



HP2024
N A G A S A K I

Jet transport in QGP fluid

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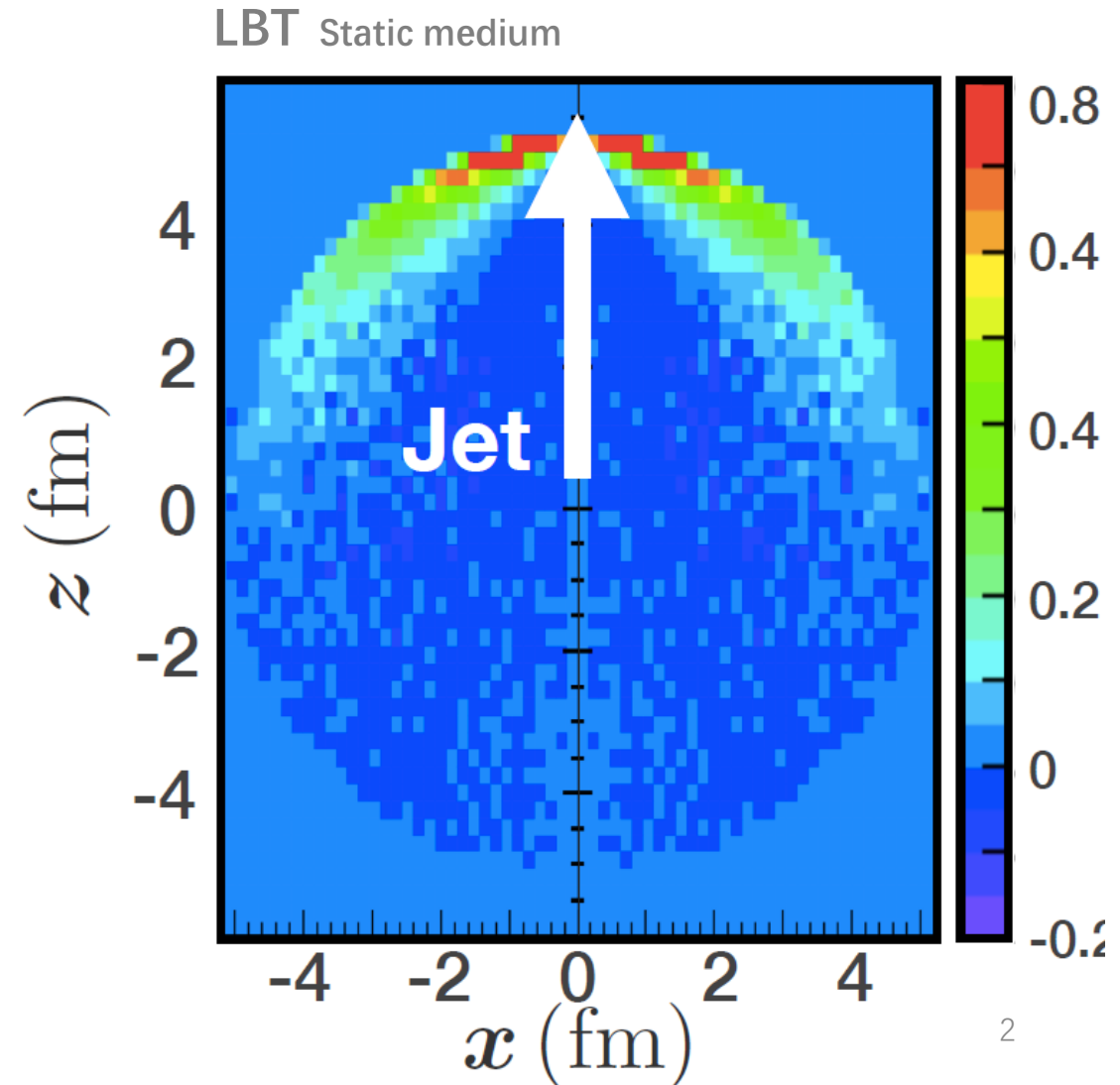
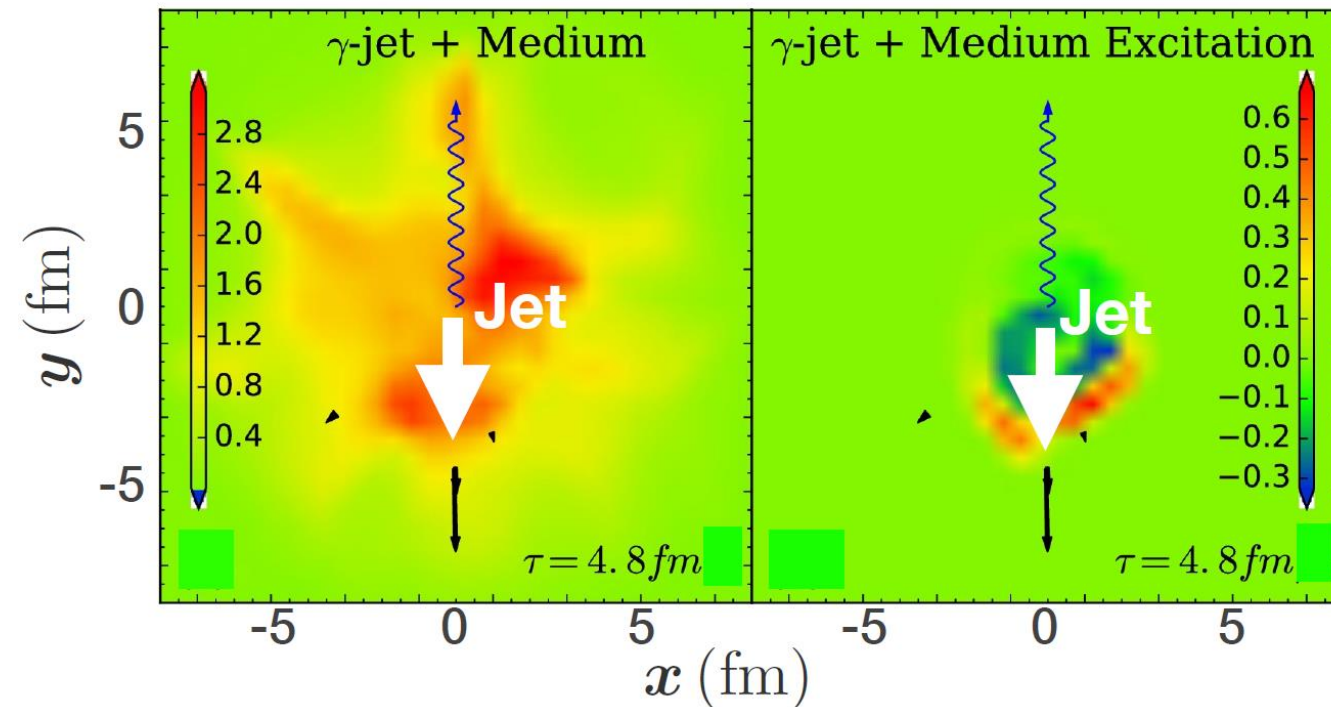
In collaboration with Yayun He, Carlos A. Salgado and Xin-Nian Wang



Jet transport in a flowing medium

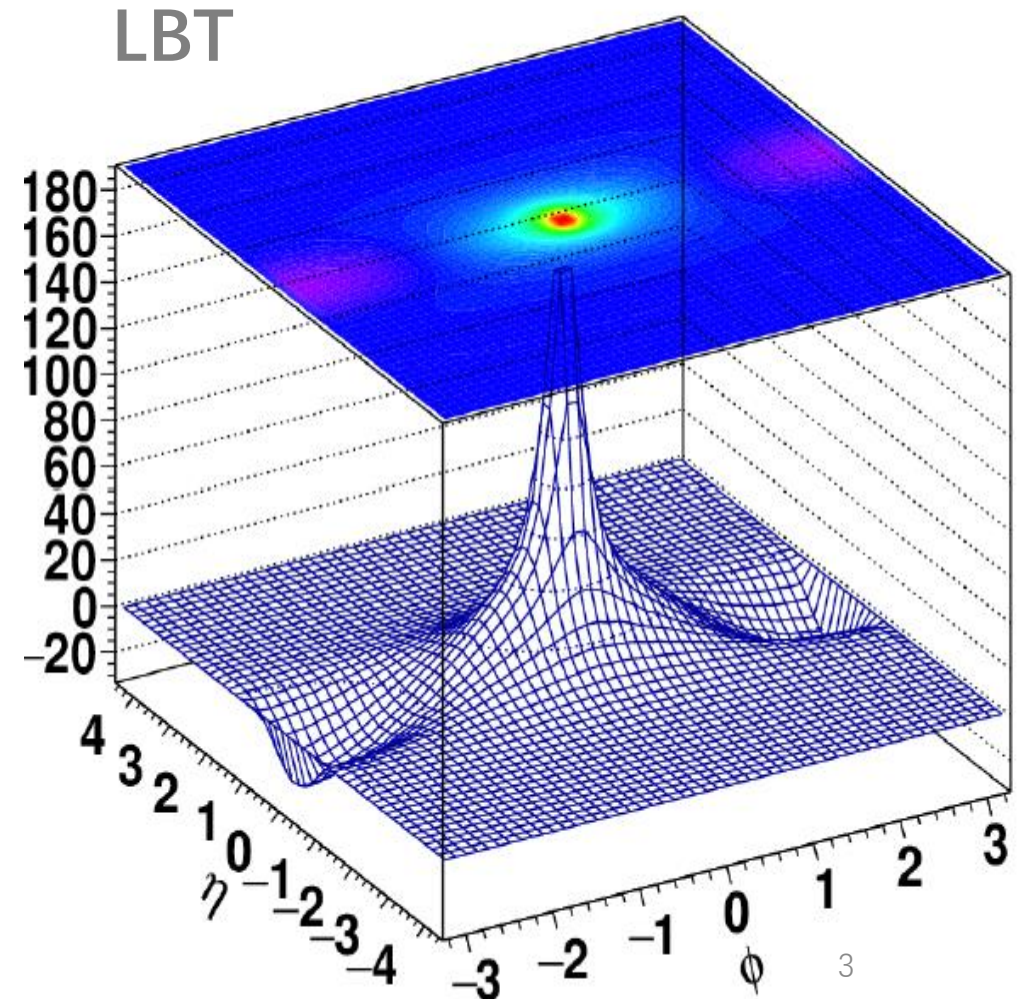
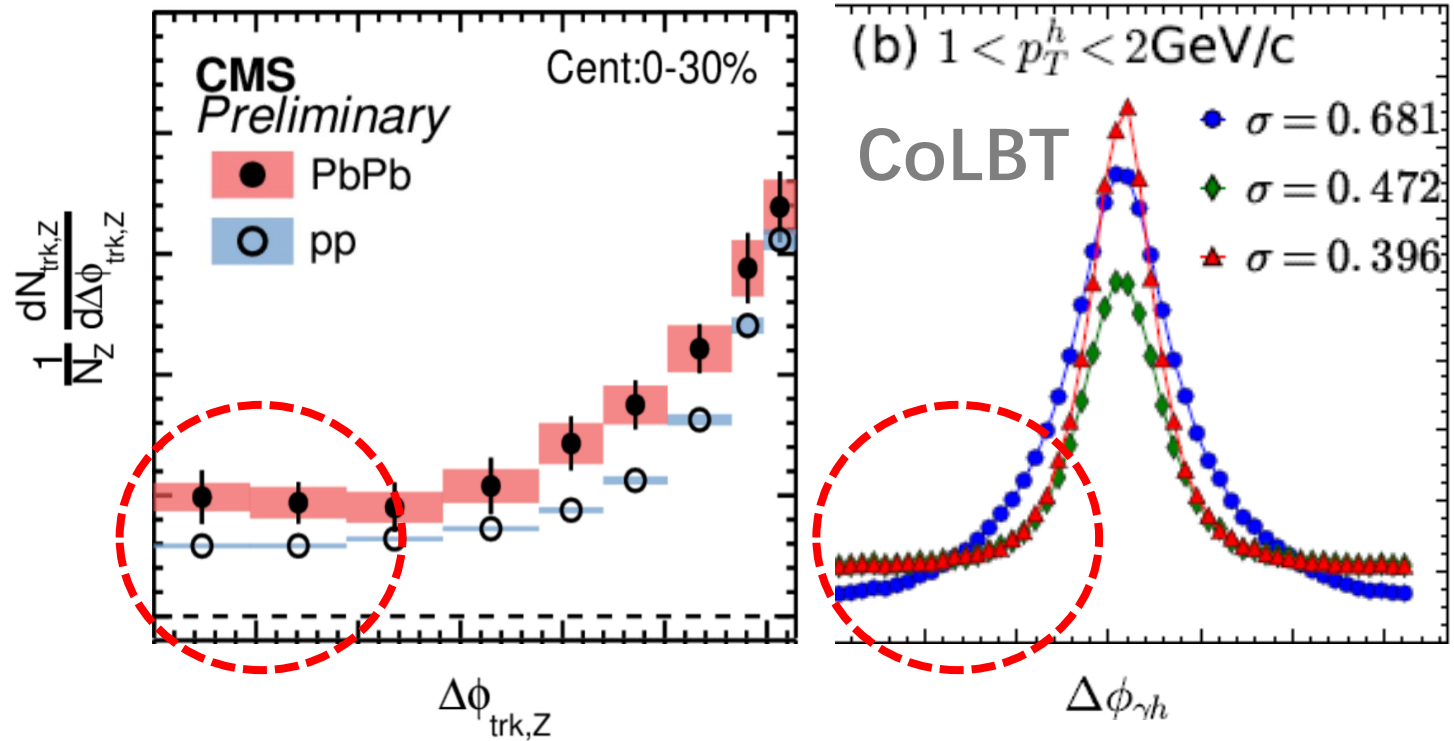
- **Structure of medium response**
Jet induced mach cone followed by a diffusion wake.
- **Distorted due to jet-medium interaction**

