Modification of Jets through the Medium

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η-reflection method

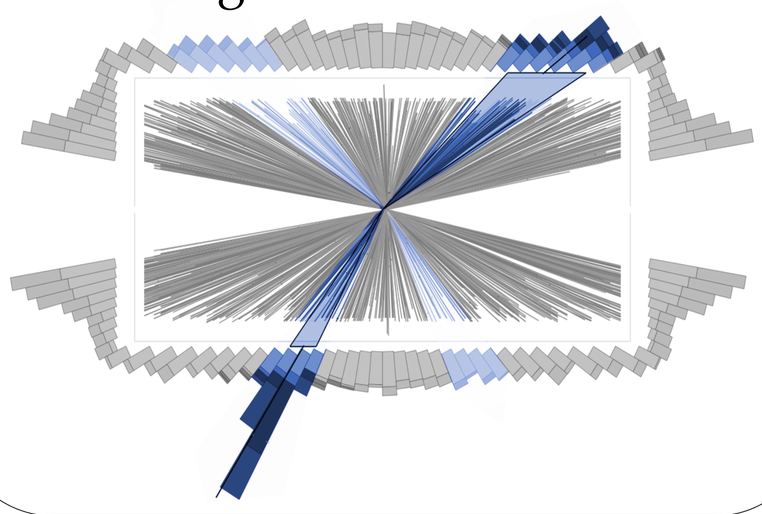
For each jet the underlying event contribution is determined by:

1. Reflecting the cone of the jet with respect to $\eta = 0$,
2. Assuming that the composition of this cone is similar to background in the jet cone,
3. Treating it as a jet and subtracting its value from the contribution coming from the jet cone.

Jets are quenched

Partons passing through strongly interacting medium lose energy. Several mechanisms are proposed such as radiative energy loss, collisional energy loss...

Background subtraction



Definition

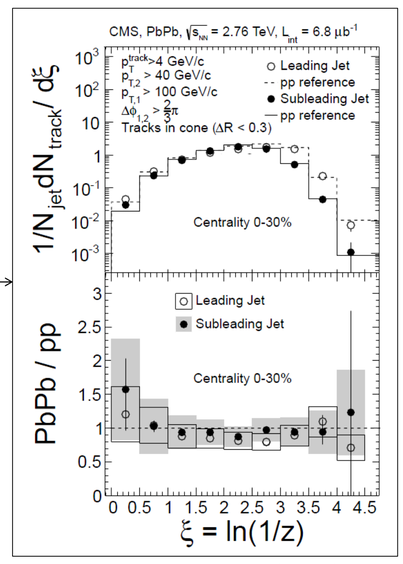
Number of charged particles in a jet which carries a given fraction of its energy.

Observation

Before: There was no significant modification. [1]
Now: There is an increase at $\xi \geq 4$, and a decrease at $1.5 \leq \xi < 3$. [2]

Fragmentation Functions

$$\xi = \ln\frac{1}{z}\ ;\ \ z = \frac{p_{\parallel}^{\text{track}}}{p^{\text{jet}}}$$



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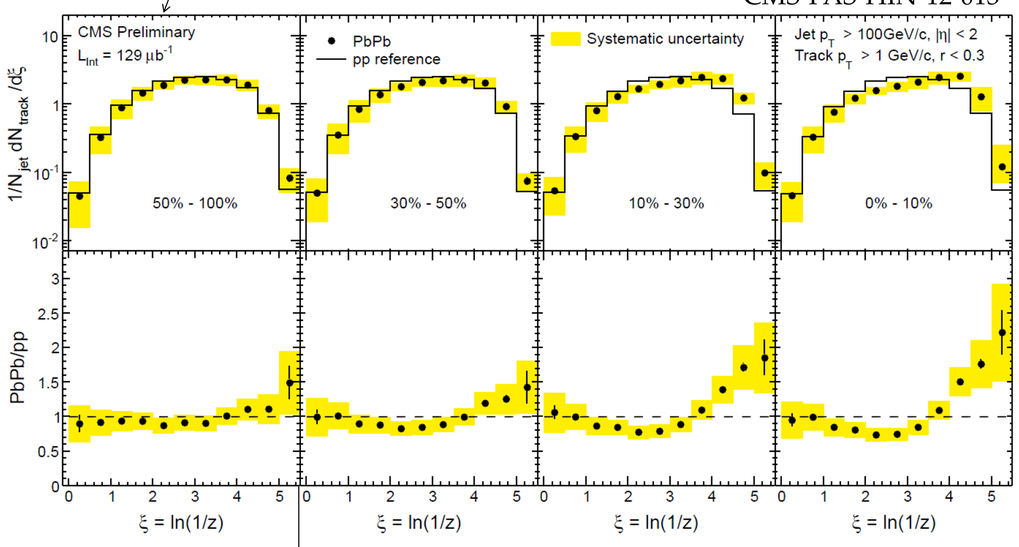

