Dear Editor,

Collective behavior lies at the center of emergent phenomena in

many-body systems with various structural, magnetic, and electronic

instabilities and the thereby induced phase transitions.

Therefore, the study of these phenomena attracts enormous scientific interest.

Experimentally detecting and theoretically describing the interactions of the collective bosonic excitations with the fermionic quasiparticles, or the interactions among the bosonic excitations leads to understanding of the given many-body problem.

To this end, our present manuscript presents a powerful theoretical method for the analysis of collective excitations by computing various Green’s functions and their spectral functions. We use this method to identify well-known collective modes such as the Higgs and Anderson-Bogoliubov modes in superconductors, longitudinal and transversal magnons as well as an exciton related to charge density wave order.

Our approach automatically complies with Goldstone's theorem yielding massless modes where continuous symmetries are spontaneously broken.

We follow their behavior as certain system parameters are tuned and, in particular, across phase transitions, thereby expanding both the available theoretical toolkit and the understanding of said collective behavior. This work paves the way to studies of more complicated systems such as multiband systems with even more relevant phases.

Hence, we believe that the submitted manuscript fits very well into your prestigious journal.

We are looking forward to the review process.

Yours sincerely

Joshua Althüser

Götz S. Uhrig