CoLBT-hydro Phys.Lett. B777 86-90



Separate the contribution of diffusion wake

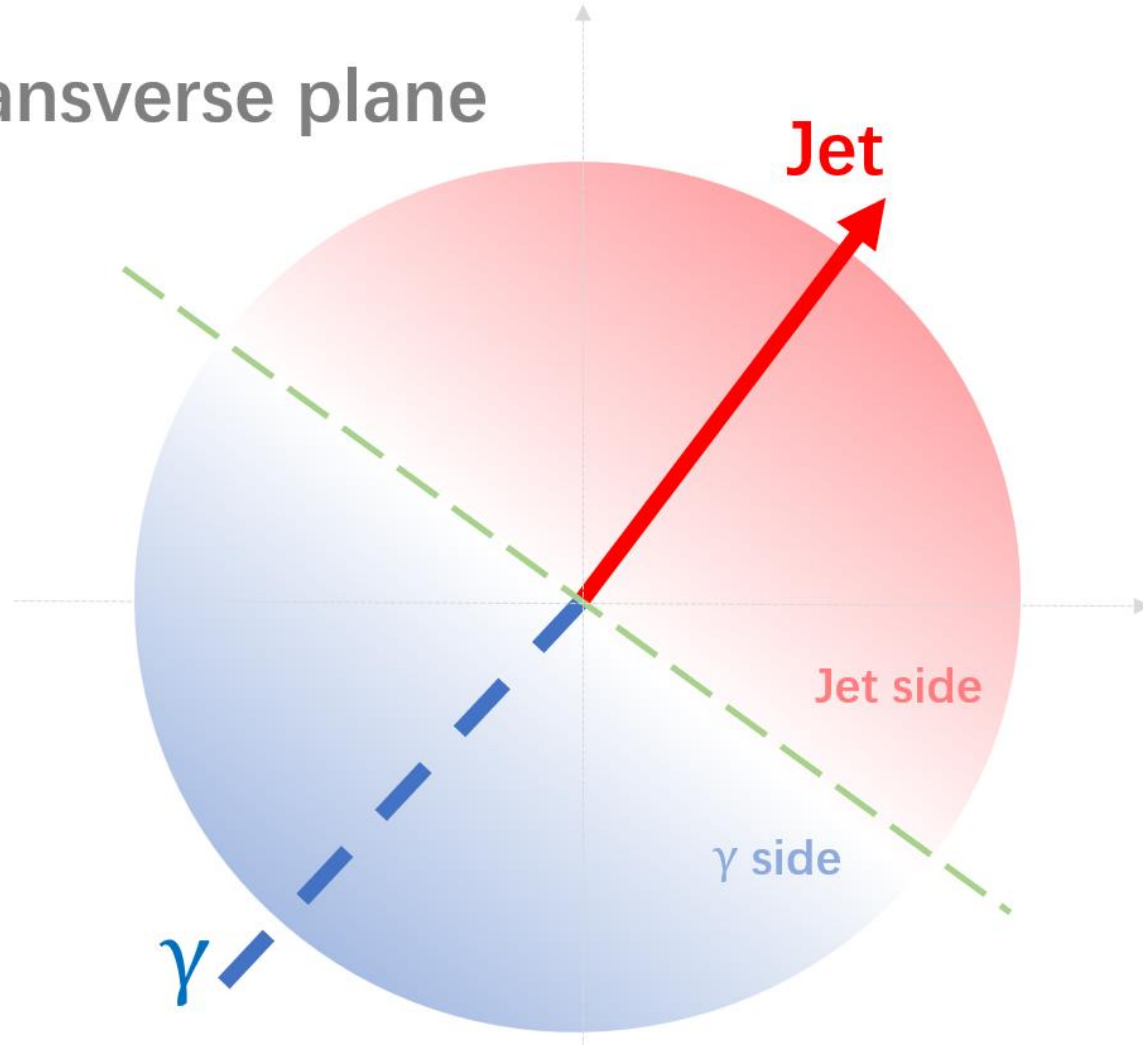
- The deep in the back side of the jet (signal of the diffusion wake)
- Diffusion wake .vs. background



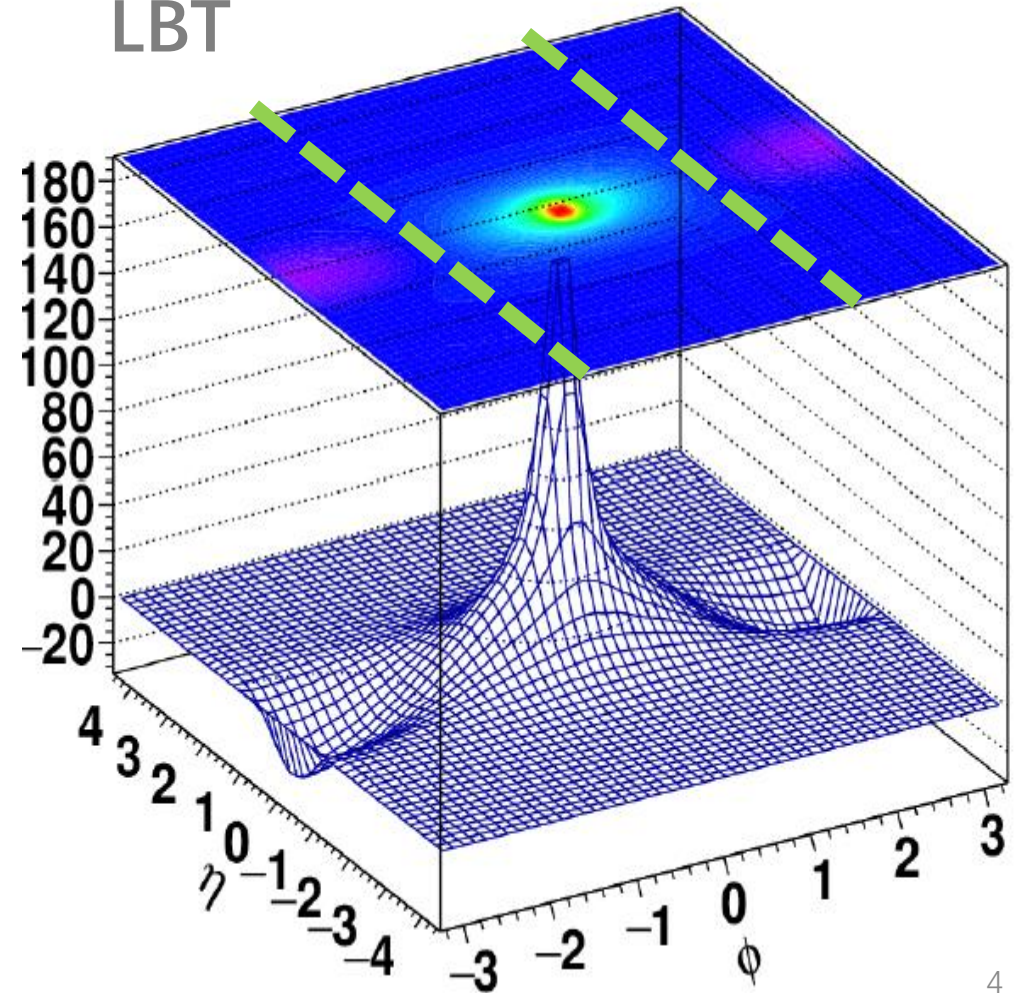
Separate the contribution of diffusion wake

- A phase space cut in the transverse plane. (Jet hemisphere & γ hemisphere)

Transverse plane

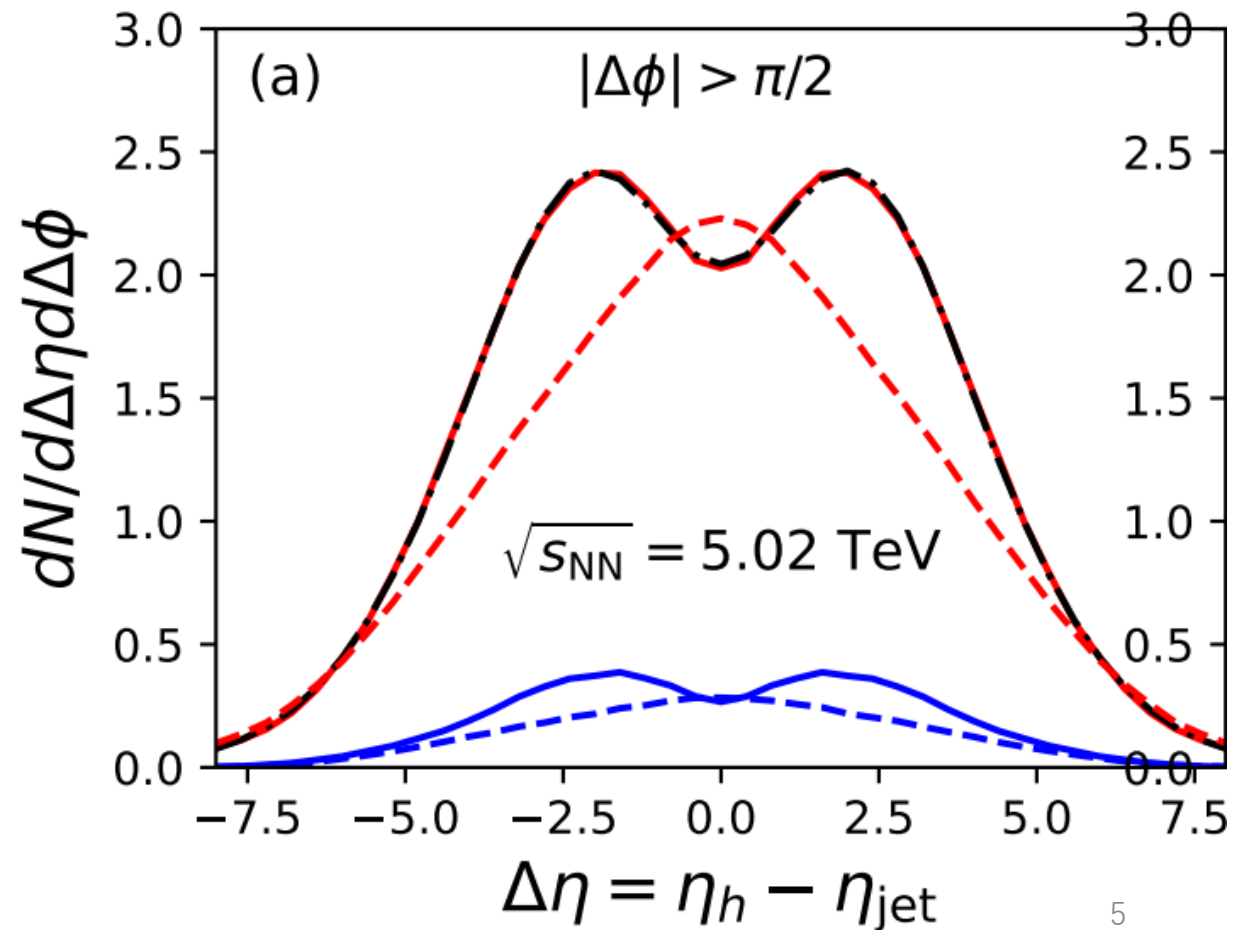
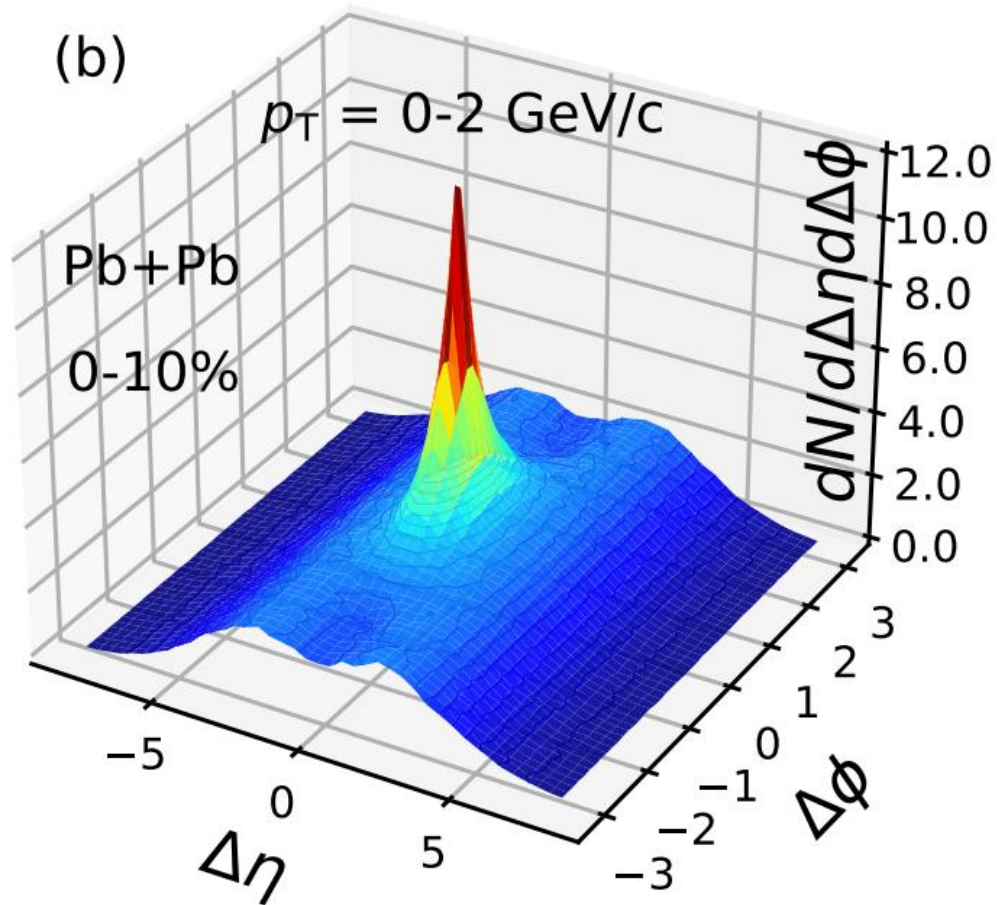


