3.1 **Introductions:**

A fundamental length scale was introduced into the Feynman propagator in a Lorentz invariant manner by invoking the principle of path integral duality by Padmanabhan [101, 114]. In view of this postulate, the weightage given for a path in the path integral should be invariant under the transformation

\[ R \rightarrow \frac{L_p^2}{R}, \]

where \( R \) be the length of the path and the fundamental length scale \( L_p \) is taken to be the order of the Planck length \( (G\hbar/c^3)^{1/2} \). The fundamental length \( L_p \) we mean that actually it is of
O(L_p). Padmanabhan [101, 114] has presented the evaluation of the path integral by lattice techniques that the effect of the duality principle is to modify the weightage given to a path of proper time s from \( \exp(-im^2s) \) to \( \exp(-i(m^2s-L_p^2/s)) \), where m be the mass of the particle. For instance, the Feynman propagator for a free scalar field of m in Schwinger’s proper time formalism propagating in four-dimensional spacetime is given by the integral.

\[
GF(x,x') = -\frac{1}{(4\pi i)^2} \int_0^\infty ds \frac{1}{s^2} \exp(im^2s) \exp\left[\frac{i(x-x')^2}{4s}\right]
\]

Feynman propagator is modified in the light of duality principle as

\[
G_F^p(x,x') = -\frac{1}{(4\pi i)^2} \int_0^\infty ds \frac{1}{s^2} \exp(im^2s) \exp\left[\frac{i(x-x')^2 + L_p^2}{4s}\right]
\]
where $J_1(z)$ is modified Bessel function of order 1. With metric signature $(+ , - , - , - , -)$. In momentum space, the modified propagator reads

\[
(3.4) \quad G_F^p(p) = -1 \int_0^\infty dz \exp \left( iL_p^2 / 4z + i(p^2 - m^2 - i\epsilon)z \right).
\]

Srinivasan, Sriram Kuamr and Padmanabhan [115] obtained that the salient feature of this prescription of path integral duality is to give an ultra-violet cutoff at the Planck energy scales, hence, to obtain a Lorentz invariant finite results.

The standard definition of Feynman propagator for Dirac particle reads

\[
(3.5) \quad S(x) = - ( -i \gamma^\mu \partial_\mu + m ) G_F(x),
\]
where $G_F(x)$ be the usual Feynman propagator for scalar particles. In view of principle of path integral duality on Dirac propagator may be defined as

\[ (3.6) \quad S^p(x) = -(i \gamma^\mu \partial_\mu + m) G^p_F(x). \]

Ohanian [112] presented a similar approach who had used a smeared propagator which is Poincare invariant, to evaluate the radiative corrections in quantum electrodynamics. But here modified Feynman propagator is found by rigorous calculation and the duality principle introduces the fundamental length scale in a Lorentz invariant manner.

### 3.2 Vacuum Polarization:

The free photon propagator $D^F_{\mu\nu}$ is modified due to the interaction of the photon field with electron field. The Photon propagator of momentum $q$, with one loop radiation correction reads

\[ (3.7) \quad i D^F_{\mu\nu}(q) = i D^F_{\mu\rho} + i D^F_{\mu\nu} \frac{i\pi p\sigma}{4\pi} (q) i D^F \sigma \nu'. \]
where $\pi^{\mu\nu}$ be the vacuum polarization tensor.

In view of the Feynmann rules of quantum electrodynamics (QED) in the momentum space, the vacuum polarization tensor reads

$$\pi_{\mu\nu}(q) = 16\pi ie^2 \int \frac{d^4k}{(2\pi)^4} (k_\mu(k-q)_\nu$$

$$+ (k-q)_\mu k_\nu$$

$$- \delta_{\mu\nu} (k^2 - qk - m^2) G_F^p(k) G_F^p(k-q).$$

In view of eq. (3.4), and using similar calculations as in conventional quantum electrodynamics, the vacuum polarization tensor may be separated into Gauge invariant and Gauge non-invariant part as shown by Geiner and Reinhardt [105]. One may obtain the resultant Gauge invariant

$$\pi_{\mu\nu}^{(i)}(q^2) = -\frac{4e^2}{\pi} (q_\nu q_\mu - q_{\mu\nu} q^2) \int_0^1 dz (1-z) J_o(\xi)$$

where
One may obtain the series expansion of \( J_\nu(z) \) about the origin as

\[
(3.11) \quad J_\nu(z) = -\gamma - \ell \ln(z/2) - \frac{z^2}{4} [1 - \gamma - \ell \ln(z/2)] + \ldots.
\]

Hence, the eq. (3.9) assumes the form

\[
(3.12) \quad \pi^{(1)}_{\mu\nu}(q^2) = (q_\nu q_\mu - g_{\mu\nu} q^2)
\]

\[
x ((z_3 - 1) - \frac{2e^4}{\pi} A_1 - \frac{e^2 L_p^2}{2 \pi} (\frac{q^2}{2} A_1)
\]

\[
+ \frac{1}{2} (1 - \gamma - \ell \ln(L_p m/2) (m^2 - \frac{q^2}{6}) ]
\]

where

\[
(3.13) \quad A_1 = \int_0^1 dz z (1-z) \ell \ln \left( \frac{m^2}{m^2 - q^2 z (1-z)} \right)
\]
to the lowest order of $J_0(\xi)$.

