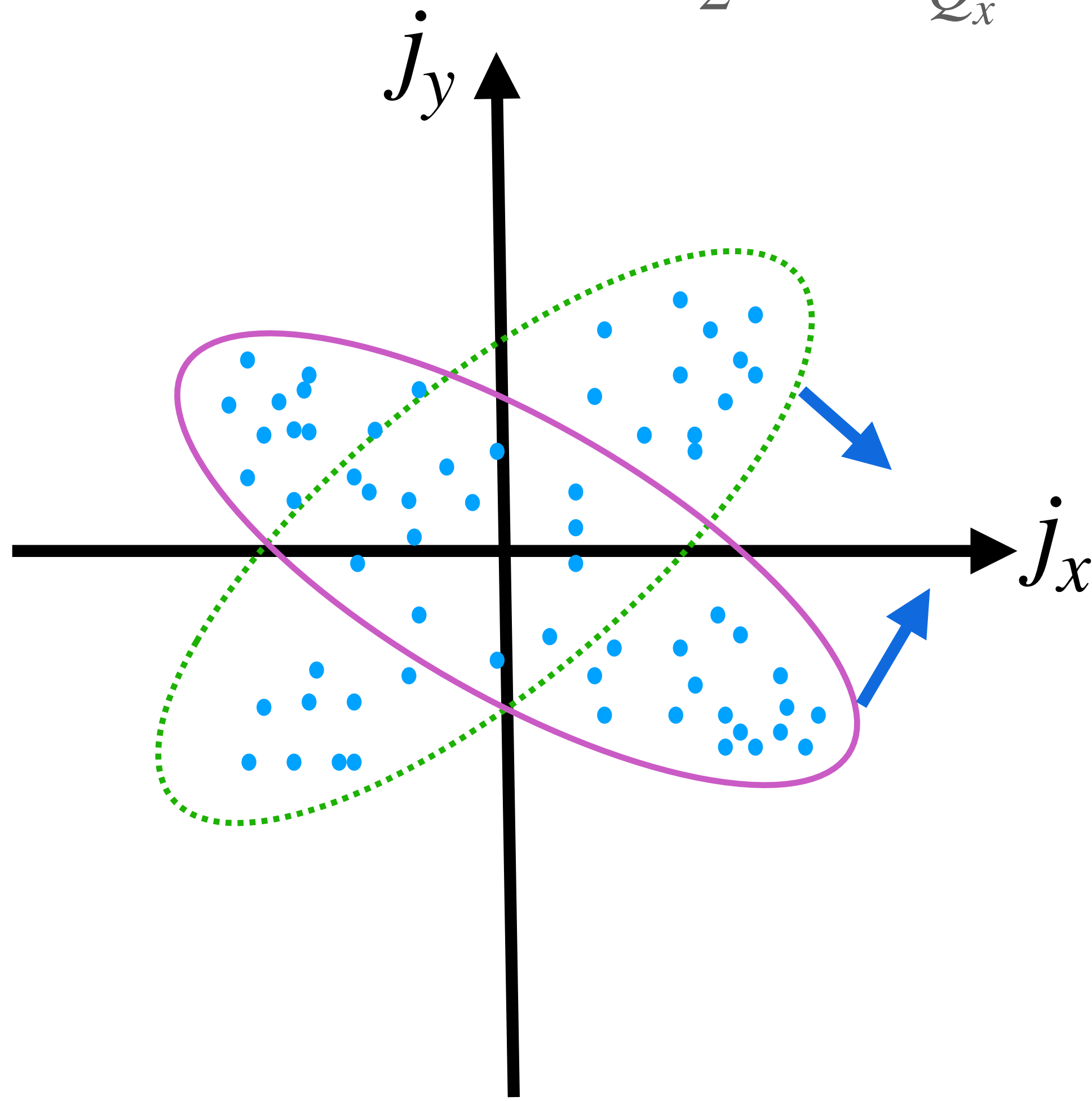


# Jet particles distribution in $\vec{j}_T$ plane

$$Q_x = \sum_i \cos(2\phi_i^*) \quad Q_y = \sum_i \sin(2\phi_i^*)$$