LBT

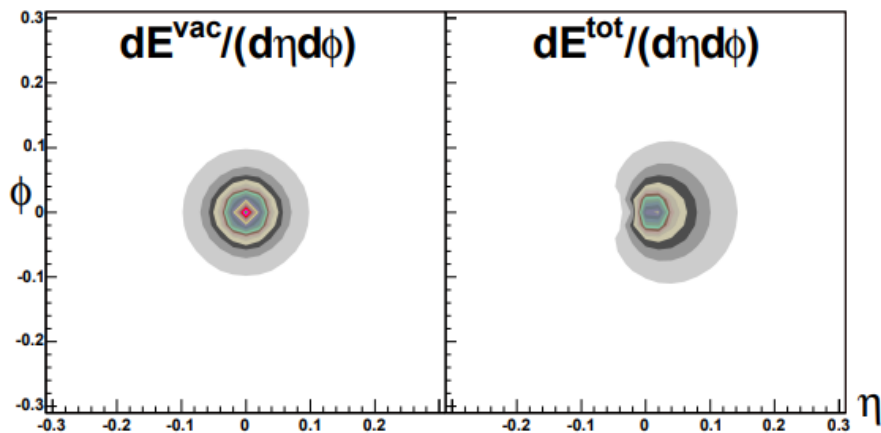
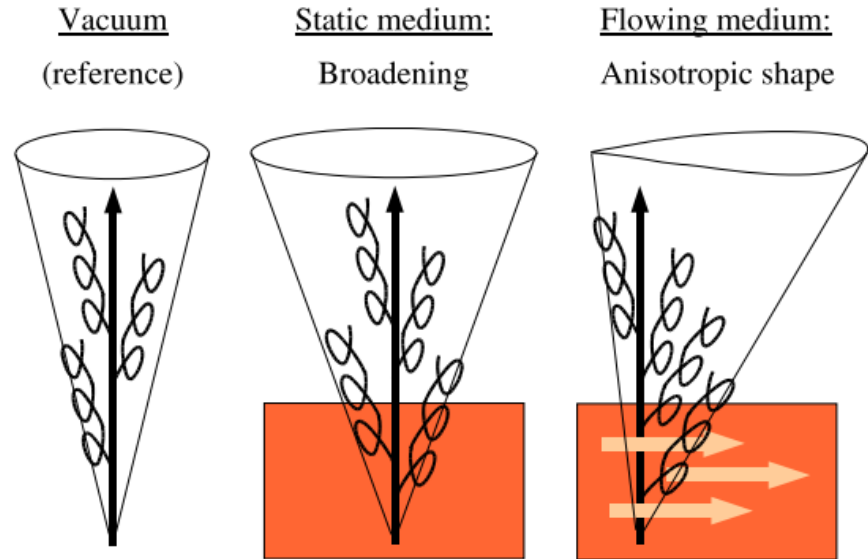


γ -jet particle number distribution

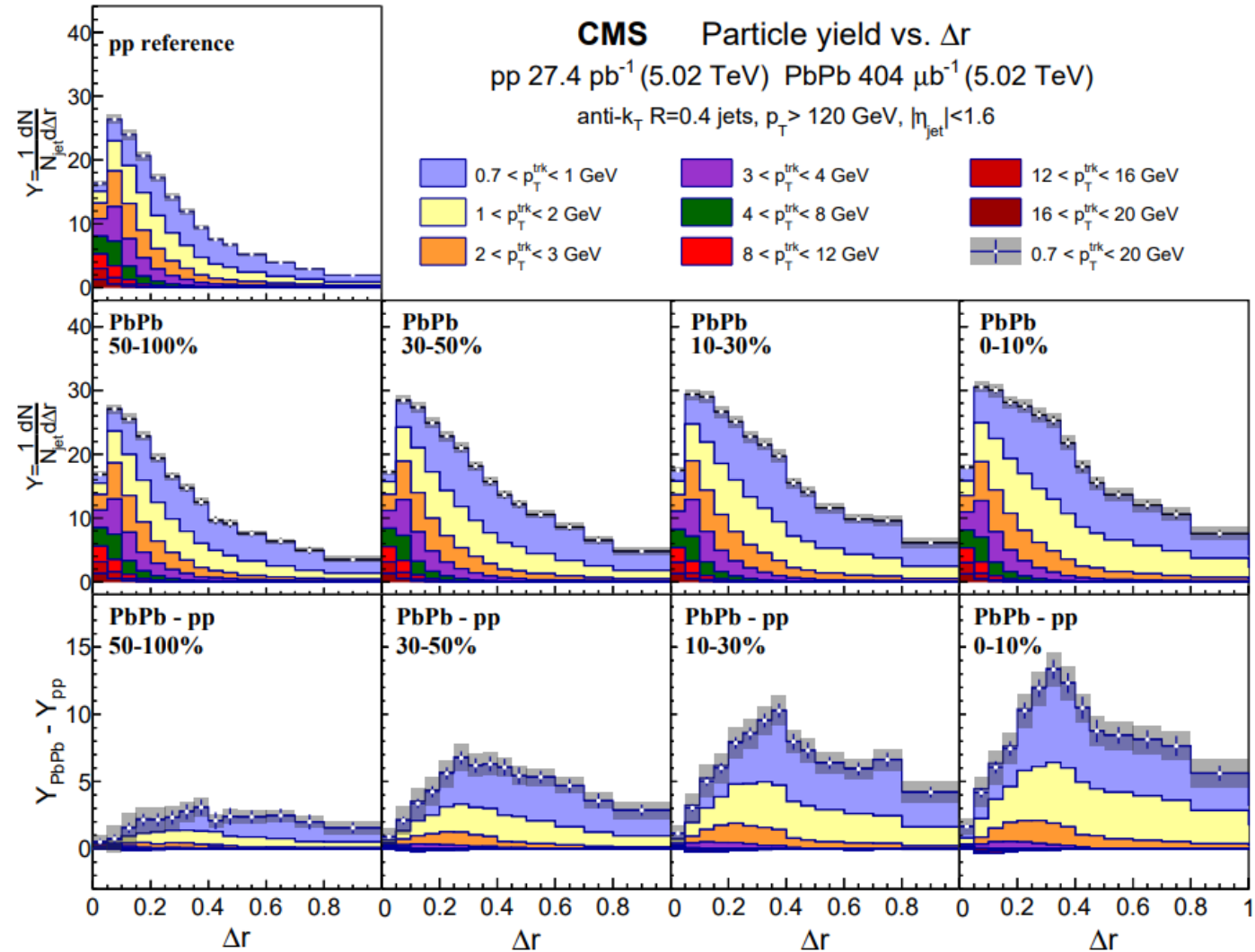
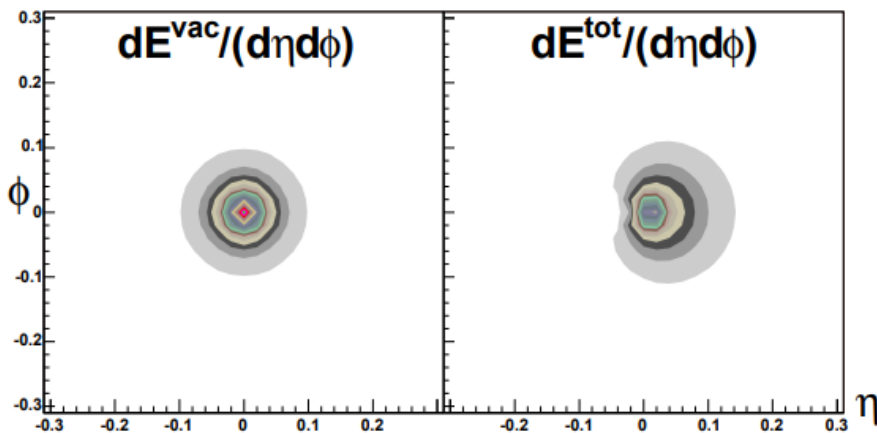
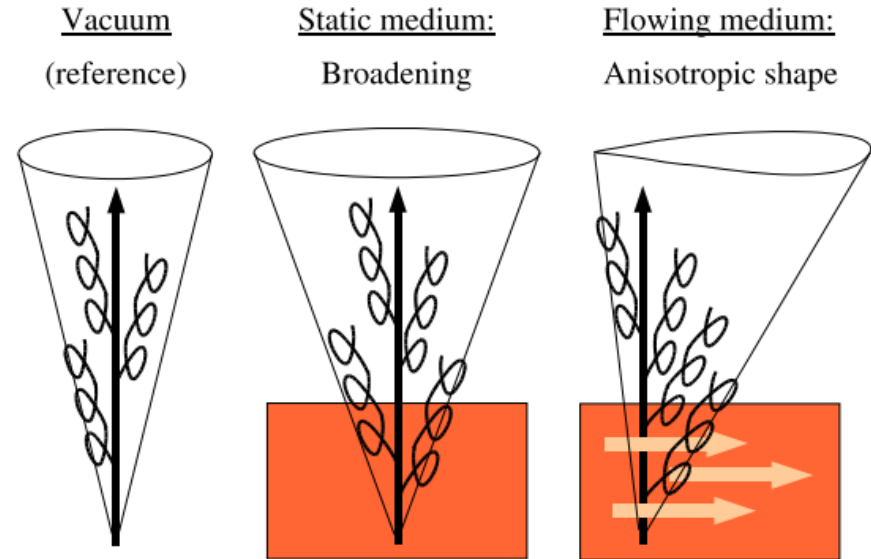
- MPI ridge & diffusion wake valley (γ -jet particle number distribution)
- Quantify the wake with Gaussian fit



Intra-jet asymmetry (Jet winnowing)



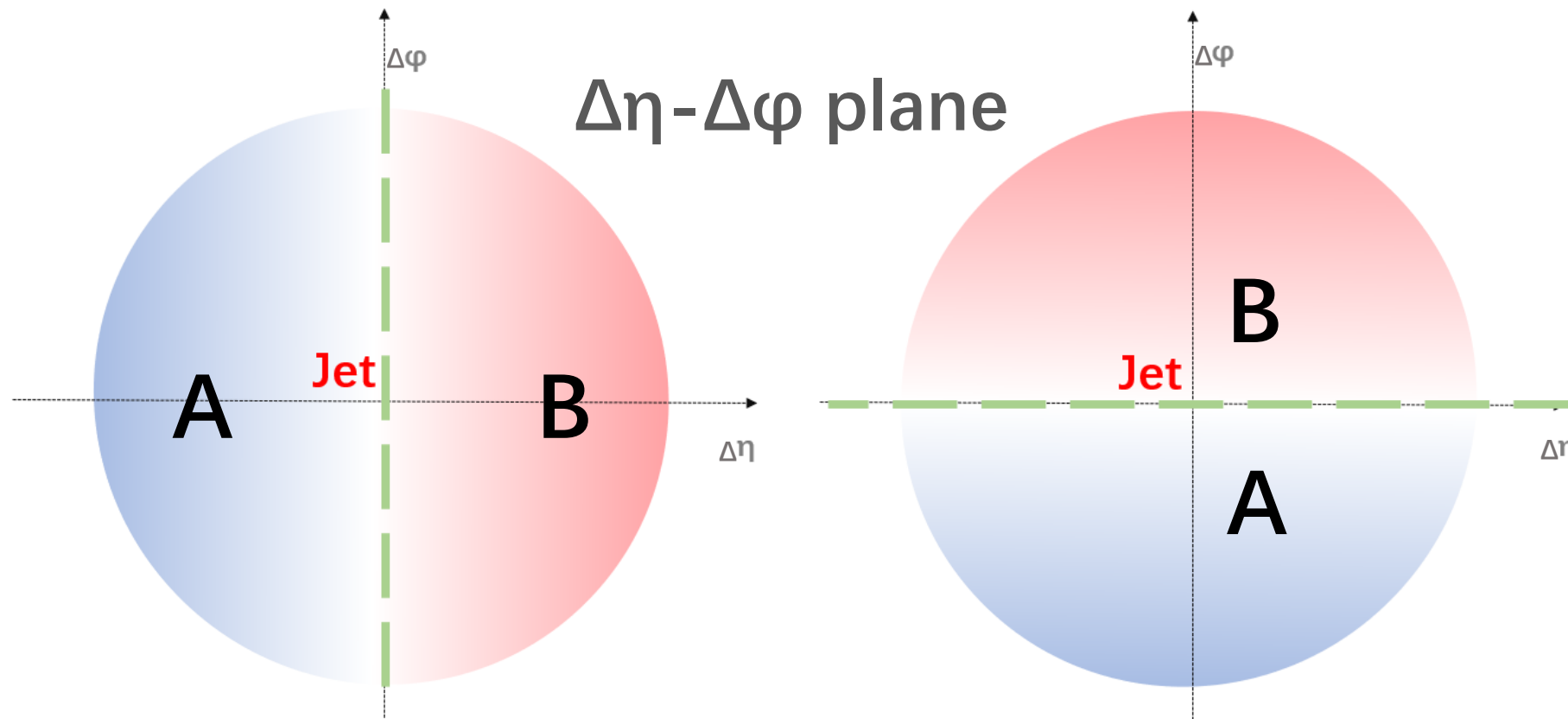
Intra-jet asymmetry (The contribution from flow)



Phase-space cut and intra-jet asymmetry

- A phase space cut inside jet cone (the $\Delta\eta$ - $\Delta\phi$ plane).

