Gravity and Cosmology Seminar

December 14, 2023 (Thursday), h. 10:15

The seminar will be held in room 404 @Pasteura 7

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Quantum Analysis of the Bianchi IX model: Exploring Chaos

ABSTRACT: According to the Belinski-Khalatnikov-Lifshitz conjecture, the Bianchi IX spacetime describes the evolution of each spatial point close to a generic spacelike singularity. However, near the singularity, quantum effects are expected to be relevant. Therefore, in this work a quantum analysis of the model is performed, mainly focusing on its chaotic nature. Considering some minimal approximations, it is possible to encode all the information of the quantum degrees of freedom in certain canonical variables, expanding thus the classical phase space. In this way, we can apply the usual methods of dynamical systems for studying chaos. In particular, two techniques are considered. On the one hand, an analytical study is carried out, which provides an isomorphism between the quantum dynamics of Bianchi IX and the geodesic flow on a Riemannian manifold. On the other hand, by means of numerical simulations, the fractal dimension of the boundary between points with different outcome in the space of initial data is studied. The main conclusion is that, although the quantum system is chaotic, the quantum effects considerably reduce this behavior as compared to its classical counterpart.

Organizers: P. Małkiewicz & J. Ostrowski