The term $A_1$ be the familiar conventional quantum electrodynamics non-divergent term and the remaining terms are of the order of $O(L_p^2)$ and are the leading order quantum gravitational power law corrections/regulators to the conventional quantum electrodymomic terms. The charge renormalization factor $z_3$, which is divergent, reads

$$
(3.14) \quad z_3 - 1 = \frac{2e^2}{\pi} \left[ \frac{\ell n (L_p m / 2)}{3} + \frac{6\gamma - 5}{18 \ell n(L_p m / 2)} \right] + O(L_p^2 m^2),
$$

One may estimate this term, and gives

$$
(3.15) \quad z_3 - 1 = \frac{2e^2}{3\pi} \ell n (L_p m)
$$

\[-0.1\.]
In the standard quantum electrodynamics evaluations, there is a Gauge non-invariant part of the vacuum polarization tensor which is divergent and renormalized to zero as shown by Hatfield [102]. Though it is a standard result and may be obtained by using modified propagator. The vacuum polarization tensor in the conventional quantum electrodynamics in $2n$ dimensions reads

\begin{equation}
\pi_{\text{reg}}^{\mu \nu}(q) = (e\mu^{2-n})^2 \int \frac{d^{2n}k}{(2\pi)^{2n}} \frac{i}{k^2 - m^2 + ie}
\end{equation}

\frac{i}{(k-q)^2 - m^2 + i\varepsilon}.

\begin{equation}
.2^n (k^\mu (k-q)^\nu + k^\nu (k-q)^\mu - (k^2 - m^2) - kq) g^{\mu \nu}).
\end{equation}

where $\mu$ has the dimensions of mass.

In view of the integral representation of the propagator one obtains

\begin{equation}
\frac{i}{k^2 - m^2 + i\omega} = \int_0^\infty dz \exp \left( iz(k^2 - m^2 + i\omega) \right)
\end{equation}
and completing the squares in the exponential, one obtains

\[(3.18) \quad \pi_{\text{reg}}^{uv}(q) = (e^{\mu^2-n})^2 \int_0^\infty dz_1 \int_0^\infty dz_2 \frac{d^2k}{(2\pi)^{2n}} \]

\[2^n (k^\mu (k-q)^\nu + k^\nu (k-q)^\mu - (k^2 - m^2 - kq) g^{\mu\nu})\]

\[\exp i \left( (z_1 + z_2) (k - \frac{z_2q}{z_1 + z_2})^2 \right).\]

\[\exp \left( i \frac{z_1 z_2 q^2}{z_1 + z_2} - i (m^2 - i\delta) (z_1 + z_2) \right).\]

Let us shift the variables of integration and in view of the relations

\[(3.19) \quad \int \frac{d^{2n}p}{(2\pi)^{2n}} \exp (iop^2) = - \frac{n}{(4\pi a)^n} \frac{1}{a} \exp (in^{\pi/2}),\]

\[(3.20) \quad \int \frac{d^{2n}p}{(2\pi)^{2n}} p^\mu p^\nu \exp (iap^2) = - \frac{g^{\mu\nu}}{(4\pi a)^n} \frac{1}{2a}\]
\[
\exp \left( \frac{in\pi}{2} \right),
\]

one obtains

(3.21) \[
\pi^{\mu\nu}_{\text{reg}}(q) = (e\mu^{2-n})^2 \frac{\exp \left( \frac{in\pi}{2} \right)}{(4\pi)^n}
\]

\[
\left[ g_{\mu\nu} Q(q^2, m^2) + (q^\mu q^\nu - g_{\mu\nu} q^2) P(q^2, m^2) \right]
\]

Where

(3.22) \[
Q(q^2, m^2) = \int_0^\infty dz_1 \int_0^\infty dz_2 \frac{2^n}{(z_1 + z_2)}
\]

\[
\left( \frac{n-1}{z_1 + z_2} + im^2 - iq^2 \cdot \frac{z_1 z_2}{(z_1 + z_2)^2} \right),
\]

\[
\exp \left( iq^2 \frac{z_1 z_2}{z_1 + z_2} - i (m^2 - i\mathcal{E}) (z_1 + z_2) \right),
\]
\begin{equation}
(3.23) \quad P(q^2, m^2) = -i2^{n+1} \int_0^\infty dz_1 \int_0^\infty dz_2 \frac{z_1z_2}{(z_1 + z_2)^{n+2}}
\end{equation}
\begin{equation}
\exp \left( i q^2 \frac{z_1z_2}{z_1 + z_2} - i (m^2 - i\epsilon)(z_1 + z_2) \right).
\end{equation}

In view of the current conservation
\begin{equation}
(3.24) \quad \partial_\mu j^\mu = 0,
\end{equation}
we obtain
\begin{equation}
(3.25) \quad q_\mu \pi^{\mu\nu}(q) = 0.
\end{equation}

But the factor proportional to $g^{\mu\nu}$ be the Gauge non-invariant part of the vacuum polarization tensor and which does not appear to obey the Gauge invariance condition.