Jet plane angle  $\Psi_{JP} = \frac{1}{2} \tan^{-1}\left(\frac{Q_y}{Q_x}\right)$

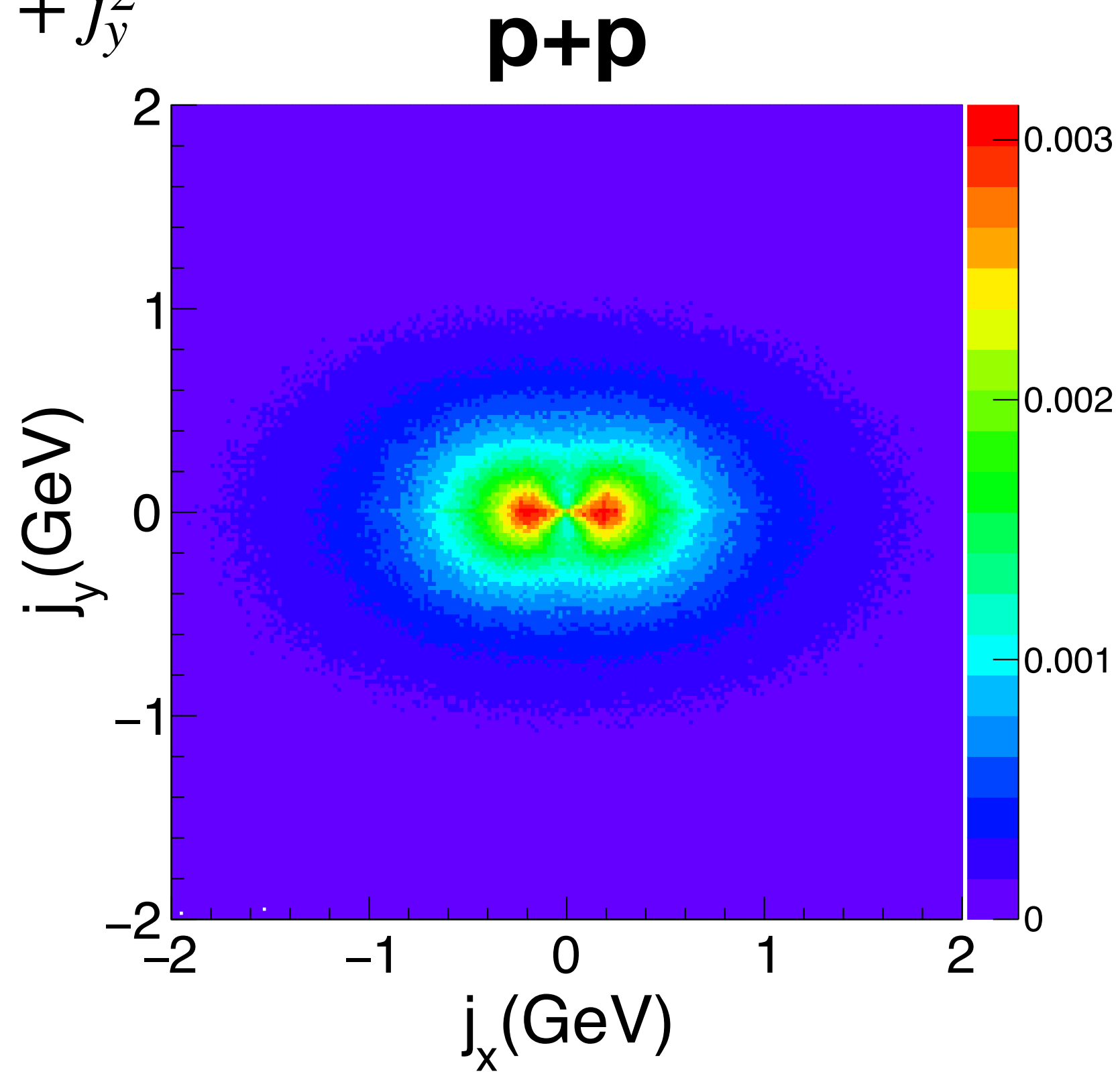
Elliptical anisotropy  $v_2 = \left\langle \frac{j_x^2 - j_y^2}{j_x^2 + j_y^2} \right\rangle$



