BLACKBODY RADIATION

ELECTRIC RANGE → NO CHANGE IN COLOR (RESISTANCE) → IR → 200°C

RED → 500°C

ORANGE → 1000°C

MOLTEN IRON → YELLOW → 2500°C

NOT ALL MATERIALS EMIT THE SAME KIND OF LIGHT WHEN HEATED AT THE SAME TEMPERATURE

WHILE Fe GLOWS ORANGE
GLASS STAYS COLORLESS (HOT) → IR

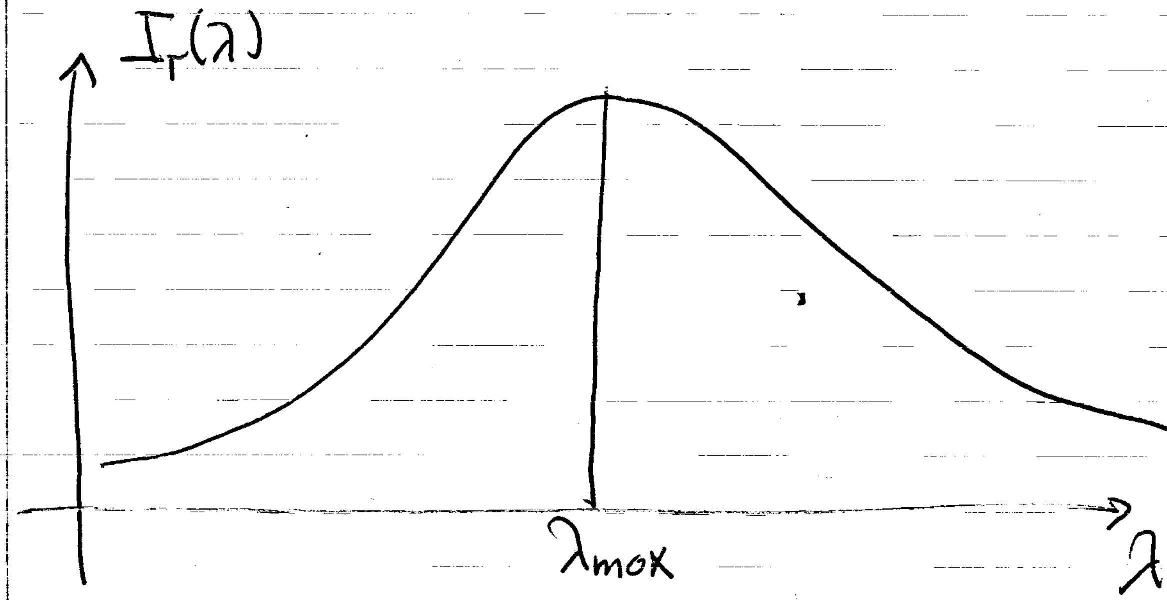
OBJECTS RADIATE STRONGLY AT λ THAT ALSO ABSORB STRONGLY (RECIPROCITY)

MOST MATERIALS RADIATE / ABSORB AT A RANGE OF λ

AN IDEAL OBJECT THAT EMITS/ABSORBS RADIATION OF ANY λ IS CALLED "BLACKBODY"

EXP

$I_T(\lambda)$ ENERGY RADIATED PER UNIT TIME PER UNIT VOLUME $\left(\frac{J}{s\,m^3}\right)$



I_T = TOTAL ENERGY FOR ALL λ $\left(\frac{J}{s\,m^2}\right)$

$I_T = e\,\sigma\,T^4$ Stephan-Boltzman

$e = 1 \Rightarrow$ IDEAL Blackbody

WIEN'S LAW

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

$\frac{I_T(\lambda)}{T^5}$ VS $\lambda T \Rightarrow$ UNIQUE PLOT

$$\Rightarrow \quad I_T(\lambda) = \frac{F(\lambda T)}{\lambda^5}$$

<u>EXP</u> $I_T(\lambda)$ FOR $\lambda >> 1 \rightarrow \frac{8\pi}{\lambda^4} k_B T$

<u>THEORY</u>
RAYLEIGH - JEANS USED A CLASSICAL APPROACH $\Rightarrow$ A CONTINUUE OF ENERGY

<u>EXP</u> $I_T(\lambda)$ FOR $\lambda << 0 \rightarrow \frac{8\pi hc}{\lambda^5} e^{-\frac{hc}{k_B T}\frac{1}{\lambda}}$

PLANK FITTED THE DATA WITH

$$I_T(\lambda) = \frac{8\pi hc}{\lambda^5} \frac{1}{e^{\frac{hc}{k_B T}\frac{1}{\lambda}} - 1}$$

THE IMPLICATIONS OF THIS ENERGY DISTRIBUTION ARE CONSISTENT WITH A THERMODYNAMIC ANALYSIS OF A SYSTEM OF OSCILLATORS IF AND ONLY IF THE ENERGY IS QUANTIZED

$$h = 6.626069 \times 10^{-34} \text{ Js}$$

THEORY

$$I_T(\lambda) = \frac{8\pi}{\lambda^4} \overline{E}_{osc}(\lambda, T)$$

$$I_T(\nu) = \frac{8\pi \nu^2}{c^3} \overline{E}_{osc}(\nu, T)$$

PHOTOELECTRIC EFFECT

EINSTEIN → ENERGY OF PHOTON ≡ $h\nu$ – (1905)

Φ = min energy to eject e^-

$h\nu - \Phi$ EXCESS ENERGY → KINETIC ENERGY

$$KE = -\Phi + h\nu$$