



# ANDREA RAZMADZE MATHEMATICAL INSTITUTE

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## Razmadze Mathematical Institute Report on the PhD thesis presented for the degree of candidate in physical and mathematical sciences

**The author of the thesis:** Melik Karapetyan

**The title of the thesis:** Interacting Higher Spin Theories in Flat and AdS Spaces

The PhD thesis of Melik Karapetyan is devoted to the study of interacting higher spin (HS) gauge theories. In particular, the author investigates the construction of cubic interactions in AdS spaces in a covariant form and analyses local quartic interaction between the HS gauge field and the scalar field in the flat space. The topic of the thesis is in the mainstream of contemporary high energy theoretical physics with possible applications in quantum gravity. One has to note that the supervisor of the thesis work is a well-known expert in this field.

The thesis starts with a short review of the work, which is similar to the synopsis, and ends with a short summary and the bibliography with 67 references. The main part of the thesis is given in three chapters, where the details of the work are discussed. A remarkable feature of the thesis is an active usage of the Wolfram Mathematica programming, which became very effective for the analysis of complicated relations created by the higher rank tensor structures. The thesis is based on six publications of the author. Two of them are published in Nuclear Physics B, which remains one of the most high-ranking journals in this field.

The first chapter of the thesis has mainly a pedagogical character, where the author gives a review of necessary ingredients from HS theory. Namely, he describes the Fronsdal formalism and the Noether procedure, together with polynomial notations, which simplify the HS objects. The Wolfram Mathematica language is also introduced here to demonstrate its usage with polynomial notations.

The chapter 2 contains the most remarkable result of the thesis, which is a construction of the cubic interaction in AdS spaces in a covariant form. This chapter is based on three publications. M. Karapetyan is a single author in one of them. Two other papers were conducted together with his supervisor and another prominent physicist Rubik Pogossian.

The chapter 3 is based on three other publications of the author. Here he constructs local quartic interaction of two scalars and two spin four fields in the physical gauge. Then, the commutator of gauge transformations is analyzed and, to handle the technical problems, the Wolfram Mathematica packages are used here as well.

As was noted, the main results presented for the defense were obtained in collaboration with leading specialists and they were published in a high-ranking journal of the field. This defines the high level of the conducted work.

To summarize the report: the obtained results of the thesis give a valuable contribution to the study of modern problems of theoretical high energy physics and its author Melik Karapetyan deserves the degree of candidate in physical and mathematical sciences.

Prof. Dr. George Jorjadze  
Chief researcher at Razmadze Mathematical Institute

*G. Jorjadze*

August 15, 2022

The report was discussed and accepted by the members of the regular seminar on problems of theoretical and mathematical physics at Razmadze Mathematical Institute. The meeting attended by the professors:  
A. Elashvili, G. Giorgadze, G. Jorjadze, T. Kadeisvili and A. Kvinikhidze.

The signature of Prof. Jorjadze certify

Director of Razmadze Mathematical Institute

of TSU

Prof. Nino Partsvania

