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Application of the Lefschetz thimble formulation to the (0+1) dimensional Thirring model at finite density

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We investigate the (0+1) dimensional Thirring model at finite chemical potential by HMC simulations based on the Lefschetz thimble formulation of path-integration. We adopt the lattice model defined with staggered fermion and a compact link field for the auxiliary vector field. We firstly find the critical points (saddle points) under the assumption that the complexified link field is space-time independent, and investigate gradient flows and the Stokes phenomenon to identify the thimbles which contribute to the path-integral. Then, we perform lattice simulations using HMC algorithm with taking one particular thimble and the results are compared to the exact solution. The numerical results are in agreement with the exact ones in small and large chemical potential regions, while we observe a discrepancy between the numerical and exact results around the intermediate transition region in the chemical potential. We also discuss the result in relation to the contributions of the other thimbles.

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