

# Abstract

## Probing the Frontiers in QCD

William A. Horowitz

With the energy scales opened up by RHIC and LHC the age of high- $p_T$  physics is upon us. This has created new opportunities and novel mysteries, both of which will be explored in this thesis. The possibility now exists experimentally to exploit these high momentum particles to uniquely probe the unprecedented state of matter produced in heavy ion collisions. At the same time naïve theoretical expectations have been dashed by data.

The first puzzle we confront is that of the enormous intermediate- $p_T$  azimuthal anisotropy, or  $v_2$ , of jets observed at RHIC. Typical lines of reasoning lead to an anticorrelation between  $v_2$  and the overall jet suppression,  $R_{AA}$ ; the larger the  $v_2$  the smaller the  $R_{AA}$ . By simultaneously plotting the two this relationship becomes manifest and it is clear that usual energy loss mechanisms cannot reproduce the observed pattern—while jets are suppressed, the  $v_2$  is anomalously large compared to the quenching. We argue that the data can be reproduced by a focusing of the partonic jets caused by processes associated with a deconfined quark-gluon plasma.

The second puzzle is the surprisingly similar suppression of light mesons