Erratum: Quantifying and Controlling Entanglement in the Quantum Magnet Cs_2CoCl_4 [Phys. Rev. Lett. 127, 037201 (2021)]

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Two mistakes were made in our Letter concerning the definition of the fluctuation-dissipation theorem. Since the theoretical background is discussed in the related Erratum [1] (for Ref. [2], which was affected by the same issues), we will only state the required corrections here. As we only analyzed positive energy transfer data, the fluctuation-dissipation theorem stated in the text $\chi''(k, \hbar\omega, T) = \tanh(\hbar\omega/2k_BT)S(k, \hbar\omega)$ should be replaced with the expression valid for nonsymmetrized $S(k, \hbar\omega)$ data [3]

$$\chi''(k, \hbar\omega, T) = \pi(1 - e^{-\hbar\omega/k_BT})S(k, \hbar\omega). \tag{1}$$

Because of an error in the computer code used to calculate χ'' (and hence QFI) we inadvertently instead used $\chi''(k, \hbar\omega, T) = (\pi/2)(1 - e^{-\hbar\omega/k_BT})S(k, \hbar\omega)$. Thus all χ'' and QFI values reported in our Letter are underestimated by a factor of 2. Corrected versions of Figs. 2 and 4 of the Letter are provided in Figs. 1 and 2 of this Erratum, respectively. Figures in the Supplemental Material have also been updated accordingly. This correction implies that QFI is a more powerful tool for witnessing entanglement in condensed matter systems than we initially reported. In particular, Fig. 2(c) now indicates that bipartite entanglement is witnessed experimentally in Cs_2CoCl_4 up to at least 1 T, and that tripartite entanglement is obtained from the polarization-factor-corrected data at low fields.

We thank Varun Menon for originally bringing this issue to our attention in the context of Refs. [1,2].

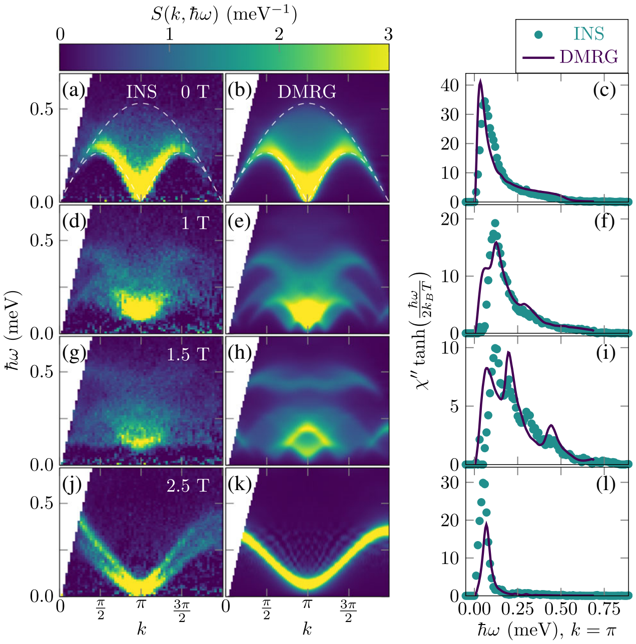

FIG. 1. (a),(d),(g),(j) INS spectra for Cs_2CoCl_4 at four representative field strengths. (b),(e),(h),(k) Calculated spectra for the XXZ chain at matching fields, accounting for the experimental polarization factor. (c),(f),(i),(l) QFI integrand at $k = \pi$. White dashed lines in (a),(b) bound the two-spinon continua. Throughout we designate the wave vector component k along the chain in units of $1/b$.

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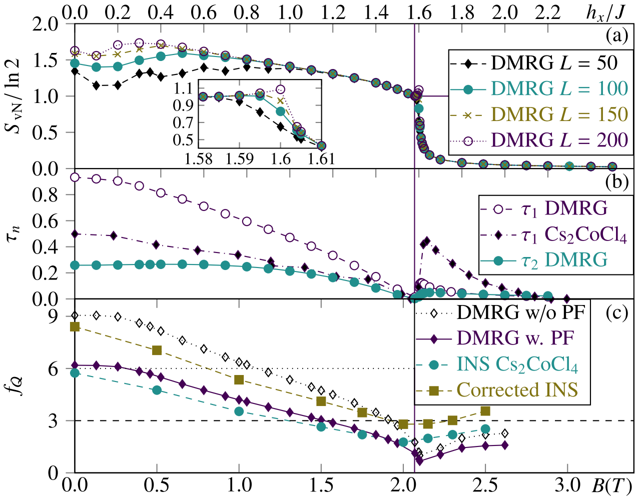

FIG. 2. (a) Entanglement entropy S_{vN} from DMRG as a function of h_x. The vertical line indicates the factoring field, where $S_{\mathrm{vN}} \approx \ln 2$ (horizontal line). For $h_x > h_{\mathrm{c}}$ there is a steep drop in entropy as the system enters a polarized phase with a nondegenerate ground state. Inset: EE near h_{c}. (b) The approximate one (τ_1) and two-tangles (τ_2) reach a minimum at h_{f}. (c) QFI from INS and DMRG $S(k, \hbar\omega)$. Above the horizontal dashed (dotted) line, QFI indicates the presence of *at least* bipartite (tripartite) entanglement. Below the dashed line QFI cannot be used to distinguish separable and entangled states. The PF-corrected INS f_Q line is obtained by scaling f_Q^{INS} by the ratio between the two DMRG f_Q values.

[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).

[3] S. Lovesey, *Theory of Neutron Scattering from Condensed Matter* (Clarendon Press, Oxford, 1984).