Erratum

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Erratum: Structural Preablation Dynamics of Graphite Observed by Ultrafast Electron Crystallography [Phys. Rev. Lett. 100, 035501 (2008)]

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In this paper, the following statement was reported: ''The overall expansion of the lattice, which can be as much as 0.08 Å at the highest fluence of 44.5 $\mathrm{mJ/cm^2}$, corresponds to 1.25% of the c-axis equilibrium value, 6.7 Å. This expansion is huge and beyond any thermal value. The thermal linear expansion coefficient ($\alpha = \frac{\Delta L}{L_0} \cdot \frac{1}{\Delta T}$, with L being the expansion and ΔT the temperature change) for graphite is 7.9×10^{-6} $\mathrm{K^{-1}}$ [1], and such a change would correspond to a temperature jump of more than 1500 K. Given our fluence and the heat capacity of graphite, the maximum expected temperature rise is around 40 K.''

In the calculation of the laser-induced temperature increase, there is an error due to a wrong unit conversion of the penetration depth. In the experimental conditions of this paper, given a penetration depth of 200 nm (as defined in [2]), a heat capacity C of $2.67 \frac{J}{\mathrm{K \cdot cm^3}}$ (obtained as the effective heat capacity between 300 and 800 K [3]), and a reflectivity $R(1.55\ \mathrm{eV}) = 0.35$ [4], the actual temperature jump

$$\Delta T = \frac{F(1 - R)}{\delta C} \tag{1}$$

would be around 542 K. Given the linear expansion coefficient specifically for the c axis, $\alpha = 28 \times 10^{-6}$ $\mathrm{K^{-1}}$ [1], with L being the expansion and ΔT the laser-induced temperature jump, the expansion corresponding to a temperature jump of 542 K would cause an increase of the c-axis lattice constant of 0.1 Å. These values are reasonably close to the observations made in this paper and suggest that most of the reported long-term dynamics is thermal in origin, while in the femtosecond regime lattice motions are driven by the out-of equilibrium electronic structure.

[1] M. S. Dresselhaus, *Graphite Fibers and Filaments* (Springer, Berlin, 1988).
[2] J. D. Jackson, *Classical Electrodynamics* (Wiley, New York, 1962).
[3] A. T. D. Butland and R. J. Maddison, J. Nucl. Mater. **49**, 45 (1973).
[4] A. B. Kuzmenko, E. van Heumen, F. Carbone, and D. van der Marel, Phys. Rev. Lett. **100**, 117401 (2008).

