Physics 113 - Lecture 10

Light is a Particle!

**Photoelectric effect**

\[ hf = KE - W \]

**Electron pair production**

Minimum Energy Photon
\[ hf = 2 m_e \]

**Compton scattering**

\[ \lambda' = \lambda + \frac{h}{m_0 c} (1 - \cos \phi) \]
Wave Particle Duality

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<th>Particle</th>
<th>Wave</th>
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<td>photoelectric effect</td>
<td>Young’s experiment</td>
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<td>Compton scattering</td>
<td>diffraction</td>
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<td>pair production</td>
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Helpful to visualize a Wave Packet

Rutherford Atomic Model

Electrons scattering through thin gold foil
hit something hard

Electrons travel in circular orbits about a small solid positive nucleus

Relative Size: {nucleus} to {electron orbits}
{baseball} to {Yankee Stadium}
Bohr

angular momentum quantized
\[ L = \frac{\hbar n}{2\pi} \quad \text{where } n = 1, 2, 3, \ldots \]

Electrons radiate by jumping between orbits emitting a single photon in the process

using Coulomb Force law with \( a = \frac{v^2}{r} \) \( \Rightarrow \)
\[ r_n = (0.529 \times 10^{-10} \text{ m}) n^2 \]
\[ E_n = \frac{-13.6 \text{eV}}{n^2} \]

Bohr hypothesis explains atomic spectra

Experimentally:
\[ \frac{1}{\lambda} = R \left( \frac{1}{n^2} - \frac{1}{m^2} \right) \quad \text{where } R = 1.097 \times 10^7 \text{ m}^{-1} \]

Bohr hypothesis is arbitrary though.
Basically chosen to fit atomic spectrum.