Quantum Fields in curved Spacetimes

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The discoveries of the last ten years [Riess1998, Maldacena1998] pose new important problems in the study of relativistic theories of gravitation and in field/string theory, both at the classical and at the quantum level. In the present project we plan to tackle some of these problems with the methods proper to mathematical physics. Two general themes can be identified:

A) Quantum field theory on the de Sitter anti de Sitter and Lobatchevski manifolds with applications to cosmology, statistical physics and integrable models

B) Classical relativistic cosmological models of dark energy modelization

In each of the above directions our research team has already given internationally acknowledged contributions and opened successfully entirely new research directions. Methods that we have introduced for the study of de Sitter and anti de Sitter quantum field theories constitute the state of the art. As regards the classical relativistic models of dark energy, a model invented by us, the (generalized) Chaplygin gas cosmological model is one of the best in the arena of models competing in accounting for the properties of dark energy

The research directions covers several topics in classical and in quantum field theory in curved spacetimes with particular (but not exclusive) reference either to models having constant spacetime curvature, or to models having just constant spatial curvature, mainly hyperbolic models. In particular we plan to investigate:
1) The de Sitter stability properties ;
2) Quantum theories in Lobatchevski - Euclidean anti de Sitter universe.
3) Relativistic cosmological models of dark energy with special reference to the Chaplygin gas
4) The fate of the universe and cosmological singularities.