Model building in AdS/CMT: DC Conductivity and Hall angle

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Using the bottom-up approach in a holographic setting, we attempt to study both the transport and thermodynamic properties of a generic system in $3+1$ dimensional bulk spacetime. We show the exact $1/T$ and T^2 dependence of conductivity and Hall angle, as seen experimentally in most copper-oxide systems, which are believed to be close to quantum critical point. This particular temperature dependence of conductivities are possible for two different cases: (1) Background solutions with scale invariant and broken rotational symmetry, (2) solutions with pseudo-scaling and unbroken rotational symmetry but only at low density limit. Generically, the study of transport properties in a scale invariant background solution, using the probe brane approach, at high density and at low temperature limit suggests us to consider only metrics with two exponents. More precisely, the spatial part of the metric components should not be same i.e., $g_{xx}\neq g_{yy}$. In doing so, we have generated the above mentioned behavior to conductivity with a very special behavior to specific heat which at low temperature goes as: $C_V\sim T^3$. However, if we break the scaling symmetry of the background solution by including a nontrivial dilaton, axion or both and keep the rotational symmetry then also we can generate such a behavior to conductivity but only in the low density regime. As far as we are aware, this particular temperature dependence to both the conductivity and Hall angle is being shown for the first time using holography.

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