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A Computer Test Of Holographic Flavour Dynamics

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Abstract. Gauge/gravity duality is among the most important theoretical developments coming from string theory. In the original formulation of Maldacena, the duality relates string theory in the AdS5×S5 background space-time to the large N limit of 3 + 1 dimensional N = 4 Supersymmetric Yang-Mill theory living on the asymptotic boundary of the AdS5 space-time. This idea has inspired numerous extensions of the duality with ever increasing phenomenological relevance, currently ranging from heavy ion collisions to condensed matter physics. In this work we are interested in holographic flavour dynamics–the generalisation of the AdS/CFT correspondence to flavoured gauge theories.

The first such generalisation was proposed by Karch and Katz, who introduced a probe D7–brane to the AdS5×S5 supergravity background. On the field theory side this corresponds to introducing an N = 2 fundamental hypermultiplet in the quenched approximation. The classical dynamics of the probe brane is governed by an effective Dirac-Born-Infeld action. Remarkably the AdS/CFT dictionary relates the classical properties of the brane to quantum vacuum expectation values in the dual flavoured gauge theory. One such quantity is the fundamental condensate of the theory, which is encoded in the classical profile of the probe brane near the asymptotic boundary.

Testing the AdS/CFT correspondence requires an alternative nonperturbative approach and for a four dimensional gauge theory lattice simulations on a computer seem a natural approach. We perform computer simulations of the Berkooz-Douglas (BD) matrix model, holographically dual to the D0/D4-brane intersection. We generate the fundamental condensate versus bare mass curve of the theory both holographically and from simulations of the BD model. Our studies show excellent agreement of the two approaches in the deconfined phase of the theory and significant deviations in the confined phase. We argue the discrepancy in the confined phase is explained by the embedding of the D4-brane which yields stronger α' corrections to the condensate in this phase.