Empirical Characteristics of Light and Heavy Flavor Parton Energy Loss Dynamics at the LHC and RHIC

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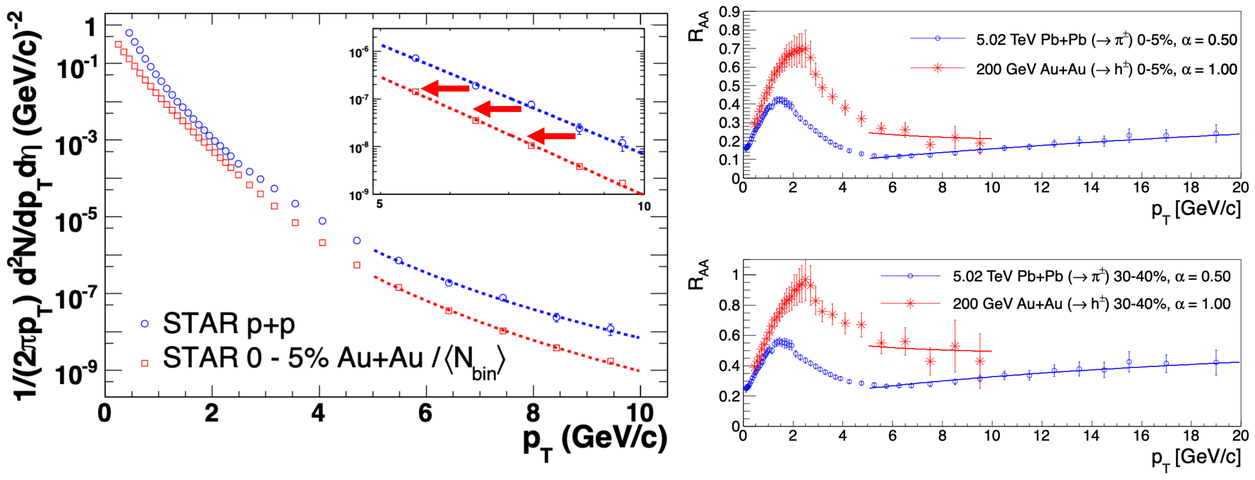
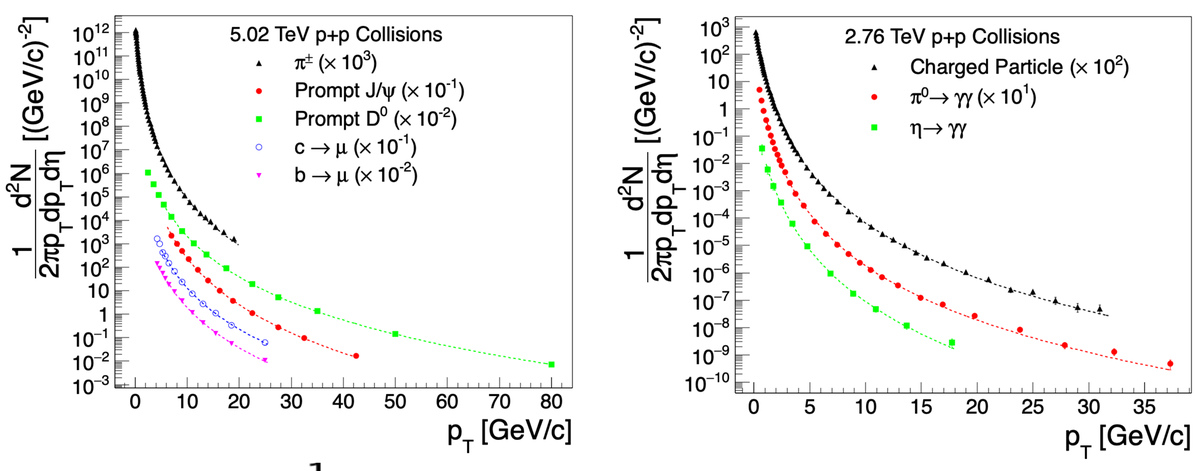
Motivation [1], [2], [3]



