

# 181(4): Laws of Particle Interactions.

Consider a particle of measured mass  $m_0$ , for example an electron. If this particle interacts with a field, the mass associated with that field is:

$$m = \left( \left( \frac{\hbar}{c} \right)^2 \left( \frac{\omega^2}{c^2} - k^2 \right) + m_0^2 \right)^{1/2} \quad - (1)$$

where  $m_0$  is the measured mass of the particle associated with the field of force. The mechanism behind eq. (1) is the minimal prescription:

$$p^\mu \rightarrow p^\mu + \hbar k^\mu \quad - (2)$$

as in previous notes to UFT 181.

For example, consider an electron of mass  $m_0$ , initially at rest, interacting with the massless photon in the theory of Compton scattering. For this interaction of particles  $p^\mu$  is eq. (2) refers to the electron and  $\hbar k^\mu$  to the photon. For the massless photon:

$$m_0 = 0 \quad - (3)$$

$$\omega = kc \quad - (4)$$

$$m = 0 \quad - (5)$$

so

$$E = \hbar \omega = \gamma mc^2 \quad - (6)$$

and therefore

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

2) where  $\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2} \quad - (8)$

and  $v \rightarrow c \quad - (9)$

So  $\gamma m c^2$  and  $\gamma m v$  are indeterminate (zero divided by zero). The energy of the massless photon is described by:  $E = hf \quad - (10)$

and its momentum by:

$$\underline{p} = \frac{E}{c} \quad - (11)$$

The energy of the electron is described by:

$$E_{\text{electron}} = \gamma m_0 c^2 \quad - (12)$$

and its momentum by:

$$\underline{p}_{\text{electron}} = \gamma m_0 \underline{v} \quad - (13)$$

Therefore, this is a field / particle description in which the field has the mass (1). The particle retains its rest mass  $m_0$ . If the electron is initially at rest its initial energy is:

$$E_i = m_0 c^2 \quad - (14)$$

and its final energy after collision is:

$$E_f = \gamma m_0 c^2 \quad - (15)$$

3) The initial energy of the photon is:

$$E_i = h \omega_i \quad - (16)$$

and its final energy is:

$$E_f = h \omega_f \quad - (17)$$

The energy conservation equation of standard Compton effect is therefore:

$$h \omega_i + m_0 c^2 = \gamma m_0 c^2 + h \omega_f \quad - (18)$$

The initial momentum of the electron is zero and the initial momentum of the photon is:

$$\underline{p}_i = h \underline{k}_i \quad - (19)$$

The final momentum of the photon is:

$$\underline{p}_f = h \underline{k}_f \quad - (20)$$

and the final momentum of the electron is:

$$\underline{p}_f = \gamma m_0 \underline{v}_f \quad - (21)$$

Therefore the equation of conservation of momentum is:

$$h \underline{k}_i = h \underline{k}_f + \underline{p}_f \quad - (22)$$

Eqs. (18) and (22) result in:

$$\lambda_f - \lambda_i = \frac{h}{m_0 c} (1 - \cos \theta) \quad - (23)$$

as observed experimentally.

4) Here  $\lambda_f$  is the final wavelength of the photon and  $\lambda_i$  its initial wavelength. The angle  $\theta$  is the scattering angle. The agreement of eq. (23) with experiment results from the fact that the photon mass is for all practical purposes zero is the quantity.

As shown in UFT 160 and notes 160(3), this apparent agreement collapses when the case of general Compton scattering is considered. In general Compton scattering

$$\gamma m_1 c^2 + m_2 c^2 = \gamma' m_1 c^2 + \gamma'' m_2 c^2 - (24)$$

and

$$\hbar \underline{\kappa} = \hbar \underline{\kappa}' + \hbar \underline{\kappa}'' - (25)$$

i.e.

$$\underline{p} = \underline{p}' + \underline{p}'' - (26)$$

where:

$$\underline{p} = \hbar \underline{\kappa} = \gamma m_1 \underline{v} - (27)$$

$$\underline{p}' = \hbar \underline{\kappa}' = \gamma' m_1 \underline{v}' - (28)$$

$$\underline{p}'' = \hbar \underline{\kappa}'' = \gamma'' m_2 \underline{v}'' - (29)$$

These equations give:

$$x_2 = \frac{\omega \omega'}{\omega - \omega'} - \left( \frac{x_1^2 + (\omega^2 - x_1^2)^{1/2} (\omega'^2 - x_1^2)^{1/2} \cos \theta}{\omega - \omega'} \right) - (30)$$

where

$$x_2 = \frac{m_2 c^2}{\hbar}, \quad x_1 = \frac{m_1 c^2}{\hbar} - (31)$$

5) It was found in HFT 160 that if  $x_1$  is constant then  $x_2$  is not, and vice-versa. This result was discovered by using data from electron Compton scattering and refutes the standard model of particle scattering.

With the insight given by the new eq. (1) we may identify:

$$m_1 = m \quad - (32)$$

$$m_2 = m_0 \quad - (33)$$

Therefore using note 160 (7):

$$m^2 = \frac{1}{2a} \left( -b \pm (b^2 - 4ac')^{1/2} \right) \quad - (34)$$

$$= \left( \frac{h}{c} \right)^2 \left( \frac{\omega^2}{c^2} - k^2 \right) + m_{10}^2$$

where:

$$a = 1 - \cos^2 \theta$$

$$b = (\omega'^2 + \omega^2) \cos^2 \theta - 2A$$

$$c' = A^2 - \omega^2 \omega'^2 \cos^2 \theta$$

$$A = (\omega \omega' - x_2)(\omega - \omega')$$

$$x_2 = \frac{m_0 c^2}{h}$$

In eq. (34),  $m_{10}$  is the measured mass of particle  $m_1$ .

b) In 4FT 160 it was found that  $m^2$  varied considerably, and this property was graphed. It can now be interpreted in terms of 6 parameters  $\omega, \pi$  and  $m_{10}$  of eq. (34) with a three variable least mean squares procedure.

These results completely change the meaning of particle physics, and make quantum dynamics obsolete.