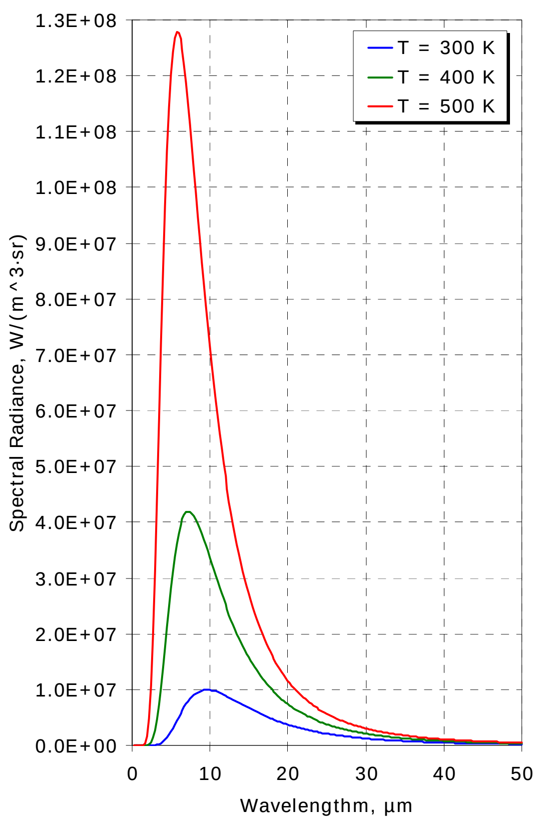
Perfect blackbody is the ideal thermal radiator that absorbs completely all incident radiation, whatever the wavelength, the direction of incidence or the polarization. This radiator has, for any wavelength and any direction, the maximum spectral radiance for a thermal radiator in thermal equilibrium at a given temperature [1].

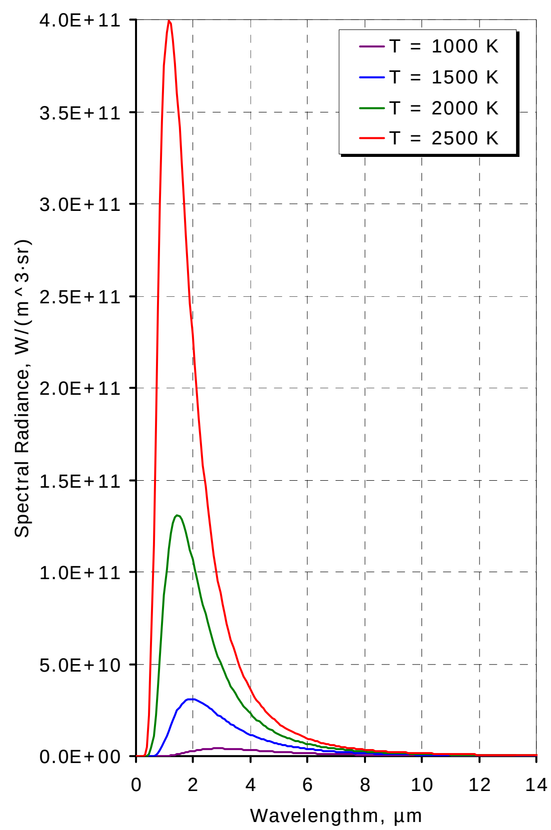
Planck's law is expressed the spectral radiance of a perfect blackbody as a function of wavelength λ and temperature T:

$$L_{e\lambda,bb}(\lambda,T)=\frac{c_1}{\pi\lambda^5}\frac{1}{\exp\left(\frac{c_2}{\lambda T}\right)-1},$$

where $c_1 = 3.74177153 \times 10^{-16}$ W·m^2 and $c_2 = 1.4387770 \times 10^{-2}$ m·K are the 1st and 2nd radiation constants, respectively [2].

Graphs below show dependences of the spectral radiance on the wavelength calculated for temperatures from 300 K to 2500 K using Planck's law.





Wien's displacement law states that the dependences of spectral radiance of a perfect blackbody on wavelength have similar shape at any temperature; the position of distribution's maximum (peak wavelength λ_{peak}) is inversely proportional to temperature:

$$\lambda_{peak} = b/T \ ,$$

where $b = 2.897\,7685 \cdot 10^{-3}\ \mathrm{m \cdot K}$ is the Wien displacement law constant.

Stefan-Boltzmann law is the relationship between the radiant exitance $M_{e,bb}$ of a perfect blackbody and its temperature:

$$M_{e,bb} = \sigma T^4 \ ,$$

where $\sigma = 5.670\,400 \cdot 10^{-8}\ \mathrm{W \cdot m^{-2} \cdot K^{-4}}$ is the Stefan-Boltzmann constant.

Lambert's law states that for a surface element whose radiance is the same in all directions of the hemisphere above the surface:

$$I_e(\theta) = I_n \cos\theta \ ,$$

where $I_e(\theta)$ and I_n are the radiant intensities of the surface element in a direction at an angle θ from the normal to the surface and in the direction of that normal, respectively.

Lambert's law is often called "*cosine law*"; surface for which Lambert's law is fulfilled is often called "Lambertian", "*perfectly diffuse*" or simply "*diffuse*".
Radiance of a perfectly diffuse source does not depend on direction. Perfect blackbody obeys Lambert's law. There is the simple relationship between radiant intensity M_e and radiance L_e of a diffuse radiation source

$$M_e = \pi \cdot L_e \, .$$

Two last equations hold true for corresponding spectral quantities.

References and Further Reading

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