

Erratum: Free-Space Optical Modulation of Free Electrons in the Continuous-Wave Regime [Phys. Rev. Lett. 134, 123804 (2025)]

Cruz I. Velasco[✉] and F. Javier García de Abajo[✉]

 (Received 30 October 2025; published 25 November 2025)

DOI: [10.1103/ggbz-nv43](https://doi.org/10.1103/ggbz-nv43)

As explained in Sec. S1 of Supplemental Material [1], we dismiss the Gouy phase $e^{-i\text{atan}(z/z_0)}$ in our calculations. This allowed us to obtain analytical results in Fig. 2 in the main text. Unfortunately, the inclusion of this phase produces a rigorously vanishing coupling coefficient [i.e., $\propto \int_{-\infty}^{\infty} dz e^{-2i\text{atan}(z/z_0)/(1+z^2/z_0^2)} = 0$] in the nonrecoil regime (i.e., no electron modulation) when integrating over an interaction region of large length L compared with z_0 , as shown by the cancellation of sidebands at large propagation distances in Fig. 1d in this erratum. However, Fig. 2 in the main text remains valid in the opposite scenario (i.e., for loosely focused light beams with $z_0 \gg L$) if we change the vertical axis label of panels (a,b) to $cLI_1/\hbar\omega_1^2$ and set $I_2 = (\omega_2/\omega_1)I_1$, where I_1 and I_2 are the intensities of light beams 1 and 2. In addition, we dismissed the Gouy phase in the numerical calculations presented in Figs. 3 and 4 in the main text. However, this phase affects our results, as recently pointed out by Zhao *et al.* [2]. The Gouy phase enters directly as a multiplication factor in the optical fields, which propagate to the coefficients $A_{jj'}^{(n)}$ and $B_{jj'}^{(n)}$. More precisely, we need to multiply $A_{11}^{(n)}$ and $B_{12}^{(n)}$ by $e^{2i\varphi_G}$, while $A_{22}^{(n)}$ and $B_{21}^{(n)}$ must be multiplied by $e^{-2i\varphi_G}$, where $\varphi_G = \text{atan}(I_n/z_0)$ (see Sec. S2 of Supplemental Material). This correction leads to substantial changes in the numerical results, as shown in Fig. 1, producing an asymmetry in the electron spectra and enabling larger values of the degree of coherence. While most of the qualitative conclusions expressed in our work remain valid, we should expect no electron modulation in the nonrecoil regime for $L \gg z_0$.

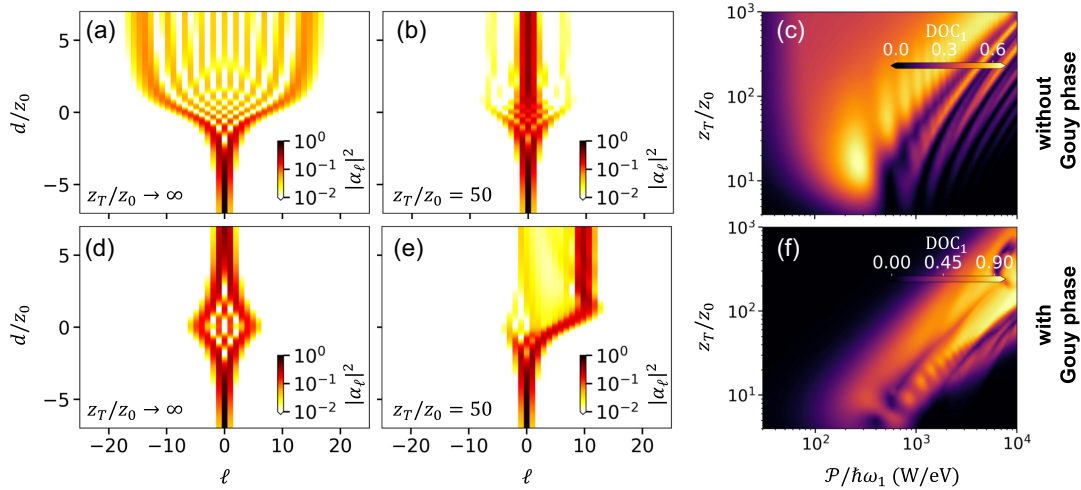


FIG. 1. Correction introduced by the Gouy phase on electron spectra and temporal compression. (a),(b) Evolution of the electron spectra without (a) and with (b) inclusion of recoil, reproduced from Figs. 3(a) and 3(b) of the main text, which are obtained without incorporating the Gouy phase. (c) Degree of coherence zoomed from Fig. 4(a), also dismissing the Gouy phase. (d)–(f) Same as (a)–(c), but now including the Gouy phase.

[1] See Supplemental Material at <http://link.aps.org/supplemental/10.1103/PhysRevLett.134.123804>.

[2] Z. Zhao, Y. Fang, M. Y. Uludag, and P. Hommelhoff, Gouy phase-related effects in the free-space optical modulation of free electrons, [arXiv:2510.24939](https://arxiv.org/abs/2510.24939).