Journal of Cosmology and Astroparticle Physics, 2015, vol.2015, N6

Giant wormholes in ghost-free bigravity theory

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Abstract

We study Lorentzian wormholes in the ghost-free bigravity theory described by two metrics, g and f. Wormholes can exist if only the null energy condition is violated, which happens naturally in the bigravity theory since the graviton energy-momentum tensors do not apriori fulfill any energy conditions. As a result, the field equations admit solutions describing wormholes whose throat size is typically of the order of the inverse graviton mass. Hence, they are as large as the universe, so that in principle we might all live in a giant wormhole. The wormholes can be of two different types that we call W1 and W2. The W1 wormholes interpolate between the AdS spaces and have Killing horizons shielding the throat. The Fierz-Pauli graviton mass for these solutions becomes imaginary in the AdS zone, hence the gravitons behave as tachyons, but since the Breitenlohner-Freedman bound is fulfilled, there should be no tachyon instability. For the W2 wormholes the g-geometry is globally regular and in the far field zone it becomes the AdS up to subleading terms, its throat can be traversed by timelike geodesics, while the f-geometry has a completely different structure and is not geodesically complete. There is no evidence of tachyons for these solutions, although a detailed stability analysis remains an open issue. It is possible that the solutions may admit a holographic interpretation.

http://dx.doi.org/10.1088/1475-7516/2015/06/017

Keywords

dark energy theory, modified gravity, Wormholes