Interference effect between jet-induced flows in dijet events

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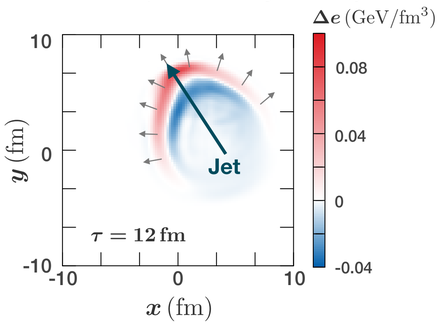
Introduction

- Jet-induced flow

Momentum transport away from jet

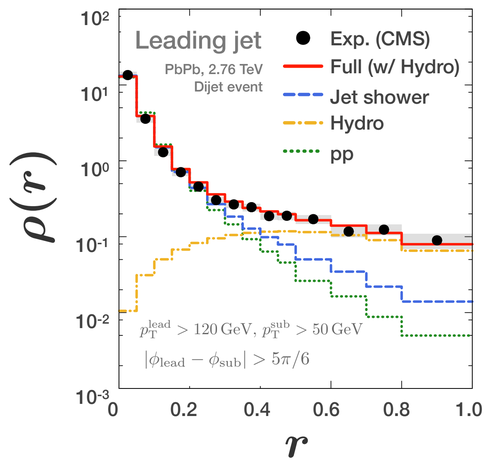


Enhancement at large-r in jet shape

However, in the previous study,

Only one jet propagating in the fluid in the simulations

YT, N.-B. Chang, G.-Y. Qin, PRC95, 044909 (2017)



- Effect of Jet-induced flow in Dijet events

Flow induced by subleading

Large expansion in QGP fluid due to long path length

→ Affect structure of leading jet

- Purpose of this study

Perform simulations with dijet propagating in QGP fluid at the same time

Study effects of jet-induced flow on structure of the opposite side jet

Coupled Jet-Fluid Model

- Jet shower evolution

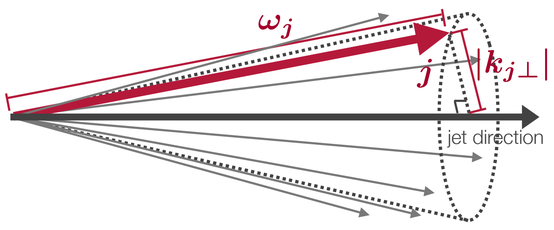
Transport equations for partons in jet shower

$$\frac{df_j(\omega_j,k_{j\perp}^2,t)}{dt} = \hat{e}_j\frac{\partial f_j(\omega_j,k_{j\perp}^2,t)}{\partial\omega_j} + \frac{1}{4}\hat{q}_j\nabla_{k_\perp}^2 f_j(\omega_j,k_{j\perp}^2,t) + \sum_i\int d\omega_i dk_{i\perp}^2\left[\frac{d\tilde{\Gamma}_{i\to j}(\omega_j,k_{j\perp}^2|\omega_i,k_{i\perp}^2)}{d\omega_j d^2k_{j\perp}dt}f_i(\omega_i,k_{i\perp}^2,t) - \frac{d\tilde{\Gamma}_{j\to i}(\omega_i,k_{i\perp}^2|\omega_j,k_{j\perp}^2)}{d\omega_i d^2k_{i\perp}dt}f_j(\omega_j,k_{j\perp}^2,t)\right]$$

collisional energy loss (longitudinal)

momentum broadening (transverse)

medium-induced radiation



$$\hat{e}_j = \frac{\hat{q}_j}{4T}$$

$$\frac{d\tilde{\Gamma}_{j\to i}(\omega_i,k_{i\perp}^2|\omega_j,0)}{d\omega_i dk_{i\perp}^2 dt} = \frac{2\alpha_s}{\pi}\frac{xP_{j\to i}(x)\hat{q}_j(t)}{\omega k_{i\perp}^4}\sin^2\left(\frac{t-t_0}{2\tau_f}\right)$$

($P_{j\to i}(x=\omega_j/\omega_i)$: vacuum splitting function)

Initial jet profiles are generated by PYTHIA

- Space-time evolution of QGP fluid with jet propagation

Hydrodynamic equations with source term

$$\partial_\mu T^{\mu\nu}(x) = J^\nu(x)$$

Energy-momentum tensor of the QGP fluid

Energy and momentum deposited from the jet

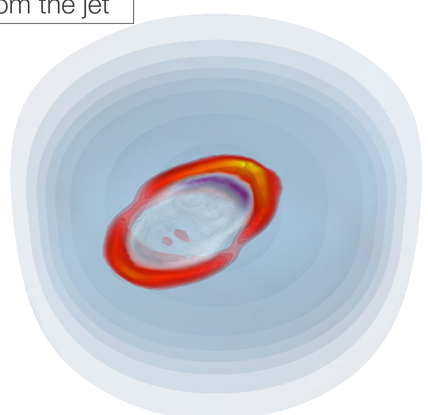
- Source term for dijet

$$J^\nu = \sum_{a=1,2} J_a^\nu = -\sum_{a=1,2}\sum_j \frac{d\omega_j dk_{j\perp}^2 d\phi_j}{2\pi}\left.\frac{df_j(\omega_j,k_{j\perp}^2,t)}{dt}\right|_{\text{col.}}\delta^{(3)}(\boldsymbol{x}-\boldsymbol{x}^{\text{jet}}(\boldsymbol{k}_j,t))$$

momentum transfer between medium and jet

$$\left.\frac{df_j(\omega_j,k_{j\perp}^2)}{dt}\right|_{\hat{e},\hat{q}} = \left(\hat{e}_j\frac{\partial}{\partial\omega_j} + \frac{1}{4}\hat{q}_j\nabla_{k_\perp}^2\right)f_j(\omega_j,k_{j\perp}^2,t)$$

$$\boldsymbol{x}_j(k,t) = \boldsymbol{x}_0^{\text{jet}} + \frac{\boldsymbol{k}_j}{\omega_j}t$$