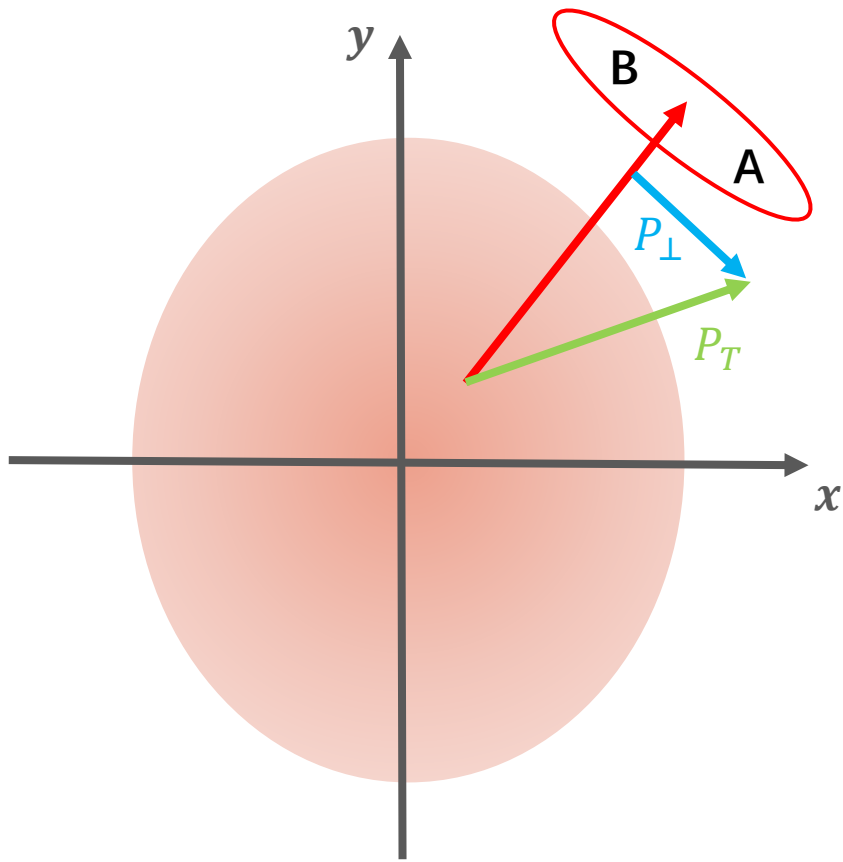
Intra-jet asymmetry $\chi = \frac{Q_A - Q_B}{Q_A + Q_B}$



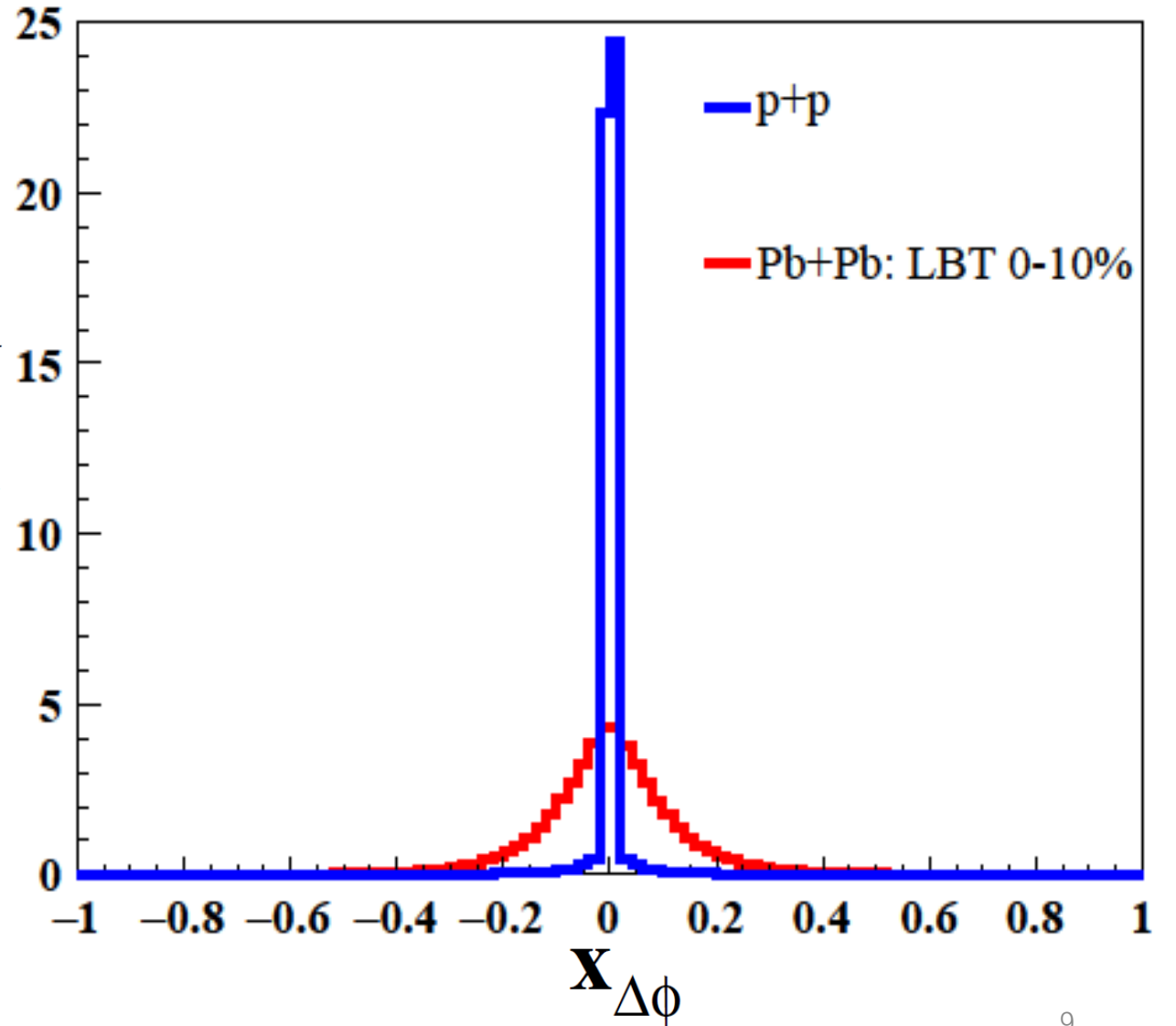
Intra-jet asymmetry (γ -jet)

$$X = \frac{Q_A - Q_B}{Q_A + Q_B} \quad Q_A = \sum_{i \in A} p_{\perp i}$$

P_T : fluctuation!

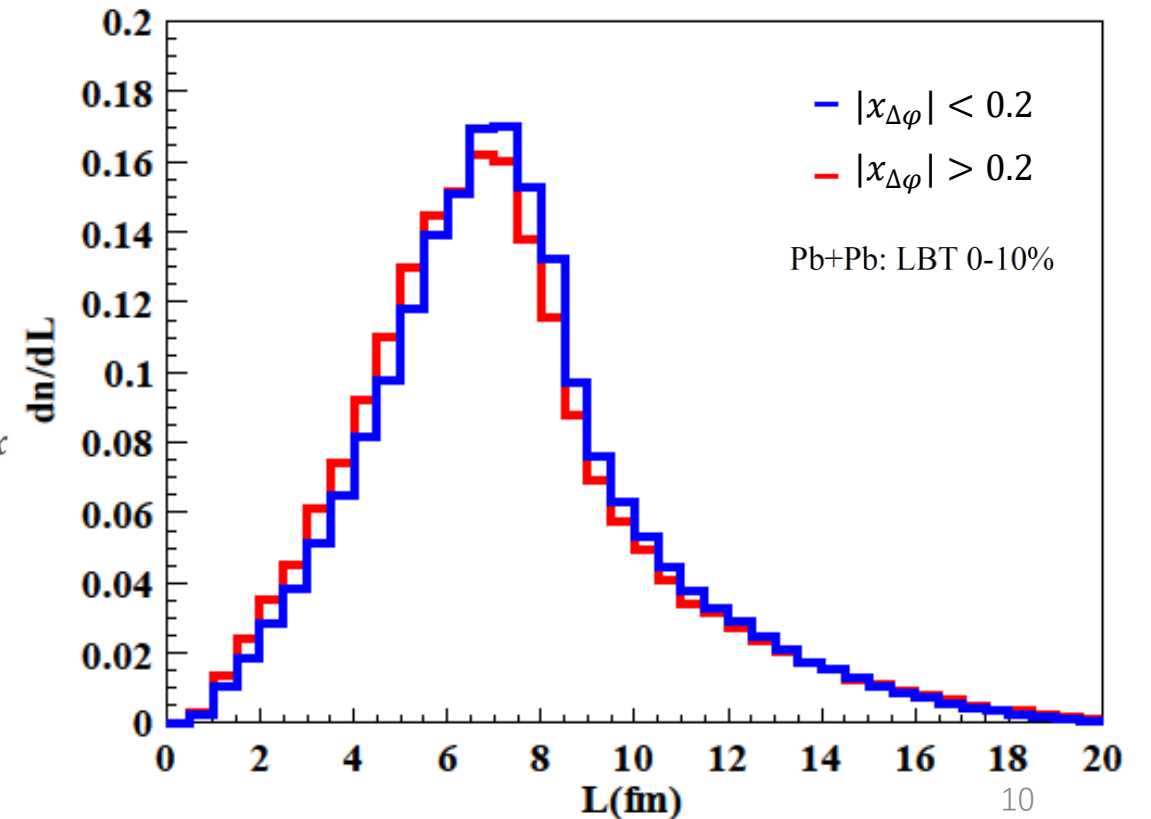
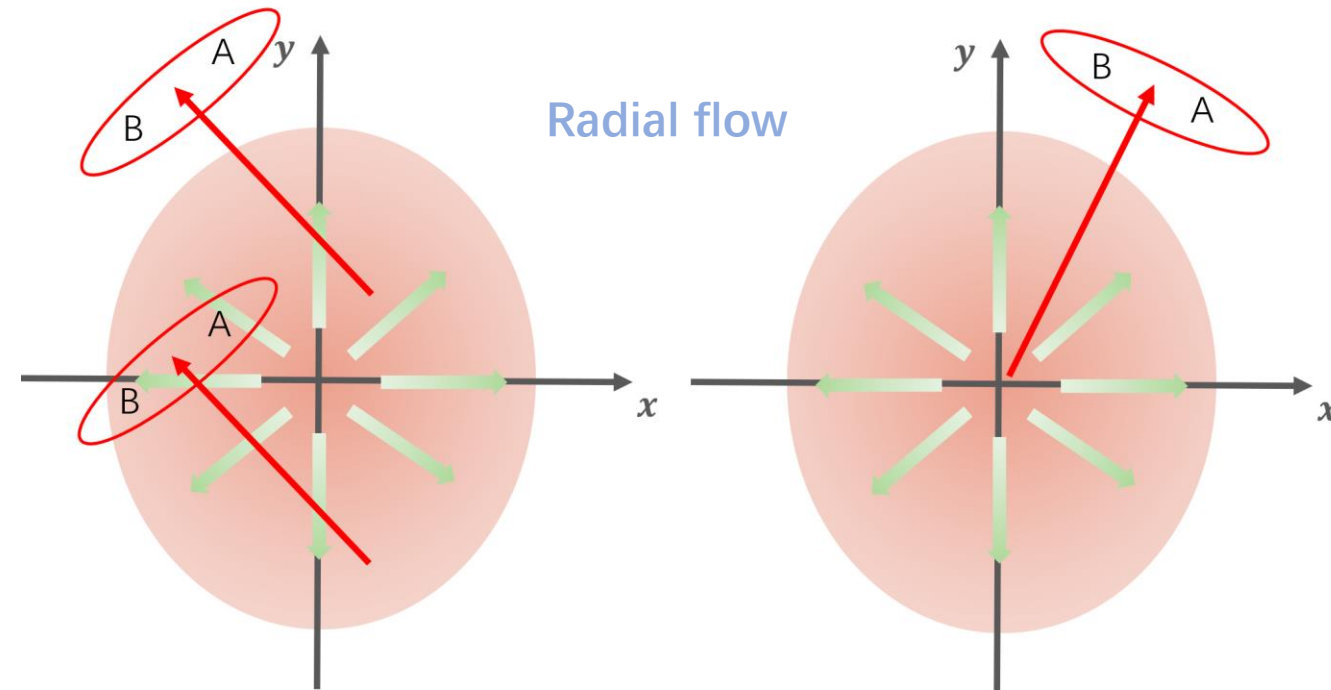


