Scalar correlators and normal modes in holographic neutron stars.

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Abstract

The holographic neutron star provides a strong coupling description for a highly degenerate metallic state on a sphere. Its phase space can be split into two different sectors, with an unstable region at intermediate degeneracies. We investigate the critical nature of such region, by analyzing the asymptotic behavior of a scalar probe to compute the two-point correlator of the boundary theory. We show that in the stable region the correlator is dominated by the normal modes, whereas it displays a critical power-law behavior as we move into the unstable region.

In previous works [1,2], we explored the physics of the holographic neutron star at finite temperature. We learned that the solution space, spanned by the central temperature and the central degeneracy, is very rich: it includes configurations with a dense core and a diluted halo, as well as more regular non-cored solutions. We plotted the phase diagram of the bulk solutions and mapped the results into the boundary gauge theory. An interesting feature that we found is that, as we approach the unstable region of the phase diagram, criticality becomes manifest on the star profile in the form of a power-law edge. Simultaneously, the correlator of a scalar boundary operator in the geodesic approximation develops a swallow tail structure. Such critical zone at intermediate degeneracies is reminiscent of the High Tc phase diagram, which at intermediate dopings is dominated by quantum fluctuations due to a critical point at zero temperature (see Fig. 1 in [3] and the related discussion). In the present work, we explore further the holographic neutron star setup from a different perspective. Motivated by the previous observations, we investigate how criticality becomes manifest on the scalar correlator out of the geodesic approximation as we approach the unstable region.

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