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Lorentzian Wormhole in the framework of Loop Quantum Cosmology

In this paper, we construct a traversable static Lorentzian wormhole in the effective scenario of Loop Quantum Cosmology (LQC), where the field equations are modified due to the ultraviolet (UV) corrections introduced at large space-time curvatures. A stable wormhole can be constructed in the effective scenario without the violation of Null energy condition (NEC) by physical matter at the throat. The NEC is effectively violated due to the corrections in the field equations from LQC, resolving the Weyl curvature singularity at the throat. However, the physical matter does violate the Strong energy condition (SEC), suggesting the interesting possibility that dark energy can be harnessed into a wormhole. A possible explanation for this is the presence of inherent pressure isotropy in the UV-corrected field equations (discussed and compared to braneworld wormholes in the discussion). No additional exotic ingredient (violating NEC) is required, avoiding quantum instabilities. The tidal forces at the throat do not diverge and also the throat is found to be stable. The wormhole features an attractive geometry. LQC can resolve both types of curvature singularities appearing at the black hole centre and wormhole throat, without exotic matter.

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