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Ground state for a real scalar field in the cosmic string spacetime with arbitrary boundary conditions

We consider a real, massive scalar field in the cosmic string spacetime. First, we determine all admissible boundary conditions that can be applied at the conical singularity, and we find that no "bound state" solutions exist under these conditions. Next, we construct the two-point function for the ground state that satisfies these boundary conditions, deriving an explicit closed-form expression. Additionally, we analyze the singularities of the resulting two-point functions, demonstrating that they meet the Hadamard form requirement in every globally hyperbolic subregion of the cosmic string spacetime.

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