

Abstract

Wormholes Created by Vacuum Fluctuations †

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Possible vacuum fluctuations of quantized fields can create wormholes. The description of such effects is possible within the framework of the semiclassical theory of gravitation. The main difficulty of such a theory is that the vacuum polarization effects are determined by the topological and geometrical properties of spacetime as a whole or by the choice of quantum state in which the expectation values are taken. Only some spacetimes with high degrees of symmetry for the conformally invariant field equations of the theory of semiclassical gravity can be solved exactly. Let us stress that the single parameter in the problem is the Planck length l_{PL} . This implies that the characteristic scale of the spacetime curvature can differ from l_{PL} only if there is a large parameter. As an example of such a parameter, one can consider the non-zero temperature of quantum state for the quantized field. It is known that the high-temperature limit $\langle T_{\mu\nu} \rangle$ for such a thermal state is proportional to the fourth power of the temperature. Here, the vacuum polarization effect of a quantized scalar field in a thermal state at an arbitrary temperature is considered. The scalar field is assumed to be both massive and massless, with an arbitrary coupling ξ to the scalar curvature, and in a thermal state at an arbitrary temperature. The gravitational background is assumed to be static spherically symmetric and slowly varying.

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