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

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Nuclear modification factors ( $R_{AA}$ ) of leading particles provide valuable information about the flavor dependent magnitude and characteristics of parton energy loss in  $A + A$  collisions. Experimental measurements of  $R_{AA}$  exhibit a distinct different dependence on transverse momentum ( $p_T$ ) at the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC). Previous analyses of RHIC data treated the difference in the  $p_T$  spectrum between  $p + p$  and  $A + A$  collisions as a leading parton  $p_T$  loss and empirically concluded that the flat  $p_T$  dependence of  $R_{AA}$  corresponds to a constant fractional  $p_T$  loss ( $\Delta p_T/p_T$ ) [1]. This feature of  $\Delta p_T$  proportional to  $p_T$  can be understood via elastic collisions in classical dynamics. We analyze LHC measurements of the strong  $p_T$  dependence of  $R_{AA}$  for light and heavy flavor leading particles. Our analyses indicate that LHC data for a variety of leading particle species are consistent with  $\Delta p_T$  proportional to  $\sqrt{p_T}$ , in contrast to proportional to  $p_T$  at RHIC. In addition, Charm hadrons exhibit differing behavior compared to the other species studied, revealing possible unique heavy flavor dynamics. These distinct features are consistent with the scenario of increased contributions from radiative energy loss at LHC energies compared with stronger collisional energy loss dominance at RHIC energies. Moreover, linear trends between fractional energy loss and initial parton density at varying  $p_T$  magnitudes indicate that the amount of parton energy loss does not depend strongly on the traversing geometrical path length of the parton during collision evolutions, which is in agreement with previous empirical findings at RHIC despite significant different initial parton densities formed at LHC and RHIC. We will also discuss further implications of the observed proportionality in LHC data and differences in fractional energy loss at varying  $p_T$  scales.

[1] Wang, G. and Huang, H. Phys. Lett. B 672, 30 (2009).

## Category

Experiment

## Collaboration (if applicable)

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