Jet Shapes

$$\rho(r) = \frac{1}{f_{\text{ch}}}\frac{1}{\delta r}\frac{1}{N_{\text{jet}}}\sum_{\text{jets}}\frac{p_{\text{T}}(r-\delta r/2, r+\delta r/2)}{p_{\text{T}}^{\text{jet}}},$$

$$f_{\text{ch}} = \frac{1}{N_{\text{jet}}}\sum_{\text{jets}}\frac{p_{\text{T}}(0,R)}{p_{\text{T}}^{\text{jet}}}$$

How to observe the effect of the medium

Comparision with pp collisions:
With/without medium,
Comparision between central/peripheral events:
Thicker/thinner medium,
Comparison between leading/subleading jet:
Shorter/Longer path length in the medium.

Definition

Fraction of transverse momentum of jet inside an annulus at distance r from jet axis and with width δr.

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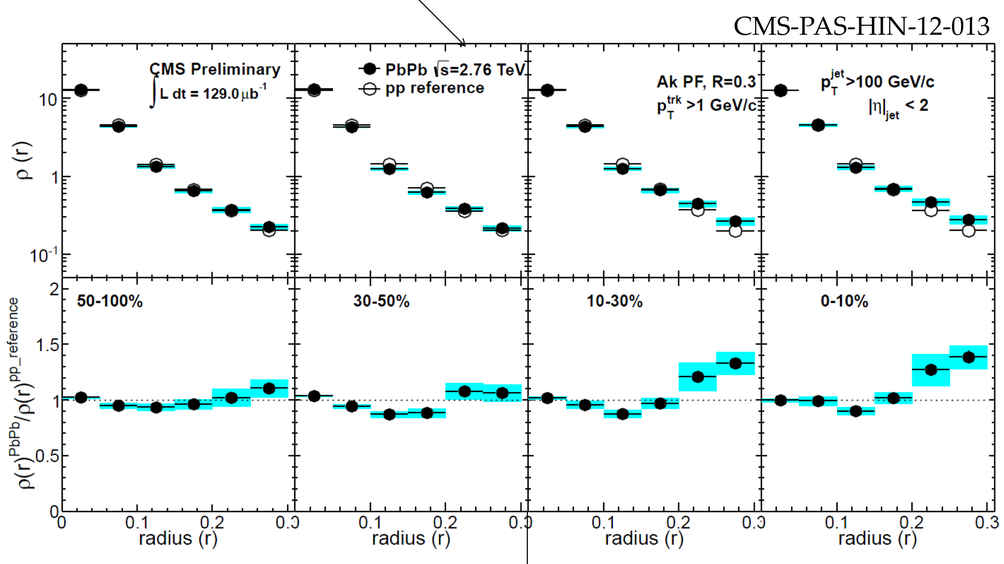

Observation

More energy deposition at large radius compared to proton collisions and the trend gets stronger at more central events. [2]

