

Thermal Radiation of Hot Electrons

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05.04.2025

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 $[S] = W/m^3$

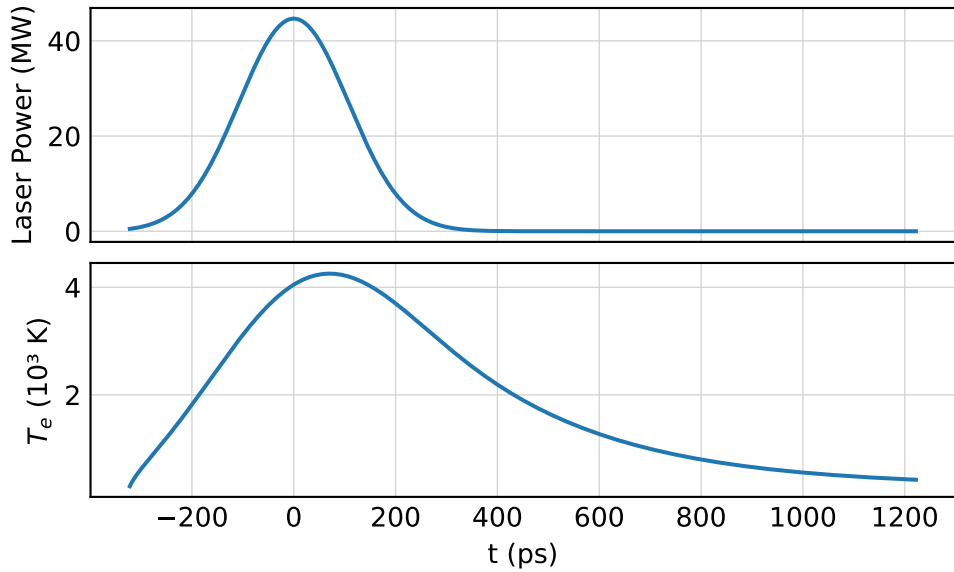
e^- Gas

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

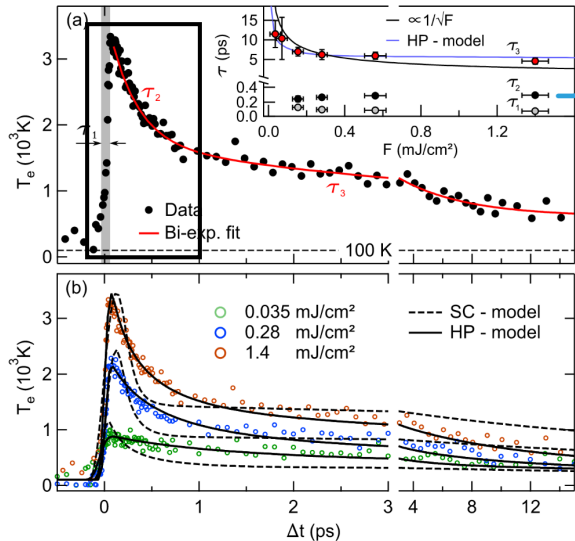
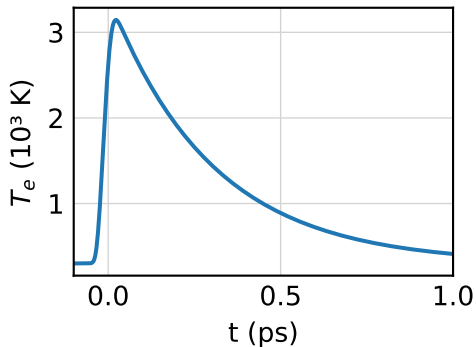
The lattice relaxation time $g \approx 300$ fs.

Diffusion is neglected. Radiative cooling is also ignored.

