Fragmentation Patterns of Jets in pPb collisions in CMS

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Motivation

A measurement of the jet fragmentation function in 2.76 TeV PbPb events observed a significant excess of low p_T tracks relative to the pp fragmentation function. This was generally interpreted as a jet quenching effect, but in principle could also be due to some cold nuclear matter effect. Studying the jet fragmentation function in pPb events, where energy densities are much lower, allows us to probe for the presence of these cold nuclear matter effects. A study of the jet fragmentation function also helps elucidate our understand of the production mechanisms for high p_T particles.

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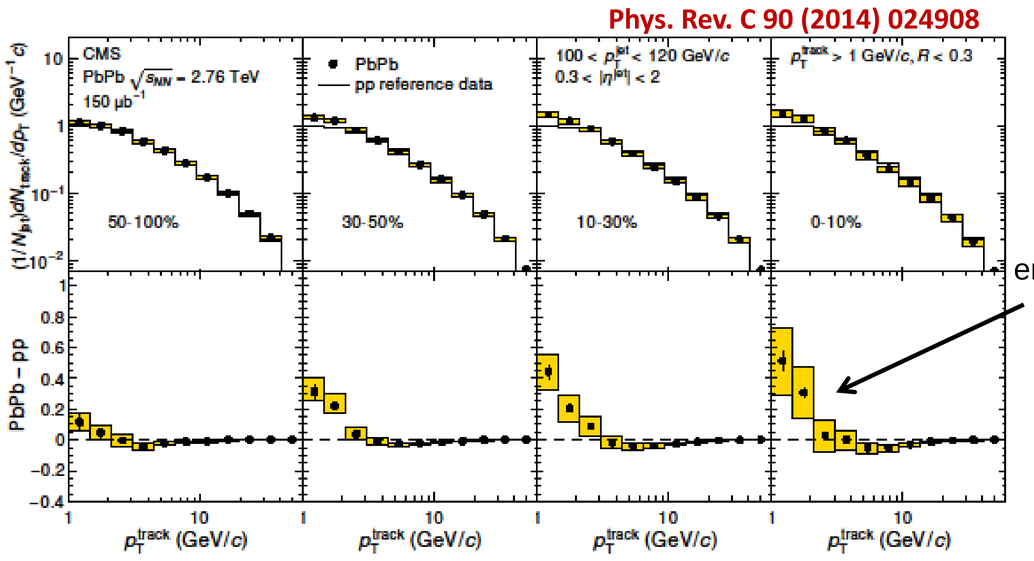
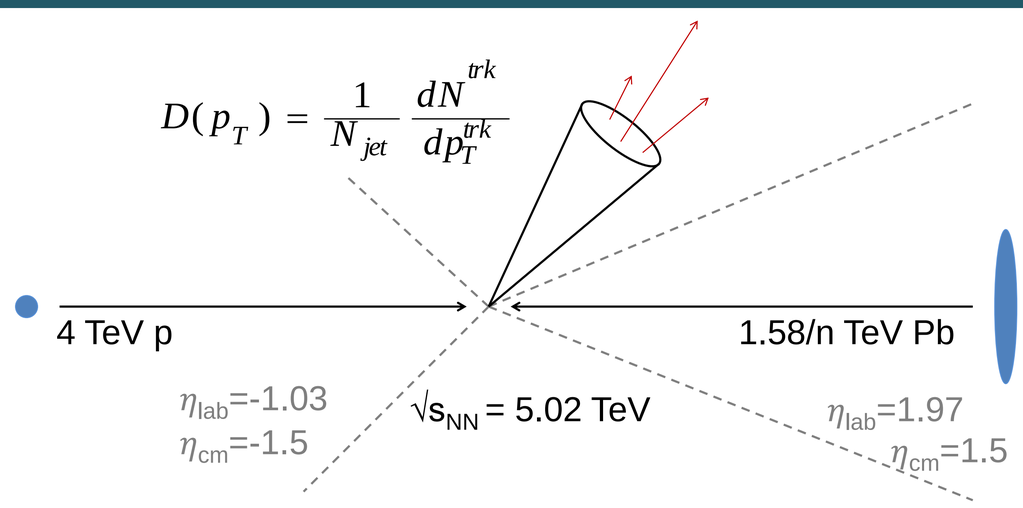


Large enhancement at low p_T.

Jet Fragmentation Function

$$D(p_T) = \frac{1}{N_{jet}} \frac{dN^{trk}}{dp_T^{trk}}$$



- Select anti-k_t (R=0.3) particle flow jets having $|\eta_{cm}|$<1.5, bin by jet p_T
- p_T spectrum of charged particles in a radius of ΔR=0.3 of the jet axis
- Normalized by number of jets – no luminosity uncertainties!
- Slightly different than the parton fragmentation function because measurement is made relative to reconstructed jet p_T

