

## Thermal (black body) radiation

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

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

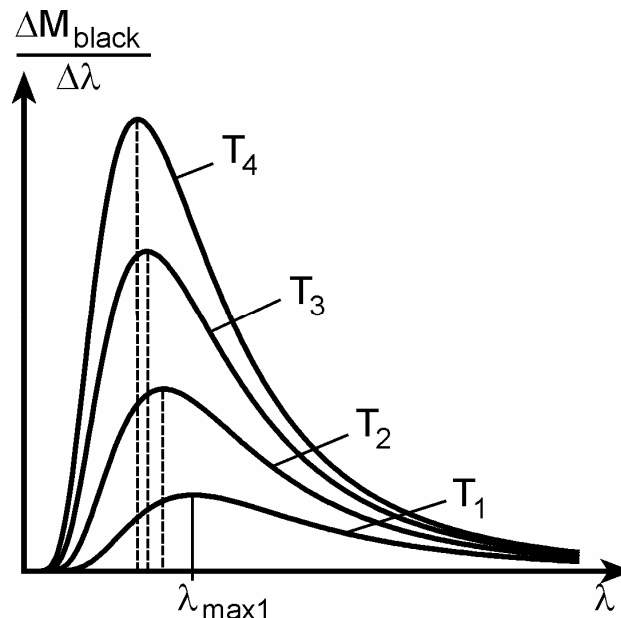
**Kirchhoff's law:** objects that have intense thermal radiation are also efficient absorbers of the same radiation

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

where  $M_{\lambda}$  is the emitted flux density (unit:  $\text{W}/\text{m}^2$ );  
 $\alpha_{\lambda}$  is the absorbtivity ( $E_{\text{absorbed}}/E_{\text{total}}$ )

**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

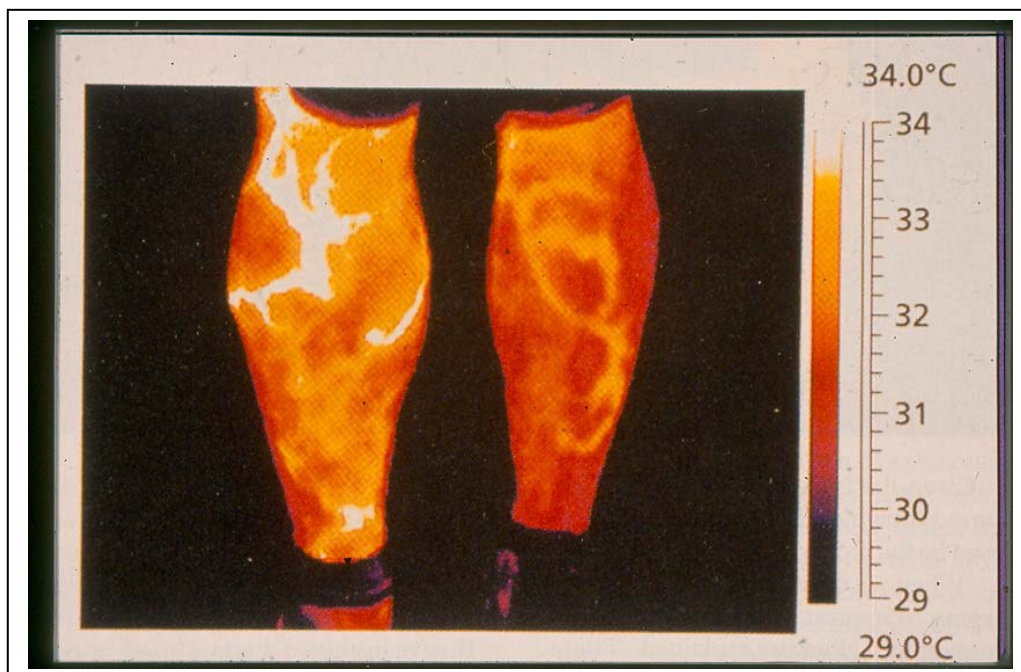
$$\lambda_{\text{max}} T = \text{constant}$$

