Light emission

Spectrum

distribution, representations

Light scattering

$$\boxed{J_{scat} \sim 1/\lambda^4}$$

Absorption

Beer's law

Thermal radiation

(black body)

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

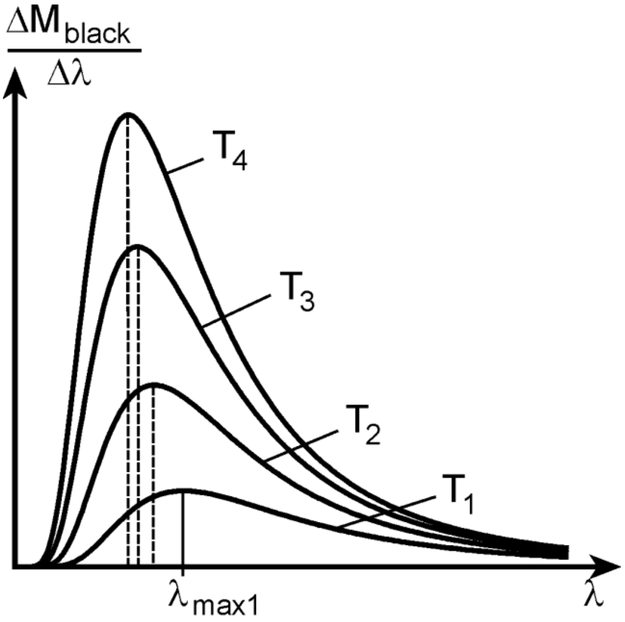
$$\frac{M_{\lambda_i}}{\alpha_{\lambda_i}} = \frac{M_{\lambda_j}}{\alpha_{\lambda_j}}$$

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:

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

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

Formulation of spectrum? (Wien)

$$\frac{\Delta M}{\Delta f} = af^{3} e^{-\frac{bf}{T}}$$

(a, b parameters)

Max Planck (1858-1947)

$$\frac{\Delta M}{\Delta f} = a' f^{3} \frac{1}{e^{\frac{b' f}{T}} - 1}$$

(a', b' parameters)

end of classical physics 1900

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