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**Report on the thesis
on
Noncommutative structures in quantum field theory**

by Lada Peksova´

The thesis begins with a well written introduction to the concept of operads and properads making it easily accessible for a mathematical physicist while providing a good motivation for the research described. We also find a short motivation for the concept of properads and IBA_∞ algebras for open strings which is the second central topic of this thesis. One comment on page 4, concerning chapter 6 seems a little out of place.

In chapter one we first have an intuitive definition of operads illustrated with well chosen examples. The inclusion of differential graded operads at this early stage is very welcome since this extension is usually relevant in mathematical physics. We then encounter the extension by defining a connected sum of the latter. As far as I can tell this is the first original contribution in this thesis whose compatibility is established in the sequel. In the final part of this chapter we find a refreshing review of properads which is somewhat elusive in the standard literature. So it is welcome to see it here. Furthermore, the description of the glueing operation for the Frobenius open properad appears to be new. One question that arises here is why the concept of connected sum is not extended to properads. A comment on this would be welcome.

To summarise, the introduction and chapter one provide a very helpful and well written half way house for a mathematical physicist with many helpful remarks finally leading to the introduction of an original extension of the existing theory whose consistency is then established.

Turning to chapter two we encounter a review of co-bar construction of the operads introduced before, which is the natural thing to do. Still, some motivation for it might be useful at this point before entering into the abstract definition.

In chapter 3 we find again an original contribution (Theorem 127) where the author shows that a modular operad endowed with a connected sum introduced in chapter one, defines a Batalin-Vilkovisky (BV) algebra. While BV-algebras can be obtained from modular operads in different ways, the approach chosen here is not only novel but also useful. In particular, one does not

have to specify the symmetry type. It is also shown that for tensor algebras the BV-algebra obtained in this way is equivalent to the known construction.

In chapter four and five, rather technical in nature, we see how the familiar objects such as functions are well defined in the present approach and how they are transferred to cohomology.

Finally in chapter 6 I liked the result concerning how homotopy associative involutive bi algebras arise from the cobar complex of a suitable properad. While a little disconnected from the rest of the thesis it is a nice result that fits well with the early chapters.

Altogether the manuscript is well presented. It may have been finished off a little hastily. This does not inflict on the scientific quality but I found the rationale for the different steps a little difficult to unearth at times, especially towards the end of the manuscript.

In sum, by Lada Peksova submitted a well written account of her research that is of relevance to mathematics as well as mathematical physics. The candidate has clearly demonstrated her ability to conduct independent and creative research and to produce original and important results. In view of these comments I recommend acceptance of this thesis.

Yours sincerely

Ivo Sachs

some typos:

from from, page 5, and The algebras on page 14, For C is a finite set, page 15, o er remarkably economical way page 16, Defined in 146, page 52, where $????$ are arbitrary bijections page 62, citation [5]

Questions for exam:

Example 30: why only oriented surfaces?

connected sum for properads?

compatibility of the connected sum with Feynman transform

For IBA_infty how is composition compatible with ordering?