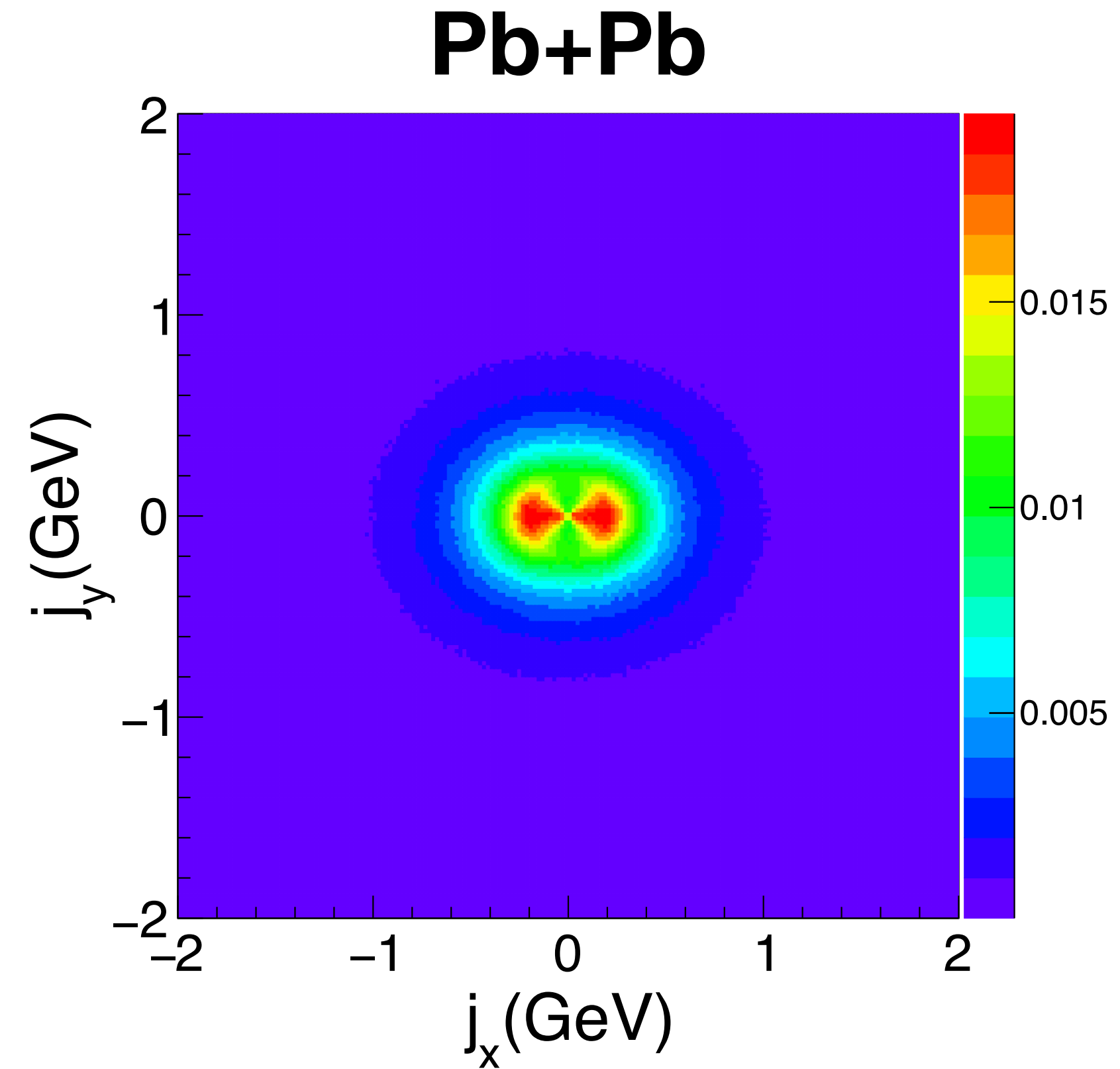


# Medium modifications in A+A collisions

