Holographic view of condensed matter physics

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We employ holographic methods to investigate strongly coupled systems at finite temperature and density in condensed matter physics. An established correspondence between theory in a d-dimensional spacetime with a $(d-1)$-dimensional theory on the boundary provides a novel approach towards understanding the strong interactions, where the traditional techniques may be insufficient. Moreover, weak/strong duality gives rise to an explanation of a continous phase transition at zero temperature (quantum criticality). The holographic principle has been already applied to, for example, unconventional superconductivity [1] or fractional quantum Hall effect [2]. We focus on the well-developed connection between anti-de Sitter space and the related conformal field theory in order to construct a class of bottom-up models.

The subject of our study is an application of the AdS/CFT correspondence for a (3+1)-dimensional bulk and its equivalent $(2+1)$-dimensional boundary theory to describe the charge transport. For the sake of simplicity, we assume the boundary theory has a large N number of degrees of freedom. We discuss the results that arise from mapping the Einstein-Maxwell theory in the bulk.

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