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Erratum: Entanglement transitions in the quantum Ising chain: A comparison between different unravelings of the same Lindbladian [Phys. Rev. B 105, 064305 (2022)]

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There is a mistake in Eq. (D5) in the original paper, which should read as follows:

$$\begin{aligned}\mathbb{M}_{i,i} &= 1 \quad \text{for } i \neq j, j+L,\\ \mathbb{M}_{j,j} &= \mathbb{M}^{-1}_{j+L\, j+L} = e^{-x}.\end{aligned} \tag{1}$$

As a consequence, the results of Sec. IV obtained by means of the quantum-jump protocol are not correct. In particular, the numerical data presented in Figs. 5 and 6 in the original paper have to be replaced with those shown in the corrected Figs. 5 and 6 below, respectively.

Our simulations, performed with the correct protocol, show that the resulting quantum-jump dynamics may also give rise to an area-law behavior, when the measurement rate γ is fixed and the transverse-field strength h_f exceeds a given threshold. Thus the logarithm-law behavior appears to be much more fragile, compared to what has been shown in the original paper. Nonetheless, we point out that the area-law behavior survives in a parameter range where the quantum-state-diffusion protocol predicts a logarithm-law phase, thus resulting in different threshold values for h_f for the two unravelings.

In conclusion, the original claim that different unravelings give rise to different entanglement behaviors is confirmed, since the two unravelings show different phase diagrams. For instance, at $\gamma = 1.5$ and $h_f = 2$, the quantum-state-diffusion protocol shows a logarithm law, while the quantum-jump protocol discloses an area law (cf. Fig. 6 in the original paper and Fig. 6 here). Moreover, in the area-law regime, quantum jumps generally produce much smaller values for the entanglement entropy (see curves for $h_f = 5$ and 8 in Fig. 6).

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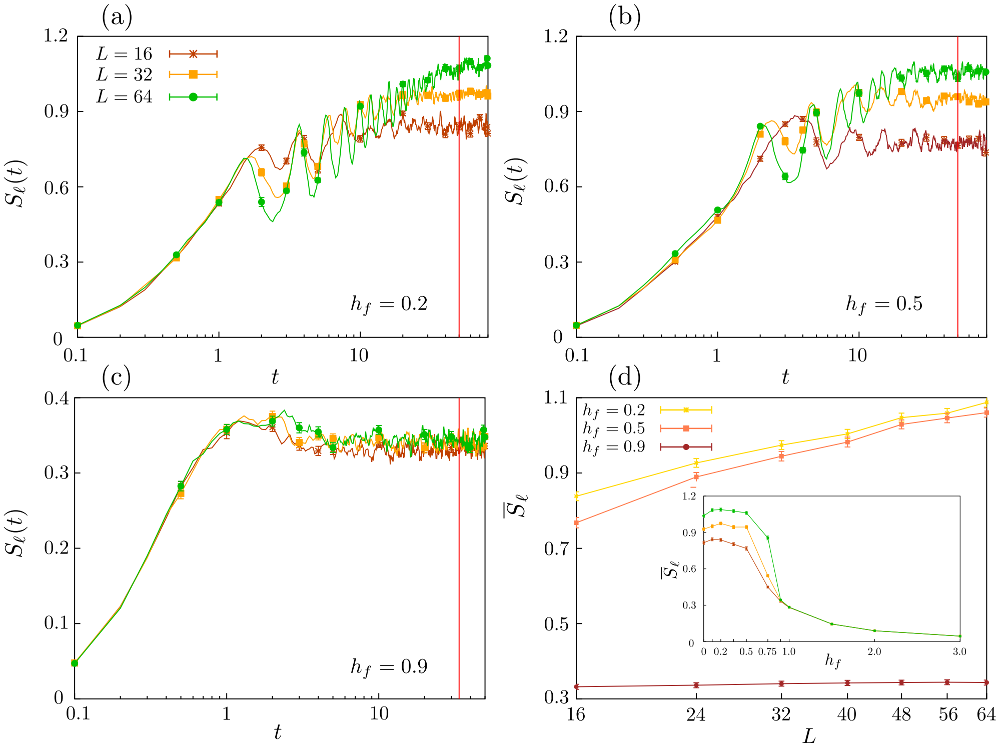

FIG. 5. Panels (a), (b), (c): The quantum-jump-dynamics entanglement entropy $S_\ell(t)$ versus time, for $h_f = 0.2, 0.5, 0.9$ and $\gamma = 0.5$. The various colors correspond to different system sizes L. Panel (d): The asymptotic value $\overline{S}_\ell$, obtained by averaging on times larger than t^* [cf. red line in panels (a), (b), (c)], for the three considered values of h_f, versus L (in semilog scale). The inset of panel (d) shows $\overline{S}_\ell$ versus h_f, evaluated for $L = 16, 32, 64$.

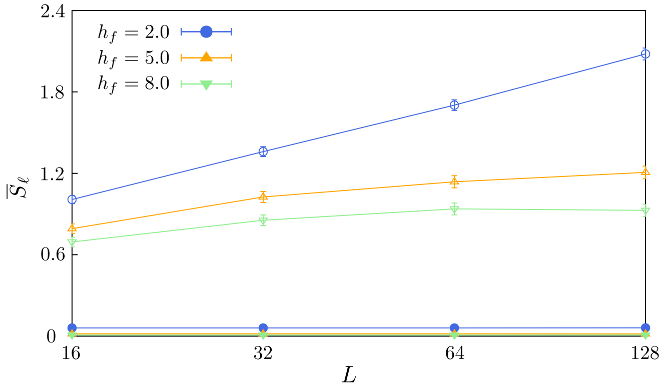

FIG. 6. Filled dots: Asymptotic entanglement entropy $\overline{S}_\ell$ versus the system size in the quantum-jump dynamics, for $h_f = 2, 5, 8$, and $\gamma = 1.5$ (in semilog scale). Empty dots: The corresponding results obtained with the quantum-state- diffusion scheme. Note the stable area-law behavior of the quantum-jump dynamics for $h_f = 2.0$, where, in contrast, quantum state diffusion shows a logarithm law (blue curves). Errors are comparable with the symbols size (not shown).