Description of the funded research project
1st Call for H.F.R.I. Research Projects to Support Faculty Members &
Researchers and Procure High-Value Research Equipment

Title of the research project: Novel non-perturbative aspects of field theories from deforming holography

Principal Investigator: Konstantinos Sfetsos

Reader-friendly title:

Scientific Area: Natural Sciences

Institution and Country: National and Kapodistrian University of Athens (NKUA), Greece

Host Institution: National and Kapodistrian University of Athens (NKUA)

Collaborating Institution(s): CERN, University of Swansea (UK), National Center for Theoretical Sciences of Taiwan, Heriot-Watt University (UK)

Budget: 200.000 €

Duration: 36 months

Project webpage (if applicable):

Research Project Synopsis

Please describe in short (max. 300 words) your funded research project.
Notice: Please do not provide confidential information about your project, since the synopsis will be published in HFRI website.

The aim of this project is to understand non-perturbative aspects of gauge theories in the context of the gauge/gravity correspondence. To achieve this, a number of important on their own objectives, should be materialized. In particular:

The NS sector of supergravity solutions that are so far of relevance in the gauge/gravity correspondence can be thought of as fields in two-dimensional σ-models. **We will construct integrable deformations of the** aforementioned σ**-models that will depend on a number of continuously varying deformation parameters. These integrable theories will typically preserve many global symmetries of the original theory. Within the above class of integrable theories, we will identify those which possess certain non-perturbative symmetries in the parametric space comprised by the coupling constants associated with the operators that deform the theory.**
We will compute the beta-functions and the anomalous dimensions of the various operators of the deformed theory to all orders in the deformation parameters which is a rare occasion in QFT. As past experience shows, this is achievable thanks to the above non-perturbative symmetry in conjunction with some perturbative information obtained from low order perturbation theory.
We will analyze the beta-function equations and search for fixed points, hence identifying an exact flow between the UV and IR. At these fixed points we will identify the operators that drive the perturbation and we will obtain their anomalous dimensions.

Project originality

Please describe in short (max. 300 words) the scientific originality of your research project.

The advance beyond the state of the art that the proposed project will provide, can be summarized as follows:

A) Understanding integrable structures in relation to novel deformation of CFTs.
B) Uncovering the role of non-perturbative symmetries in the coupling space and their significance to all order computations within the RG framework.
C) Construct and embed new integrable models in type-II supergravity.
D) Identify the corresponding QFT duals and the role of the deformation parameters in their mathematical structure and in various physical quantities.

Expected results & Research Project Impact

Please describe in short (max. 300 words) the expected results (TRL included, if available) and the scientific, social and/or artistic impact of your research project.

The expected deliverables at the end of the present project consist of eleven papers in peer-review journals and four conference presentations.

The primary goal of the project is to contribute to the production of front-line research results in modern cutting-edge topics in theoretical high-energy physics. The realization of the research proposal will contribute to further strengthening the scientific projection of the NKUA and the Department of Physics and the financial support of the younger scientists. In that aspect, it is of the outmost importance to halt and reverse the brain drain of young scientists observed the last years in Greece. Moreover, many of the most significant results in this field were achieved by researchers working in European institutions and many of the major conferences and workshops in the field have taken place in Europe. The topics of this area have attracted a lot of attention worldwide with several groups working in these subjects (in UK, Spain, Switzerland, US, France, Brazil etc). Materializing the goals and objectives of the project will sustain and further enhance the reputation of the NKUA as well as European competitiveness in these and related subjects.

The importance of this funding

Please describe in short (max. 150 words) what the H.F.R.I. funding of your research project means to you.

The funding allowed me to employ top level younger scientists in order to work on the project. This contributed to the brain gain as well. In addition, since I believe that internationally competitive scientists should gain more from their work, the funding increased the low university (with EE standards) salary academics are getting towards the low-average of the EE standards.

H.F.R.I.
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Research & Innovation

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