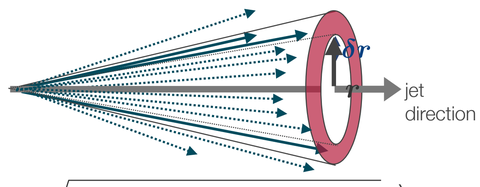
Assumption

Instantaneous local thermalization of deposited energy and momentum

Results

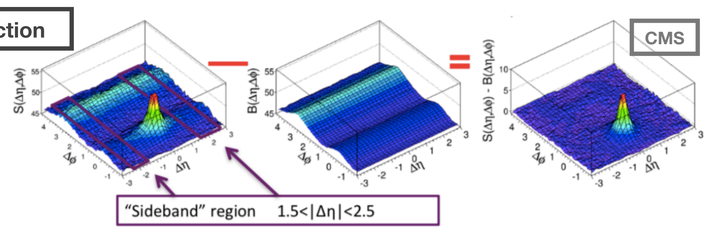
- Jet shape

$$\rho(r) = \frac{1}{N_{\text{jet}}}\sum_{\text{jet}}\left[\frac{1}{p_{\text{T}}^{\text{jet}}}\frac{\sum_{\text{asso}\in(r-\delta r/2,r+\delta r/2)}p_{\text{T}}^{\text{asso}}}{\delta r}\right]$$

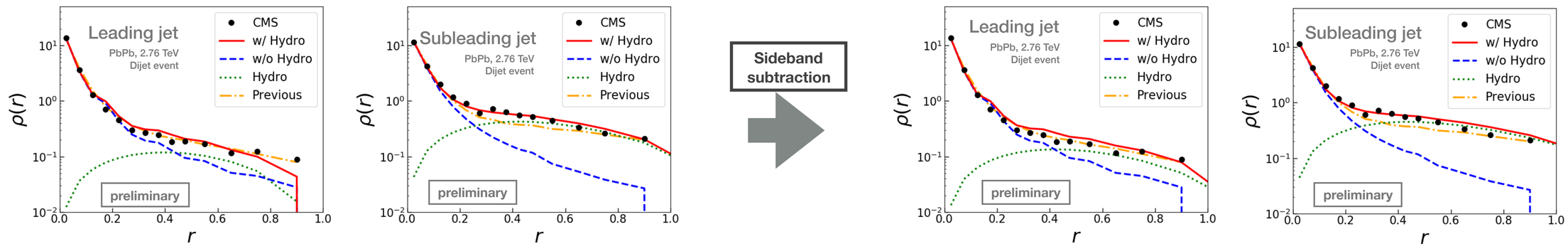


$$\left(r = \sqrt{(\eta_p-\eta_{\text{jet}})^2 + (\phi_p-\phi_{\text{jet}})^2}\right) \qquad A_{\text{J}} = \frac{p_{\text{T}}^{\text{lead}} - p_{\text{T}}^{\text{sub}}}{p_{\text{T}}^{\text{lead}} + p_{\text{T}}^{\text{sub}}}$$

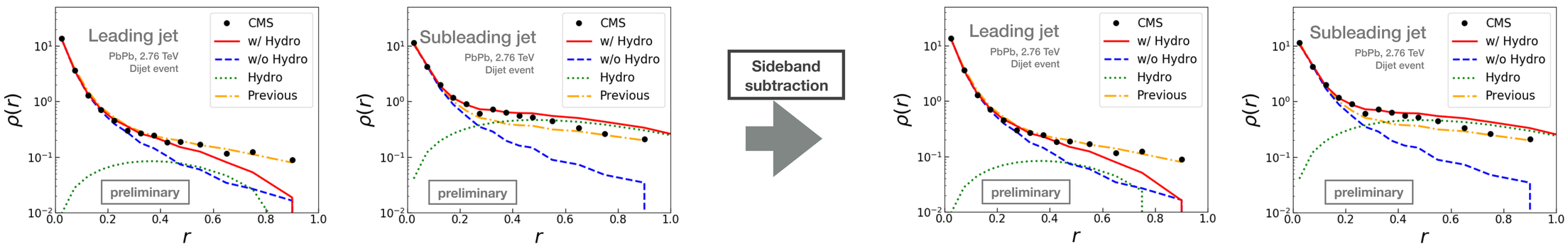
Sideband subtraction



a) Inclusive $A_{\text{J}}, |\eta_{\text{lead}} - \eta_{\text{sub}}|$



b) Selected events: $A_{\text{J}} > 0.22, |\eta_{\text{lead}} - \eta_{\text{sub}}| < 0.2$ *CMS data , results from previous study are for inclusive case



Decrease of hydro contribution in leading jet caused by flow induced by subleading jet

Effect of flow induced by subleading jet still can be seen for $A_{\text{J}} > 0.22, |\eta_{\text{lead}} - \eta_{\text{sub}}| < 0.2$

Summary

Effect from flow induced by subleading jet can be seen in large angle region of leading jet

The effect is strong when the dijet asymmetry is large and rapidity difference between jets is small

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