Updates to some TSBB21 lectures 2024

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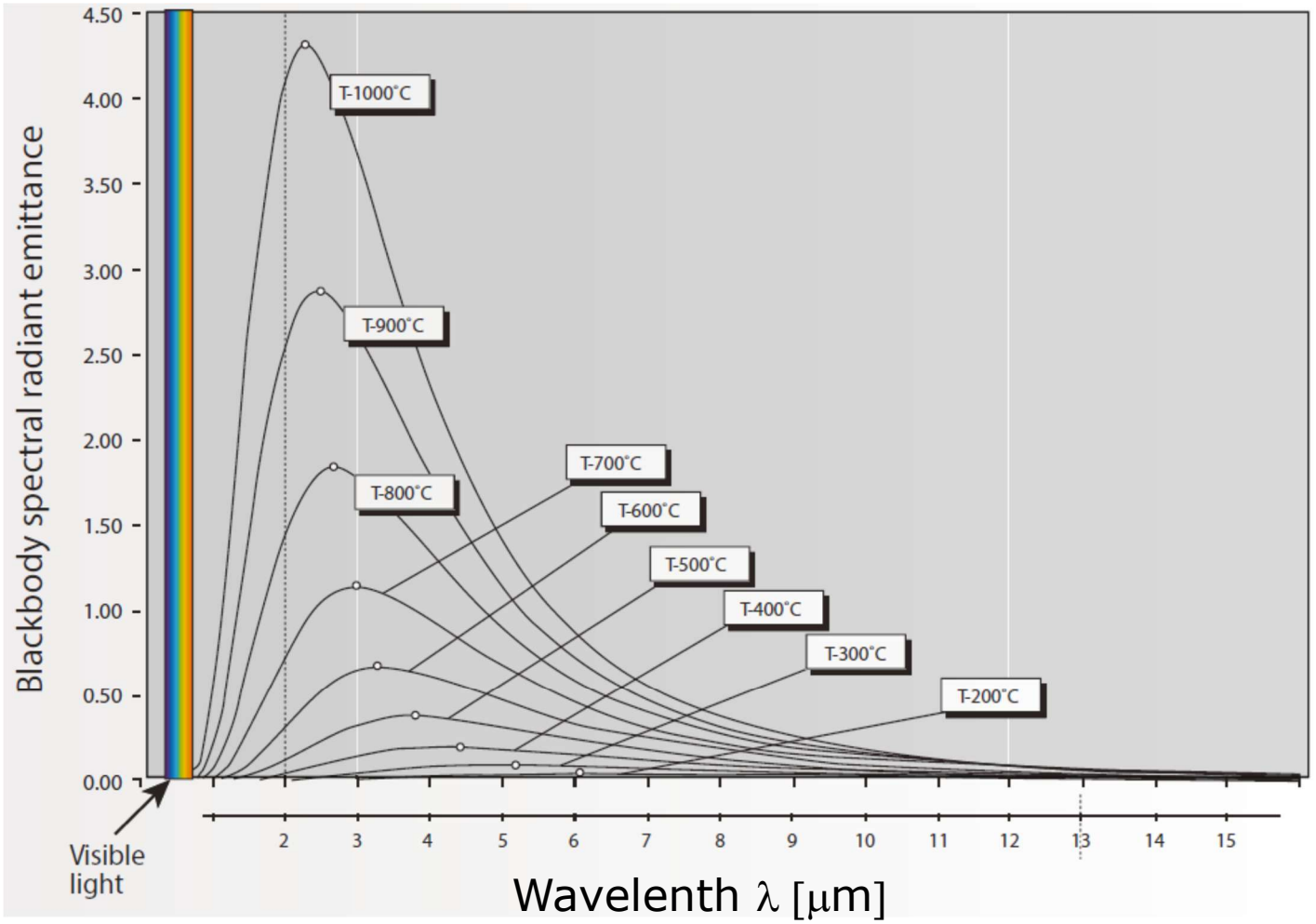
Planck's and Stefan-Boltzmann's laws

Repetition: Planck's law



The relation between Planck's and Stefan-Boltzmann's laws

- According to Planck's law, the spectral emittance of a blackbody is:

$$M(\lambda, T) = \frac{2\pi hc^2}{\lambda^5 (e^{hc/\lambda kT} - 1)}$$

- It can be shown that the integral over Planck's law for all wavelengths of a blackbody gives that the total radiated energy is:

$$W = \sigma T^4 \ [W/m^2],$$

where σ is the Stefan-Boltzmann's constant. (It is not so easy to perform the integration!)

- For a greybody, $W = \varepsilon\sigma T^4 \ [W/m^2]$, where ε is the emissivity.

From the first lecture: Absorption spectrum

- The spectrum of the reflected/transmitted light is given

$$s_2(\nu) = s_1(\nu)a(\nu)$$

or

$$s_2(\lambda) = s_1(\lambda)a(\lambda)$$

  - s_1 = incident spectrum
  - s_2 = reflected/transmitted spectrum
  - a = absorption spectrum $(0 \leq a(\nu) \leq 1)$
- Example:
  - An incident spectrum of red light, has an absorption spectrum high in blue and green light. Therefore, the reflected light will be red!