Skoltech
Skolkovo Institute of Science and Technology

# Jury Member Report – Doctor of Philosophy thesis.

**Name of Candidate:** Andrey Tarkhov

**PhD Program:** Physics

**Title of Thesis:** Ergodization dynamics of the Gross-Pitaevskii equation on a lattice

**Supervisor:** Associate Professor Boris Fine, Skoltech

**Name of the Reviewer: Nikolay A. Gippius**

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|---|---|
| I confirm the absence of any conflict of interest<br><br>(Alternatively, Reviewer can formulate a possible conflict) | **Signature:**<br><br>**x**  <br><br>**Date: 01-10-2020** |

*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 thesis by Andrey Tarkhov focuses on the dynamical thermalization of the discrete Gross-Pitaevskii equation on a lattice (DGPE). The thesis incorporates five chapters. Chapter 1 is a brief introduction into the historical context of dynamical foundations of statistical physics, the definition of classical chaos, Lyapunov exponents and Loschmidt echo, and the overview of the dynamic, thermodynamic and topological properties of the DGPE. Chapter 2 describes a method for probing chaoticity of a many-particle system, and discusses its experimental implementation in ultracold atoms in an optical lattice. Chapter 3 introduces a new measure of ergodization time based on the Lyapunov process. Chapter 4 is experimentally motivated by an CDW-melting experiment in LaTe3, and applies the 3D DGPE dynamics to simulation of non-equilibrium quenches across a second order phase transition, the role of topological defects emerging in the process of quenching is discussed. Overall, the thesis covers three important aspects of dynamical thermalization of a many-particle system: chaoticity, ergodization and the role of topological defects in the slowing down of thermalization. The results are extensively validated by numerical simulations in all chapters. The results of Chapters 2 and 3 are published in Physical Review A and the New Journal of Physics.

**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*