Thermal (black body) radiation

Convection ?, Conduction ?, **Radiation!**

All material objects that are at non-zero absolute temperature emit electromagnetic radiation

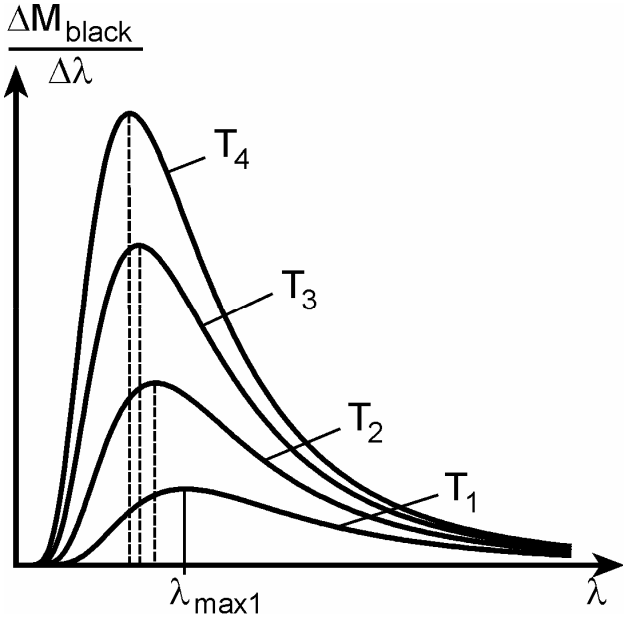
Kirchhoff's law: objects that have intense thermal radiation are also efficient absorbers of the same radiation

$$\frac{M_{\lambda_i}}{\alpha_{\lambda_i}} = \frac{M_{\lambda_j}}{\alpha_{\lambda_j}}$$

where M_λ is the emitted flux density (unit: W/m^2);
α_λ is the absorbtivity ($E_{absorbed}/E_{total}$)

Absolute black body: fully absorbs all incident energies ($\alpha = 1$)
(The human body is 95% black body)

Emission spectrum of thermal radiation at various temperatures



$T_1 < T_2 < T_3 < T_4$

The emission spectrum is continuous with a maximum

Stefan – Boltzmann law:

$$M_{\text{black\_total}}(T) = \sigma T^4$$

(area below the curve of the emission spectrum)

Wien's displacement law

$$\lambda_{\max} T = \text{constant}$$

The wavelength of maximum intensity shifts to shorter wavelengths when T is increased

Application in medical diagnostics:
Telethermography
Mapping the intensity of IR radiation emitted by the human body over a given surface by IR camera inflammations, changes in blood circulation, metabolic changes in tumors lead to temperature changes i.e. changes in the intensity of IR radiation