Report on the

**SCIENTIFIC AND TECHNICAL JUSTIFICATION FOR OPENING A NEW THEME**

**OR FOR EXTENDING THEME**

**to be included in the**

**TOPICAL PLAN FOR JINR RESEARCH FOR 2019–2023**

The Bogolyubov Laboratory for Theoretical Physics is running two research themes related to high-energy (or particle) physics, two more are connected with solid state and low-energy nuclear physics, respectively, one more is education. Earlier we were hearing and discussing some theoretical themes from experimental laboratories and oriented to the experimental research conducted there.

The present one is purely “theoretical theory”. Let us briefly list the main ideas and objectives behind the proposed them:

Mathematical physics shows increasing interest in identifying and effective use of integrability in various areas, and in applying powerful mathematical methods of quantum groups, supersymmetry and non-commutative geometry to quantum theories of fundamental interactions as well as to classical models. The main goals and tasks of the research within the theme include:

- development of new mathematical methods for investigation and description of a variety of classical and quantum integrable models and their exact solutions;

- analysis of a wide range of problems in supersymmetric theories including models of superstrings and superbranes, study of nonperturbative regimes in supersymmetric gauge theories;

- development of cosmological models of the early Universe, primordial gravitational waves and black holes.

It is of high interest to quantize such theories, to compute their quantum effective action and to learn the full structure of admissible counterterms. For such an analysis, of high importance is the formalism of harmonic superfields with the maximal number of manifestly realized supersymmetries. Applications of these superfield methods to analyze the higher-dimensional counterterms in the theories just mentioned as well as to check the hypothesis about profound relationships between the relevant quantum effective actions and the Born-Infeld type actions is among the priorities

BLTP is planning investigations of the confinement-deconfinement transportation, using exact solutions of the holographic flow of renormgroup with SL(2,C)-symmetry and AdS-fixed point will be continued including

- the construction of holographic RG flows with a couple of effictive charges. Interpretation of the flows as a collection of branes in the corresponding supergravity theory;

- studies of the transport coefficients of quark-gluon plasma using holographic approach in 5 dimensional Kerr - AdS solution.

I have also some critical remarks: large part of the project is just a list of “advanced” “super-topics”, such as integrability, quantum groups, supersymmetry with little or no use for experiments, The number of potential collaborates is huge. In my opinion, management of this team may require much effort, and quantity does not necessarily transforms in quality. These theorists prefer any dimension but 4. Realistic approaches to quark confinement (central problem in the standard theory) are not discussed, not to mention comparison with the data.

Still, I suggest to support this Proposal at first priority. 

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