$$\frac{1}{N^{J\gamma}} \frac{dN^{J\gamma}}{dx_{\Delta\phi}}$$



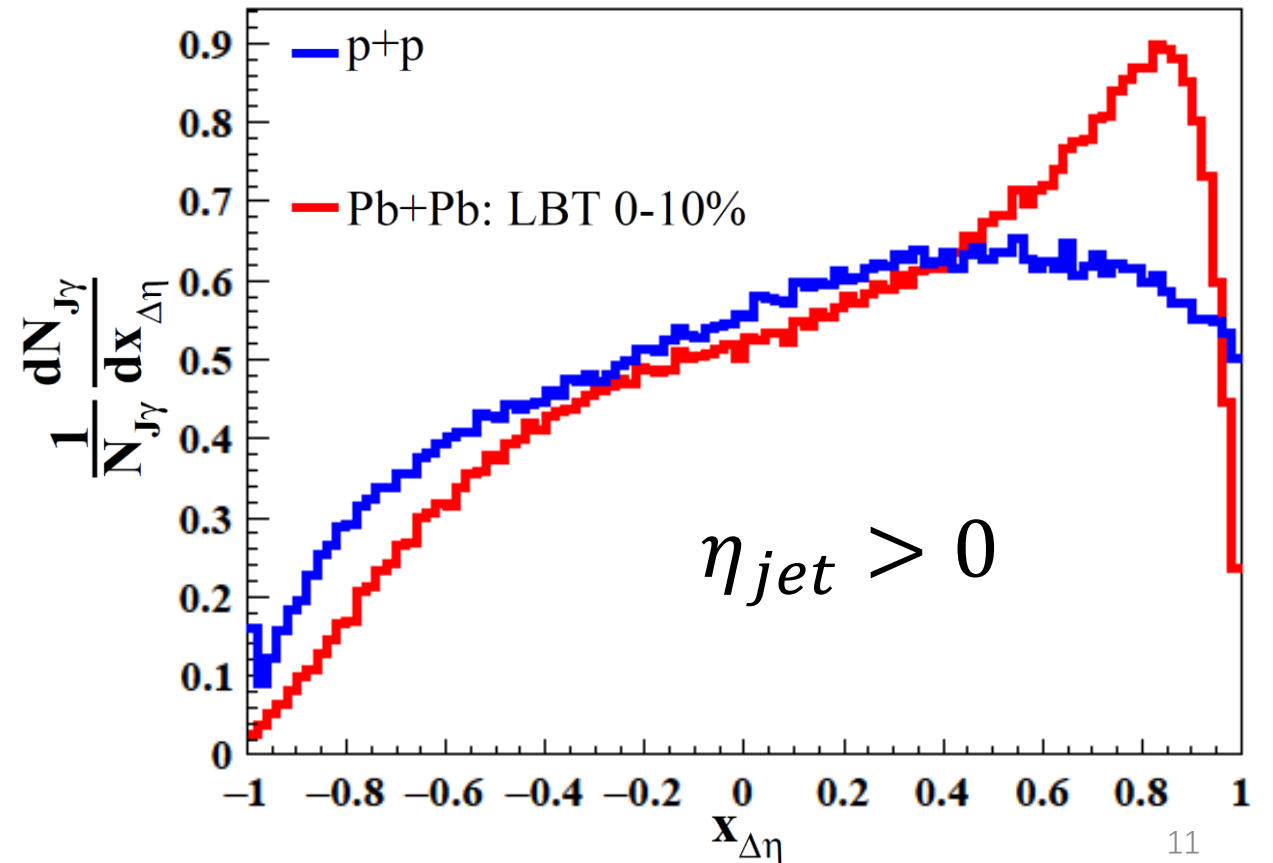
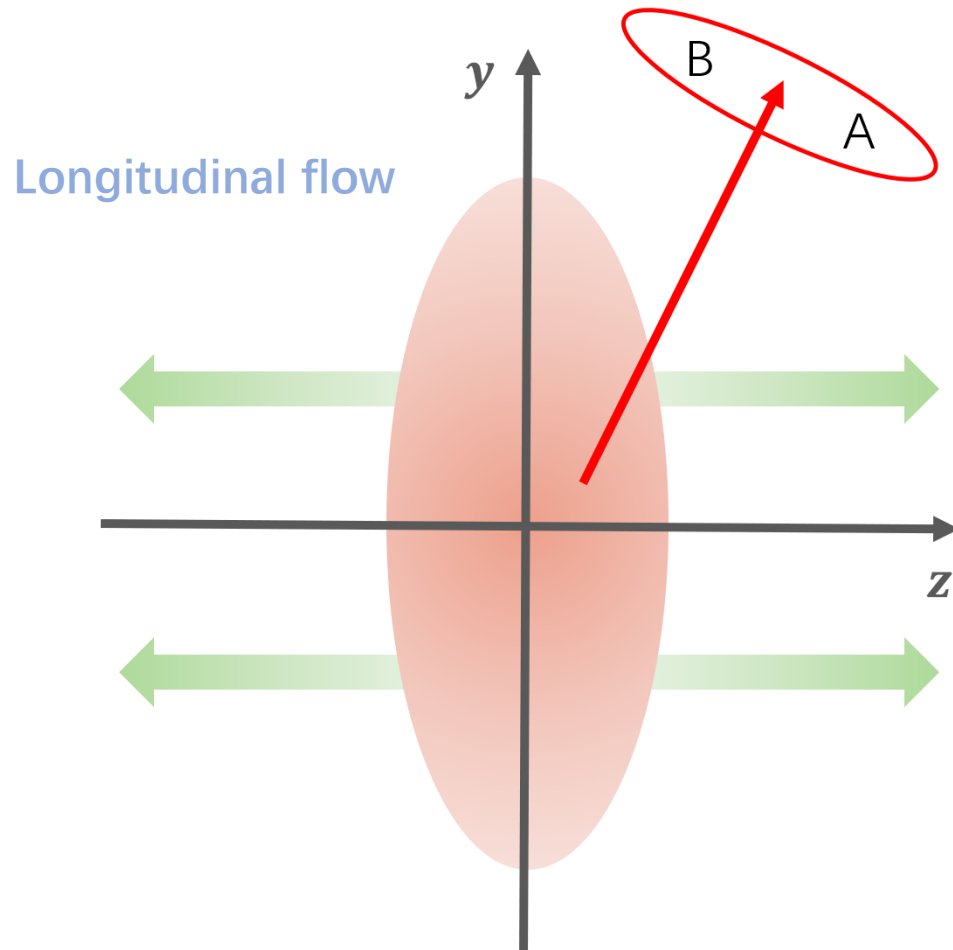
Intra-jet asymmetry increase in AA collisions (γ -jet)

- Jets propagating perpendicularly to the flow will suffer stronger distortion.
- In average, the path length of the jets with larger asymmetry will be slightly shorter compared to jets that are more symmetric.



Intra-jet asymmetry increase in AA collisions (γ -jet)

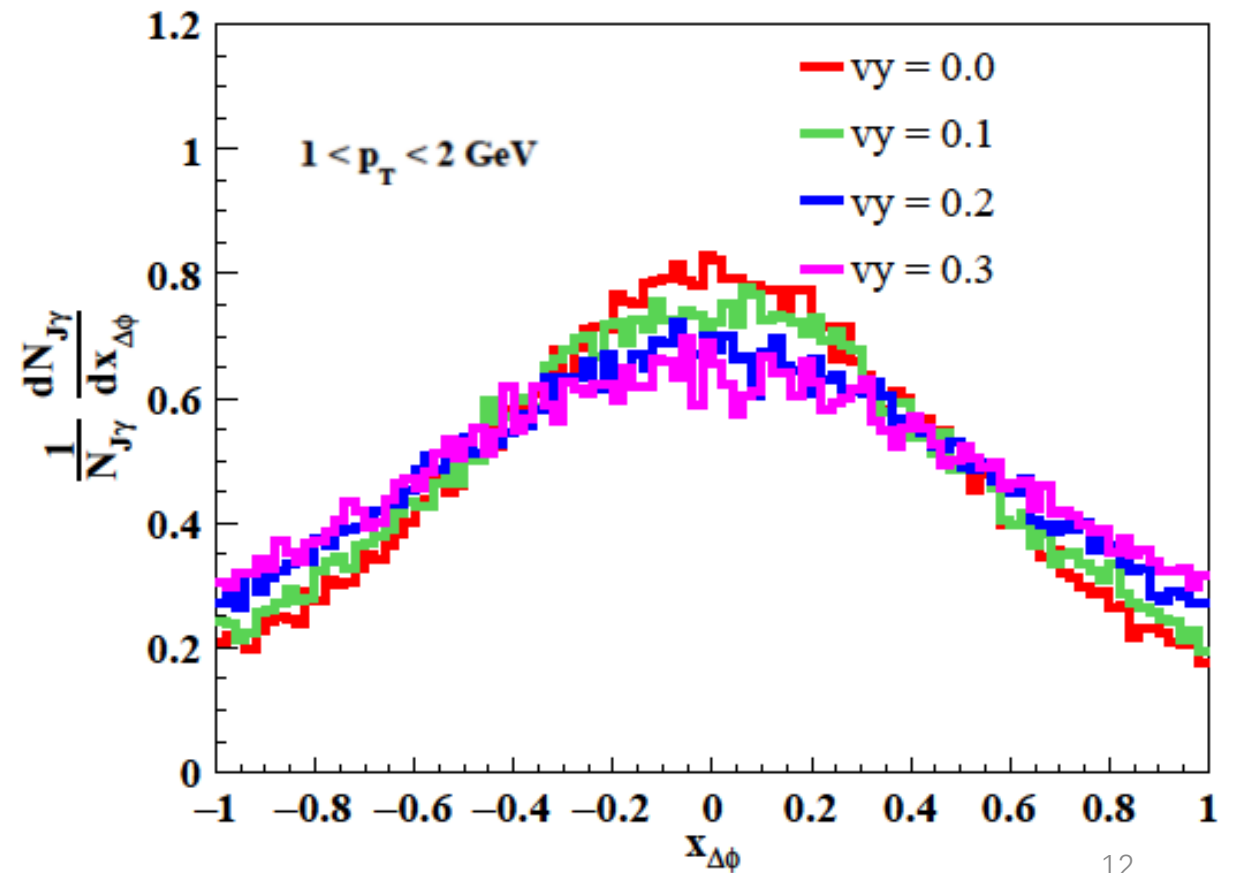
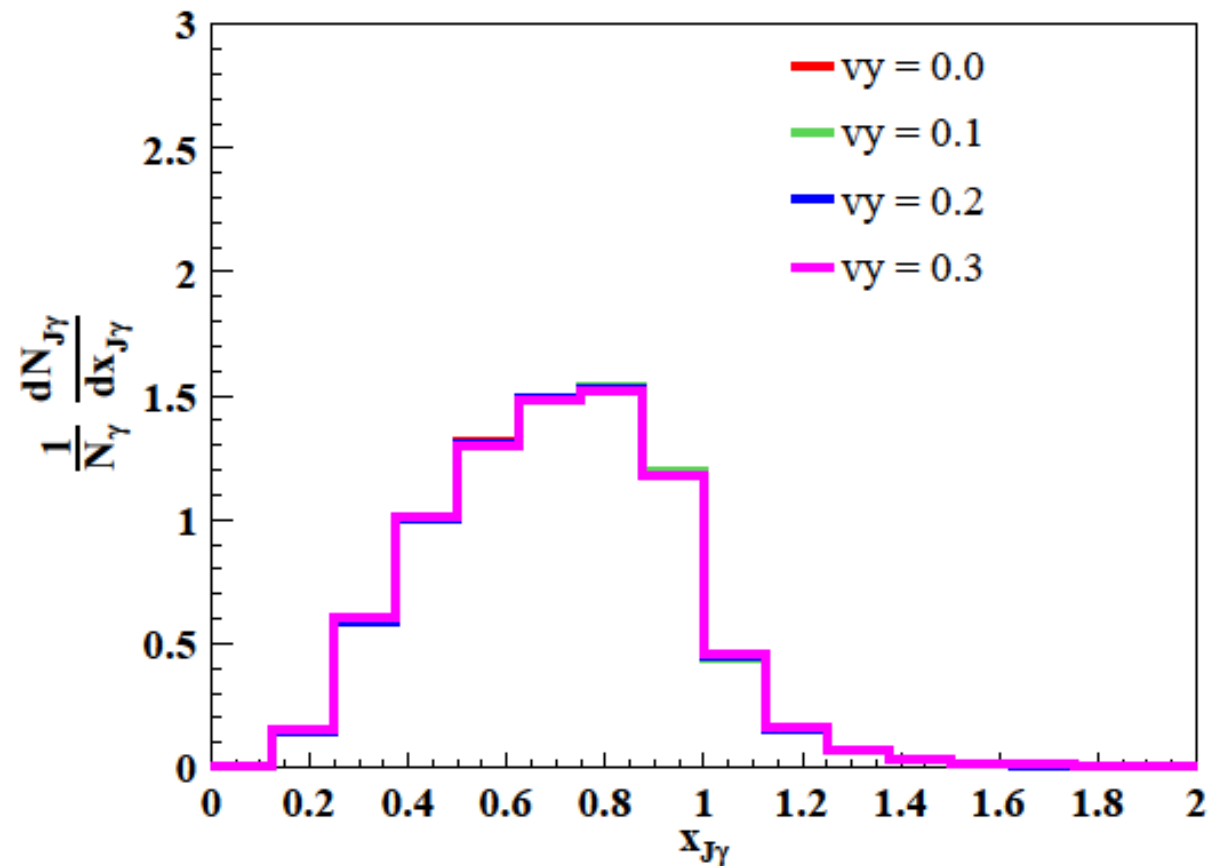
- Large longitudinal asymmetry in pp .
- The longitudinal flow will push the particles inside the jet to the large rapidity range.



