

Thermal Radiation of Hot Electrons

Leon Oleschko
01.04.2025

Laser Power

The laser has a power of:

$$P(t) \propto e^{-(t-t_0)/2\sigma^2}$$

with a total energy:

$$E = \int S(t)dt = P_{\text{Average}}/f \approx 1.2 \text{ W}/100 \text{ MHz} = 12 \text{ uJ}$$

Absorption

only a fraction $A = 1$ is absorbed into a volume given by the laser radius $r \approx 200 \text{ }\mu\text{m}$ and the optical depth $d \approx 250 \text{ nm}$:

$$V = \pi r^2 \cdot d$$

$$S = \frac{P}{V} A$$

with $[S] = W/m^3$

e^- Gas

The temperature change due to absorption can be calculated with the molar Volume $V_m = M/\rho$ and the specific heat capacity $c_e = 1/M dQ/dT$.

The lattice relaxation time $g \approx 300$ fs.

Diffusion is neglected. Radiative cooling is also ignored.

$$\frac{dT_e}{dt} = \frac{V_m}{c_e(T)} S - \frac{T_e - T_l}{g} - \frac{T_e - T_{\text{Room}}}{\tau_e}$$

Lattice Temperature

For now the lattice temperature is assumed to be constant.
For the lattice it is similar with the diffusion $\tau_l \approx$:

$$\frac{dT_l}{dt} = \frac{T_e - T_l}{g} - \frac{T_e - T_{\text{Room}}}{\tau_l}$$