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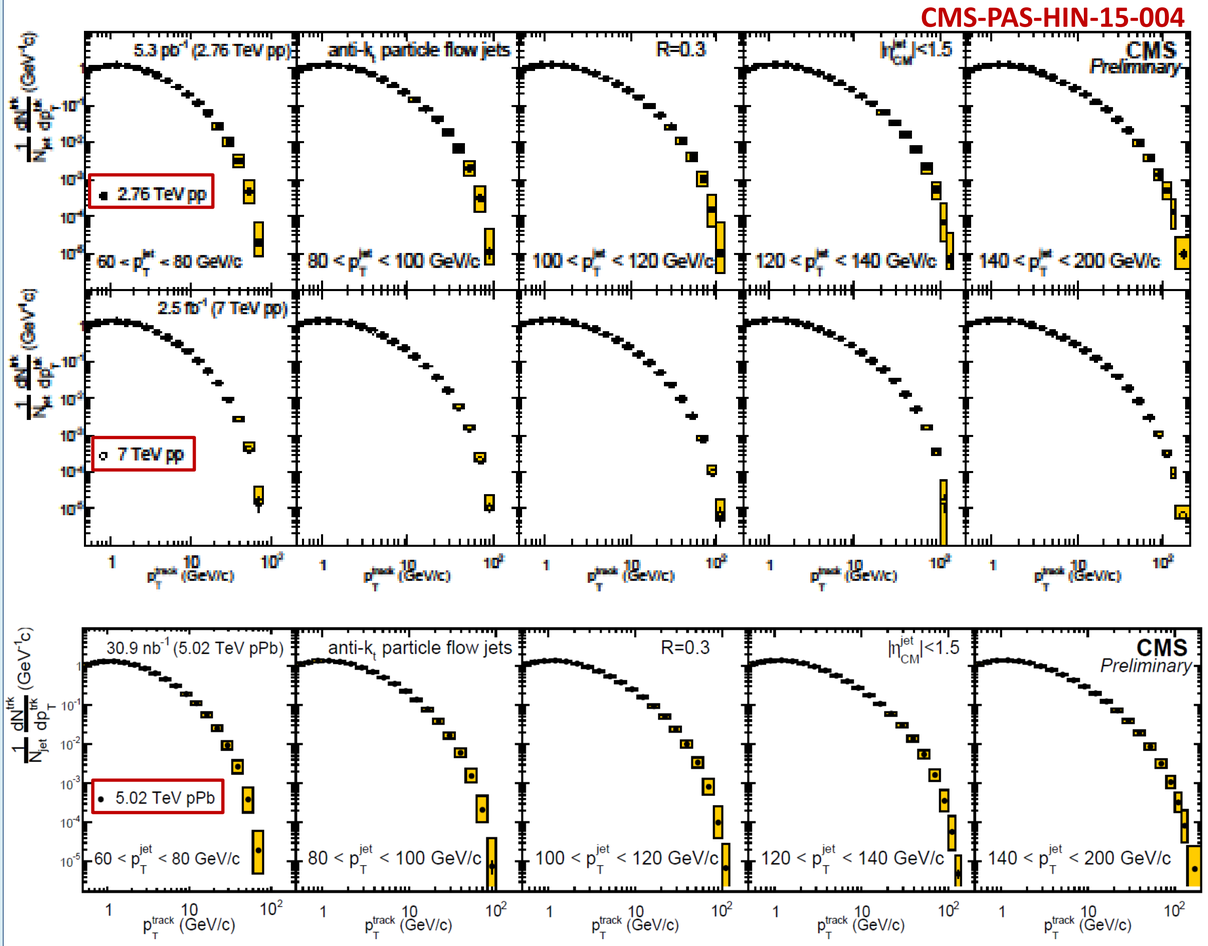
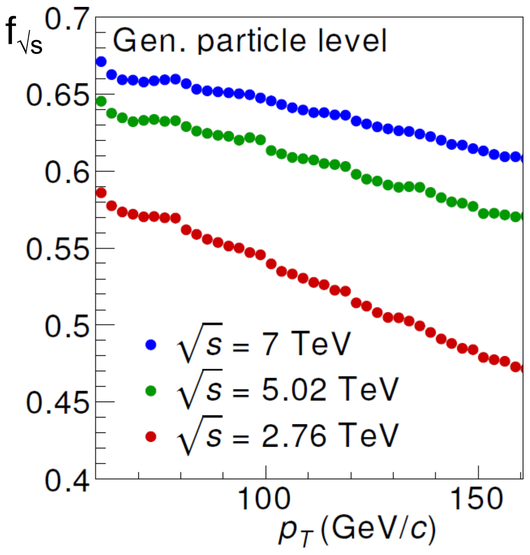


Interpolated 5.02 TeV pp Reference

No 5.02 TeV pp data existed at the end of Run 1, so a reference needed to be constructed from existing 2.76 and 7 TeV pp data.