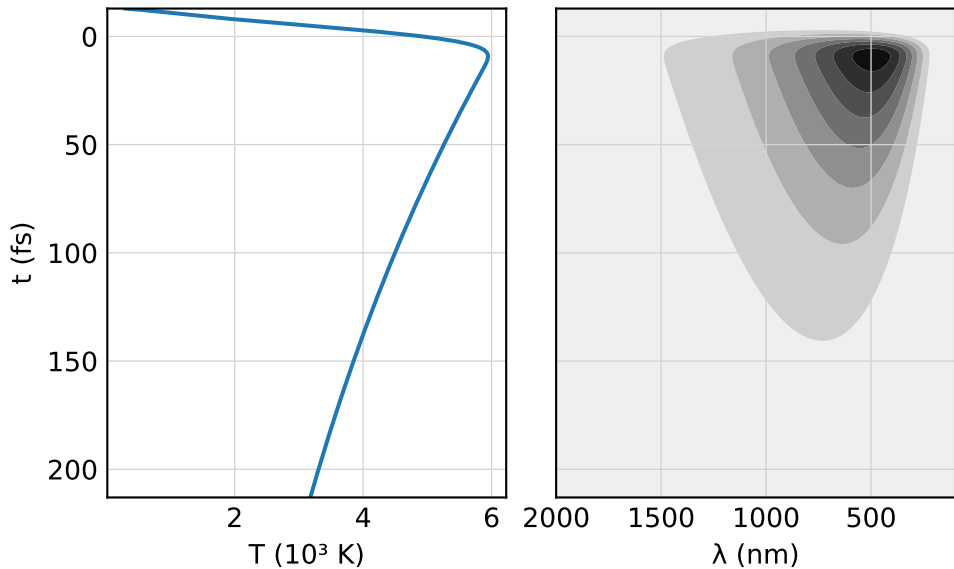
$$\frac{dT_e}{dt} = \frac{V_m}{c_e(T)} S - \frac{T_e - T_l}{g}$$



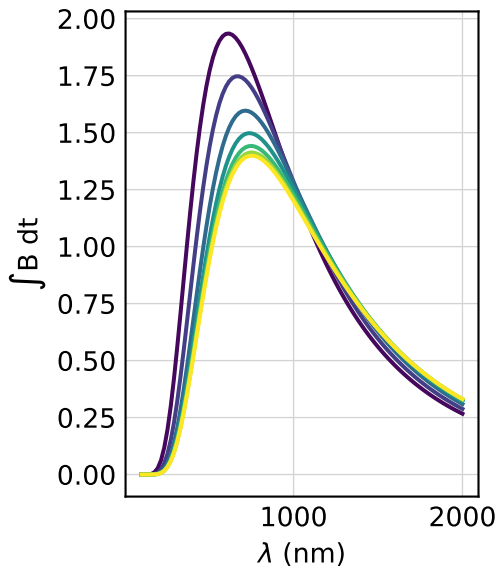
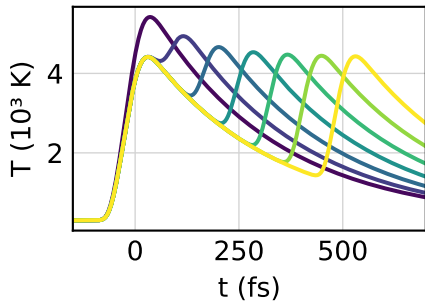
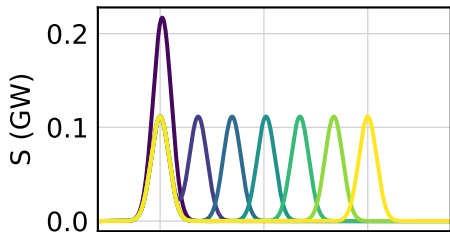
Validation



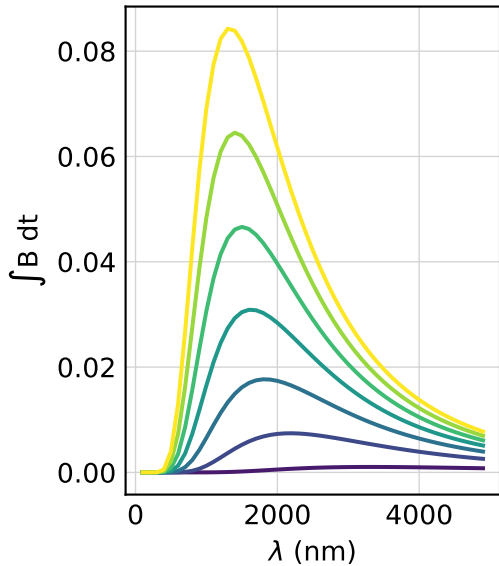
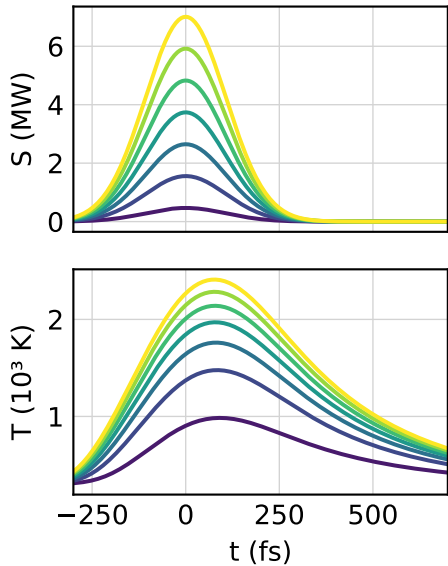
"Hot electron cooling in graphite", Stange et al. 2015 (Fig. 4)