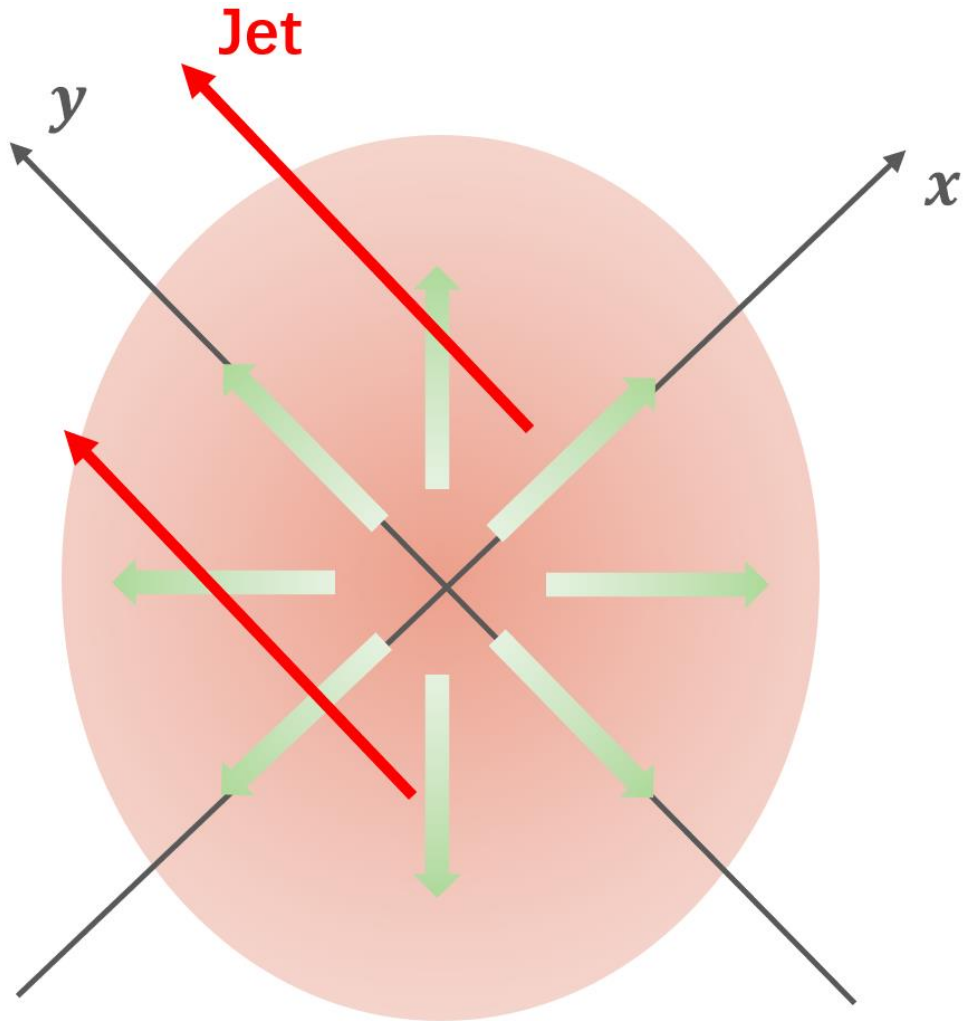
Intra-jet asymmetry & Jet-flow coupling (γ -jet)

Jet propagation in a uniform medium with different flow velocities

A clear broadening of the intra-jet asymmetry with the increasing flow velocities.

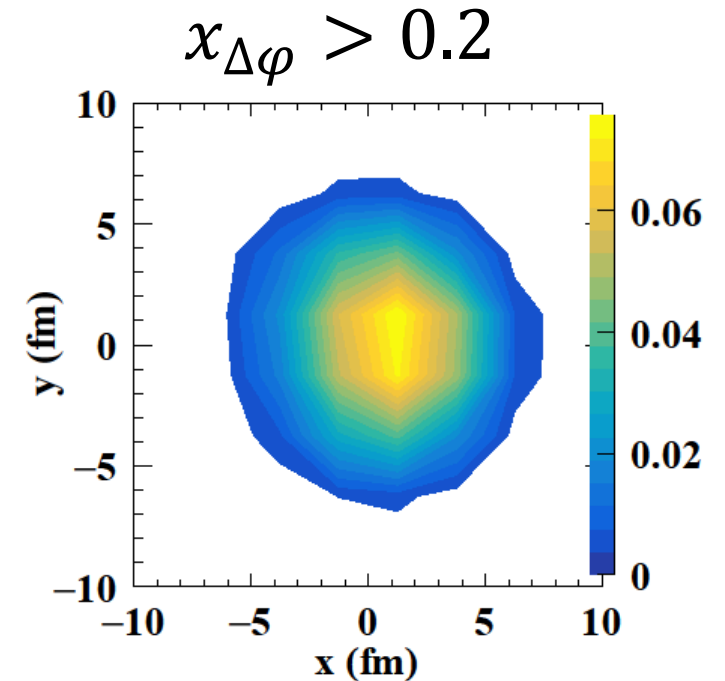
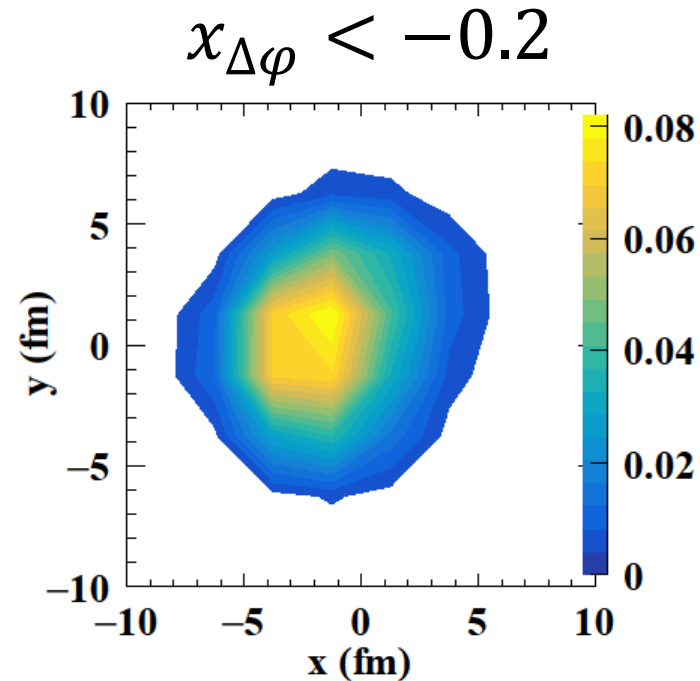


Jet localization (γ -jet)



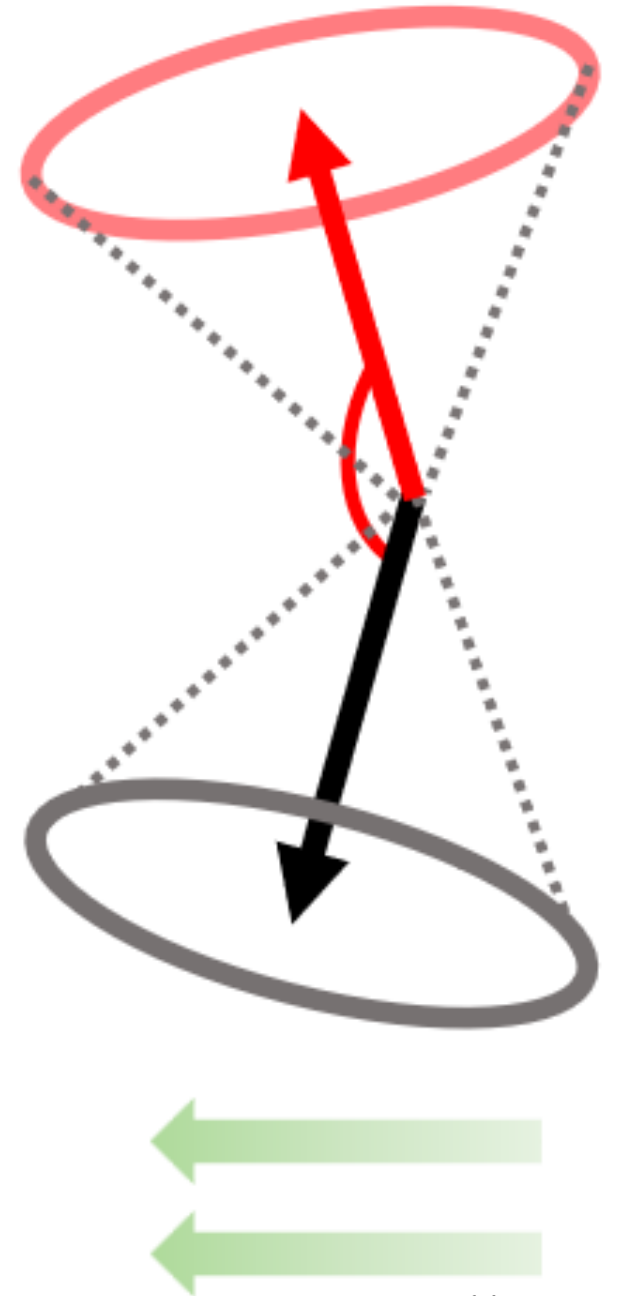
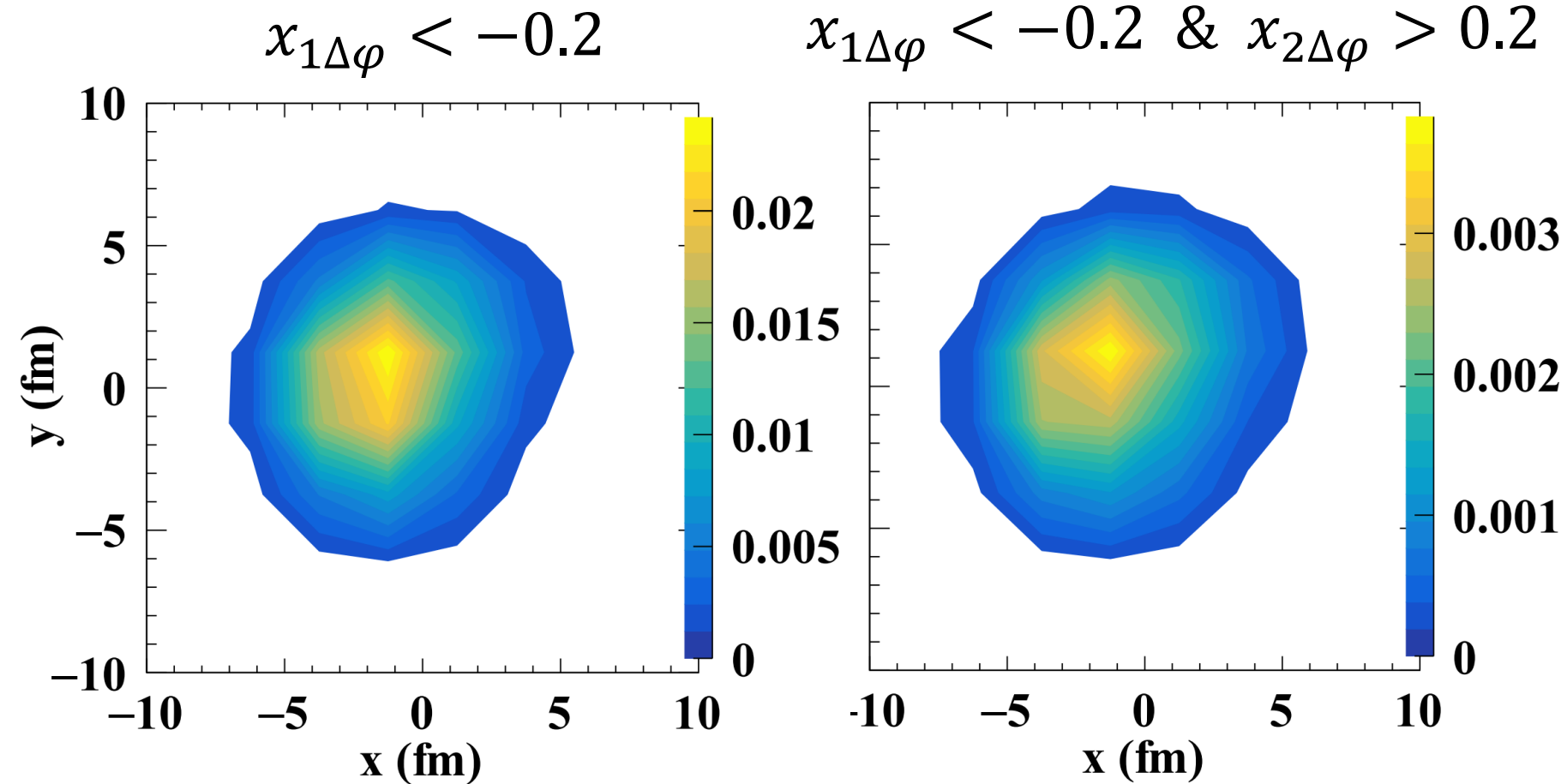
Since the relative angle between jet and the event plane is random, we can use the jet axis as the coordinate axis y in the transverse plane.

Better localization in multiple jets (Dijet) events?



Jet localization (Dijet)

More jets, more information, better localization.
(Interplay with the jet-induced diffusion wake)



Summary

- A new method to detect the effect of jet-flow coupling in heavy-ion collisions. Intra-jet asymmetry are observed at both the longitudinal and transverse direction.

