4F1289(2): Compton Type Theory of Refraction and Reflection

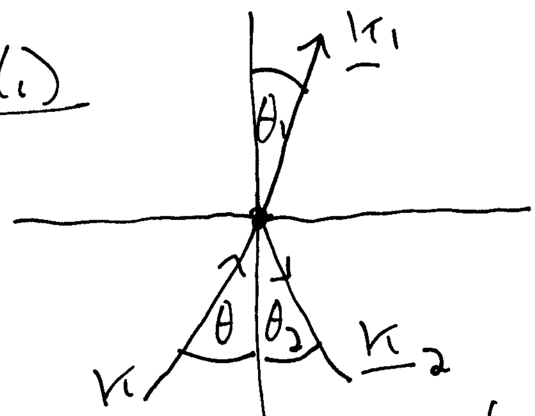
The usual Compton theory can be developed as:

$$\hbar\omega + mc^2 = \hbar\omega_1 + \gamma mc^2 \quad -(1)$$

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

where mc^2 is the rest energy of an electron, $\hbar\omega$ is the energy of an incident photon, $\hbar\omega_1$ is the energy of the scattered photon, and γmc^2 the energy of the scattered electron

Fig (1)



With reference to Fig (1) it could be adapted directly for refraction and reflection to give the following results:

Refraction

$$\frac{1}{\omega_1} - \frac{1}{\omega} = \frac{\hbar}{mc^2}\left(1 - \cos\left(\pi - \theta + \theta_1\right)\right) \quad -(3)$$

Reflection

$$\frac{1}{\omega_2} - \frac{1}{\omega} = \frac{\hbar}{mc^2}\left(1 - \cos\left(\theta + \theta_2\right)\right) \quad -(4)$$

where m is an effective mass at the interface, and

$$\cos\left(\pi - (\theta - \theta_1)\right) = -\cos\left(\theta - \theta_1\right) \quad -(4a)$$

2) the angle between $\underline{K}$ and $\underline{K}_1$ is $\frac{\pi}{2} - \theta + \theta_1$, and the angle between $\underline{K}$ and K_2 is $\theta + \theta_2$.

By Snell's law:

$$\theta = \theta_2 \quad -(5)$$

and

$$n \sin\theta = n_1 \sin\theta_1 \quad -(6)$$

where n is the refractive index of the medium of incidence and where n_1 is the refractive index of the medium of refraction.

Therefore:

$$\frac{1}{\omega_1} - \frac{1}{\omega} = \frac{\hbar}{mc^2}\left(1 + \cos\left(\theta - \theta_1\right)\right) \quad -(7)$$

$$\frac{1}{\omega_2} - \frac{1}{\omega} = \frac{\hbar}{mc^2}\left(1 - \cos\left(\theta + \theta_2\right)\right) \quad -(8)$$

When ω, ω_1 and ω_2 are the frequencies of γ rays incident on a metal foil, then m is the mass of the electron:

$$m = 9.10953 \times 10^{-31}\ \text{kg} \quad -(9)$$

At visible frequencies of about 10^{16} radians per second, the Evans / Morris effects are given by an effective mass of:

$$m(\text{visible}) \sim 10^{-36} \text{ kg} \quad -(10)$$

and both ω_1 and ω_2 are shifted to the red as in the Compton effect.

The ae photon theory is approximately valid to about 100 cm^{-1} in the far infra-red, where

$$\omega \doteq 10^{13} \text{ radians per second} \quad -(11)$$

So

$$m(\text{far infra-red}) \doteq 10^{-38} \text{ kg} \quad -(12)$$

In the classical dogma:

$$\omega = \omega_1 = \omega_2 \quad -(13)$$

So

$$\cos(\theta + \theta_1) = 0 \quad -(14)$$

and

$$\theta + \theta_1 = \frac{\pi}{2} \quad -(15)$$

which contradicts experimental data. Similarly:

$$\sin(\theta + \theta_2) = 1 \quad -(16)$$

and

$$\theta + \theta_2 = \frac{\pi}{2} \quad -(17)$$

From eqs. (10) and (11):

$$\theta_1 = \theta_2 \quad -(18)$$

Eqs (11) and (12) again contradict data.

The effective mass m is a property

of the material in which refraction takes place. The angles θ, θ_1 and θ_2 can be related to the refractive index by Snell's second law (6) so knowing ω, ω_1, ω_2, θ, θ_1 and θ_2, the effective mass m can be determined.

This theory regards refraction as a glancing collision of the incoming photon from the effective mass m. Reflection is an acute angle collision in which

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

experimentally. In both types of collision, eqs. (1) and (2) are obeyed.

As in UFT 158 ff. this theory can be greatly developed to incorporate photon mass, and can also be developed for use with the Planck distribution.

By wave particle dualism:

$$\frac{\hbar}{mc^2} = \frac{1}{\omega_0} \quad - (20)$$

so:

$$\boxed{\begin{aligned} \frac{1}{\omega_1} - \frac{1}{\omega} &= \frac{1}{\omega_0}\left(1 + \cos(\theta - \theta_1)\right) \\ \frac{1}{\omega_2} - \frac{1}{\omega} &= \frac{1}{\omega_0}\left(1 - \cos(\theta + \theta_2)\right) \end{aligned}}$$