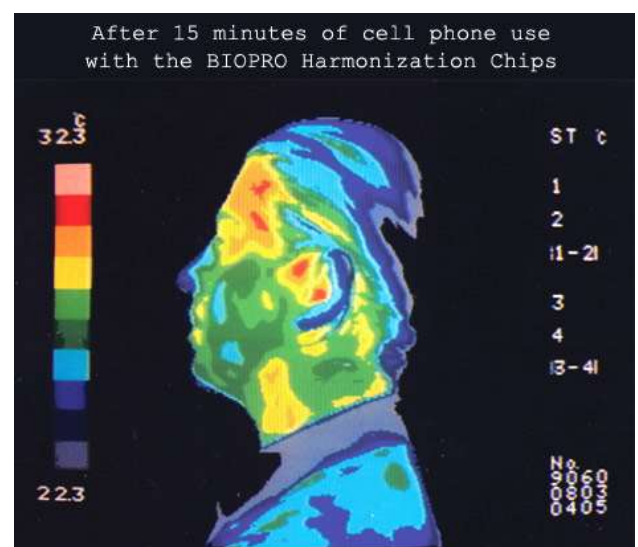
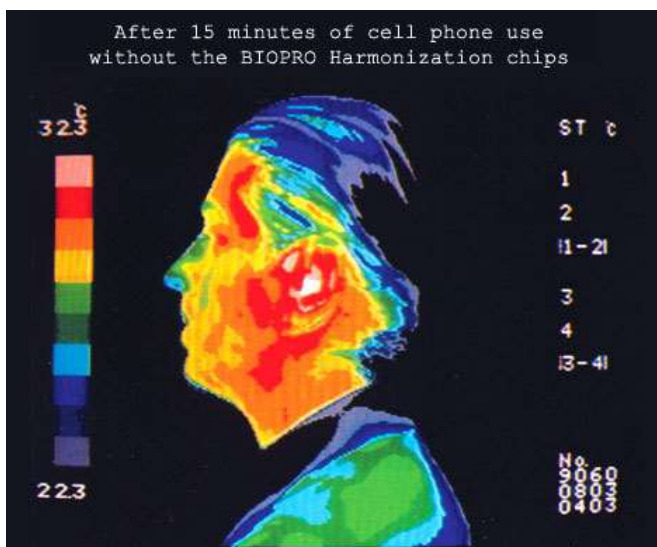
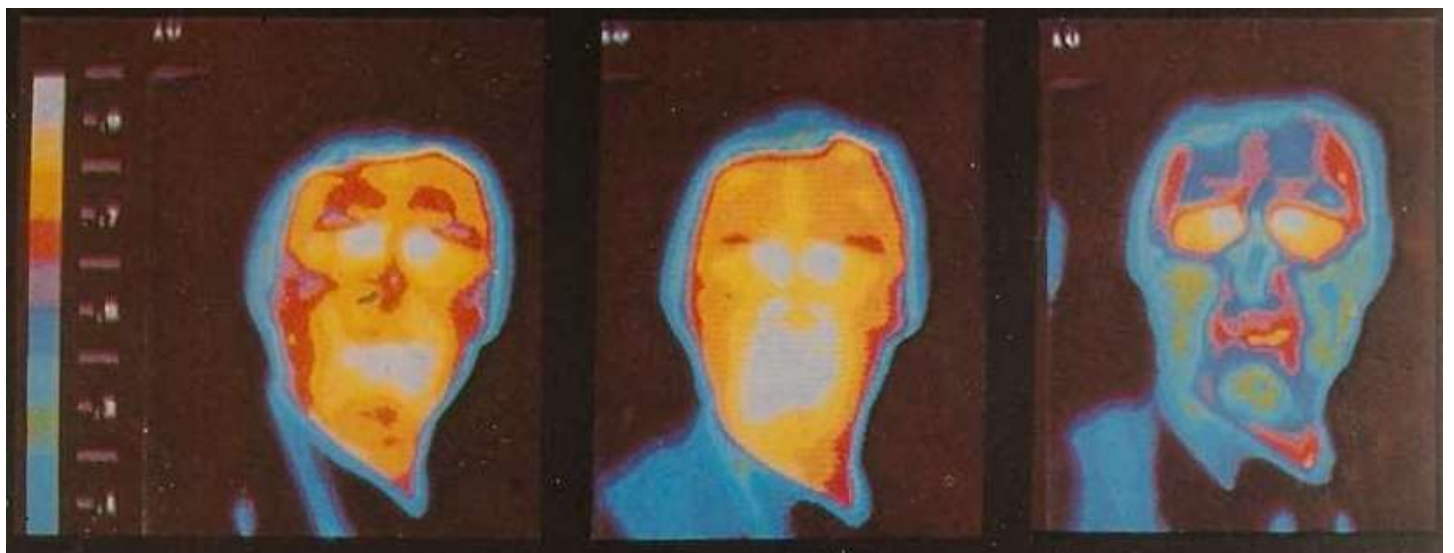
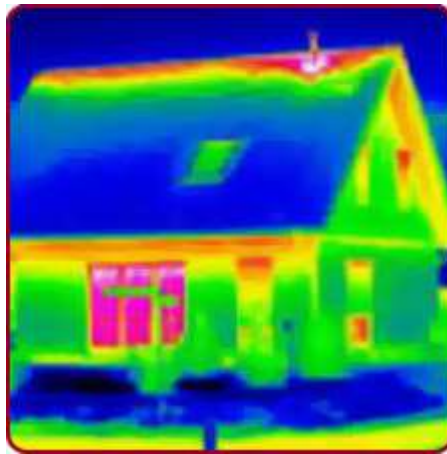
The wavelength of maximum intensity shifts to shorter wavelengths when  $T$  is increased

