

## Spanish and Portuguese Relativity Meeting



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# On the torsion, nonmetricity & gauge invariance in the formulation of the gravitational field equation as an equation of state and in the laws of black hole thermodynamics

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This project has as its general objective the extension of the classical formulation of gravity, considering it not only as a geometric theory, but as a consequence of the laws of thermodynamics applied to accelerated observers. The general case involving curvature, torsion and non-metricity will be addressed, in the context of gauge theories of gravity, with emphasis on the complete generalization of Lovelock's theorem in four dimensions. Specific objectives include obtaining the generalized version of T. Jacobson's result, which identifies the gravitational interaction as a consequence of the thermodynamics on Riemannian manifolds, considering not only curvature, but also torsion and non-metricity. Furthermore, we seek to completely generalize Lovelock's theorem in an arbitrary number of dimensions for non-Riemannian geometries. The results obtained in these two objectives will be compared to evaluate their implications. The project also proposes to search for analytical and numerical solutions of black holes for the class of theories of gravity that belong to both the generalized version of T. Jacobson's result and the generalized version of Lovelock's theorem in four dimensions, and that are also aligned with the gauge theories of gravity. The laws of black hole dynamics will be determined for this class of theories and the relationship between these laws and the laws of thermodynamics will be investigated. In summary, this project addresses a novel perspective on gravity, exploring its connection with the laws of thermodynamics and proposing significant generalizations within the framework of gauge theories, thus contributing to the advancement of the understanding of gravitational physics in broader contexts.

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