Erratum: Magnetic excitations, nonclassicality, and quantum wake spin dynamics in the Hubbard chain [Phys. Rev. B 106, 085110 (2022)]

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Due to an error in the code used to calculate χ'' and, hence, quantum Fisher information (QFI), the QFI values reported in our paper are underestimated by a factor of 2, cf. the related correction [1]. Figure 1 provides a corrected version of Fig. 3 in the paper. After this correction, the QFI is capable of witnessing at least bipartite entanglement in the Hubbard chain for all $u > 0$ (with the energy resolution $\eta = 0.05\tilde{t}$). For $u > 2.5$, the QFI becomes capable of witnessing at least tripartite entanglement. For the case of energy resolution scaled as $\eta \propto 1/L$, the sentence in Sec. IV B starting with "The lowest u at which..." should be modified to read "The lowest u at which *tripartite* entanglement is witnessed is $u = 3.0$ for $L = 64$, $u = 2.75$ for $L = 80$, $L = 96$, and $u = 2.5$ for $L \geqslant 112$." In footnote 4, the value of nQFI for the Heisenberg chain should be nQFI ≈ 4.4, which is compatible with Ref. [2] following the correction in Ref. [1].

We also note typographical errors in the expressions given for the fluctuation-dissipation theorem stated in the text on p. 2 and in footnote 1, which lack prefactors of π. The frequency-symmetrized fluctuation-dissipation theorem in the text should read $\chi''(\mathbf{k}, \hbar\omega, T) = \pi\ \tanh(\hbar\omega/2k_BT)\tilde{S}(\mathbf{k}, \hbar\omega)$. Footnote 1 should be corrected to read "The fluctuation-dissipation relation

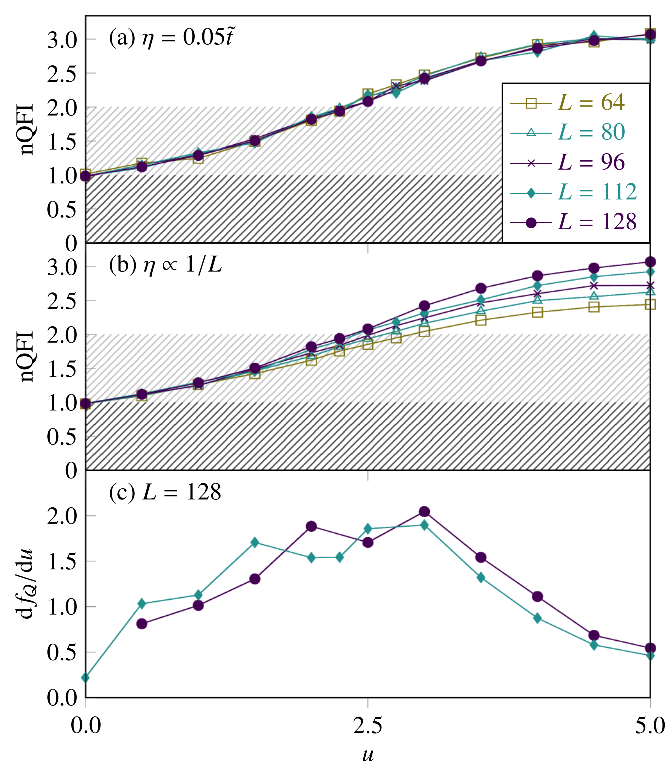

FIG. 1. (a) The normalized QFI (nQFI) as a function of $u = U/\tilde{t}$, calculated from $S(k = \pi, \omega)$ where elastic contributions have been removed and with $\eta = 0.05\tilde{t}$ for several system sizes. For nQFI > 1 (i.e. outside the dark shaded region), at least bipartite entanglement is witnessed by QFI. For nQFI > 2 (i.e. outside the shaded regions), at least tripartite entanglement is witnessed. For this energy resolution, we find $u = 2.5$ to be the lowest interaction strength at which tripartite entanglement may be witnessed. (b) The nQFI evaluated for $\eta \propto 1/L$, i.e., with size-dependent energy resolution. A suppression of nQFI is found for smaller systems, primarily at higher u values. (c) The first derivative of the $L = 128$ nQFI, calculated using both a standard forward finite difference (circles) and the Fornberg finite difference method (diamonds). Together these curves indicate a broad peak around $u = 2.5$.

states $S(\mathbf{k}, \hbar\omega) = \pi(1 - e^{-\hbar\omega/k_BT})^{-1}\chi''(\mathbf{k}, \hbar\omega, T)$. Detailed balance yields $S(\mathbf{k}, -\hbar\omega) = \pi(e^{\hbar\omega/k_BT} - 1)^{-1}\chi''(\mathbf{k}, \hbar\omega, T)$ and, thus, $S(\mathbf{k}, \hbar\omega) + S\mathbf{k}, -\hbar\omega) = \pi \ \coth(\frac{\hbar\omega}{2k_BT})\chi''(\mathbf{k}, \hbar\omega, T)$."

These changes do not affect our results for quantities other than QFI or conclusions regarding the crossover from itinerant to localized physics. However, our revised results show that QFI at a particular energy resolution detects a higher entanglement depth than estimated in the original paper, rendering QFI a more powerful experimental probe.

[1] A. Scheie, P. Laurell, A. M. Samarakoon, B. Lake, S. E. Nagler, G. E. Granroth, S. Okamoto, G. Alvarez, and D. A. Tennant, Erratum: Witnessing entanglement in quantum magnets using neutron scattering [Phys. Rev. B 103, 224434 (2021)], Phys. Rev. B **107**, 059902(E) (2023).

[2] A. Scheie, P. Laurell, A. M. Samarakoon, B. Lake, S. E. Nagler, G. E. Granroth, S. Okamoto, G. Alvarez, and D. A. Tennant, Witnessing entanglement in quantum magnets using neutron scattering, Phys. Rev. B **103**, 224434 (2021).