

HABILITATION THESIS REVIEWER'S REPORT

Masaryk University

Applicant	Jörgen Linus Wulff
Habilitation thesis	Integrable deformations of strings
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The thesis is based on results obtained by Dr. Wulff in nine articles. All these articles have been published in peer reviewed international journals with high impact factors. These articles are a subset of the long publication list of the author. They are devoted to the topic of integrable deformations of string sigma-models.

This topic has been and is still a very lively field of research in Theoretical Physics. In particular, many interesting connections are studied. These connections are between different areas of research such as String theory, Integrability, Deformations, Dualities. The thesis describes major contributions of the author to the unveiling and understanding of these connections as well as the important fate of them under quantum corrections. Furthermore, the problems tackled by the author are very hard. The thesis shows that Dr. Wulff has been able to solve them because he has a deep and thorough knowledge of his field of research and masters a variety of techniques at the forefront of this field.

Among the many results obtained by Dr. Wulff in the nine articles, three main ones can be pointed out. The structure of the thesis reflects this as a chapter is devoted to each of these main outcomes.

Homogenous Yang-Baxter deformations have been originally constructed when the target space is a Lie (super-)group or a (super-)coset. The reason is that this deformation has been sought in an integrability context. And these target space manifolds correspond to integrable sigma-models. The author explains how homogeneous Yang-Baxter deformations can be generated using non-abelian T-duality. One adds a closed and non-degenerate B-field defined on a subalgebra of the isometry algebra and dualizes on that subalgebra. This is a beautiful construction. Its impact is very high because such a procedure can then be applied to a general sigma-model as long as this model admits isometries which can be dualized. In particular, the author has constructed the homogeneous Yang-Baxter deformations of a generic Green-Schwarz superstring with isometries.

An immediate and important question when deforming a sigma-model defining a string theory is whether the deformation is still a string theory. One must prove that Weyl invariance is preserved by the deformation. This is a very difficult question. The author explains that there is an algebraic sufficient condition for Weyl invariance, called

unimodularity. Although this sufficient condition can be formulated simply in terms of the quantity defining the deformation, proving it is quite hard. The author explains how to prove it by using Double Field Theory. This setting is natural in view of the generation of homogeneous Yang-Baxter deformations via non-abelian T-duality. Indeed, the homogeneous Yang-Baxter deformation becomes equivalent to a coordinate dependent $O(d,d)$ -transformation. In particular, the so-called generalised 3-form flux is invariant while the shift of the 1-form flux vanishes when the unimodularity condition is imposed, hence the result.

The previous results hold at one-loop. The two-loop Weyl invariance is discussed in the next chapter. The author shows that Weyl invariance extends to first order in α' correction while the homogeneous Yang-Baxter deformation receives corrections.

The results presented in this thesis bring new and crucial questions. The most important one is the fate of higher α' corrections. This is mentioned in the conclusion and the author has even obtained some new results after completion of his Habilitation Thesis.

The thesis is structured in an introduction, three chapters summarised briefly above, a conclusion and the reprints of the nine selected publications. The thesis is self-contained which I greatly appreciated when reading it. It is written in a pedagogical way and with all the rigor of Theoretical Physics. This makes this Habilitation Thesis enjoyable to read.

In conclusion, the Habilitation Thesis entitled *Integrable deformations of strings* by Jorgens Linus Wulff fulfils by far all requirements expected of an Habilitation Thesis in the field of Theoretical Physics and Astrophysics. Dr. Wulff is a well-established and respected researcher, with strong publication list and citation records and his contribution to his field of research is a major one. I fully and enthusiastically support his application to become Associate Professor (to be given the title docent).

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