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Jacobson's thermodynamic approach to classical gravity applied to non-Riemmanian geometries: remarks on the simplicity of nature

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Three decades ago, Ted Jacobson surprised us with a very appealing approach to General Relativity. According to his proposal, the gravitational field equations are the consequence of the first law of thermodynamics applied to a Rindler observer. Together with the dynamical laws of the black holes, Jacobson's approach has become a very strong piece of evidence supporting the intimate connection between gravity, thermodynamics, and quantum theory. By the time, advances in this direction have been, nevertheless, somewhat scarce. Jacobson's approach being formulated for Riemmanian geometries, we have wondered what its consequences would be for non-Riemmanian geometries, i.e., those that involve both torsion and non metricity. The results of our quest have been particularly appealing: we have found that, in an arbitrary number of dimensions, the Einstein-Hilbert action remains as one of the possibilities that nature could have selected in agreement with Jacobson's proposal (the only one, indeed, for Riemmanian geometries). There exist other "more complex"possibilities if either torsion or non metricity or both are involved. In the search of a unique alternative, we have been led towards an analysis of additional requirements like, for instance, one or some of the set employed in the formulation of the Lanczos-Lovelock theories of gravity.

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