



# SUMMARY

(FNSF-2004)

Reg. No.:

**Project Leader** Title, Rank, Degrees, Family Name, First Name, Middle Name:

Corresponding member of BAS, Prof., Dr.Sc., Petkova, Valentina, Borissova

**Project Title:**

New paradigms for the fundamental structure of matter

## Summary

This project is motivated by the rapid development of string theory as unified theory of the fundamental forces in nature and the structure of matter - both at the level of elementary particles and the cosmological scale (origin, structure and evolution of the universe). String theory is based on quantum field theory and relativistic gravity and cosmology (Einstein's theory of relativity and its modern generalizations) in a synergistic symbiosis with modern branches of pure and applied mathematics. The project is aimed at priority "3. New materials and technologies, including research in chemistry, physics and engineering sciences", and more specifically - fundamental research in particle physics and astrophysics with a focus on contemporary aspects of quantum field theory and relativistic gravity in the context of string theory. The objectives of this project are: (i) to acquire new knowledge about the structure and behavior of matter at ultramicroscopic and galactic distances; (ii) to contribute to solving "the mystery" about the cardinal problems of modern physics with a global ideological significance - "supersymmetry", "extra space-time dimensions," "dark matter" and "dark energy" in the universe; (iii) to contribute to the preparation of highly qualified specialists for professional realization in such important innovative fields of science and technologies of the future as "relativistic quantum informatics" and "new energy sources based on sub-nuclear and relativistic-gravitational processes." The project is interdisciplinary, inter-institutional, connected with a number of prestigious international projects, incl. those with European funding, includes many young specialists. We plan to organize several working groups in close collaboration whose main tasks will lead to the main results of the project: (1) Gravity and cosmology - thermodynamics and entropy in the physics of black holes and space-time portals ("wormholes"), supersymmetry and supergravity, astrophysics and gravitational waves; (2) Duality between quantum gauge field theories and gravity; (3) Quantum field theory and quantum computers; (4) Mathematical aspects - group-theoretic, algebraic and geometric approaches to quantum field theory and string theory.

## Keywords:

black holes, space-time portals ("wormholes"), gravitational waves, extra space-time dimensions, p-dimensional membranes, thermodynamics and entropy, quantum braided ("entanglement"), holographic duality gravity/gauge field theories, conformal symmetry, supersymmetry, dynamically spontaneous symmetry violation, integrability, quantum Hall effect, quantum computers, quantum groups, vertex algebras, unconventional quantum statistics, (super)-Lie algebras