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Failure of the Baym-Kadanoff construction to consistently match quantum dynamics with thermodynamic critical behavior

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We disclose a serious deficiency of the Baym-Kadanoff construction of thermodynamically consistent conserving approximations. There are two vertices in this scheme: dynamical and conserving. The divergence of each indicates a phase instability. We show that each leads to incomplete and qualitatively different behavior at different critical points. The diagrammatically controlled dynamical
vertex from the Schwinger-Dyson equation does not obey the Ward identity and cannot be continued beyond its singularity. The divergence in the conserving vertex, obeying the conservation laws, does not invoke critical behavior of the spectral function and the specific heat. Consequently, the divergence of the conserving vertex must coincide with that of the dynamical one to yield a consistent and reliable description of criticality coming from an effective static fermion-fermion interaction taking place, for instance, in magnetism, superconductivity, and chiral symmetry breaking.

Alternate track

I read the instructions above

Yes

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