Thermal Radiation
of Hot Electrons

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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 is absorbed into a volume given by the laser radius $r \approx 200\,\text{um}$ and the optical depth $d \approx 250\,\text{nm}$:

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

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

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

Diffusion

Diffusion is ignored for now

TODO: ADD radiative cooling

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 is 100s of fs.

Diffusion is neglected with $\tau_e \approx \infty$ for now.

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

Lattice Temperature

For the lattice it is similar with the diffusion $\tau_l \approx$:

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