Skoltech

Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Grigory Starkov

PhD Program: Physics

Title of Thesis: Simulations of high temperature spin dynamics

Supervisor: Assistant professor Anatoly Dymarsky

Co-advisor: Associate professor Boris Fine

Chair of PhD defense Jury: Professor Anton Andreev ***Email:*** *An.Andreev@skoltech.ru*

Date of Thesis Defense: 16 October 2019

Name of the Reviewer:

I confirm the absence of any conflict of interest In 2017 and 2019, I visited Skoltech, and my expenses were partially reimbursed by the co-advisor of the PhD candidate, Professor B. Fine. However, I do not know whether this constitutes a conflict of interests.	**Signature:** V. DOBROVITSKI **Date: 12-09-2019**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

The PhD dissertation of Mr. Starkov is an impressive work, devoted to an important and timely scientific problem of numerical modeling of the quantum dynamics in the systems of many coupled spins. This problem has become particularly important recently. On one hand, this kind of modeling is crucial for development of the novel systems for quantum information processing; on the other hand, it is important for fundamental studies of complex quantum dynamics that still remains beyond the reach of other approaches (analytical approximations are often insufficient, and experiments often do not provide conclusive answers). The text of the dissertation is well structured, and provides good explanation of the problem, previous attempts and approaches to the solution, and the proposed method based on the ingenious combination of the classical and quantum simulation methods. The results of Mr. Starkov, obtained using the proposed hybrid method, look interesting and encouraging, and the outlook seems very promising and interesting.

The content of the dissertation corresponds to the declared topic, and the methods are absolutely relevant. The presented method of hybrid quantum-classical simulations, and the results obtained using this method, are of much scientific interest, and are definitely at the level of the current state of the art in the field, if not exceeding this level. The method and the results constitute an important contribution to the field, and might be useful for modeling advanced systems for quantum information processing.

The dissertation is ready for defense in its current form. There are only two optional changes that may improve the presentation. First, it would be useful to comment on the number of the samples of the random function |psi> needed for accurate evaluation of the quantum correlation function (in purely quantum simulations, for sufficiently large systems, even a single sample often would suffice, while the current method requires many more samples). Second, it might be good to emphasize the difference between the method of Ref. 32, based on calculation of <psi|A(t)|psi><psi|A|psi>, and the previously used method based on calculation of <psi|A(t) A(0)|psi>, and clarify the difference between the two.

Summarizing, I find the dissertation of Mr. Starkov an impressive scientific work, which is ready to be defened (with a couple of small optional changes), and which constitutes an excellent contribution to the field of numerical modeling of quantum many-body systems.

Provisional Recommendation

☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*

☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*