Summary Lecture 10

At the turn of the century, evidence began to pile up showing that the energy of electro-magnetic radiation is not continuous but comes in small amounts called light quanta or photons.

Blackbody Radiation
Photo Effect

A photon is a massless bundle of electromagnetic energy. The Energy \( E \) of a single photon depends on its frequency \( f \)

\[
E = hf
\]

Planck’s constant: \( h = 6.63 \times 10^{-34} \text{ Js} \)
more on photons

Energy \[ E = hf \quad \text{or} \quad E = \hbar \frac{c}{\lambda} \]

Mass \[ m_o = 0 \]

Speed \[ c \quad \text{(speed of light, } 3 \times 10^8 \text{ m/s)} \]

Momentum \[ p = \frac{E}{c} = \frac{hf}{c} = \frac{h}{\lambda} \]

\[ E^2 = p^2c^2 + (m_o c^2)^2 \quad \text{but } m_o = 0 \rightarrow E = pc \]

Photon Interaction with matter:

- **Photoeffect**: electron knocked out of metal
  - Photon disappears

- **Compton Effect**: elastic scattering between photon and electron. Photon continues with reduced energy

- **Pair Production**: Photons with energy \( E > 2 m_o c^2 \) can create an electron-positron pair