Skoltech

Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Andrii Liashyk

PhD Program: Mathematics and Mechanics

Title of Thesis: Bethe vectors and their scalar products in quantum integrable models

Supervisor: Professor Anton Zabrodin

Date of Thesis Defense: 20 January 2020

Name of the Reviewer: Andrei Marshakov, professor of CAS

I confirm the absence of any conflict of interest	Signature:
(Alternatively, Reviewer can formulate a possible conflict)	Date: DD-MM-YYYY 19.12.2019

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 Thesis of A.Liashyk is devoted to study of a class of quantum integrable models using the algebraic Bethe ansatz. The symmetries of this class of models are related with quite complicated quantum algebras (the Yangian $Y(\mathfrak{gl}_{n|m})$ and the quantum affine algebra $U_q(\hat{\mathfrak{gl}}_n)$), and a very nontrivial problem is to find the eigenvectors of Hamiltonian (and other integrals of motion), and especially to compute their scalar products, giving contribution to the matrix elements of physical observables.

In particular, the results of the PhD thesis include:

- Construction of the Bethe vectors for $Y(\mathfrak{gl}_{n|m})$ using the Gauss decomposition;

- The co-product formula for Bethe vectors in the case of $Y(\mathfrak{gl}_{n|m})$, found by using the Drinfeld co-product properties for the currents;

- The bilinear sum formula for the scalar products in the cases of $Y(\mathfrak{gl}_{n|m})$ and $U_q(\hat{\mathfrak{gl}}_n)$, which also reproduces the so called ``Reshetikhin sum formula'';

- The recursion relations for the Bethe vectors, giving rise to explicit expression for the highest coefficients in the Reshetikhin formula;

- For both cases ($Y(\mathfrak{gl}_{n|m})$ and $U_q(\hat{\mathfrak{gl}}_n)$) it has been proven, that the norms of eigenvectors are proportional to the Gaudin determinant.

Andrii Liashyk is already a highly motivated young researcher working in the theory of quantum integrable models, he already has more than 10 published papers, so only part of his scientific results formed the basis of his PhD thesis. I am sure that the results and thesis of Liashyk satisfy all necessary requirement for the PhD thesis of the highest quality, and the thesis is ready for defence at Skoltech.

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