

Erratum: Superradiance-driven optomechanical entanglement [Phys. Rev. A 111, 053713 (2025)]

Kai-Wei Huang, Xin Wang, Yi Ren, and Hao Xiong



(Received 16 June 2025; published 8 July 2025)

 DOI: [10.1103/yv1s-9g6b](https://doi.org/10.1103/yv1s-9g6b)

We found a bug in the code that calculates the collective spin operator X . As a result, the number of intracavity photons in the superradiant phase was reduced. In this Erratum, we provide the updated parameters ($g/2\pi = 300$ Hz and $N = 10^{11}$) and present the corrected plots. The conclusions in the main text of our paper remain unchanged.

In the main text, “the entanglement occurs only when $N > 10^{3.9}$ for the collective coupling strength $\lambda/2\pi = 0.4$ MHz” was modified to “the entanglement occurs only when $N > 10^{8.6}$ for the collective coupling strength $\lambda/2\pi = 1$ MHz.”

We discovered three typos in Eqs. (11), (13), and (15) of the original paper, which should read

$$\lambda_c = \frac{1}{2} \sqrt{\frac{\omega_0(\kappa^2 + \Delta^2)}{|\Delta|}}, \quad (1)$$

$$X = \pm \frac{N}{2} \sqrt{1 - \left(\frac{\lambda_c}{\lambda}\right)^4}, \quad (2)$$

and

$$A = \begin{pmatrix} -\kappa & \Delta & -2G_{\text{Im}} & 0 & 0 & 0 \\ -\Delta & -\kappa & 2G_{\text{Re}} & 0 & \frac{-2\sqrt{2}\lambda}{\sqrt{N}} & 0 \\ 0 & 0 & -\gamma & \omega_m & 0 & 0 \\ 2G_{\text{Re}} & 2G_{\text{Im}} & -\omega_m & -\gamma & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -\omega_0 \\ \frac{-2\sqrt{2}\lambda Z}{\sqrt{N}} & 0 & 0 & 0 & \omega_0 + \frac{4G_{\text{Re}}\lambda X}{\sqrt{N}gZ} & 0 \end{pmatrix}. \quad (3)$$

The corrected figures are as follows:

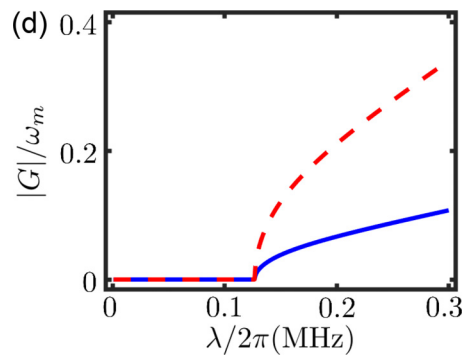


FIG. 1. (d) The absolute value of effective optomechanical coupling as a function of the collective coupling strength $\lambda/2\pi$ at $\Delta/\omega_m = 0.8$ with $N = 10^{10}$ (blue solid line) and 10^{11} (red dashed line), respectively. The other parameters are $\omega_m/2\pi = 10$ MHz, $\kappa/\omega_m = 0.2$, $g/2\pi = 300$ Hz, and $\omega_0/2\pi = 7.6$ kHz.

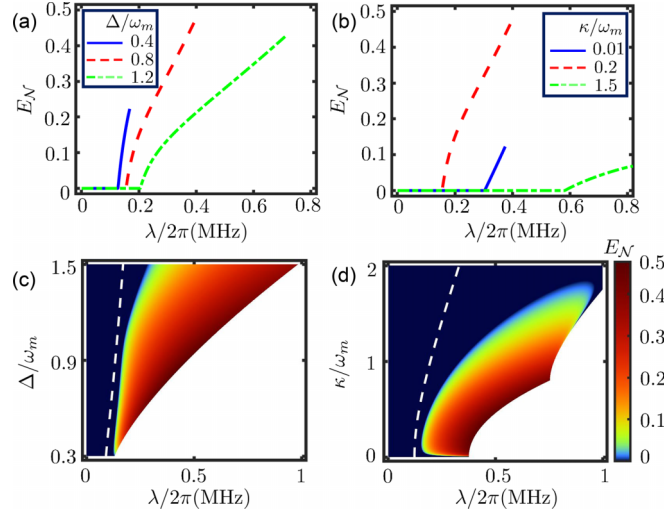


FIG. 2. (a) and (b) The entanglement E_N as a function of the collective coupling strength λ . (c) The entanglement E_N as a function of the collective coupling strength λ and the effective cavity detuning Δ/ω_m at $\kappa/\omega_m = 0.2$. (d) The entanglement E_N as a function of the collective coupling strength λ and the cavity dissipation rate κ/ω_m at $\Delta/\omega_m = 0.8$. In (c) and (d), the white dashed line represents the critical coupling value λ_c , and the white background indicates the unstable region. Here, $\gamma/2\pi = 100$ Hz, $T = 0.1$ K, $N = 10^{11}$, and other parameters are the same as those in Fig. 1.

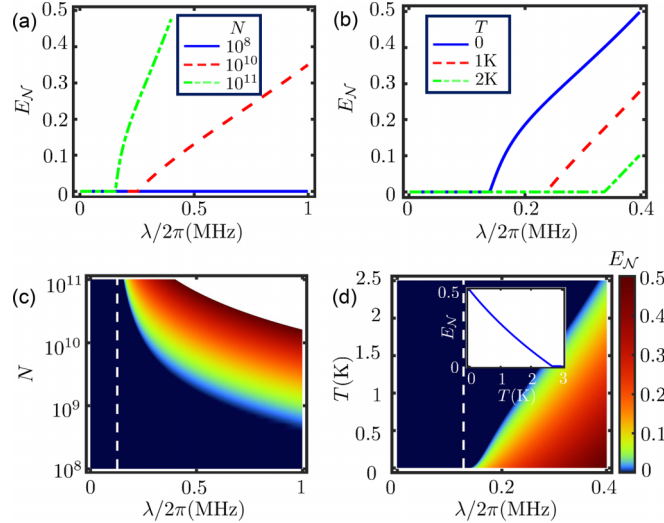


FIG. 3. (a) and (b) The entanglement E_N as a function of the collective coupling strength λ for $\kappa/\omega_m = 0.2$ and $\Delta/\omega_m = 0.8$. (c) The entanglement E_N as a function of the collective coupling strength λ and the atom number N . (d) The entanglement E_N as a function of the collective coupling strength λ and the temperature T . Inset in (d) illustrates the relationship between the entanglement E_N and the temperature T for $\lambda/2\pi = 0.4$ MHz. In (c) and (d), the white dashed line denotes the critical coupling value λ_c , and the white background highlights the unstable region. The other parameters are the same as those in Fig. 2.