Outlook

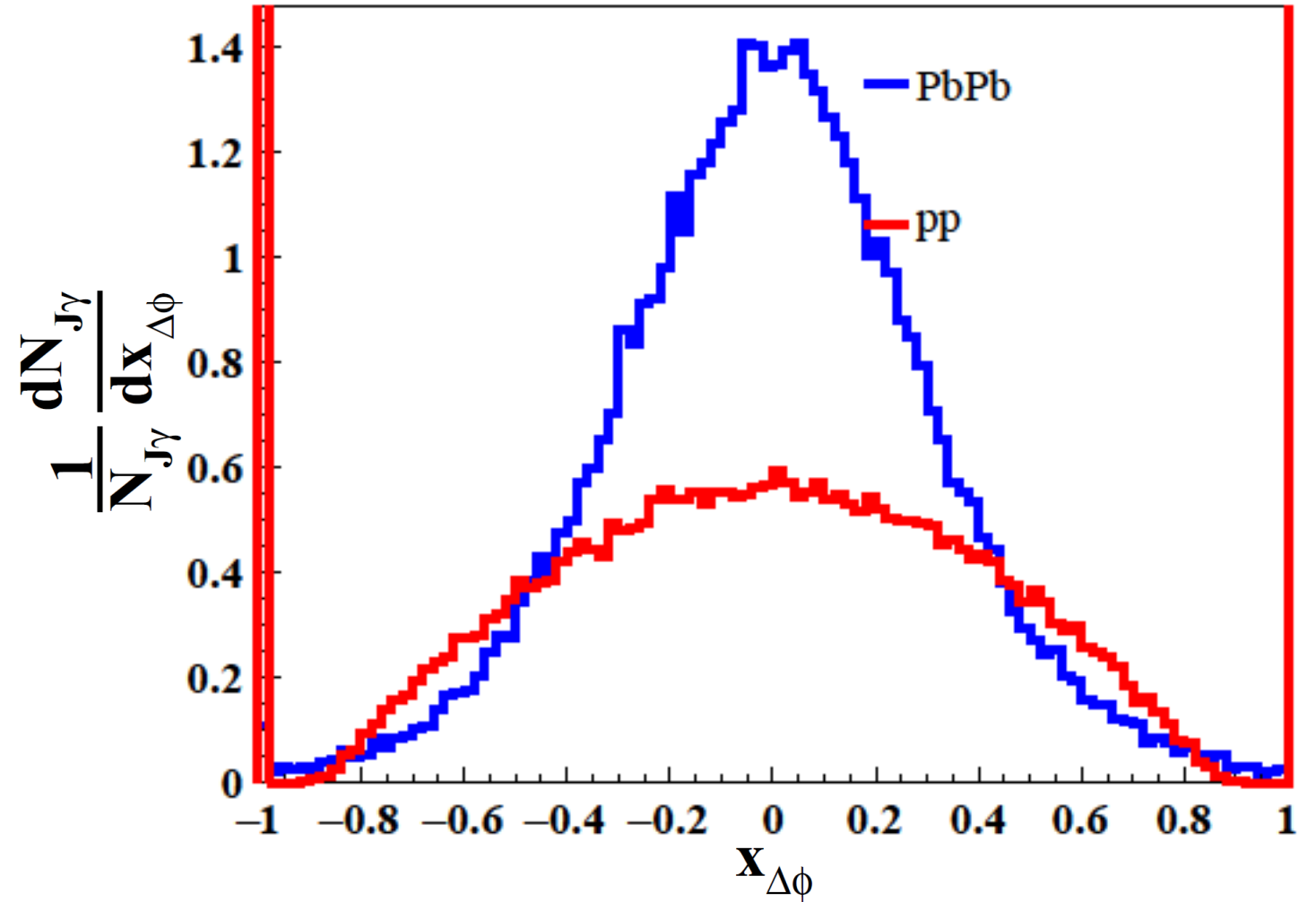
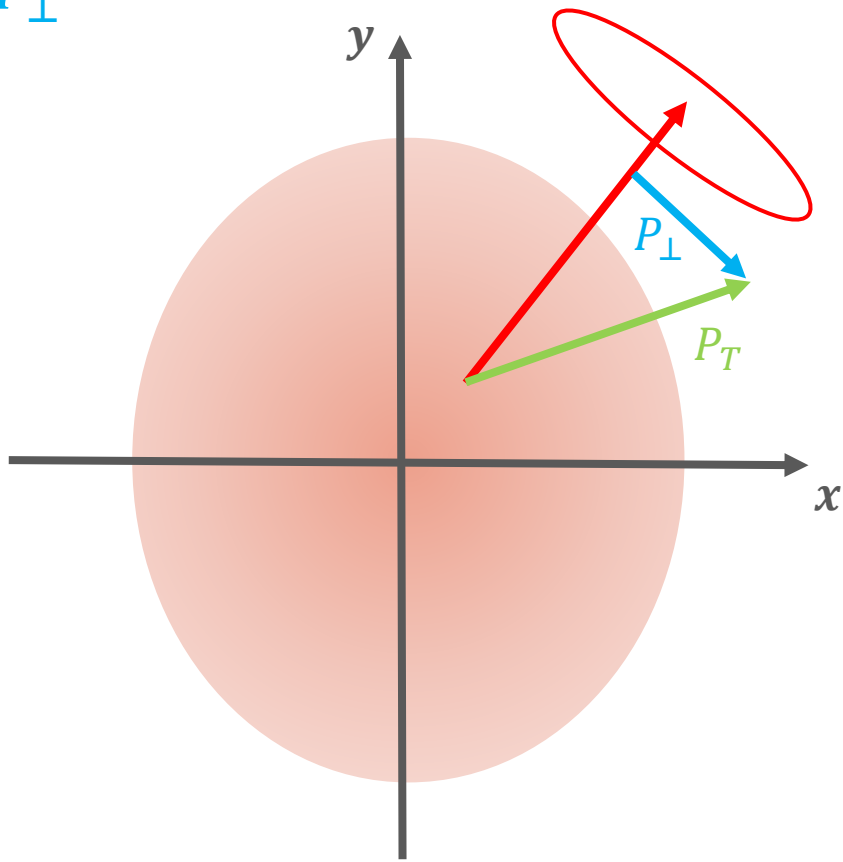
- Measuring flow with jets.
(Medium fluctuation, Hadron cascade, Medium-induced splitting)

Intra-jet asymmetry (γ -jet)

$$X = \frac{Q_A - Q_B}{Q_A + Q_B}$$

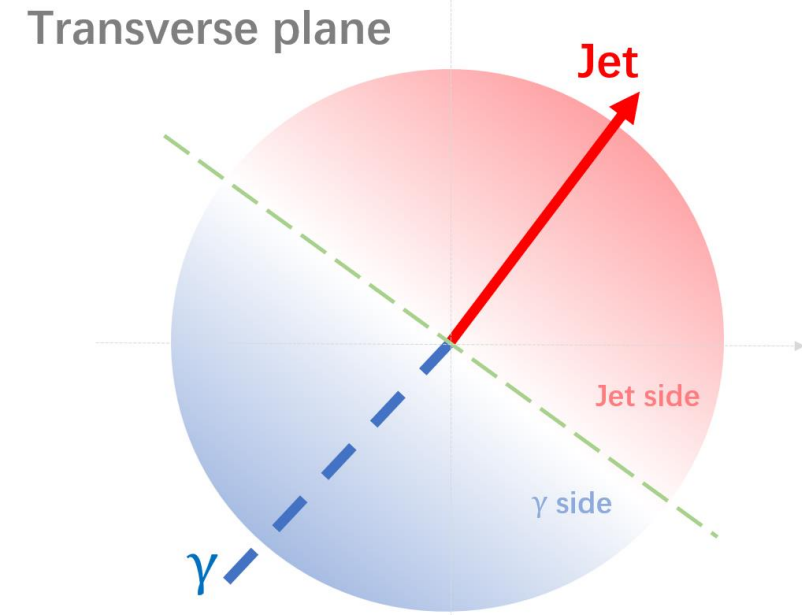
P_T : fluctuation!

P_\perp

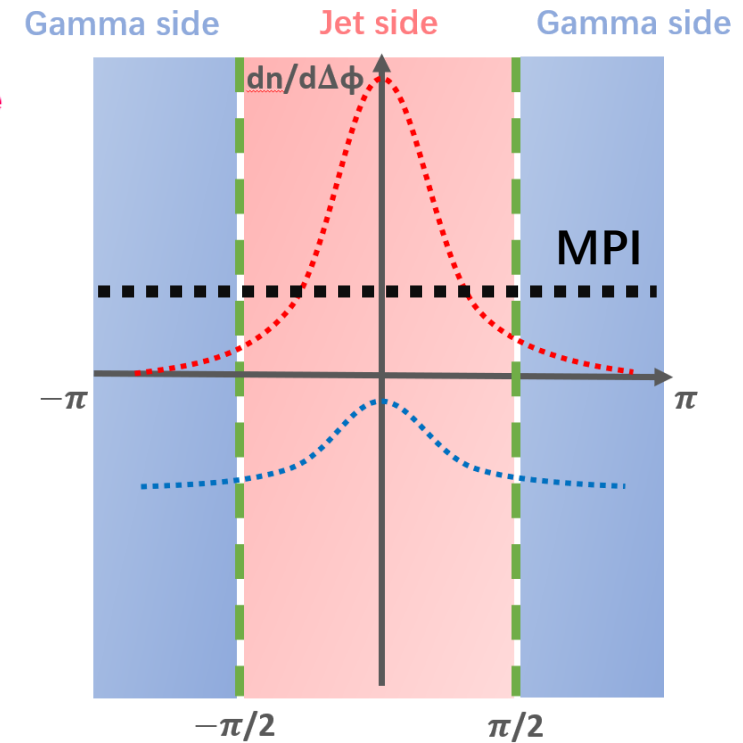
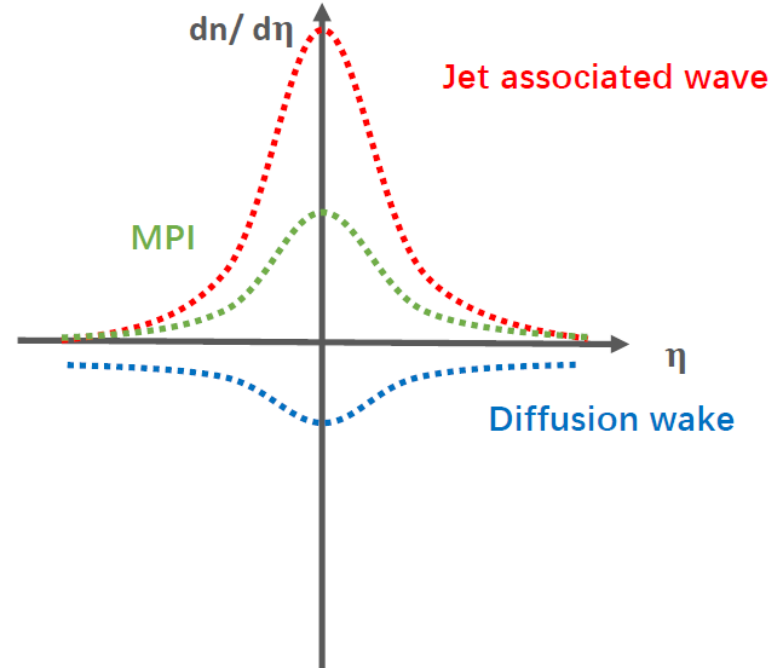
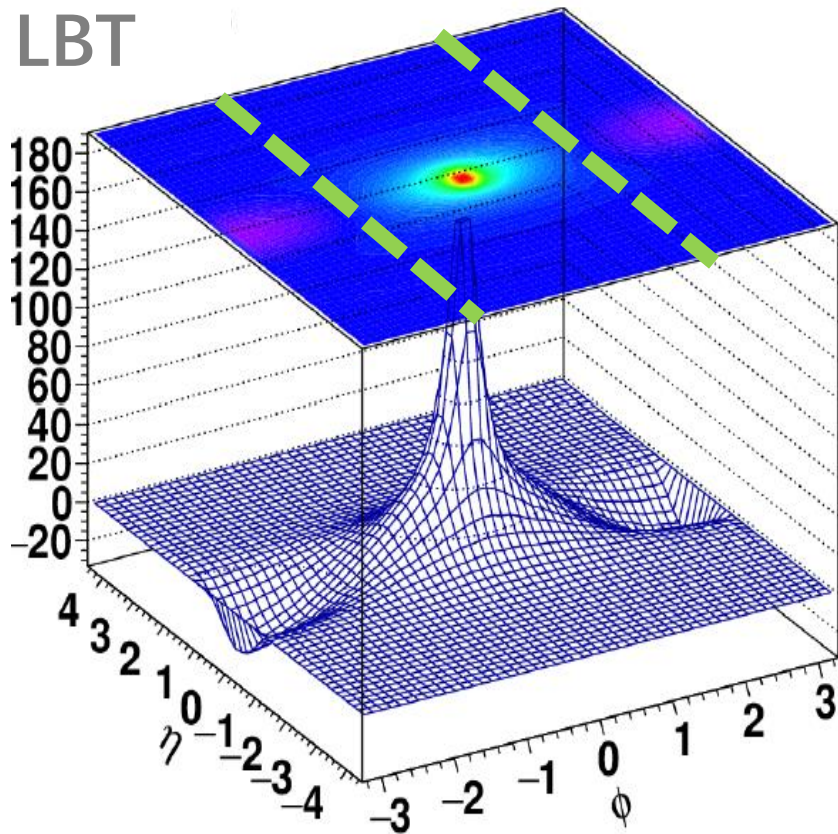


Separate the contribution of diffusion wake

- A phase space cut in the transverse plane. (Jet hemisphere & γ hemisphere)
- Diffusion wake show up in the γ hemisphere.



