326(7): A New Interpretation of the Relation Between Special Relativity and Photon Mass

Consider the relativistic momentum:

$$\mathbf{p} = \gamma m \mathbf{v}_o \quad -(1)$$

and the classical momentum:

$$\mathbf{p}_o = m \mathbf{v}_o \quad -(2)$$

It follows that:

$$\boxed{\mathbf{v} = \gamma \mathbf{v}_o} \quad -(3)$$

where

$$\mathbf{p} = m \mathbf{v} \quad -(4)$$

The Lorentz $\gamma$ factor is:

$$\gamma = \left(1 - \frac{v_o^2}{c^2}\right)^{-1/2} \quad -(5)$$

so

$$v^2 = \frac{v_o^2}{1 - \frac{v_o^2}{c^2}} \quad -(6)$$

and

$$v_o^2 = \frac{v^2}{1 + \frac{v^2}{c^2}} \quad -(7)$$

<u>Usual Interpretation</u>

In the usual interpretation:

$$v_o \rightarrow c \quad -(8)$$

2)

So for a particle moving at c:

$$\gamma \rightarrow \infty \quad -(9)$$

and

$$m \rightarrow 0 \quad -(10)$$

The relativistic momentum p is indeterminate and is in fact unphysical in the usual interpretation. It is claimed that a particle moving at c must have zero mass. This conflicts with the Poincaré / de Broglie / Vigier concept of finite photon mass.

New Interpretation

The relativistic velocity is allowed to go to c:

$$v \longrightarrow c \quad -(11)$$

so from eqs. (6) and (7):

$$v_0^2 \rightarrow \frac{c^2}{2} \quad -(12)$$

So $v_0$ is bounded above by eq. (12).

This interpretation has two major advantages:

1) The photon mass is non-zero.
2) The correct deflection of light by gravity is obtained immediately:

$$\Delta\phi = \frac{2MG}{R_0 v_0^2} \xrightarrow[v \rightarrow c]{} \frac{4MG}{R_0 c^2} \quad -(13)$$