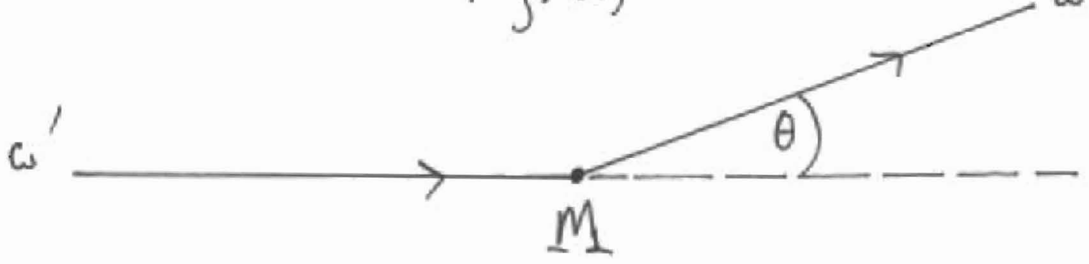
1)

159(9): Electron Electron Compton Scattering

Consider an electron wave ω colliding with a stationary and particulate electron target, and being scattered at angle θ and angular frequency ω'. The experiment is summarized in Fig (1).

Fig. (1)



Conservation of Energy

$$\gamma \underline{m} c^2 + \underline{m} c^2 = \gamma' \underline{m} c^2 + \left(\underline{m}^2 c^4 + c^2 p'^2\right)^{1/2} \quad -(1)$$

where

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2}, \quad \gamma' = \left(1 - \frac{v'^2}{c^2}\right)^{-1/2} \quad -(2)$$

Here:

$\underline{m}$ = mass of electron
v = initial velocity of electron
v' = final velocity of electron
θ = angle of scatter.

Conservation of Momentum

$$\underline{p}' = \hbar\left(\underline{\kappa} - \underline{\kappa}'\right) \quad -(3)$$

where $p' = |\underline{p}'|$ is the momentum of the ~~scattered~~ target electron

2)

$\underline{\kappa}$ = initial wavenumber of incoming electron

$\underline{\kappa}'$ = final wavenumber of scattered electron

According to wave particle duality, the electron is a wave and a particle. The wave and particle are related by:

$$\left.\begin{aligned} \hbar\omega &= \gamma M c^2, & \hbar\kappa &= \gamma M v \\ \hbar\omega' &= \gamma' M c^2, & \hbar\kappa' &= \gamma' M v' \end{aligned}\right\} \quad -(4)$$

the de Broglie Einstein equation of the electron.

So:

$$\kappa = \frac{\omega v}{c^2}, \quad \kappa' = \frac{\omega' v'}{c^2}, \quad -(5)$$

and

$$\frac{\omega'}{\omega} = \frac{\gamma'}{\gamma}. \quad -(6)$$

The solution of this set of equations is as given in UFT 158, and is:

$$v^2 = \frac{1}{2a}\left(-b \pm \left(b^2 - 4ac'\right)^{1/2}\right) \quad -(7)$$

where

$$a = \frac{1}{c^2}\left(1 - \cos^2\theta\right), \quad -(8)$$

$$b = \left(\left(1 - \left(\frac{\omega'}{\omega}\right)^2\right)\cos^2\theta - \frac{2B}{c^2\omega^2}\right), \quad -(9)$$

$$c' = \left(\frac{B}{c\omega^2}\right)^2, \quad -(10)$$

$$B = \frac{1}{2}\left[\left(1 - \frac{\omega'}{\omega}\right)^2 \omega^2 c^2 \left(1 - \frac{2Mc^2}{\hbar\omega}\left(1 - \frac{\omega'}{\omega}\right)^{-1}\right) - c^2\omega'^2\left(1 - \left(\frac{\omega}{\omega'}\right)^2\right)\right]. \quad -(11)$$

3) The electron mass is defined by:

$$\underline{M} = \frac{\hbar\omega}{c^2}\left(1-\frac{v^2}{c^2}\right)^{1/2} \quad -(12)$$

Eq. (7) and (12) give an equation for $\underline{M}$.

Secondly:

$$v'^2 = \frac{1}{2a}\left(-b' \pm \left(b'^2 - 4ac''\right)^{1/2}\right) \quad -(13)$$

where

$$a = \frac{1}{c^2}\left(1-\cos^2\theta\right), \quad -(14)$$

$$b' = \left(1-\left(\frac{\omega}{\omega'}\right)^2\right)\cos^2\theta - \frac{2B'}{c^2\omega'^2} \quad -(15).$$

$$c'' = \left(\frac{B'}{c\omega'^2}\right)^2 \quad -(16)$$

$$B' = \frac{1}{2}\left(A' - \omega^2c^2\left(1-\left(\frac{\omega'}{\omega}\right)^2\right)\right) \quad -(17)$$

$$A' = c^2\omega'^2\Omega'^2\left(1+\frac{2\underline{M}c^2}{\hbar\omega'\Omega'}\right) \quad -(18)$$

$$\Omega' = \frac{\omega}{\omega'} - 1, \quad -(19)$$

$$\underline{M} = \frac{\hbar\omega'}{c^2}\left(1-\frac{v'^2}{c^2}\right)^{1/2} \quad -(20)$$

Eqs. (13) and (20) give another equation for $\underline{M}$.

4) The two equations for $\underline{M}$ are:

$$\left.\begin{aligned} \underline{M} &= \frac{\hbar\omega}{c^2}\left(1-\frac{v^2}{c^2}\right)^{1/2}, \\ v^2 &= \frac{1}{2a}\left(-b \pm \left(b^2-4ac'\right)^{1/2}\right) \end{aligned}\right] \quad -(21)$$

and

$$\left.\begin{aligned} \underline{M} &= \frac{\hbar\omega'}{c^2}\left(1-\frac{v'^2}{c^2}\right)^{1/2}, \\ v'^2 &= \frac{1}{2a}\left(-b' \pm \left(b'^2-4ac''\right)^{1/2}\right) \end{aligned}\right] \quad -(22)$$

Computer Algebra

To eliminate human error, eqs. (21) and (22) can be solved by computer algebra for $\underline{M}$.

Overall Conclusion

It is already clear that $\underline{M}$ will depend on ω, ω' and θ, and is not a constant in Einstein / de Broglie theory, which therefore fails. The concept of electron mass fails. In ECE theory it is replaced by

$$R = \left(\frac{\underline{M}c}{\hbar}\right)^2 \quad -(23)$$