

**Erratum: Coherent anti-Stokes Raman scattering with squeezed light:
CARS for quantum-enhanced spectroscopy and imaging
[Phys. Rev. A **113**, 013704 (2026)]**

Santiago Pinto , Frank Hagelberg , Ali Passian, and Xu Yi 



(Received 19 May 2026; published 9 June 2026)

DOI: [10.1103/2h4x-rmpp](https://doi.org/10.1103/2h4x-rmpp)

In our original publication, the final photonic state used in the CARS transition-rate calculation was not properly normalized. This introduced an overall multiplicative correction to the transition amplitudes and rates. The corrected normalization reduces the magnitude of the reported enhancement factors but does not affect the qualitative conclusions of the work. The properly normalized state is

$$|\phi_f\rangle = \frac{1}{\mathcal{N}} \hat{a}_A^\dagger \hat{a}_S^\dagger \hat{a}_p^2 |\phi_i\rangle,$$

where $\mathcal{N} = \sqrt{\langle \phi_i | \hat{a}_p^{\dagger 2} \hat{a}_S \hat{a}_A \hat{a}_A^\dagger \hat{a}_S^\dagger \hat{a}_p^2 | \phi_i \rangle}$ is the normalization factor. As a result, the transition rates scale as

$$\Gamma_{f,i} \propto \langle \phi_i | \hat{a}_p^{\dagger 2} \hat{a}_S \hat{a}_A \hat{a}_A^\dagger \hat{a}_S^\dagger \hat{a}_p^2 | \phi_i \rangle,$$

rather than as the square of this quantity, as stated in the original paper. Then Eq. (14) becomes

$$\langle \phi_f | \hat{\mathbb{E}} | \phi_i \rangle = \sqrt{6 e^{-2i\phi} \cosh^2 r \sinh^4 r} \left(\frac{\hbar}{2\epsilon_0 V} \right)^2 \omega_p \sqrt{\omega_S \omega_A}. \quad (14)$$

The correct enhancement factor in Eq. (17) is

$$\beta = \frac{6 \cosh^2(r) \sinh^4(r)}{n_p(n_p - 1)(n_S + 1)}. \quad (17)$$

For the coherent-state comparison, the photonic matrix element in Eq. (18) becomes

$$\langle \phi_f | \hat{\mathbb{E}} | \phi_i \rangle_{\text{classical}} = \left(\frac{\hbar}{2\epsilon_0 V} \right)^2 \omega_p \sqrt{\omega_S \omega_A} \sqrt{(1 + |\alpha_S|^2) |\alpha_p|^4}. \quad (18)$$

The photonic matrix element for the displaced two-mode squeezed state shown in Eq. (21) becomes

$$\begin{aligned} \langle \phi_f | \hat{\mathbb{E}} | \phi_i \rangle &= \left(\frac{\hbar}{2\epsilon_0 V} \right)^2 \omega_p \sqrt{\omega_A \omega_S} (\langle \alpha_p, \alpha_S | (\hat{a}_p^\dagger \cosh r + \hat{a}_S \sinh r e^{-i\phi})^2 (\hat{a}_S \cosh r + \hat{a}_p^\dagger \sinh r e^{i\phi}) \\ &\quad \times (\hat{a}_S^\dagger \cosh r + \hat{a}_p \sinh r e^{-i\phi}) (\hat{a}_p \cosh r + \hat{a}_S^\dagger \sinh r e^{i\phi})^2 | \alpha_p, \alpha_S \rangle)^{1/2}, \end{aligned} \quad (21)$$

and the reported enhancement in Eq. (23) becomes the square root of the originally reported value:

$$\beta = \frac{\langle \phi_i | \hat{a}_p^{\dagger 2} \hat{a}_S \hat{a}_A \hat{a}_A^\dagger \hat{a}_S^\dagger \hat{a}_p^2 | \phi_i \rangle}{|\alpha_p'|^4 (1 + |\alpha_S'|^2)}, \quad (23)$$

In terms of our results, as summarized in the tables and figures, the only modification consists in a rescaling of the enhancement factor β . None of the physical arguments, nor the trends or orderings reported in our paper are affected. For the convenience of the readers, Table 1 and Figs. 1–6 show the corrected table and figures that change as a consequence of the correction.

Finally, we note an editorial error in the published manuscript: Figs. 2 and 3 were inadvertently interchanged.

TABLE I. The squeezing-induced enhancement factor β for the two-mode squeezed vacuum state input compared with an input Fock state with $n_A = 0$, where R denotes the squeezing level in decibels, defined as $R = 10 \log_{10}(e^{2r})$.

