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Black holes in a bouncing universe

Abstract:

Bouncing universes are alternative models to the standard cosmological model (ΛCDM) that solve the problem of the initial cosmological singularity present in the ΛCDM model by construction. The bounce is preceded by a contraction phase starting from a practically flat and dilute universe. After the bounce, the universe evolves into the current expansion stage as described by the ΛCDM model. During the contraction, most of the structure of the universe disappears. However, since black holes are regions of spacetime with a specific curvature, they could survive the bounce.

The aim of this work is to analyze the evolution of a black hole gas in the phases of contraction, bounce and expansion. In turn, we determine how the cosmological background fluid is affected by the presence of the black holes. To this end, we have developed a cosmological model of a two-fluid interaction. We determine the evolution of the population of black holes and the cosmological background fluid by solving an integro-differential system of equations, which are derived from the conservation of the energy-momentum tensor and the cosmological equations of General Relativity. We find that the presence of the black hole population substantially affects the behaviour of the cosmological fluid near the bounce.

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