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.

$(\text{Light})_4 = \hbar \cdot (\omega, K_x, K_y, K_z)$ $\quad (\text{Electron})_4 = (E, P_x, P_y, P_z)$ $\quad E^2 - c^2P^2 = E_o^2$

(2) $KE = \hbar\omega - \hbar\omega' = E - E_o = mc^2 - m_oc^2 = m_oc^2\left[\dfrac{1}{\sqrt{1 - v^2/c^2}} - 1\right] \sim \dfrac{m_ov^2}{2}$ for $v << c$

(14)
$$\hbar K = \hbar K' \cos(\theta) + P\cos(\psi)$$
$$\hbar K' \sin(\theta) = P\sin(\psi)$$

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

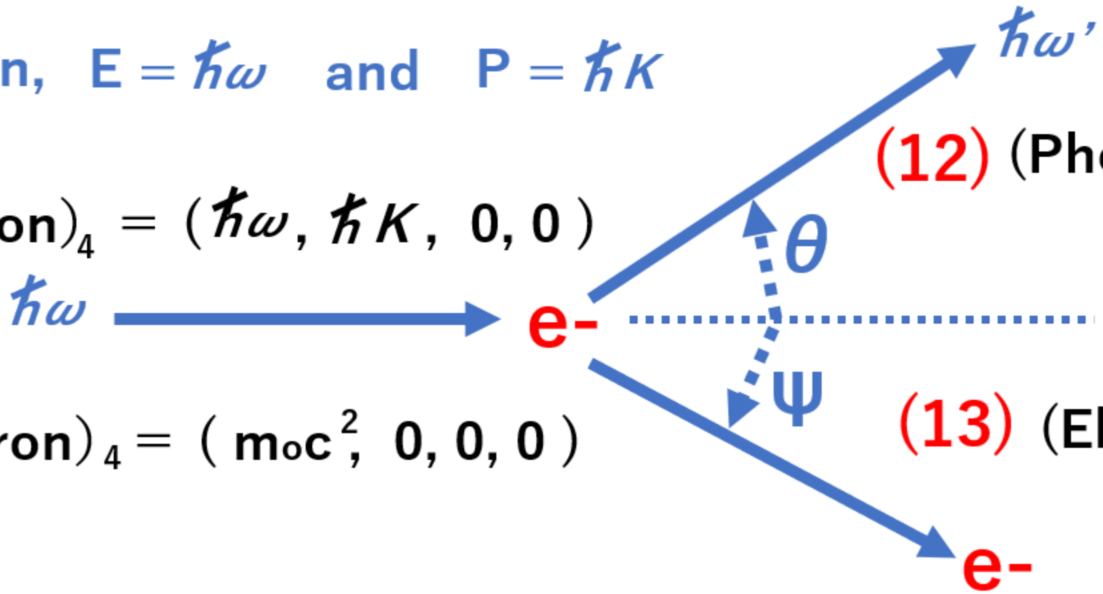
(4) $\omega = cK = 2\pi c/\lambda$

(15) $P^2 = (\hbar K')^2 + (\hbar K)^2 - 2(\hbar K')(\hbar K)\cos(\theta)$ $\;\Rightarrow\;$ $\lambda' - \lambda = \dfrac{h}{m_oC}\{1 - \cos(\theta)\}$

For photon, $E = \hbar\omega$ and $P = \hbar K$

(12) $(\text{Photon})'_4 = (\hbar\omega', \hbar K'\cos(\theta), \hbar K'\sin(\theta), 0)$

(10) $(\text{Photon})_4 = (\hbar\omega, \hbar K, 0, 0)$



(11) $(\text{Electron})_4 = (m_oc^2, 0, 0, 0)$

(13) $(\text{Electron})'_4 = (mc^2, P\cos(\psi), -P\sin(\psi), 0)$