

## Spanish and Portuguese Relativity Meeting



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# Space-time symmetry breaking and the mystery of dark matter

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If 4D diffeomorphism invariance were to break down to 3D diffeomorphisms on the leaves of a preferred foliation something dramatic would happen to the Universe, even after full 4D diffeo symmetry is restored. The usual algebra of constraints of General Relativity would feel the symmetry breaking effects for ever after the end of the symmetry breaking phase in the form of a leftover violation of the Hamiltonian constraint. We show that this violation can be seen as a form of dark matter, with the Dirac algebra and the geodesic nature of the foliation determining whether this is something almost equivalent to cold dark matter, or an entirely new beast altogether. Scenarios where this early tragedy in the life of the Universe comes to pass include the mainstream Horava-Lishitz gravity model but also theories with evolution in the laws of physics (in terms of global time variables generalizing 4-volume time in unimodular theories), or any other theory with global or Machian interactions. We provide examples of astrophysical implications.

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