- Previous treatment of R_{AA} as a p_T spectrum horizontal shift from p+p to A+A (left) agreed with constant R_{AA} behavior above ~ 5 GeV/c found at RHIC
- LHC high-p_T R_{AA} data instead has a rising trend, wanted to investigate this difference using the same methodology

Invariant p_T Spectrum Fits [2],[4],[5],[6],[7],[8]



$$\frac{1}{2\pi p_T} d^2N/dp_T d\eta = A(1 + p_T/p_0)^{-n}$$

$$R_{AA}(p_T) = \frac{(1 + p'_T/p_0)^{-n} p'_T}{(1 + p_T/p_0)^{-n} p_T} \left[1 + \frac{dS(p_T)}{dp_T}\right] \qquad p'_T = p_T + S(p_T)$$

$$S(p_T) = S_0 p_T \longrightarrow S(p_T) = S_0 p_T{}^{\alpha}$$

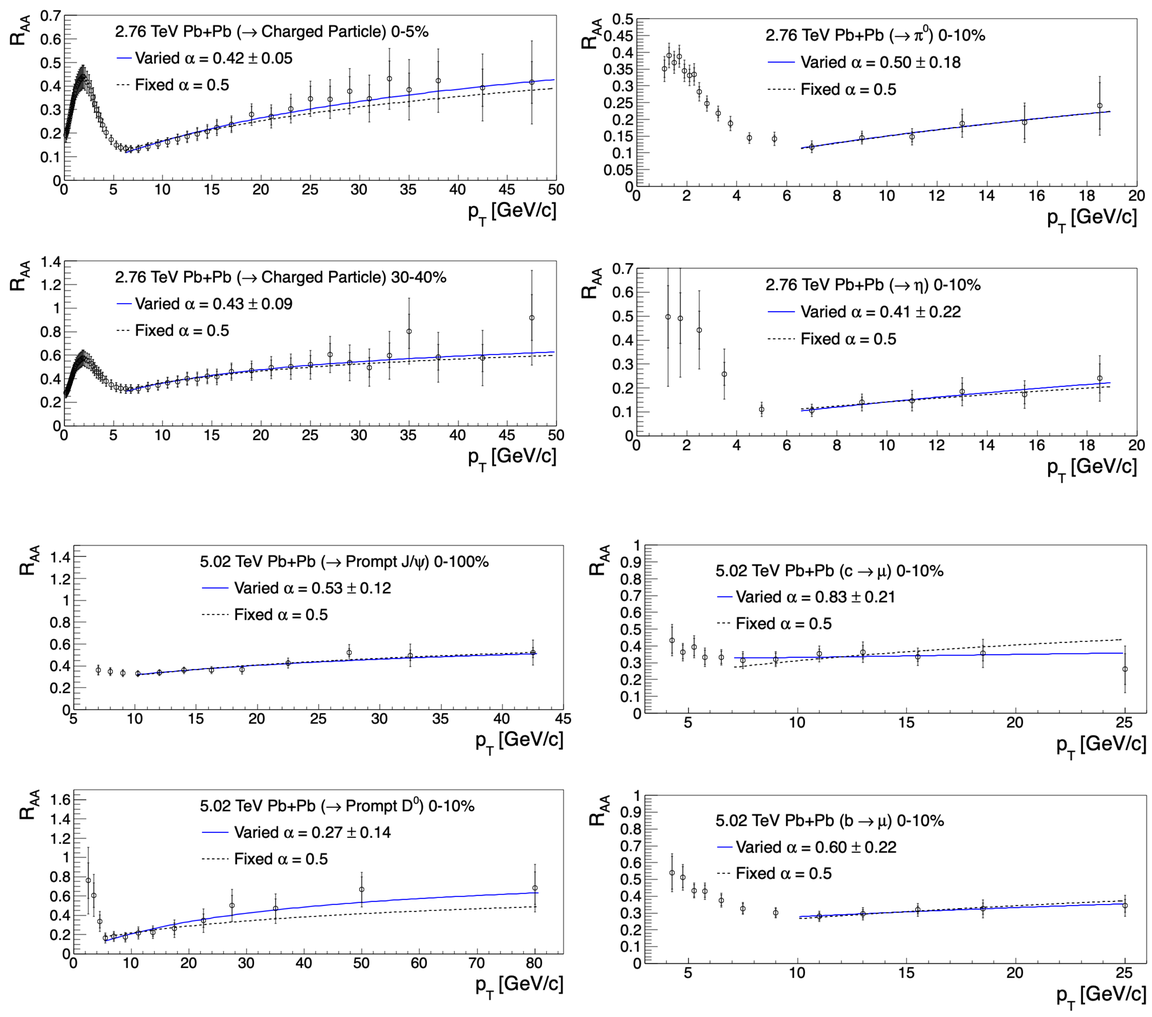
Conclusions

- We present an empirical parton energy loss evaluation of LHC data compared to RHIC data
- Drastic change in parton energy loss phenomena observed from collisional loss (α = 1.0) dynamics at RHIC to radiative loss (α = 0.5) domination at LHC
- Parton energy loss magnitude from various centralities depends mostly on initial parton density of participant medium, not on static path length that the high p_T parton traverses in the medium
- Lack of dependence on static path length at RHIC and LHC is consistent with a scenario where parton energy loss is a strong function of initial energy/parton density and the high density/temperature fireball experiences an explosive expansion with rapid decrease in density