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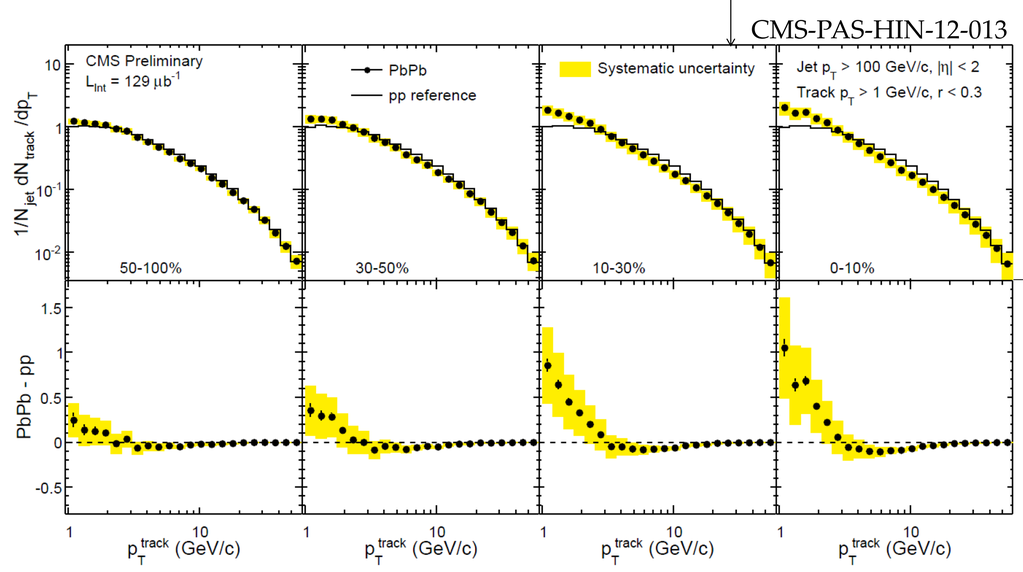
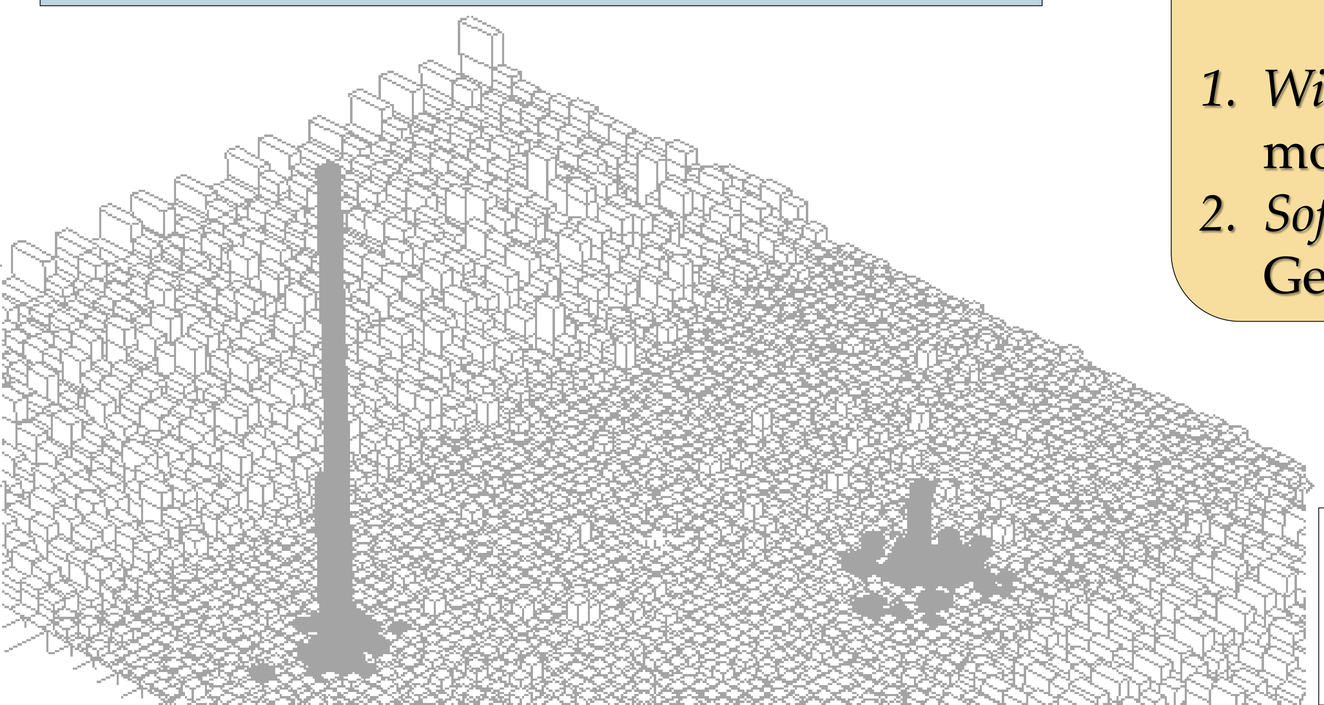


Observation

The enhancement of softer component of jets is due to an increase in the charged hadrons with $p_T < 3$ GeV.

Depletion of particles with 4 GeV< p_T <10 GeV. [2]



As jets pass through the medium they get

1. *Wider*: Increase in the fraction of transverse momentum deposited at r > 0.2
2. *Softer*: Increase in softer component of jets below 3 GeV/c.

References

[1] S. Chatrchyan et al. (CMS Collaboration), "***Measurement of jet fragmentation into charged particles in pp and PbPb collisions at 2.76 TeV***" JHEP 10 (2012) 087 arxiv.1102.1957
[2] S. Chatrchyan et al. (CMS Collaboration), "***Detailed Characterization of Jets in Heavy Ion Collisions Using Jet Shapes and Jet Fragmentation Functions***" CMS-PAS-HIN-12-013