

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: Prof. Henni Ouerdane

I confirm the absence of any conflict of interests

Date: 26-08-2022

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

Reviewers report should contain the following items:

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

The scientific content of the thesis is of high quality, and the calculations developed in sufficient details for any interested reader. The thesis manuscript in its present version consists of 8 sections spread over 66 pages + abstract and reference sections. Having sections instead of proper chapters probably aims to offer a concise text, but it also seems to aim to simply reduce the writing load. Many typos clutter the text.

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

The actual content of the thesis is perfectly in line and coherent with the topics treated, notably the eigenstate thermalization hypothesis, the quantum KdV charges, and two-dimensional conformal field theories.

- The relevance of the methods used in the dissertation

The methods used are based on the formalism of the two-dimensional conformal field theory, notably the Virasoro algebra, and basic statistical physics. They are perfectly relevant for the computation of spectrum of the quantum KdV charges, and the partition function of the generalized Gibbs ensemble.

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

The main results of the thesis are the quantum spectrum of the Korteweg – de Vries charges, the partition function of the generalized Gibbs ensemble, and interestingly, an analytic proof of eigenstate thermalization hypothesis in spatially extended systems. These results are original and of high scientific level, certainly complying with international standards and the state of the art.

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

The obtained results are essentially valuable contributions to theoretical physics, notably in the area of statistical thermodynamics of quantum systems. The reflection developed in the thesis can have implication in black hole physics.

- The quality of publications

With 3 JHEP and 1 PRL published in 2019 and in 2020, the quality of the publications originating in the doctoral work is obviously high.

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

See the next page.

I have no criticism concerning the scientific content. I would qualify some of the results as “tour de force”. My main issues with the present version of the thesis manuscript are as follows:

1. There is no research question properly and clearly formulated and though the doctoral dissertation contains a number of solid results, it is not clear what the thesis is, the intellectual proposition so to speak. As a consequence, the abstract does not even state the gap(s) that the research aims to close, why it is important to address the issue, and the exact purpose of the work. The introduction is rushed and full of jargon and acronyms. Very unsatisfactory. The thesis title does not mean much except that it indicates the areas of research rather than the purpose.
2. The candidate systematically is second author of the published articles. Given the typical authorship practice, the first author is that who contributes the most and gets the major part of the credit. So, how to interpret the fact that the candidate is never the first author of papers based on his doctoral thesis? This should be clarified with an explicit statement of the scientific contributions of the authors to the works presented by the candidate. For a doctoral degree, the intellectual input of the candidate should be the major one. What are the original ideas of the candidate? What work did he actually intellectually lead?
3. Points 1 and 2 lead me to ask the candidate to rewrite the Introduction altogether. In its present form, it is not clear whether the candidate clearly understands what he wrote. Some parts are excerpts from the published articles, but the candidate never offers a text that would satisfy a reader who wants a useful, informative overview of the problems tackled in the doctoral work. The candidate should prove that he understands the concepts that he writes about and that he can put them in a proper scientific context that logically leads to the research question that is to be addressed.
4. The doctoral thesis should be written not in the format of a large preprint that is globally structured with sections, but with actual chapters, sections, and subsections. The English should be polished and greater care shown by paying attention to the typos. Further, a list of acronyms would be welcome.

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