Erratum: Electron thermalization and quantum decoherence in metal nanostructures [Phys. Rev. B 81, 241401(R) (2010)]

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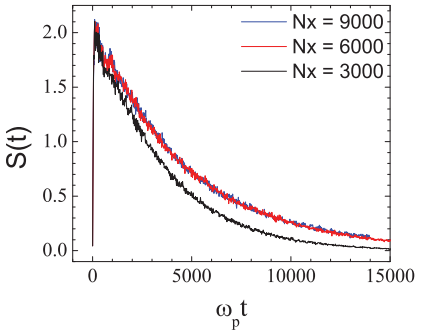

FIG. 1. (Color online) Evolution of $S(t)$ for $\delta v = 0.22 v_F$ and different spatial resolutions: $N_x = 3000$ (black curve), $N_x = 6000$ (red), and $N_x = 9000$ (blue). Time is normalized to the inverse of the plasmon frequency ω_p.

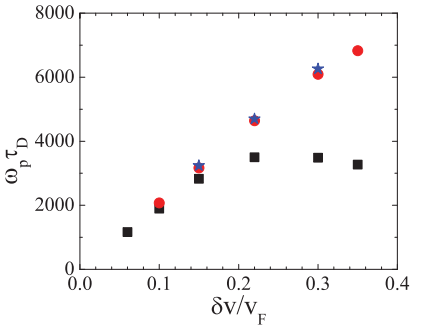

FIG. 2. (Color online) Decoherence time as a function of the excitation amplitude δv for different spatial resolutions: $N_x = 3000$ (black squares), $N_x = 6000$ (red circles), and $N_x = 9000$ (blue stars). Time is normalized to the inverse of the plasmon frequency ω_p.

In the original work, we studied the quantum electron dynamics in a thin metal film. Our approach was based on the Wigner (phase space) representation of quantum mechanics and included the incoherent coupling of the electron gas to the ion lattice (electron-phonon interactions).

A relevant quantity investigated in the original work was the decoherence time, which quantifies the rate at which quantum correlations are lost to the environment. The decoherence time was defined as the total weight of the negative values of the electron Wigner function $f(x,v,t)$, which can be considered as a measure of the classicality of the electron population. This led us to compute the quantity $S(t) = \iint f_< dx dv_x$, where $f_< = -f$ when $f < 0$, and zero elsewhere. The decoherence time τ_D was then estimated by fitting $S(t)$ with a decaying exponential function. In Fig. 3 of our original work, we claimed that the decoherence time increases with increasing excitation energy, then saturates around $\delta v = 0.2 v_F$, where δv is a measure of the excitation and v_F is the Fermi speed (black squares in Fig. 2 of the present Erratum). In this Erratum, we show that the observed saturation was actually due to spurious numerical errors arising from the low spatial resolution.

The simulations shown in the original work were performed with the following numerical parameters: number of points in real space: $N_x = 3000$, with $-100 < x/L_F < 100$; number of points in velocity space: $N_v = 1024$, with $-5.2 < v/v_F < 5.2$; time step: $\omega_p \Delta t = 0.1$ (quantities are expressed in the nondimensional units defined in the original work).

Increasing the number of points in velocity space or reducing the time step did not affect the numerical results. In contrast, when the spatial resolution was increased, no saturation of the decoherence time was observed at large excitations. In Figs. 1 and 2, we show the corresponding numerical results for $N_x = 3000$, 6000, and 9000. For $N_x = 3000$, the quantity $S(t)$ is damped more quickly than it should be (Fig. 1): this is presumably due to the numerical diffusion induced by the low resolution. This numerical diffusion artificially increases the "real" diffusion that is present in the electron-phonon scattering term of our model. For $N_x = 6000$ and 9000, the curves are basically identical, indicating that the numerical solution has indeed converged.

Figure 2 shows the decoherence time against the amplitude of the excitation, obtained by fitting the results of Fig. 1 with a decaying exponential. The results for $N_x = 6000$ and 9000 are again almost identical and show no saturation at large excitations.

Thus, in view of the present results, the decoherence time appears to increase monotonically with the excitation amplitude, at least for the range of excitations considered here. All other results published in the original work were not affected by the increased spatial resolution.

