

PHOTONS

WAVELENGTH 0

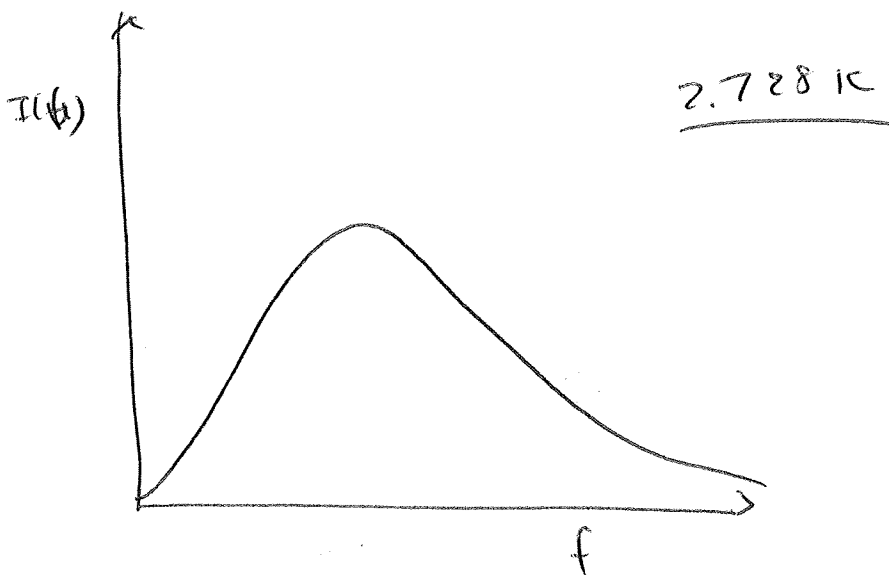
$$\frac{P}{A} = \frac{2\pi^5 R^4}{15h^3 c^2} T^4$$

$$\frac{U}{V} = \frac{8\pi^5 R^4 T^4}{15h^3 c^3}$$

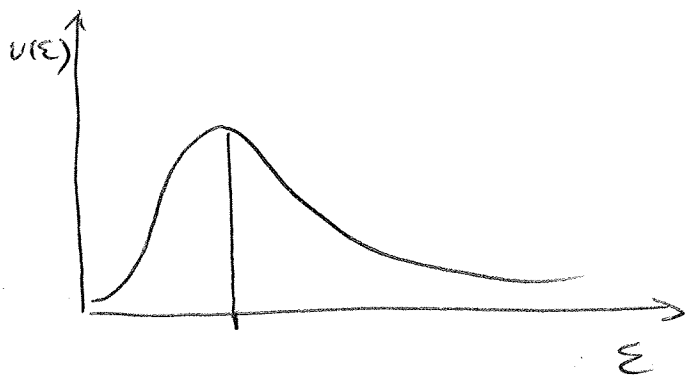
$$C_U = \frac{\partial U}{\partial T} = \frac{32\pi^5 R^4 T^3}{15h^3 c^3}$$

$$\frac{S(T)}{V} = \int_0^T \frac{C_U}{T} dT = \frac{32\pi^5}{45} \left(\frac{RT}{hc}\right)^3 R$$

COSMIC BACKGROUND RADIATION



$$u(\epsilon) = \frac{8\pi}{(hc)^3} \frac{\epsilon^3}{e^{\frac{\epsilon}{kT}} - 1}$$



2.82kT

WIEN'S LAW

WHAT IS THE # OF PHOTONS AT EQUILIBRIUM IN A BOX OF VOLUME V AT TEMPERATURE T ?

$$I = \sigma T^4$$

REAL MATERIAL

~~ARE~~

$$I = \underbrace{\epsilon}_{\text{EMISSIVITY}} \sigma T^4$$

QUARTZ

$$\underline{\underline{\epsilon(\lambda)}}$$

SUN EMITS

1370 W/m² : SOLAR CONSTANT

150 x 10⁶ km SUN-TO-EARTH

TOTAL OUT PUT

$$1370 \text{ W/m}^2 \times 4\pi (150 \times 10^6 \text{ m})^2 = \boxed{3.9 \times 10^{26} \text{ W}} \quad \text{TOTAL OUTPUT}$$

~~ASSUME~~

$$\text{SUN'S DIAMETER} = \boxed{7.0 \times 10^8 \text{ m}}$$

~~7.0 x 10⁸ m~~

$$4\pi (7.0 \times 10^8 \text{ m})^2 = 6.1 \times 10^{18} \text{ m}^2$$

$$I = \frac{3.9 \times 10^{26} \text{ W}}{6.1 \times 10^{18} \text{ m}^2} = 6.4 \times 10^7 \text{ W/m}^2 = \sigma T^4$$

$$\sigma = 5.67 \times 10^{-8} \text{ W/m}^2 \cdot \text{K}^4$$

$$T = \underline{5795 \text{ K}}$$

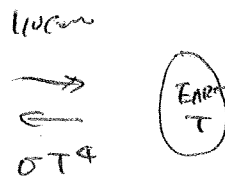
WIEN'S LAW

$$E_{\text{MAX}} = \frac{\cancel{2.82 kT} - 1.41}{2.82 kT}$$

$$= 2.82 \times 5795 \text{ K} \times 1.38 \times 10^{-23} \text{ J/K}$$

$$= 2.26 \times 10^{-19} \text{ J}$$

$$= \boxed{1.407 \text{ eV}}$$



INCOMING RADIATION = OUTGOING RADIATION

$$1370 \text{ W/m}^2 \cdot \pi R_{\text{EARTH}}^2 = 4\pi R^2 \sigma T^4$$

$$T = \underline{279 \text{ K}}$$

