Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Kirill Pavlenko

PhD Program: Mathematics and Mechanics

Title of Thesis: Quantum KdV charges, 2d conformal theories and eigenstate thermalization hypothesis

Supervisor: Associate Professor Anatoly Dymarsky

Name of the Reviewer: Boris Fine

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Date: 25.08.2022**

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

- Brief evaluation of the thesis quality and overall structure of the dissertation.

The Ph.D. thesis submitted by Kirill Pavlenko and titled "QUANTUM KDV CHARGES, 2D CONFORMAL THEORIES AND EIGENSTATE THERMALIZATION HYPOTHESIS " deals with the subject of current scientific interest, namely, the dynamic thermalisation in many-particle systems posessing atypical integrals of motion in addition to the total energy of the system. The system considered, is a conformal field theory in two dimensions (2d CFT) associated with the charges (integrals of motion) that , in turn, are linked for historical reasons to the Korteweg-de Vries (KdV) equation. While that system is rather special, it is of a long-standing interest for the mathematical physics community and also for the community investigating black hole physics and quantum gravity.

The thesis first describes the 2d CFT system classically, then quantizes the description, and then, finally, uses the resulting quantum description to show analytically the validity of the generalised eigenstate thermalisation hypothesis (GETH), which is related to the notion of the generalised Gibbs ensemble The GETH result, particularly, important, because it is obtained fully analytically, while other investigations pertaining to the generalised Gibbs ensemble were numerical. The thesis includes a number of detailed derivations, which will be valuable for expert readers.

Overall, the thesis reports substantive new scientific findings that justify awarding to the author an internationally competitive Ph.D. degree. As an indication of the level of these results, I note that they appeared as peer-reviewed articles coauthored by Kirill Pavlenko in highly respectable and selective international journals.

- The relevance of the topic of dissertation work to its actual content

The topic of the dissertation accurately describes the dissertation's actual content.

- The relevance of the methods used in the dissertation

The methods are fully appropriate.

- The scientific significance of the results obtained and their compliance with the international level and current state of the art

As noted earlier, the scientific results are significant, highly competitive internationally. They advance state-of-the-art in the researched subject.

- The relevance of the obtained results to applications (if applicable)

The dissertation reports on a fundamental research, which, at present, only has a rather distant connection to applications.

- The quality of publications

As noted above, the relevant publications of Kirill Pavlenko are in highly respectable and selective international journals, all are peer reviewed.

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

While I overall positively assess the the fact that the presentation in the dissertation is rather compact, I also feel that the author could have made more effort to make the text accessible to non-specialists. In particular, some abbreviations, such as, for example, KdV, CFT, ODE/IT are not defined in the text. The background discussion for the conducted investigation could have also been a bit more self-contained.

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*