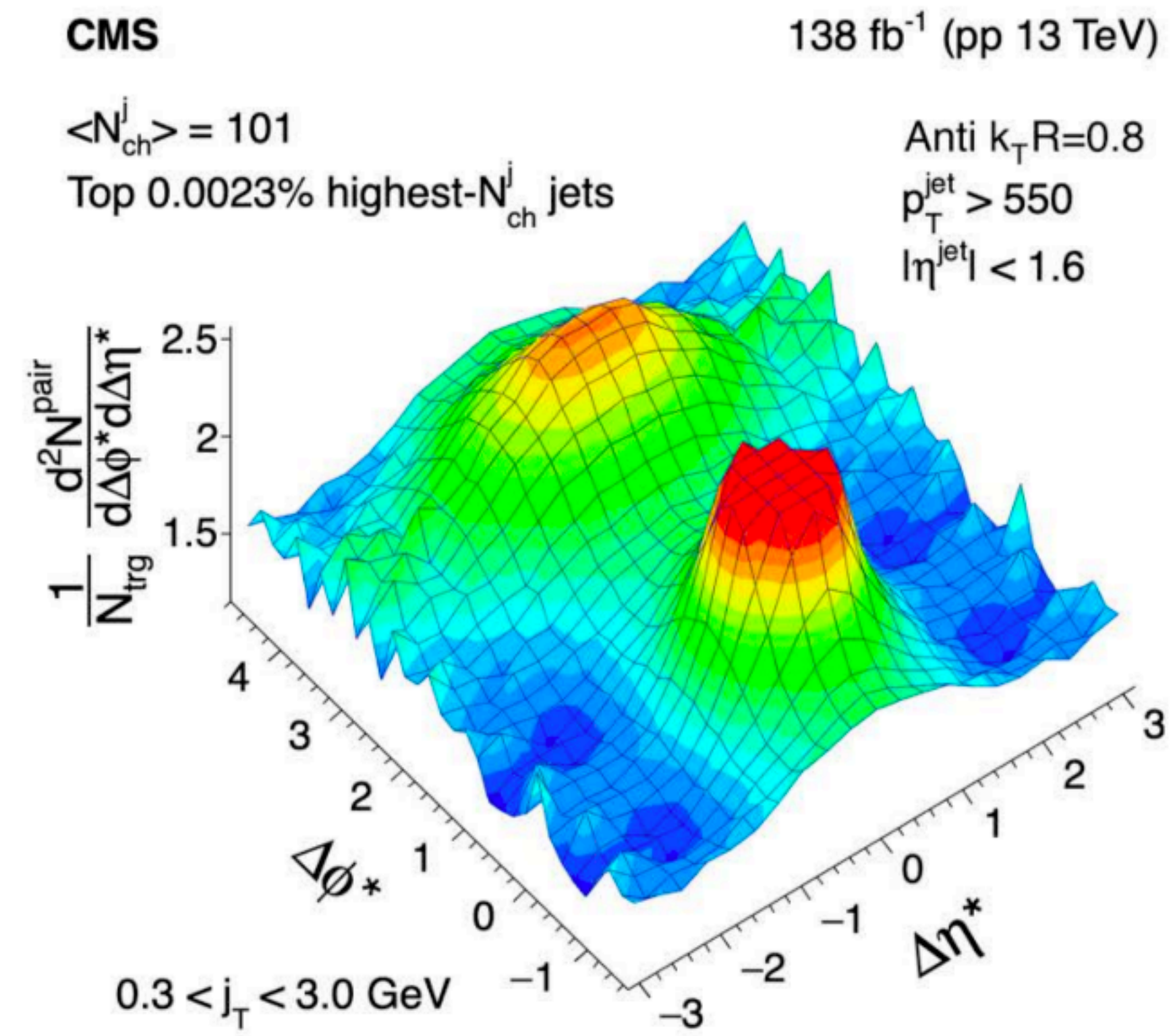
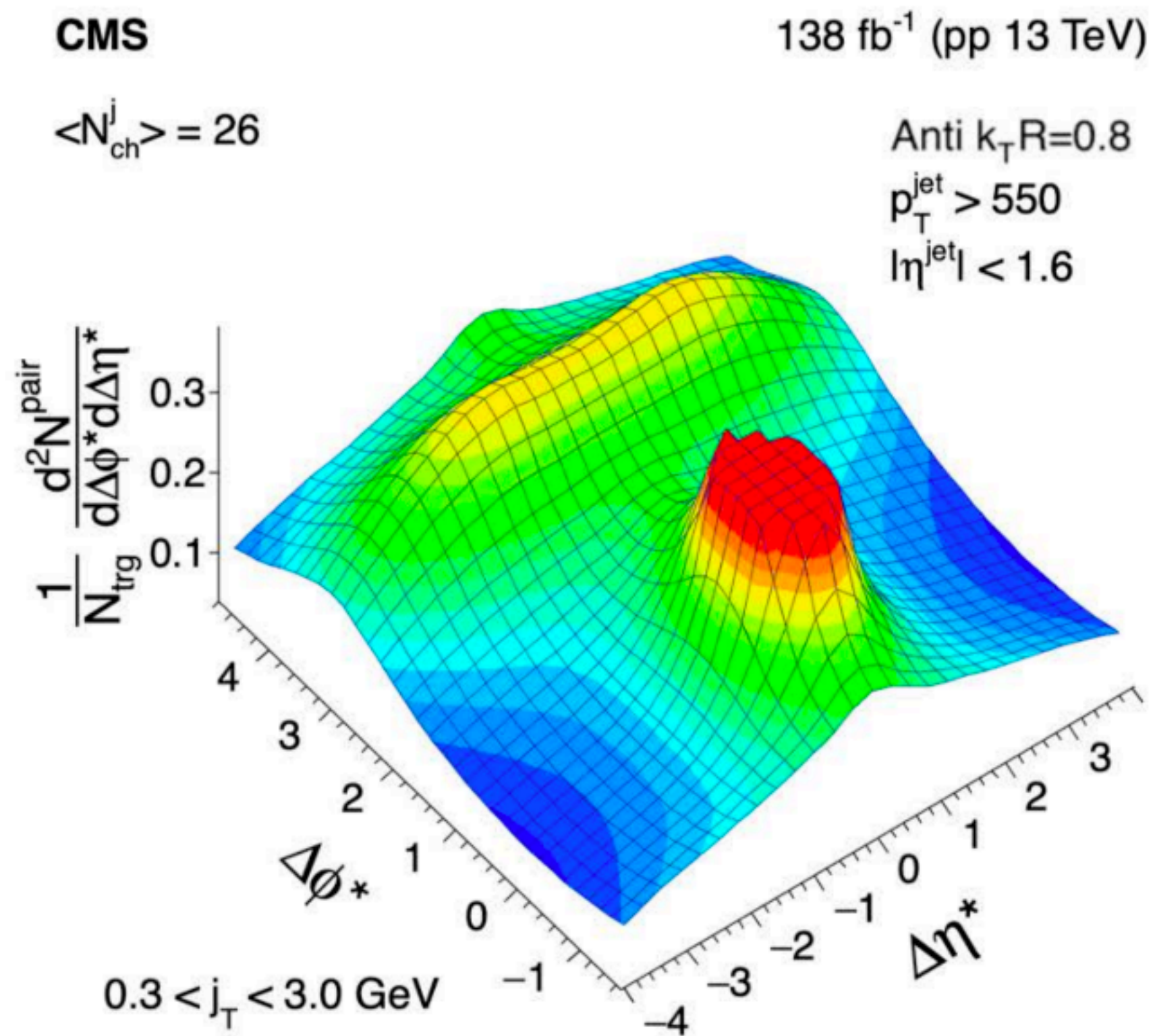
$$v_2 = \left\langle \frac{j_x^2 - j_y^2}{j_x^2 + j_y^2} \right\rangle$$



$$v_2 = 0.33$$



$$v_2 = 0.16$$



*Phys. Rev. Lett.* 133(2024)14