R (dB)	r	n_p	n_s	β
Low-photon-number case: $n_p = n_s = \mathcal{O}(1)$				
3	0.35	2	2	1.7×10^{-2}
7	0.81	2	2	1.2
11	1.27	$\sinh^2 r \approx 3$	$\sinh^2 r \approx 3$	6.5
15	1.73	$\sinh^2 r \approx 8$	$\sinh^2 r \approx 8$	5.5
High-photon-number case: $n_p = n_s = 10^3$				
3	0.35	10^3	10^3	1.0×10^{-10}
7	0.81	10^3	10^3	7.0×10^{-9}
11	1.27	10^3	10^3	1.6×10^{-7}
15	1.73	10^3	10^3	2.8×10^{-6}

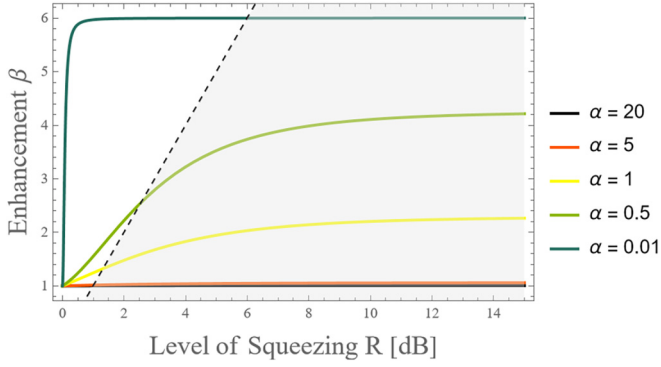


FIG. 1. Corrected plot for Fig. 2(a) in the original manuscript.

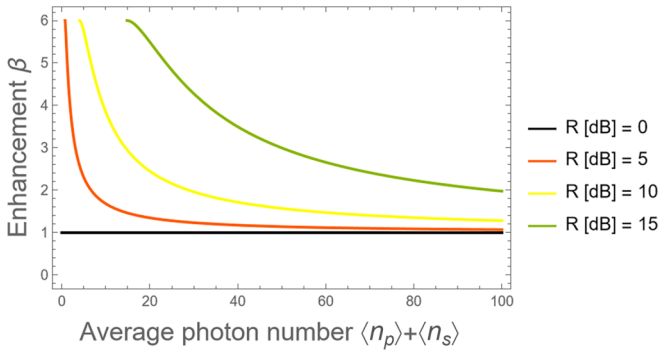


FIG. 2. Corrected plot for Fig. 2(c) in the original manuscript.

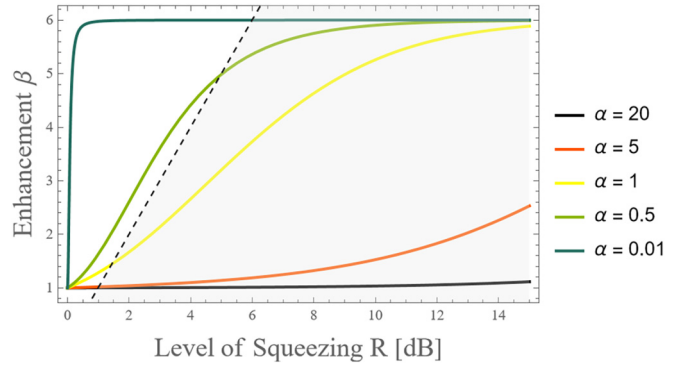


FIG. 3. Corrected plot for Fig. 3(a) in the original manuscript.

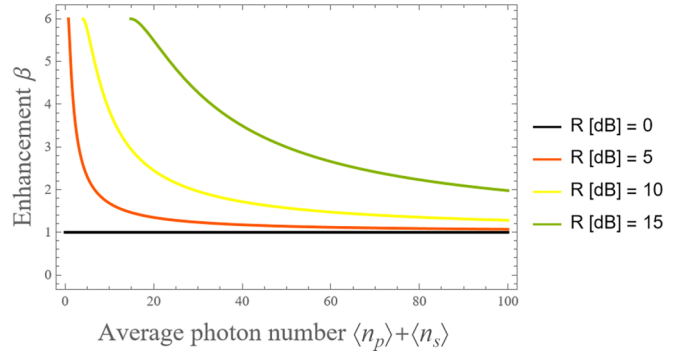


FIG. 4. Corrected plot for Fig. 3(c) in the original manuscript.

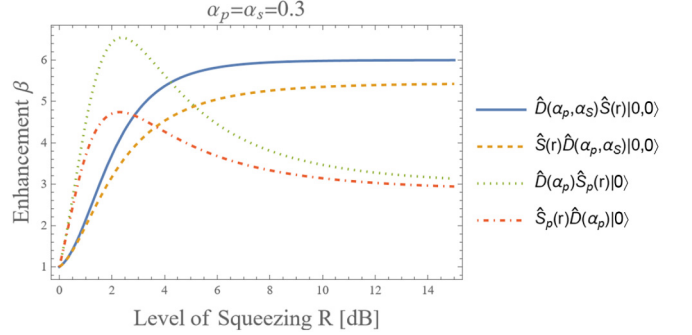


FIG. 5. Corrected plot for Fig. 4(a) in the original manuscript.

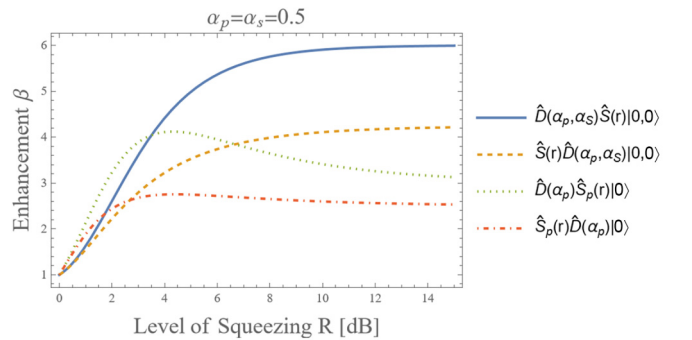


FIG. 6. Corrected plot for Fig. 4(b) in the original manuscript.