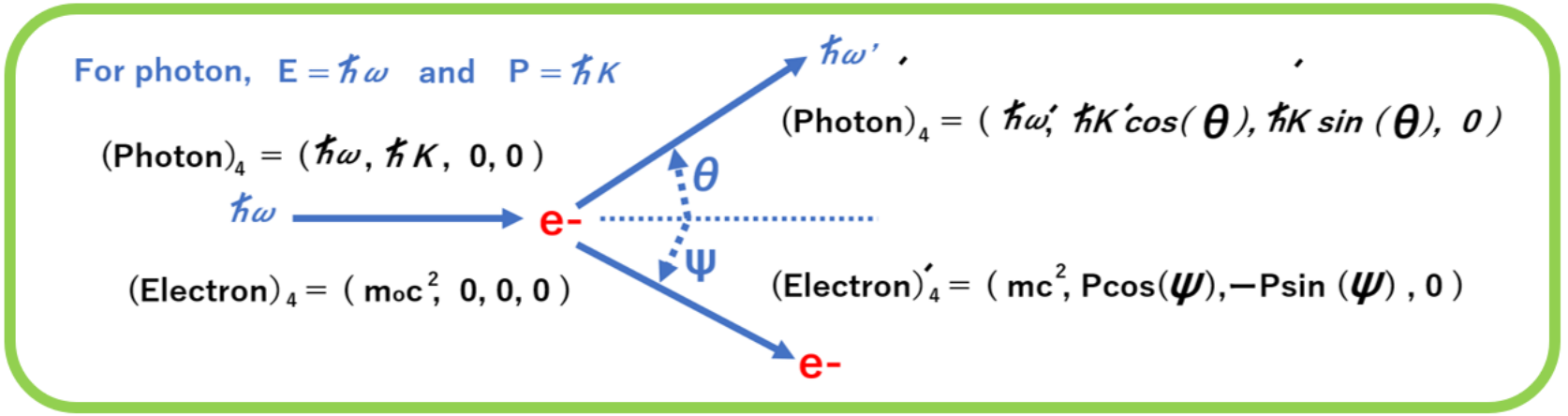
Arthur H. Compton (1892～1962), while at Washington University at St. Louis found that x-rays increase in wave length when scattered, which he explained in 1923 on the basis of the quantum theory of light.

(1) $E_o = m_o c^2$

For photon,

$E = \hbar\omega$ and $P = \hbar K$

$E^2 - c^2 P^2 = 0 \quad \omega = cK$



(2) $KE = \hbar\omega - \hbar\omega' = E - E_o = mc^2 - m_o c^2$

(7) $E^2 = (KE + m_o c^2)^2 = m_o^2 c^4 + P^2 c^2$

(8) $P^2 c^2 = (KE)^2 + 2 m_o c^2 (KE)$

(9) $P^2 c^2 = (\hbar\omega - \hbar\omega')^2 + 2 m_o c^2 (\hbar\omega - \hbar\omega')$

(4) $\omega = cK = 2\pi c / \lambda$

(6) $E^2 - c^2 P^2 = E_o^2 = m_o^2 c^4$

$$\lambda' - \lambda = \frac{h}{m_o c}\{1 - \cos(\theta)\}$$