Falsifying AdS/CFT Drag or pQCD Heavy Quark Energy Loss with A+A at RHIC and LHC

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We propose the novel observable of the double ratio of charm to bottom nuclear modification factors as the only robust experimental measurement that can falsify AdS/CFT, pQCD, or both formalisms as applied to relativistic heavy ion reactions. Previous efforts to connect AdS/CFT calculations with experiment focused on the entropy to viscosity ratio [1] which, due to its sensitivity to the uncontrolled initial conditions [2], is a fragile probe of the "perfection" of the QGP fluid. The nonphotonic electron puzzle poses a challenge to prevailing pQCD prejudices but does not falsify pQCD methods [3]. Imminent detector upgrades in current experiments and the capabilities of near-future colliders will for the first time allow identified heavy quark suppression measurements. We show that current theoretical errors lead to weak predictions for the individual heavy quark nuclear modification factors but that these cancel to an astonishing degree in the ratio of the two, leading to the possibility of experimental falsification. We will discuss the "speed limits" of the classical supergravity approach, beyond which the AdS/CFT techniques may not be applicable, from both field and string theoretic perspectives. The double ratio signal will be most easily observed at LHC, with its large momentum reach and relatively soft heavy quark production spectra, but will also be measurable at RHIC, where the lower medium temperature leads to higher speed limits.

References

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