

# Anomalous diffusion and factor ordering in (1+1)-dimensional Lorentzian quantum gravity

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Using properties of diffusion according to a quantum heat kernel constructed as an expectation over classical heat kernels on  $S^1$ , we probe the non-manifold-like nature of quantized space in a model of (1+1)-dimensional quantum gravity. By computing the mean squared displacement of a diffusing particle, we find that diffusion is anomalous, behaving similarly to that on a porous substrate, network, or fractal over short distances. The walk dimension of the path for a particle diffusing in quantized space is calculated to have an infimum of 4, rising to arbitrarily large values depending on a parameter labeling the choice of factor ordering in the quantum Hamiltonian for our model and figuring in the asymptotic behavior of the wavefunction used to construct the quantum heat kernel. Additionally, we derive an expansion for return probability of a diffusing particle, whose modifications from the classical power-series form depend on the factor-ordering parameter.

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