

Erratum: Phases and exotic phase transitions of a two-dimensional Su-Schrieffer-Heeger model [Phys. Rev. B **109**, 195154 (2024)]

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Equation (46) in the original paper should be replaced by

$$\frac{\partial F}{\partial \omega_0} = m\omega_0 \sum_b \langle \hat{X}_b^2 \rangle + \frac{g}{\omega_0} \sum_b \langle \hat{X}_b \hat{K}_b \rangle. \quad (1)$$

The equation can be derived by a canonical transformation of the position $\hat{X}_b \rightarrow \alpha \hat{\tilde{X}}_b$ and momentum $\hat{P}_b \rightarrow \frac{1}{\alpha} \hat{\tilde{P}}_b$ operators of the phonons. The canonical commutation relations $[\hat{X}_b, \hat{P}_{b'}] = [\hat{\tilde{X}}_b, \hat{\tilde{P}}_{b'}]$ and the partition function $Z = \text{Tr} e^{-\beta \hat{H}} = \text{Tr} e^{-\beta \hat{H}(\alpha)} = Z(\alpha)$ are invariant under this transformation, where we have used the following definition,

$$\hat{H}(\alpha) = \sum_b (-t + g\alpha \hat{\tilde{X}}_b) \hat{K}_b - \lambda \sum_b \hat{K}_b^2 + \sum_b \left(\frac{1}{2m\alpha^2} \hat{\tilde{P}}_b^2 + \frac{k\alpha^2}{2} \hat{\tilde{X}}_b^2 \right). \quad (2)$$

Both the electron-phonon coupling, $g^2/2k$, and the phonon frequency, $\omega_0 = \sqrt{k/m}$, are independent of α and constitute the two independent parameters required to fully define the model. Here, we will vary the phonon frequency while keeping the electron-phonon coupling constant. Varying the partition function with respect to the parameter α yields the following relation,

$$\left. \frac{\partial \ln Z(\alpha)}{\partial \alpha} \right|_{\alpha=1} = -\beta \sum_b \left\langle g\hat{\tilde{X}}_b \hat{K}_b - \frac{1}{m} \hat{\tilde{P}}_b^2 + k\hat{\tilde{X}}_b^2 \right\rangle = 0 = \frac{\partial \ln Z}{\partial \alpha}, \quad (3)$$

which can be used to calculate the derivative of the free energy with respect to the phonon frequency ω_0 ,

$$\frac{\partial F}{\partial \omega_0} = -\frac{2m}{\omega_0} \frac{\partial F}{\partial m} = \frac{1}{\omega_0 m} \sum_b \langle \hat{P}_b^2 \rangle = \frac{1}{\omega_0} \sum_b \langle g\hat{X}_b \hat{K}_b + k\hat{X}_b^2 \rangle. \quad (4)$$

As a consequence, two figures of the original paper have to be replaced. Figure 1(a) replaces Fig. 5(b) and Fig. 1(b) replaces Fig. 17(b) of the original paper. Around the critical phonon frequencies, the derivatives change their qualitative behavior, indicating the phase transitions. Importantly, the derivative at $t = 0.1$ remains smooth on the considered scale and on the finite lattices [Fig. 1(a)], where we argued for a deconfined quantum critical point or a weakly first-order transition between a $(\pi, 0)$ -ordered valence bond solid and an antiferromagnetic phase in the original paper. In Fig. 1(b), the dip in $\frac{1}{N_b} \frac{\partial F}{\partial \omega_0}$ reflects the crossover from the antiferromagnetic to pseudogap phase.

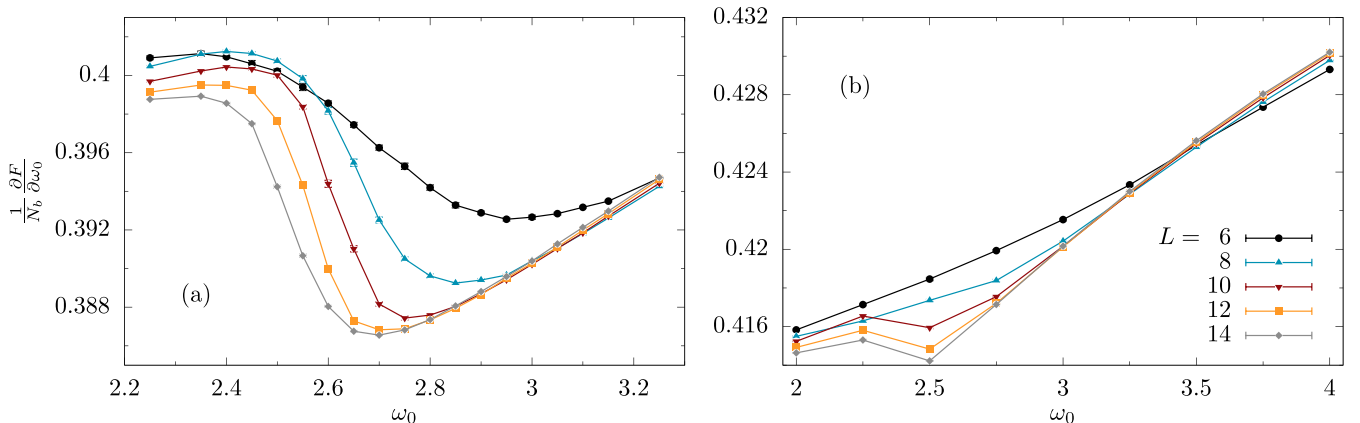


FIG. 1. Normalized free-energy derivative with respect to ω_0 at (a) $t = 0.1$ and (b) $t = 1.0$. Here, $\beta = L$.