289(5): Two Photon Theory of Energy and Momentum Conservation.

Consider a beam consisting of two photons reflected and refracted at a boundary. In general:

$$\hbar\omega + \hbar\omega = \hbar\omega_1 + \hbar\omega_2 \quad -(1)$$

and

$$\hbar\underline{\kappa} + \hbar\underline{\kappa} = \hbar\underline{\kappa}_1 + \hbar\underline{\kappa}_2 \quad -(2)$$

and this is a variation on the Compton effect.

In the obsolete dogma:

$$\omega = \omega_1 = \omega_2 \quad -(3)$$

under all conditions. So in the old dogma it is argued that:

$$\hbar\omega + \hbar\omega = \hbar\omega + \hbar\omega \quad -(4)$$

but at the same time:

$$\underline{\kappa} \neq \underline{\kappa}_1 \neq \underline{\kappa}_2 \quad -(5)$$

Eq. (3) in the old dogma originates in the boundary condition:

$$\omega t - \underline{\kappa}\cdot\underline{r} = \omega_1 t - \underline{\kappa}_1\cdot\underline{r} = \omega_2 t - \underline{\kappa}_2\cdot\underline{r} \quad -(6)$$

at the boundary - the boundary condition.

It is assumed without proof that eq. (3) is true.

2) So it follows that:

$$\underline{k}_1 \cdot \underline{r} = \underline{k}_1 \cdot \underline{r} = \underline{k}_2 \cdot \underline{r} \quad -(7)$$

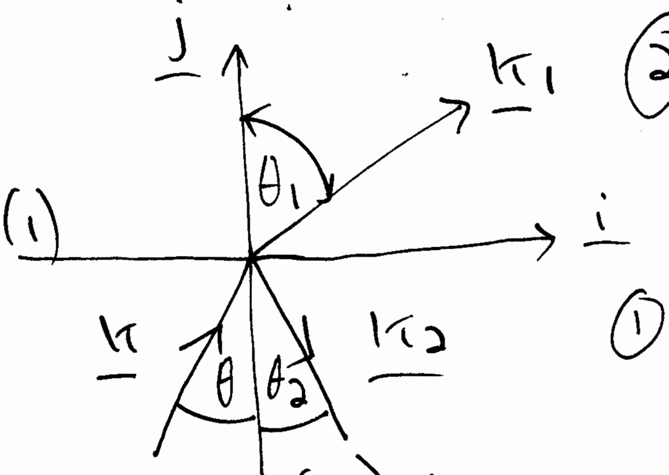

Fig. (1)

With reference to Eq. (7):

$$\underline{k} = k\left(\underline{i}\sin\theta + \underline{j}\cos\theta\right) \quad -(8)$$

$$\underline{k}_1 = k_1\left(\underline{i}\sin\theta_1 + \underline{j}\cos\theta_1\right) \quad -(9)$$

$$\underline{k}_2 = k_2\left(\underline{i}\sin\theta_2 - \underline{j}\cos\theta_2\right) \quad -(10)$$

and

$$\underline{r} = X\underline{i} + Y\underline{j} \quad -(11)$$

From eqs. (7) to (11):

$$X k\sin\theta + Y k\cos\theta \quad -(12)$$
$$= X k_1 \sin\theta_1 + Y k_1 \cos\theta_1$$
$$= X k_2 \sin\theta_2 - Y k_2 \cos\theta_2$$

The second assumption made without proof is ~~that~~

$$k\sin\theta = k_1\sin\theta_1 = k_2\sin\theta_2 \quad -(13)$$

3)

The third assumption made without proof is:

$$\kappa = \kappa_2 \quad -(14)$$

which follows from

$$\omega = \omega_2 \quad -(15)$$

and

$$\kappa = \frac{\omega}{v}, \quad \kappa_2 = \frac{\omega_2}{v} \quad -(16)$$

where v is the phase velocity in medium ①. If medium ① is air then:

$$v = c. \quad -(17)$$

So in the old dogma:

$$\sin\theta = \sin\theta_2 \quad -(18)$$

and it arrives without mathematical proof of any kind at Snell's first law:

$$\theta = \theta_2 \quad -(19)$$

The fourth assumption made without proof is:

$$\kappa \sin\theta = \kappa_1 \sin\theta_1 \quad -(20)$$

with

$$\frac{\kappa}{\kappa_1} = \frac{n}{n_1} \quad -(21)$$

to arrive at Snell's second law without mathematical proof of any kind.

This dogmatism is easily refuted as follows.

From eqs. (12) and (13):

$$\kappa \cos\theta = \kappa_1 \cos\theta_1 = \kappa_2 \cos\theta_2 \quad - (22)$$

Using the dogmatic:

$$\kappa = \kappa_2 \quad - (23)$$

and the experimental:

$$\theta = \theta_2 \quad - (24)$$

it is found that:

$$\theta = -\theta_2 \quad - (25)$$

Equation (25) contradicts equation (24) and the dogma collapses.

From eq. (22):

$$\kappa \cos\theta = \kappa_1 \cos\theta_1 \quad - (26)$$

i.e.

$$\kappa \sin\left(\frac{\pi}{2} - \theta\right) = \kappa_1 \sin\left(\frac{\pi}{2} - \theta_1\right) \quad - (27)$$

which contradicts eq. (20), and the dogma collapses as shown in a second way.

So eq. (1) is the correct equation of the two photon model, and not eq. (4).