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Sine-Gordon model at finite temperature: the method of random surfaces

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The sine-Gordon theory is a paradigmatic integrable field theory, relevant for the description of many 1D gapped systems. Despite its integrability, calculating finite temperature physical quantities, such as correlation functions, remains a challenge. We generalize the numerical method of random surfaces to compute the free energy, and finite temperature one- and two-point correlation functions of exponential operators non-perturbatively. We demonstrate the method's accuracy by comparing our results to the predictions of other methods and to exact results in the thermodynamic limit, finding excellent agreement when the temperature is not too small with respect to the mass gap.

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