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Finite size effects in the thermodynamics of a free neutral scalar field on the lattice and in the continuum

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The exact analytical lattice results for the partition function of the free neutral scalar field in one spatial dimension in both the configuration and the momentum space were obtained in the framework of the path integral method. The symmetric square matrices of the bilinear forms on the vector space of fields in both configuration space and momentum space were found explicitly. The exact lattice results for the partition function were generalized to the three-dimensional spatial momentum space and the main thermodynamic quantities were derived both on the lattice and in the continuum limit. The thermodynamic properties and the finite volume corrections to the thermodynamic quantities of the free real scalar field were studied.

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