REPORT ON THE DOCTORAL THESIS "NONCOMMUTATIVE STRUCTURES IN QUANTUM FIELD THEORY" BY LADA PEKSOVA

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Overview. Operads originate in algebraic topology from the study of iterated loop spaces by J. Michael Boardman and Rainer M. Vogt, and J. Peter May in 1970s. Interest in operads was considerably renewed in the early 1990s when, based on early insights of Maxim Kontsevich, Victor Ginzburg and Mikhail Kapranov discovered that some duality phenomena in rational homotopy theory could be explained using Koszul duality of operads. Operads have since found many applications, such as in deformation quantization of Poisson manifolds, the Deligne conjecture, or graph homology in the work of Maxim Kontsevich and Thomas Willwacher.

The thesis under review investigates several applications of the theory of operads in quantum physics.

The thesis is based on two articles of the author: "Properads and Homotopy Algebras Related to Surfaces" and "Quantum Homotopy Algebras and Homological Perturbation Lemma".

In her thesis Lada Peksova defines connected sum for modular operads which allows her to construct the graded commutative product on the algebra over Feynman transform of the modular operad. This leads to the structure of Batalin-Vilkovisky algebra with symmetry given by the modular operad. The author uses homological perturbation lemma in order to transfers this structure to the cohomology.

In addition, the author defines open Frobenius properad which is an associative analogue of Frobenius properad, constructs the cobar complex over it and interprets algebras over cobar complex as homological differential operators. Finally, the author presents IBA_∞-algebras as an analogue of IBL_∞-algebras.

Conclusion. Save for a few typos and inessential mistakes, the presentation of the material in the thesis appears to be correct and the thesis is reasonably well written.

Lada Peksova wrote an excellent doctoral thesis. I recommend the doctoral thesis of Lada Peksova to be considered for the defense with the highest possible grade.

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