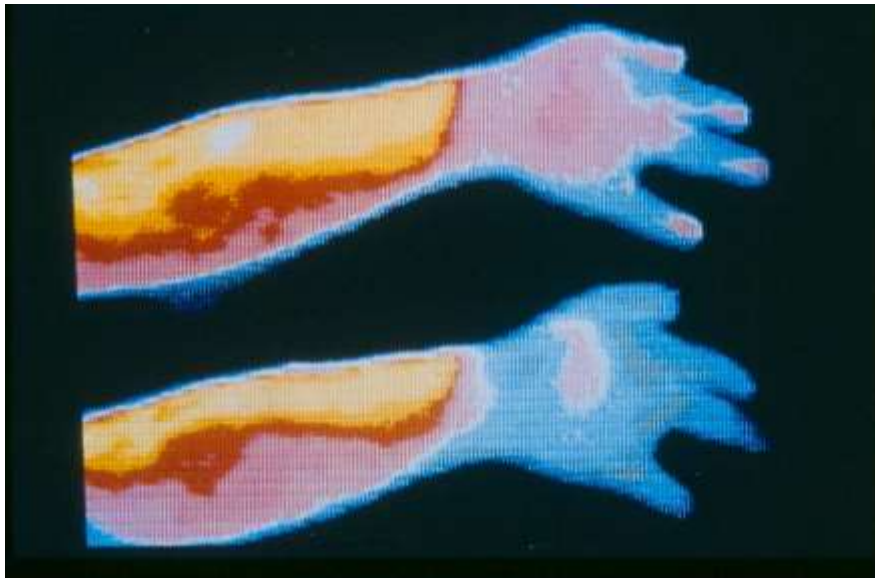
## Application in medical diagnostics:

### 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







## **Love Your Heart... Prevent Heart Disease**

Heart disease and strokes are **PREVENTABLE**, but only if you  
**KNOW** before it's too late

