Seminario
Departamento de Física Teórica

"Confinement of ghosts and stability in higher derivative quantum gravity"

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Abstract:

The presence of higher derivatives in the gravitational action is required for renormalizability in semiclassical and quantum gravity. On the other hand, higher derivatives produce unphysical massive ghosts, making classical solutions unstable and quantum theory non-unitary. Trying to resolve this contradiction, we explore classical cosmological solutions in the presence of ghosts and find out that instability takes place only if the seeds of initial perturbations are about the Planck order of magnitude, such that the ghost can be generated from the vacuum. In the superrenormalizable versions of quantum gravity, there may be a pair of complex conjugate massive poles. In this case, the complex ghost-like states may form normal bound states. For a while, the demonstration of this mechanism was achieved only for a simplified toy model that reproduces the general structure of the ghost-like poles. This model is much simpler than quantum gravity. However, suppose the same situation takes place in realistic higher derivative models. In that case, such a mechanism may explain the existence of the Planck scale cut-off for the frequencies of gravitational perturbations and resolve the problem of ghosts. At low energies, we show, using another toy model, how the IR limit of the fundamental theory fits the UV limit of the effective low-energy theory.

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