

# Erratum: Nonclassicality of multiphoton-added cat states [Phys. Rev. A **113**, L041701 (2026)]

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A typographical error in our Letter has been brought to our attention. The quantity in Eq. (3.2) was defined as

$$Q = \frac{\langle a^{\dagger 2} a^2 \rangle}{\langle a^{\dagger} a \rangle^2}, \quad (1)$$

which is the definition of the zero-delay second-order correlation function  $g^{(2)}(0)$ , rather than the quantity intended in the Letter. The intended quantity was the Fano factor

$$Q = \frac{\langle (a^{\dagger} a)^2 \rangle - \langle a^{\dagger} a \rangle^2}{\langle a^{\dagger} a \rangle}$$

for which Poissonian statistics correspond to  $Q = 1$ , sub-Poissonian statistics to  $Q < 1$ , and super-Poissonian statistics to  $Q > 1$ . This quantity is related to the Mandel parameter by  $Q_M = Q - 1$ . Using the identity  $\langle a^x a^{\dagger x} \rangle = N_{m+x}/N_m$ , Eq. (3.3) should therefore read

$$Q = \frac{N_{m+2} - 4N_{m+1} + 2N_m}{N_{m+1} - N_m} - \frac{N_{m+1}}{N_m} + 2. \quad (2)$$

Another typographic error was the additional factor of 2 missing from Eq. (3.3). We emphasize, however, that these typographical errors did not affect any numerical calculations, figures, or physical conclusions reported in the Letter, all of which were obtained using the correct expression.

We would also like to clarify the relationship between our work and previous studies, in particular that of Arman *et al.* [1], which motivated our study.

Our work generalized the algebraic description of photon-added even and odd coherent states developed by Dodonov *et al.* [2] and further considered the general cat states by Arman *et al.* [1] with the  $m$ -photon addition to the general cat state

$$a^{\dagger m}(|\alpha\rangle + e^{i\phi}|- \alpha\rangle), \quad (3)$$

up to normalization, where  $\phi$  is an arbitrary relative phase between the two coherent-state components  $|\alpha\rangle$ .

The study benefited greatly from Dodonov *et al.* [2], who systematically studied the  $m$ -photon-added even ( $\phi = 0$ ) and odd ( $\phi = \pi$ ) cat states and their photon-number statistics, quadrature squeezing, and Wigner function representations. Arman *et al.* [1] extended this to arbitrary  $\phi$  in the single- and two-photon addition limits ( $m = 1, 2$ ). The choice of Arman *et al.* [1] is sufficient to demonstrate the main features of the photon-added cat states, such as the sub-Poissonian character of photon-added cat states or a strong sensitivity of the quantum interference fringes of Yurke-Stoler cat states ( $\phi = \pi/2$ ) to even and odd photon addition, leading to sign alternation of the fringes. They even suggested the presence of squeezing, which has not been addressed qualitatively.

Our results are consistent with these observations and extend them by providing a unified algebraic description for arbitrary  $m$  and arbitrary relative phase  $\phi$ . In particular, we analyzed the photon-number distributions and their systematic modification under photon addition, as well as the quadrature and second-order squeezing of the resulting states. In the Letter we discussed in detail the addition of  $m = 0, 1, 2$  photons, which provides representative examples of the qualitative changes associated with photon addition. In particular, photon addition changes the parity of the state for odd  $m$ , while even  $m$  preserves the parity of the initial cat state. Thus, two-photon addition restores the initial parity sector, although it does not restore the complete Fock-state distribution.

Using the unified algebraic description developed in our Letter, we further investigated the properties of higher-order photon-added cat states. Figure 1 illustrates that the sub-Poissonian character (characterized by the Fano factor  $Q$ ) observed for low-order photon addition persists for the higher photon-addition numbers  $m = 5$  and 10. This extends the observations of Ref. [1] beyond the single- and two-photon added cases.

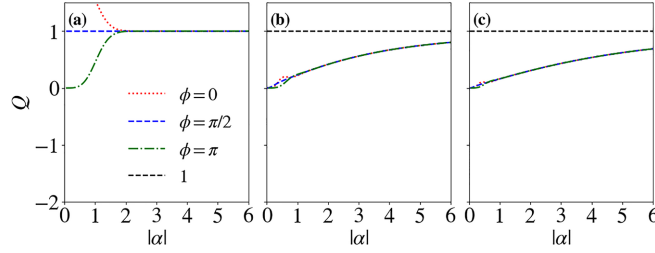


FIG. 1. Parameter  $Q$  vs  $|\alpha|$  for the (a) nonadded, (b) five-photon-added, and (c) ten-photon-added cat states.

Additionally, Fig. 2 shows a systematic modification of the quadrature variance  $(\Delta x_\theta)^2 = \langle x_\theta^2 \rangle - \langle x_\theta \rangle^2$ ,  $x_\theta = \frac{1}{2}(ae^{i\theta} + a^\dagger e^{-i\theta})$ , with the degree of quadrature antisqueezing increasing with the number of added photons, with examples of  $m = 5$  and 10.

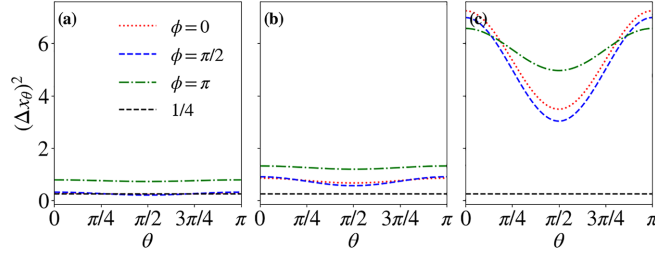


FIG. 2. Squeezing parameter vs  $\theta$  for the (a) nonadded, (b) five-photon-added, and (c) ten-photon-added cat states with  $\alpha = 0.25$ .

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 [2] V. V. Dodonov, Y. A. Korennoy, V. I. Man'ko, and Y. A. Moukhin, Non-classical properties of states generated by the excitations of even/odd coherent states of light, *Quantum Semiclass. Opt.* **8**, 413 (1996).