LBT



A Linear Boltzmann Transport (LBT) Model

Parton shower

Pythia Sherpa

Jet propagation

$$p_1 \square \partial f_1(x_1, p_1) = E_1 (C_{elastic} + C_{inelastic})$$

- Rescattering

Shower-thermal & recoil-thermal

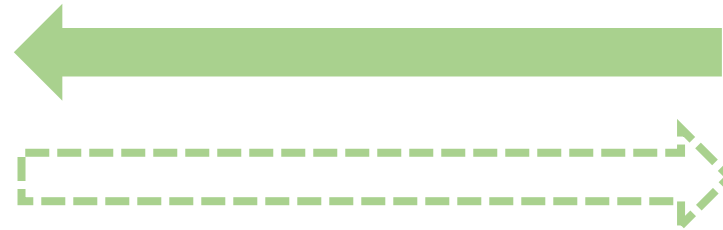
- Back reaction

Track the initial thermal parton

Fragmentation

Recombination

Local medium information $\epsilon T u$



Initial profile

AMPT TRENTO

Medium evolution

$$\partial_\mu T^{\mu\nu} = 0$$

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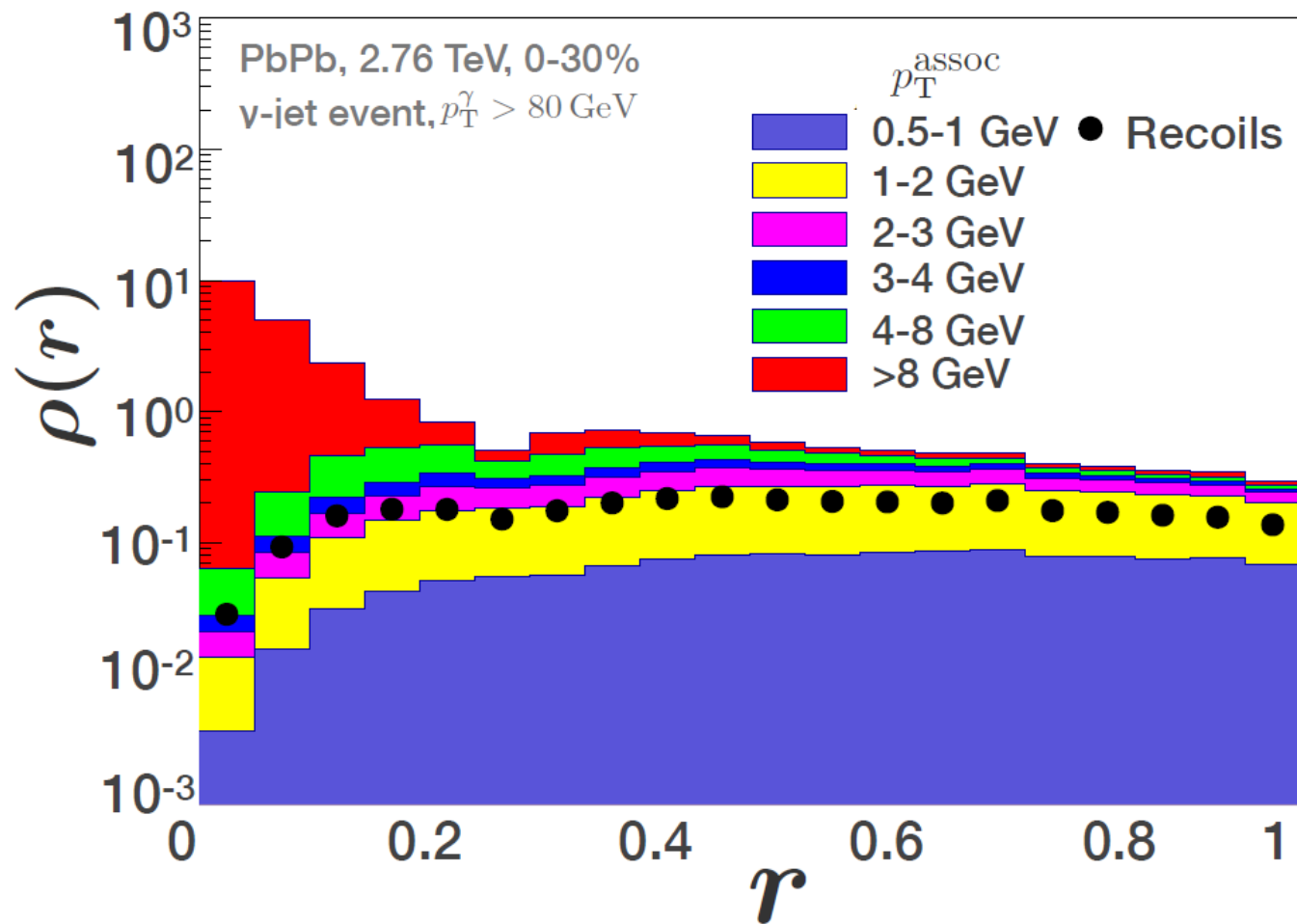
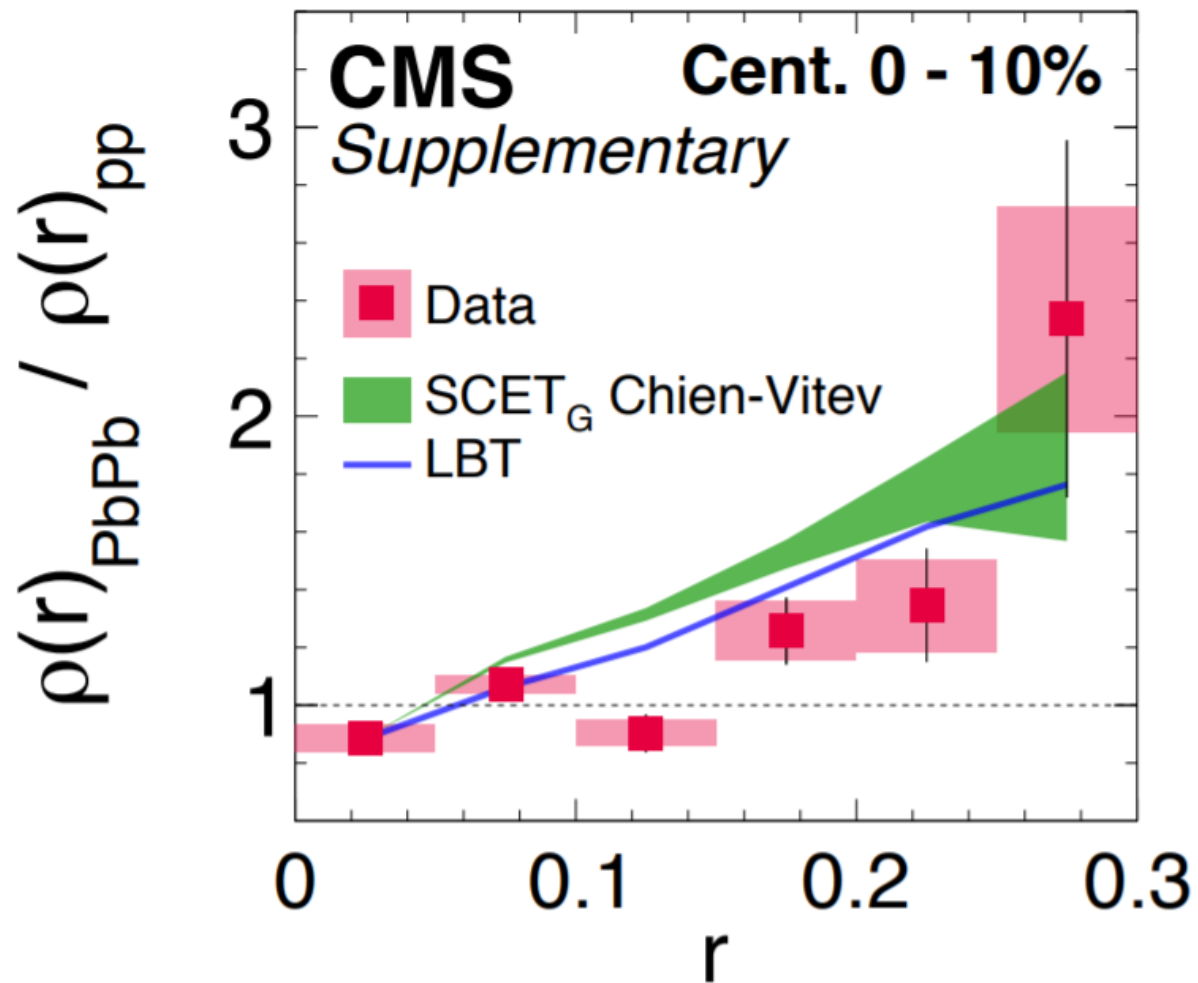
Cooper Frye

LBT
Hard

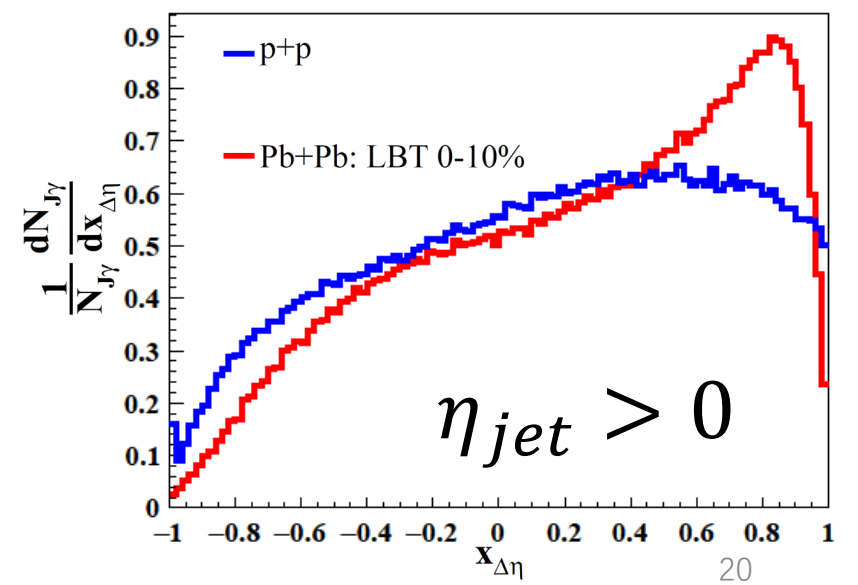
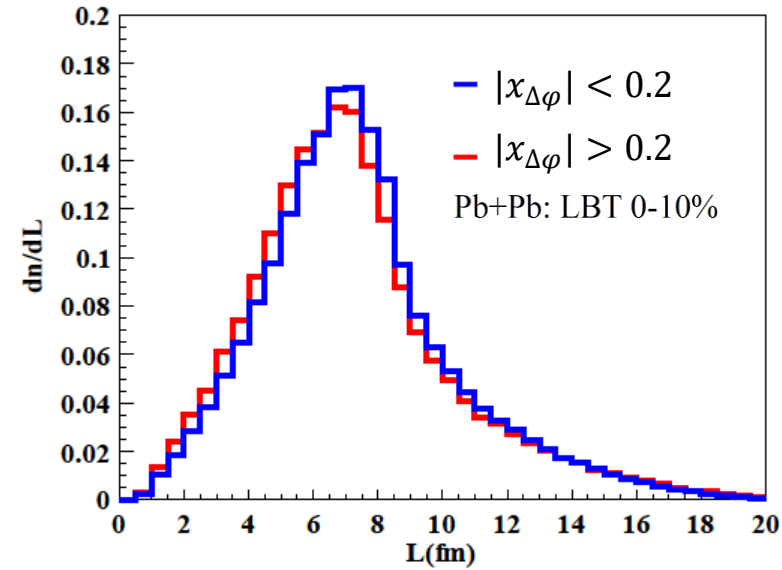
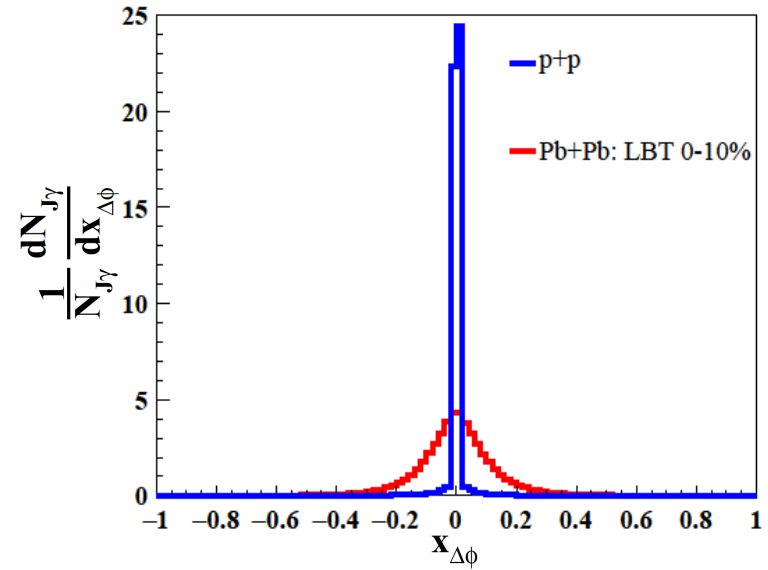
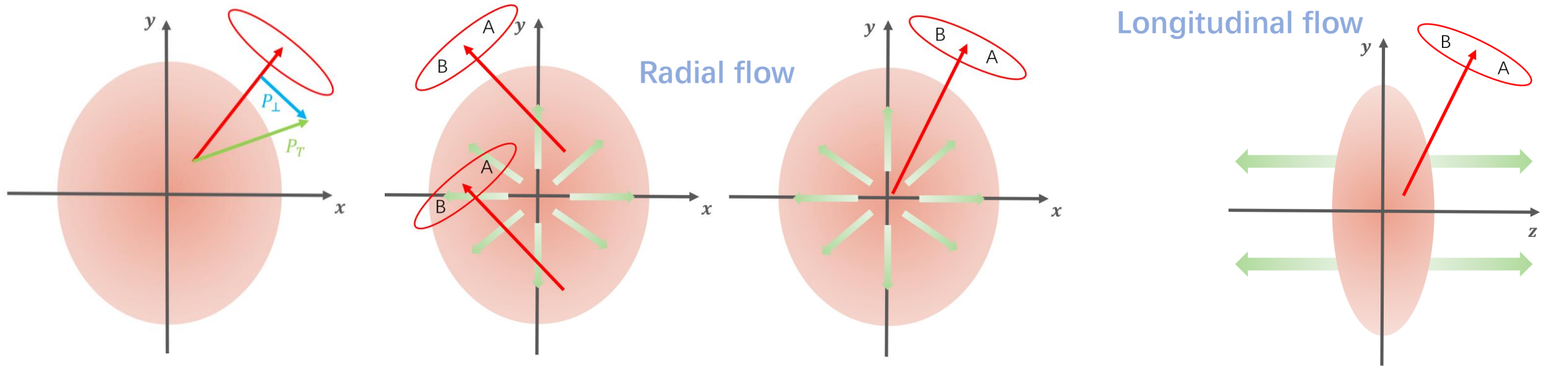
Hadronic observables

Jet shape within LBT model

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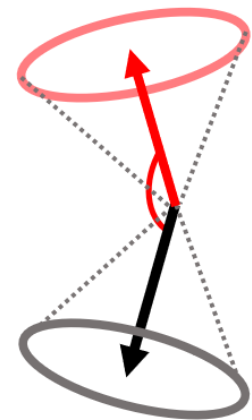


Intra-jet asymmetry increase in AA collisions



Jet localization (Dijet)

More jets, more information, better localization.
(Interplay with the jet-induced diffusion wake)



$$x_{1\Delta\varphi} < -0.2$$

$$x_{1\Delta\varphi} < -0.2$$

$$x_{2\Delta\varphi} > 0.2$$

$$x_{1\Delta\varphi} < -0.2$$

$$x_{2\Delta\varphi} < -0.2$$

