08 The Compton Vector

The Compton Effect discovered in 1923 represents the interaction between a photon (x ray) and an electron. The interaction is elastic; the photon is "scattered", and the electron "recoils".

The interaction includes force. The "interactive force" may be represented as a vector. If two conditions apply, then the components will also give the Compton equation.

Energy is transferred from the x-ray photon to the electron. The medium of transfer is assumed to be a "transfer photon". Components of the Compton Vector will give mass dilation (associated with the electron) and wave-length contraction (associated with the transfer photon).

The Compton Equation;

The Compton equation defines the change of wavelength of an x-ray photon after collision with an electron;

$$\lambda_2 - \lambda_1 = (h/m_ec)(1 - \text{Cos}\theta)$$

Where; λ_2 is the wavelength of the x-ray photon after the interaction

λ_1 is the wavelength of the x-ray photon before the interaction; $\lambda_2 > \lambda_1$

h is the Plank constant

c is the light constant

m_e is the rest mass of an electron

θ is the scattering angle of the photon

The Transfer Photon;

Energy is transferred from the x-ray photon to the electron. Assume the transfer is mediated by a "transfer photon". The energy (E_4) of the transfer photon is;

$$E_4 = hc/\lambda_3$$

Where; $\lambda_3 = \lambda_2 - \lambda_1$

The Compton equation may also be written as; $\frac{1}{2}m_ec(\lambda_3/h) = \text{Sin}^2(\frac{1}{2}\theta)$

The Compton Vector;

A force acts upon the transfer photon. This force may be represented as a three dimensional "interaction vector" of force (***F***) which is the Compton Vector;

$$\boldsymbol{F} = F_1\boldsymbol{i} + F_2\boldsymbol{j} + F_3\boldsymbol{k}$$

Where; ***i***, ***j***, ***k*** are directional vectors (orthogonal unit vectors)

F_1 , F_2, F_3 are scalar components of force

The vector has a magnitude; $|\boldsymbol{F}| = F_4$

The components are related to magnitude; $F_1^2 + F_2^2 + F_3^2 = F_4^2$

A sub-component (F_5) is related as; $F_5^2 = F_1^2 + F_2^2 = F_4^2 - F_3^2$

The sub-component may be called the "force of materialization".

Component Geometry;

The vector (***F***) has components and a sub-component arranged as geometry;

$F_1 = F_5\mathrm{Cos}(A)$ and $F_2 = F_5\mathrm{Sin}(A)$

$F_5 = F_4\mathrm{Cos}(B)$ and $F_3 = F_4\mathrm{Sin}(B)$

Two conditions are required for interaction (and materialization);

Condition 1; $A = B$

Condition 2; $B + ½\theta = ½\pi$

Giving; $\mathrm{Cos}(B) = \mathrm{Sin}(½\theta)$

Materialization;

Energy may "condense" (materialize) into matter. The force (F_5) of materialization has a wave representation (associated with the transfer photon) and a particle representation (associated with the dynamic electron);

$$F_5 = hc/\lambda_3\lambda_0 = ½mc^2/\lambda_3$$

Giving the De Broglie equation of materialization; $mv_0 = h/\lambda_0$

Where; m is dynamic mass

v_0 is velocity of materialization; $v_0 = ½c$

λ_0 is wave-length of materialization

Definitions of Force;

Components of force may be defined as;

$F_1 = ½m_ec^2/\lambda_3$ $F_2 = ½mvc/\lambda_3$ $F_3 = hv/\lambda_3^2$

$F_4 = hc/\lambda_3^2$ $F_5 = hc/\lambda_3\lambda_0 = ½mc^2/\lambda_3$

Mass Dilation;

Mass dilation is associated with the electron. Vector geometry gives;

$Cos(A) = F_1/F_5 = m_e/m$ and; $Sin(A) = F_2/F_5 = v/c$

$Cos^2(A) + Sin^2(A) = 1$

$m_e^2/m^2 + v^2/c^2 = 1$

giving mass dilation; $m = \gamma m_e$

Where; γ is the Lorentz factor; $\gamma = 1/(1 - v^2/c^2)^{½}$

Length Contraction;

Length contraction is associated with the transfer photon. Vector geometry gives;

$Cos(B) = F_5/F_4 = \lambda_3/\lambda_0$ and; $Sin(B) = F_3/F_4 = v/c$

$Cos^2(B) + Sin^2(B) = 1$

$\lambda_3^2/\lambda_0^2 + v^2/c^2 = 1$

giving length contraction; $\lambda_3 = \lambda_0/\gamma$

Where; λ_0 is the wavelength of condensation

The Force Equation;

Two conditions for interaction are required.

From condition 1; $A = B$

$Cos(A) = Cos(B)$

$F_1/F_5 = F_5/F_4$

Giving; $F_1F_4 = F_5^2$

From condition 2; $\mathrm{Cos(B)} = \mathrm{Sin}(½\theta) = F_5/F_4$

$\mathrm{Sin}^2(½\theta) = F_5^2/F_4^2$

$\mathrm{Sin}^2(½\theta) = (F_1F_4)/F_4^2$

The force equation is; $\mathrm{Sin}^2(½\theta) = F_1/F_4$

Force definition gives; $\mathrm{Sin}^2(½\theta) = (½m_ec^2/\lambda_3)/(hc/\lambda_3^2)$

Reducing to the Compton equation;

$\mathrm{Sin}^2(½\theta) = ½m_ec(\lambda_3/h)$

Conclusion;

An “interactive force” may be represented as a vector. If two conditions apply, then vector components will give the Compton equation.

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