247(1): Particle Collision Theory with Transmutation into Unequal Masses.

In this case the equation of conservation of energy is:

$$\gamma m c^2 + m c^2 = \gamma' m_1 c^2 + \gamma'' m_2 c^2 \quad -(1)$$

and the equation of conservation of momentum is:

$$\underline{p} = \underline{p}' + \underline{p}'' \quad -(2)$$

Here:

$$E_1 = \hbar\omega = \gamma m c^2 \quad -(3)$$

$$E_2 = \hbar\omega_0 = m c^2 \quad -(4)$$

$$E_3 = \hbar\omega' = \gamma' m_1 c^2 \quad -(5)$$

$$E_4 = \hbar\omega'' = \gamma'' m_2 c^2 \quad -(6)$$

The momentum duality equations are:

$$\underline{p} = \hbar \underline{\kappa} = \gamma m \underline{v} \quad -(7)$$

$$\underline{p}' = \hbar \underline{\kappa}' = \gamma' m_1 \underline{v}' \quad -(8)$$

$$\underline{p}'' = \hbar \underline{\kappa}'' = \gamma'' m_2 \underline{v}'' \quad -(9)$$

It follows that:

$$\kappa''^2 = \kappa^2 + \kappa'^2 - 2\kappa\kappa'\cos\theta \quad -(10)$$

From eqs. (3) to (9) it follows that:

$$\kappa = \frac{\omega v}{c^2}, \quad \kappa' = \frac{\omega' v'}{c^2}, \quad \kappa'' = \frac{\omega'' v''}{c^2} \quad -(11)$$

Therefore:

2)

$$\omega''^2 v''^2 = \omega^2 v^2 + \omega'^2 v'^2 - 2\omega\omega' v v' \cos\theta \quad -(12)$$

The Lorentz factors are:

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2}, \gamma' = \left(1 - \frac{v'^2}{c^2}\right)^{-1/2}, \gamma'' = \left(1 - \frac{v''^2}{c^2}\right)^{-1/2} \quad -(13)$$

From the equations:

$$\hbar\omega = \gamma m c^2, \hbar\omega' = \gamma' m_1 c^2, \hbar\omega'' = \gamma'' m_2 c^2 \quad -(14)$$

it follows that:

$$\gamma = \frac{\hbar\omega}{mc^2}, \gamma' = \frac{\hbar\omega'}{m_1 c^2}, \gamma'' = \frac{\hbar\omega''}{m_2 c^2} \quad -(15)$$

Now let:

$$x = \frac{mc^2}{\hbar}, x_1 = \frac{m_1 c^2}{\hbar}, x_2 = \frac{m_2 c^2}{\hbar}, \quad -(16)$$

So

$$\gamma = \frac{\omega}{x}, \gamma' = \frac{\omega'}{x_1}, \gamma'' = \frac{\omega''}{x_2} \quad -(17)$$

and

$$v^2 = c^2\left(1 - \left(\frac{x}{\omega}\right)^2\right); v'^2 = c^2\left(1 - \left(\frac{x_1}{\omega'}\right)^2\right); \frac{v''^2}{c^2} = 1 - \left(\frac{x_2}{\omega''}\right)^2 \quad -(18)$$

From eqs. (12) and (18):

$$\omega''^2 - x_2^2 = \omega^2 - x^2 + \omega'^2 - x_1^2 - 2\left(\omega^2 - x^2\right)^{1/2}\left(\omega'^2 - x_1^2\right)^{1/2}\cos\theta \quad -(19)$$

3) From conservation of energy:

$$\omega + \omega_0 = \omega' + \omega'' \quad -(20)$$

So

$$\omega'' = \omega - \omega' + \omega_0 \quad -(21)$$

Therefore:

$$(\omega - \omega' + \omega_0)^2 - x_2^2 = \omega^2 - x^2 + \omega'^2 - x_1^2 - 2(\omega^2 - x^2)^{1/2}(\omega'^2 - x_1^2)^{1/2}\cos\theta \quad -(22)$$

$$= (\omega - \omega')^2 + 2\omega_0(\omega - \omega') + \omega_0^2$$

$$= \omega^2 + \omega'^2 - 2\omega\omega' + 2\omega_0(\omega - \omega') + \omega_0^2$$

Therefore, using: $\qquad x = \omega_0 \quad -(23)$

we obtain:

$$(\omega^2 - x^2)^{1/2}(\omega'^2 - x_1^2)^{1/2}\cos\theta$$

$$= \frac{1}{2}(x_2^2 - x_1^2) + \omega\omega' - (\omega - \omega')x - x^2$$

$$= \frac{1}{2}(x_2^2 - x_1^2) + (\omega' - x)(\omega + x) \quad -(24)$$

$$\boxed{\text{So: } x_2^2 = x_1^2 + 2\left[(\omega^2 - x^2)^{1/2}(\omega'^2 - x_1^2)^{1/2}\cos\theta - (\omega' - x)(\omega + x)\right]}$$

$-(25)$

t) If

$$x_1 = x_2 \quad -(26)$$

the results of UFT246 are obtained, notably eq. (28) of note 246(7).

For 90° scattering:

$$\cos\theta = 0 \quad -(27)$$

so:

$$\boxed{2(\omega' - x)(\omega + x) = x_1^2 - x_2^2} \quad -(28)$$

where

$$x = \omega_0 = \frac{mc^2}{\hbar} \quad -(29)$$

where m is the rest mass of the electron.

Therefore in this kind of collision there is a change of curvature, which can be studied numerically by plotting $x_1^2 - x_2^2$ from eq. (25). However, there is another possible approach that can be taken by assuming that:

$$\boxed{\gamma m_1 c^2 + m_2 c^2 = \gamma' m_1 c^2 + \gamma'' m_2 c^2 + E} \quad -(30)$$

This assumes that the energy E is released in general scattering theory and this idea will be developed in the next note.