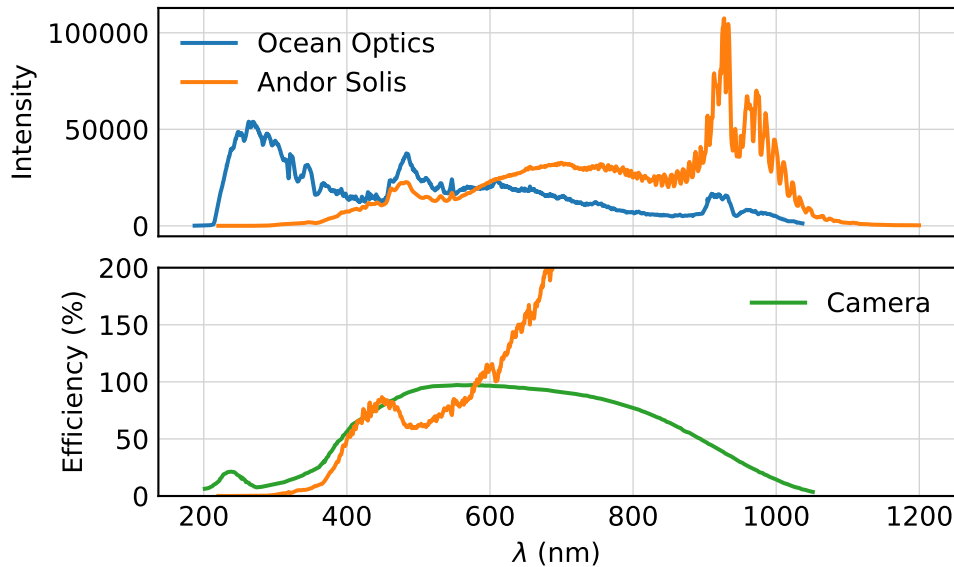
Thermal radiation after 50 fs Laser pulse

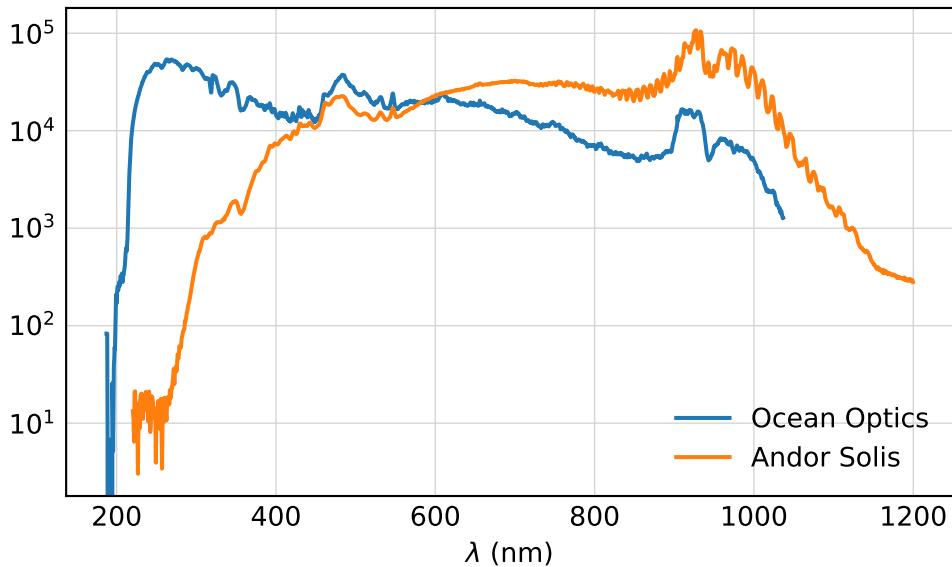


Consecutive 50 fs Laser pulses



250 fs Laser pulse with different fluence





DH-2000 Deuterium Tungsten Halogen Spectral Output

