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Compton Scattering as a Geodesic Path at the Bloch's Sphere

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Commonly Compton scattering can be explicitly defined by the Quantum Electrodynamics rules. In this manner the present investigation formulates the following question: There is another type of diagrammatic manifestation of light-matter interaction such free electron and photons? This paper tries to answer such question. For this end it is needed to define a set of angles from the QED amplitude of scattering.

$$\mathcal{S} = \int d^4p\boldsymbol{\mathcal{A}}\delta^4(p+k-q+k') = \int d^3\mathbf{p}\boldsymbol{\mathcal{A}}\delta^3(\mathbf{p}+\mathbf{k}-\mathbf{q}+\mathbf{k}') \times \int dp_0\delta(\mathcal{E}+\omega-\mathcal{E}'-\omega')$$

Special attention is paid on the p0 integration

$$\boldsymbol{\mathcal{I}} = \int \boldsymbol{dp_0\delta(\mathcal{E}+\omega-\mathcal{E}'-\omega')}$$

$$\int dtExp\left[-i\frac{t}{\hbar}(\boldsymbol{\mathcal{E}+\omega-\mathcal{E}'-\omega'})\right]$$

Definitions:

$$\int dt\ Exp\left[-i\frac{t\boldsymbol{\mathcal{E}}}{\hbar}\right]\ Exp\left[i\frac{t\boldsymbol{\mathcal{E}'}}{\hbar}\right]\ Exp\left[-i\frac{t\omega}{\hbar}\right]\ Exp\left[i\frac{t\omega'}{\hbar}\right]$$

$$\frac{t}{\hbar} = aSin(x), \mathcal{E} = bCos(y)$$

$$\frac{t}{\hbar} = aCos(x), \mathcal{E}' = bSin(y)$$

$$\frac{t}{\hbar} = cSin(w), \omega = dCos(z)$$

$$\frac{t}{\hbar} = cCos(w), \omega' = dSin(z)$$

$$\mathcal{J} = \int dt \;\; Exp[-iab[Sin(x)Cos(y) - Cos(x)Sin(y)]]Exp[-icd[Sin(w)Cos(z) - Cos(w)Sin(z)]]$$

$$\mathcal{J} = \int dt \;\; Exp[-iab[Sin(x-y)]] \;\; Exp[-icd[Sin(w-z)]]$$

$$x = w = y = z = \frac{\pi}{4}$$

$$\mathcal{J} = \int_{-T/2}^{T/2} dt = T$$

Angles:

$$Tan(x) = 1 \qquad Tan(w) = 1$$

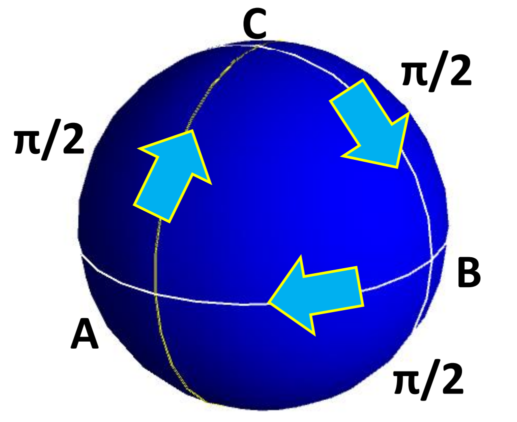
$$Tan(y) = \frac{\mathcal{E}'}{\mathcal{E}} \qquad Tan(z) = \frac{\omega'}{\omega}$$

Compton scattering:
w’ < w
E’ < E

$$a = \sqrt{2}\frac{t}{\hbar} \qquad b = \sqrt{\mathcal{E}^2 + \mathcal{E}'^2}$$

$$c = \sqrt{2}\frac{t}{\hbar} \qquad d = \sqrt{\omega^2 + \omega'^2}$$

Pancharatnam Triangle



Closed Geodesic: Compton Scattering as a closed Cycle

The angular definitions have had as result the apparition of the Geodesic as well as the interpretation over the Bloch Sphere seen as the Panchratnam triangle have defined the Compton scattering as a simple geodesic.

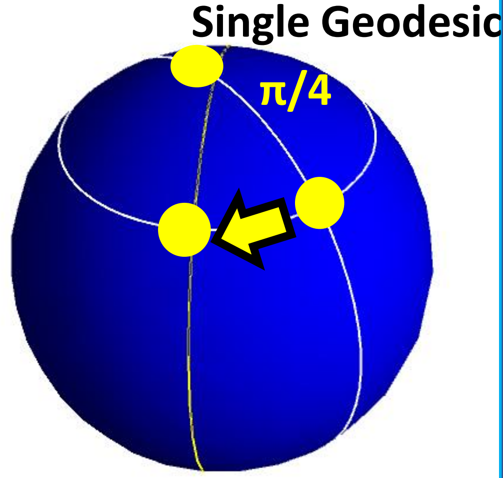
CONCLUSION OF PAPER:

1.- The time integration of the amplitude of scattering can also perceived as an angular displacement.

2.- The displacement over the Sphere is also seen a kind of Geodesic.

3.- The case of w’ = n w with “n” integer number defines a case of nonlinear Compton scattering.

Geodesic



Geodesic determines the number of absorbed photons