Using QCD factorization as motivation, we can write the fragmentation function, $\mathbf{D_{\sqrt{s}}}$, as a linear combination of the gluon and light quark jet fragmentation functions, $\mathbf{D_g}$ and $\mathbf{D_q}$, with the coefficients generated by sampling (n)pdfs with a Monte Carlo generator.



$$D_{\sqrt{s}} = f_{\sqrt{s}} D_g + (1 - f_{\sqrt{s}}) D_q$$

$f_{\sqrt{s}}$: MC fraction of gluon jets at √s

$(1 - f_{\sqrt{s}})$: MC fraction of light quark jets at √s

Rewrite the 2.76 and 7 TeV data, D_2 and D_7

$$D_2 = f_2 D_g + (1 - f_2) D_q \qquad D_7 = f_7 D_g + (1 - f_7) D_q$$

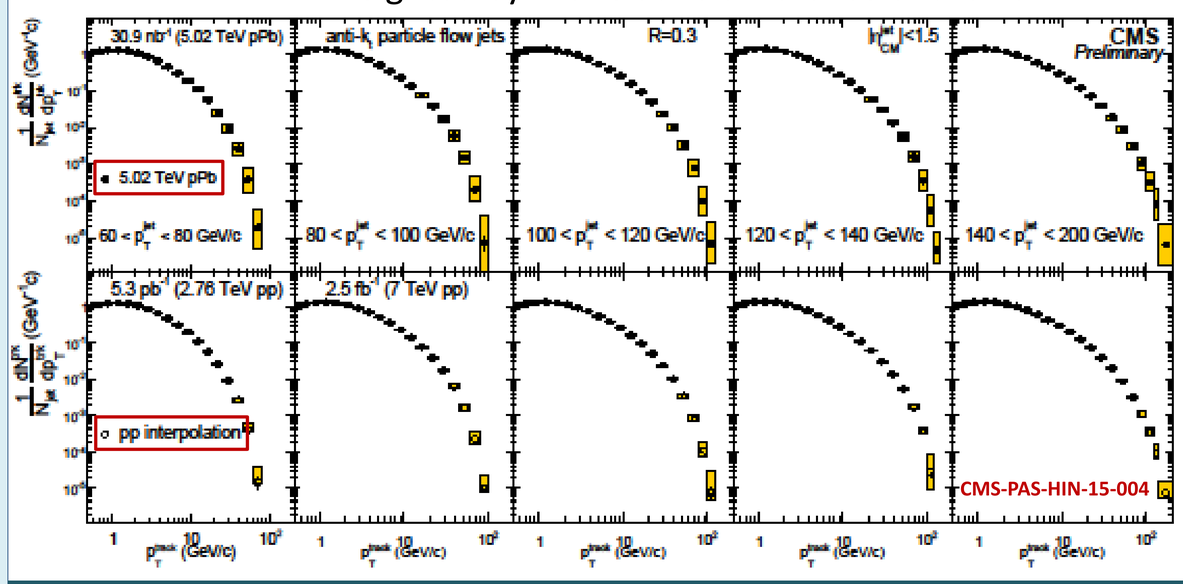
Solve for q/g fragmentation functions

$$D_g = \frac{(1 - f_7) D_2 - (1 - f_2) D_7}{f_2 - f_7} \qquad D_q = \frac{f_2 D_7 + f_7 D_2}{f_2 - f_7}$$

Reassemble into a reference using 5.02 TeV q/g fractions

$$D_5 = f_5 D_g + (1 - f_5) D_q = \frac{(f_7 - f_5) D_2 + (f_5 - f_2) D_7}{f_7 - f_2}$$

The interpolated reference is an average of the 2.76 and 7 TeV data, weighted by the relative difference of the f's



Fragmentation Function Ratio

Taking the ratio of the pPb jet fragmentation function with an interpolated pp reference at the allows interpretation of **same center of mass energy** allows interpretation of any effects due to the presence of the lead ion.

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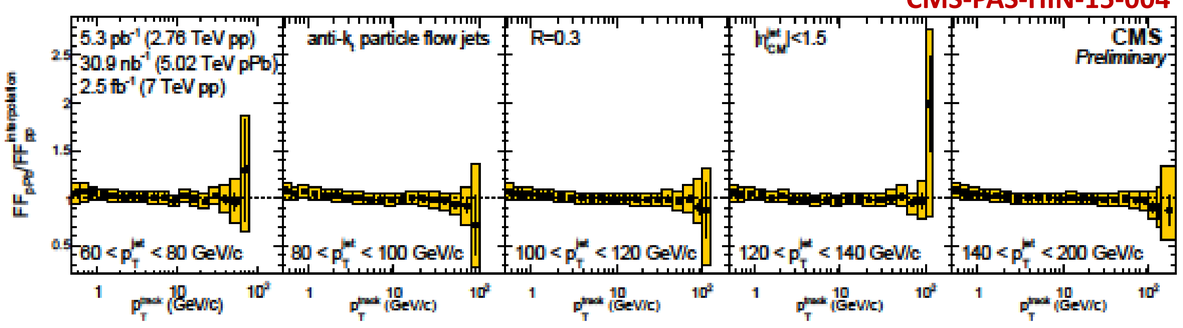

The fragmentation function in pPb is consistent with a jet-flavor based pp interpolation.

Implies that the observed PbPb jet fragmentation function modification is not a cold nuclear matter effect, but due to the presence of a hot, dense medium.

- *Preliminary*: *Jet Fragmentation Function in pPb Collisions at sqrt(sNN) = 5.02 TeV and pp Collisions at sqrt(s) = 2.76 and 7 TeV*, https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsHIN15004