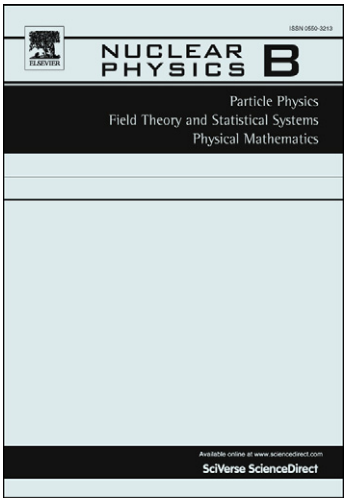

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Holographic fermions with running chemical potential and dipole coupling

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Abstract

We explore the properties of the holographic fermions in extremal R-charged black hole background with a running chemical potential, as well as the dipole coupling between fermions and the gauge field in the bulk. We find that although the running chemical potential effect the location of the Fermi surface, it does not change the type of fermions. We also study the onset of the Fermi gap and the gap effected by running chemical potential and the dipole coupling. The spectral function in the limit $\omega \to 0$ and the existence of the Fermi liquid are also investigated. The running chemical potential and the dipole coupling altogether can make a non-Fermi liquid become the Landau-Fermi type.

Keywords: AdS/CFT Correspondence, Holographic Fermions

1. Introduction

The gauge/gravity correspondence[1, 2, 3] is known as a powerful tool to provide key insights to disclose the mysterious phenomena observed in high temperature superconductor and heavy fermion systems, which are relative to the strongly correlated electron system. People are still lack of a general theoretical framework to deal with this so called non-Fermi liquids. Fortunately, with the use of gauge/gravity correspondence, tremendous progress has been made in our understanding of these strongly coupled system. In [4, 5, 6, 7, 8, 9], the authors has investigated the holographic Fermi surfaces where Fermi liquid and non-Fermi liquid are obtained by probing the behavior of the Dirac field in the RN-AdS black hole.

The high T_c cuprates have a very rich phase structure and at different doping region show their very different properties. As shown in figure 1, we can see that without doping ($x = 0$) the cuprate is the antiferromagnetic Mott insulator. By doping holes, the antiferromagnetic Mott phase is rapidly destroyed. Beyond

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