Contribution ID: **228** Type: **Talk in the parallel session**

Wormhole geometries induced by action-dependent Lagrangian theories

Tuesday, 6 July 2021 12:15 (15 minutes)

In this work, we explore wormhole geometries in a recently proposed modified gravity theory arising from a non-conservative gravitational theory, tentatively denoted action-dependent Lagrangian theories. The generalized gravitational field equation essentially depends on a background four-vector λ^{μ}, that plays the role of a coupling parameter associated with the dependence of the gravitational Lagrangian upon the action, and may generically depend on the spacetime coordinates. Considering wormhole configurations, by using "Buchdahl coordinates", we find that the four-vector is given by $\lambda_{\mu} = (0, 0, \lambda_{\theta}, 0)$, and that the spacetime geometry is severely restricted by the condition $g_{tt}g_{uu} = -1$, where u is the radial coordinate. We find a plethora of specific asymptotically flat, symmetric and asymmetric, solutions with power law choices for the function λ, by generalizing the Ellis-Bronnikov solutions and the recently proposed black bounce geometries, amongst others. We show that these compact objects possess a far richer geometrical structure than their general relativistic counterparts.

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Session Classification: Wormholes, Energy Conditions and Time Machines

Track Classification: Alternative Theories: Wormholes, Energy Conditions and Time Machines