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Multi-channel fluctuating field approach to interplaying collective fluctuations in strongly correlated systems

Correlated fermion systems often display complex phase diagrams with different competing orderings. A theoretical description of competing instabilities remains one of the major challenges of modern condensed matter physics. We introduce a multi-channel extension of the recently developed fluctuating field approach to tackle this problem, based on a variational optimisation of a trial action that explicitly contains the leading fluctuations channels [1]. Application of the approach to the extended Hubbard models captures the interplay of competing charge density wave, antiferromagnetism, s-wave superconductivity, and phase separation fluctuations [1,2]. For the case of the attractive model, our approach has allowed us to identify a novel phase that is characterised by the coexistence of s-wave superconductivity and phase separation [2]. Our findings resonate with previous observations of interplaying phase separation and superconducting phases in electronic systems, most importantly in high-temperature superconductors.

References :

- [1] E. Linnér, A. I. Lichtenstein, S. Biermann, E. A. Stepanov, arXiv:2210.05540 (2022).
- [2] E. Linnér, C. Dutreix, S. Biermann, E. A. Stepanov, arXiv:2301.10755 (2023).

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