Editors

New Journal of Physics

Apr. 2, 2019

Dear Editors,

Recently, we have received the rejection letter on our manuscript (NJP-110230). We thank the Associate Editor for the pre-review. However, from his/her comments we find that the Associate Editor’s rejection is based on the basic misunderstanding of our claim and our results. Therefore, we kindly ask you to reconsider your decision and allow us to resubmit our paper to New J. Phys. based on the following reply. To make our purpose and results be more clearly presented, we have made some modifications to our paper. The pdf version of the revised manuscript can be found in the attachment.

Following is our reply:

1. “The manuscript claims to invalidate one of the expressions for Chern number in presence of translation symmetry breaking and interactions.”

We totally have no such claim and even no such intention in our paper! In fact, the validity of this expression for Chern number is the base of our paper, what we want to show is how to use this formula correctly in the framework of quantum cluster approaches to calculate the interacting Chern number of correlated Chern insulators.

As we know, the translation symmetry breaking is universal to most quantum cluster approaches, but its effect on the computation of the topological invariant in terms of the above formula has been long ignored in the community. In our work, we have pointed out for the first time that this explicit breaking of translation symmetry may lead to false interacting Chern number if we naively compute it within the natural unit cell, e.g., a 2-site unit cell denoted as H2 in our paper, just like what the community usually does (e.g., as has been done in Ref. 36 of our manuscript). Moreover, we propose that the correct way to get the faithful Chern number is to compute it within the enlarged unit cell (e.g., a 6-site hexagonal cluster denoted as H6), as it is free of the fault caused by the explicit translation symmetry breaking and consistent with the interacting bulk-edge correspondence.

1. “While this topic potentially warrants a publication, the claim is only supported by a single numerical simulation. The authors neither present a rigorous explanation of the reasons why the expression fails nor do they propose an algorithmic way to fix it.”

Based on this expression of Chern number, we find that the scheme of applying it to calculate the interacting Chern number in the previous quantum cluster approach has a fault in the Haldane-Hubbard model. We note what we claim is the calculating scheme not the expression has a fault.

In fact, we only need one example to show that the previous scheme does not work. In the meantime, we have explained in detail why this scheme fails due to the explicit breaking of the translation symmetry. Most importantly, as has been clarified above, we have proposed the correct scheme as well (see Sec. 3.3).

1. “Given that the original invariant is a result of a formal derivation with clearly stated assumptions, the relatively weak evidence the authors present is more likely a sign of e.g. a computational instability or a wrong implementation.”

The Associate Editor thought wrongly that we would like to invalidate the original expression for Chern number using a numerical example. In fact, as replied above it is not the case.

As for our modification of the numerical scheme, it is solid because it is 1) free of the fault caused by the explicit translation symmetry breaking, 2) consistent with the interacting bulk-edge correspondence, and 3) supported by the physical argument that real bulk Chern number should be stable against small local perturbations, as discussed in detail in Sec. 3.3 of our paper. In fact, the wrong implementation has been unconsciously adopted by others in the quantum cluster approach community. We only use this wrong implementation in our paper to uncover its failure.

In summary, we have examined the scheme of applying quantum cluster approaches to the detection of the topological properties in correlated topological insulators. We point out the long-standing fault in the numerical calculation scheme that may lead to incorrect topological invariants due to the explicit breaking of the translation symmetry, and propose the right way to fix it. This fault is commonly present in most quantum cluster approaches but has been ignored. Therefore, our work is essential to the faithful determination of a nontrivial topology in an interacting system and should be of particular importance for both the quantum cluster approach community and the correlated topological insulator community.

Thanks in advance for your kind reconsideration.

Yours sincerely,

Zhao-Long Gu, Kai Li, and Jian-Xin Li

School of Physics

Nanjing University

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

The modifications we have made in the new version

We admit that some statements or expressions in our original manuscript may be misleading, so that the Associate Editor misunderstood the main points of our paper. To clarify this, we make some modifications on our paper, especially on the abstract part and the introduction part, so that readers can easily follow now. The main changes are listed below:

1. In the abstract, we emphasize that the previous scheme of the computation of interacting Chern number is performed in the natural unit cell and the last sentence is replaced with “Instead, we assert that the faithful interacting bulk Chern number in the framework of quantum cluster approaches can be computed in the enlarged unit cell, which is free of the fault caused by the explicit translation symmetry breaking and consistent with the interacting bulk-edge correspondence.”
2. In the 4th paragraph of Sec. 1, we emphasize again that the previous scheme of computing the interacting Chern number is performed within the natural unit cell (which gives wrong results), and our modification is performed within the enlarged unit cell (the correct way that is free of the fault caused by the explicit translation symmetry breaking and consistent with the interacting bulk-edge correspondence).
3. In the last paragraph of Sec. 1, the third sentence is replaced with “In Sec. 3, we present the numerical results to elaborate the falsity of the interacting bulk Chern number calculated within the natural unit cell and verify the validity of the interacting bulk Chern number computed in the enlarged unit cell.”
4. In the last paragraph of Sec. 2, we reformulate the Eq. (7), and explain how to use Eqs. (7) and (8) to compute the interacting bulk Chern number in the framework of quantum cluster approaches.
5. In Sec. 3.2, we emphasize that the wrong Chern number are computed within the natural unit cell.
6. The original last paragraph of Sec. 3.3 is removed. Instead, in the revised version, we explain in detail the validity of our scheme in the calculation of interacting Chern number within the enlarged unit cell.
7. In the first paragraph of Sec. 4, the last sentence is replaced similarly as that in the abstract.