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Title: Breakdown of the Meissner effect at the exceptional point in non-Hermitian two-band BCS model

Abstract: Non-Hermitian many-body physics has recently emerged as a significant area of research, motivated in part by the success of ultra-cold atom experiments [1] in which the non-Hermitian Bardeen-Cooper-Schrieffer (BCS) model is effectively realized [5]. The dynamics of such systems are described by the Gorini-Kossakowski-Sudarshan-Lindblad (GKSL) master equation [2,3], with the short-time behavior described by the effective *non-Hermitian BCS model*.

This presentation explores the direct link between the *non-Hermitian two-band BCS model* and the *two-component complex Ginzburg-Landau model* (2cGL). We will demonstrate that the Meissner effect is broken at the exceptional point of the 2cGL model, whereas the gap parameter remains finite. This breakdown of the Meissner effect represents a unique mechanism enabled by the non-Hermiticity of the model.

In Fig. 1, we plotted the gap parameters of the 2cGL model. The dotted vertical line indicates the temperature at which the model is at the exceptional point, and the Meissner effect is broken. From the intersection point between the vertical line and the gap parameters, it is clear that they are finite when the Meissner effect is broken. This talk is based on Ref. [4].

References:

1. I. Bloch et al. Rev. Mod. Phys, 80(3):885, 2008.

2. V. Gorini et al. J Math Phys, 17(5):821-825, 1976.

3. G. Lindblad. Commun. Math. Phys, 48:119-130, 1976.

4. T. Taira, arXiv:2211.11422.

5. Y. Takasu et al. PTEP, 2020(12):12A110, 2020.

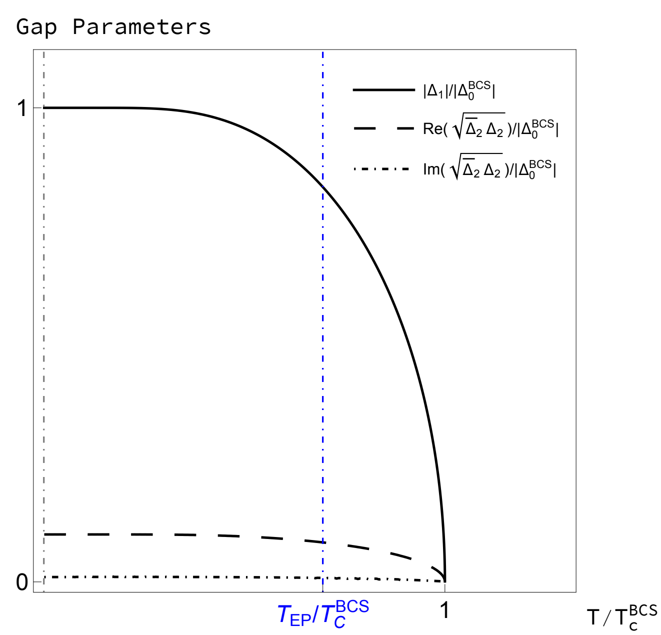

Figure 1: A real and complex gap parameters $|\Delta_1|$ and $\overline{\Delta}_2\Delta_2$ are plotted against scaled temperature T/T_c^{BCS}, where T_c^{BCS} is the critical temperature in the standard BCS theory.