The Generalized Gibbs Ensenble in the Heisenberg spin chain: A Hilbert space Monte Carlo approach

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I. INTRODUCTION

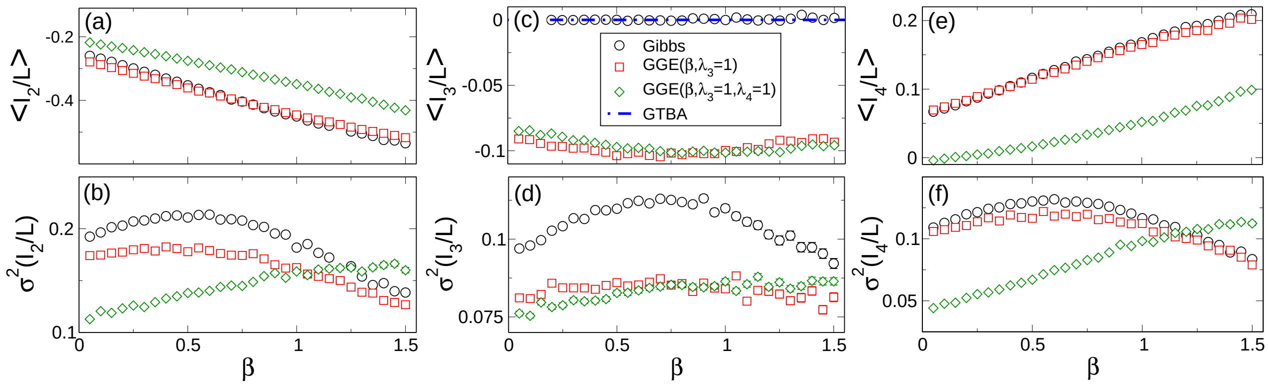

FIG. 1. The Generalized Gibbs Ensemble (GGE) for the finite-size Heisenberg spin chain with $L = 16$ sites. The GGE is constructed including the conserved charges I_2, I_3, I_4. The corresponding Lagrange multipliers are denoted as $\lambda_2, \lambda_3, \lambda_4$. Here I_2 is the Hamiltonian and $\lambda_2 \equiv \beta$ the inverse temperature. (a) The GGE average $\langle I_2/L \rangle$ of I_2/L plotted as a function of β. The data are obtained using the Hilbert space Monte Carlo approach described in the manuscript. The different symbols correspond to GGEs with different fixed values of λ_3 and λ_4. The circles correspond to the Gibbs ensemble. (b) The fluctuations $\sigma^2(I_2)/L \equiv \langle (I_2/L)^2 \rangle - \langle I_2/L \rangle^2$ as function of $0 \leq \beta \leq 1.5$. (c)(d) and (e)(f): Same as in (a)(b) for I_3 and I_4, respectively. In all panels the dash-dotted lines are the analytical results obtained using the Generalized Thermodynamic Bethe Ansatz (GTBA) approach.

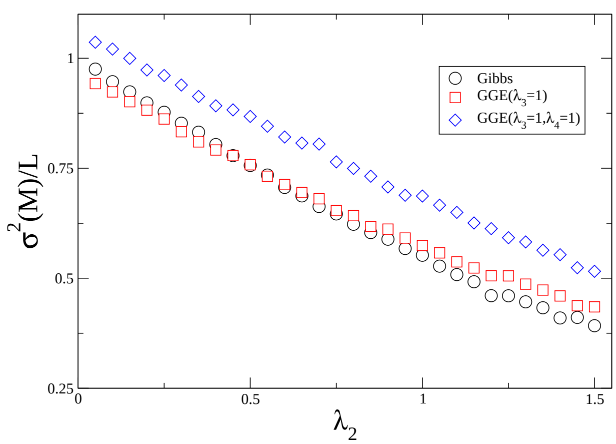

FIG. 2. The Generalized Gibbs Ensemble (GGE) in the Hisenberg spin chain of length $L = 16$. The GGE is obtained including the first three non-trivial conserved quantity I_2, I_3, I_4. Here I_2 is the Hamiltonian. The corresponding Lagrange multipliers are denoted as $\lambda_2, \lambda_3, \lambda_4$, with λ_2 being the inverse temperature $\lambda_2 = \beta$. In all the panels circles, squares, and rhombi correspond to the the situations with $\lambda_3 = \lambda_4 = 0$ (i.e., the Gibbs ensenble), $\lambda_3 = 1, \lambda_4 = 0$, and $\lambda_3 = \lambda_4 = 1$. The GGE expectation value for the fluctuations of the total magnetization M, plotted as a function of λ_2.

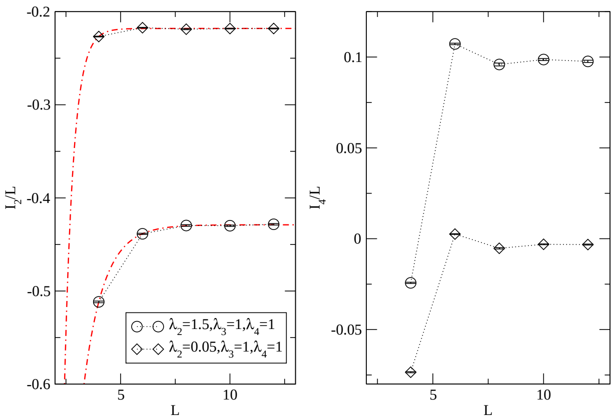

FIG. 3. The Generalized Gibbs Ensenble (GGE) in the Hisenberg spin chain of length $L = 16$. The GGE is obtained including the first three non-trivial conserved quantity I_2, I_3, I_4. Here I_2 is the Hamiltonian. The corresponding Lagrange multipliers are denoted as $\lambda_2, \lambda_3, \lambda_4$, with λ_2 being the inverse temperature $\lambda_2 = \beta$. In all the panels circles, squares, and rhombi correspond to the the situations with $\lambda_3 = \lambda_4 = 0$ (i.e., the Gibbs ensenble), $\lambda_3 = 1, \lambda_4 = 0$, and $\lambda_3 = \lambda_4 = 1$. The GGE expectation value for the fluctuations of the total magnetization M, plotted as a function of λ_2.