- Slight difference between heavy and light quark energy loss at LHC could indicate possible different details in dynamics of the energy loss mechanism between heavy and light quarks at LHC energies
- Future sPHENIX and LHC measurements with more statistics and tagged jets will shed more insight on these partonic energy loss dynamics

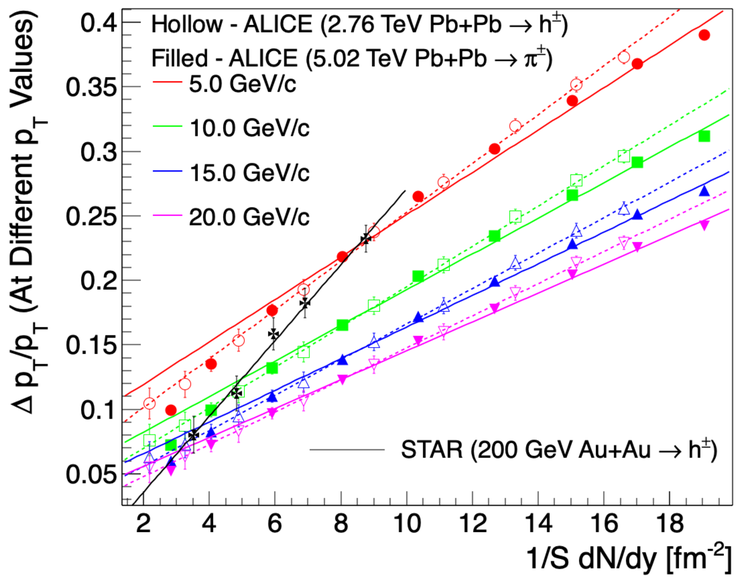
LHC R_{AA} Fits: [4],[5],[6],[7],[8]

α = 0.5 is consistent with predominantly radiative energy loss

α = 1.0 is consistent with predominantly collisional energy loss



Path Length Dependence of Energy Loss: [2],[3],[7]



- Linear fractional energy loss relationship with (1/S)(dN/dy) is consistent with dependence on initial collision density rather than path length
- Could be explained by rapid expansion of the medium in the first few fermi not allowing the parton to traverse a full path length
- Increased slope at RHIC vs LHC further suggests stronger collisional energy loss at RHIC relative to the LHC (more things to collide with and lose energy when the medium is more dense)

References

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