Now let us show that the term, $Q(q^2, m^2)$ may vanish and hence the regularization preserves the gauge symmetry. Let us define
\begin{equation}
N(q^2, m^2) \equiv \int_0^\infty d z_1 d z_2 \frac{1}{(z_1 + z_2)^{n+2}} \\
\left( i q^2 \frac{z_1 z_2}{z_1 + z_2} - \text{Im}^2 (z_1 + z_2) \right)
\end{equation}

and

\begin{equation}
z_1 \to \beta z_1,
\end{equation}

\begin{equation}
z_2 \to \beta z_2,
\end{equation}

one obtains

\begin{equation}
N(\beta, q^2, m^2) = \frac{1}{\beta^{n-1}} \int_0^\infty d z_1 d z_2 \frac{1}{(z_1 + z_2)^{n+1}} \exp \left[ i \beta \left( q^2 \frac{z_1 z_2}{z_1 + z_2} - m^2 (z_1 + z_2) \right) \right].
\end{equation}

The quantity $N(\beta, q^2, m^2)$ is independent of $z_1$ and $z_2$, hence is also independent of $\beta$ i.e.
(3.30) \[
\frac{\partial N (\beta, q^2, m^2)}{\partial \beta} = 0
\]

So, by differentiating the above eq. (3.29) with respect to \(\beta\) and regrouping terms, we obtain

(3.31) \[
-\beta \frac{\partial N}{\partial \beta} = 0 = \int_0^\infty dz_1 dz_2 \frac{\beta^{2-n}}{(z_1 + z_2)^n}
\]

\[
\left( \frac{n-1}{z_1 + z_2} + im^2 - iq^2 \frac{z_1 z_2}{(z_1 + z_2)^2} \right)
\]

\[x \exp \left[ i \beta \left( q^2 \frac{z_1 z_2}{z_1 + z_2} - m^2 (z_1 + z_2) \right) \right].
\]

Let us rescale the variables \(z_1\) and \(z_2\) by \(\beta^{-1}\) i.e.
(3.32) \[ z_1 = z_i / \beta \]

in the above expression (3.31) to obtain

(3.33) \[ -\beta \frac{\partial N}{\partial z} = 0 \int_0^\infty dz_1 \int_0^\infty dz_2 \frac{2n}{(z_1 + z_2)^n} \]

\[ \left( \frac{n-1}{z_1 + z_2} + i m^2 - iq^2 \frac{z_1 z_2}{(z_1 + z_2)^2} \right) \]

\[ \exp \left\{ i \left( q^2 \frac{z_1 z_2}{z_1 + z_2} - m^2 (z_1 + z_2) \right) \right\} \]

\[ = Q (q^2, m^2) \]

Hence, the Gauge non invariant art of the vacuum polarization tensor \( Q (q^2, m^2) \) vanishes, i.e.

(3.34) \[ q_\mu \ Pi^{\mu \nu} (q) = 0 \ . \]

Therefore, the gauge non-invariant part of the vacuum polarization tensor gets modified as
\( (3.35) \quad \Pi^{(2)}_{(\mu \nu)} (q^2, L_p) = (e\mu^{2-n}) \frac{\exp (\text{in}\Pi/2)}{(4\Pi)^n} \)

\( g_{(\mu \nu)} \Pi^{(2)}_0 (q^2, L_p) \)

where,

\( (3.36) \quad \Pi^{(2)}_0 (q^2, L_p) = \int_0^\infty dz_1 dz_2 \frac{2^n}{(z_1 + z_2)^n} \)

\( \left( \frac{n - 1}{z_1 + z_2} + i m^2 - iq^2 \frac{z_1 z_2}{(z_1 + z_2)^2} \right) \)

\( \exp \left( iq^2 \frac{z_1 z_2}{z_1 + z_2} - i (m^2 - i\epsilon) (z_1 + z_2) \right) \)

\( \exp \left( i \frac{L_p^2}{4} (z_1^{-1} + z_2^{-1}) \right) . \)

now let us define

\( (3.37) \quad S (q^2, m^2, L_p) \equiv \int_0^\infty dz_1 \; dz_2 \frac{1}{(z_1 + z_2)^{n+1}} \)
\[
\exp \left( i q^2 \frac{z_1 z_2}{z_1 + z_2} - \text{im}^2 (z_1 + z_2) \right)
\]

\[
\exp \left( \frac{i L_p^2}{4} (z_1^{-1} + z_2^{-1}) \right).
\]

Let us again rescale the variables \(z_1\) and \(z_2\) i.e.

(3.38) \quad z_1 \rightarrow \beta z_1

and by differentiating the resulting expression with respect to \(\beta\), we get

(3.39) \quad -\beta \frac{\partial s(\beta, q^2, m^2, L_p)}{\partial \beta} = T(\beta, q^2, m^2, L_p) - R

\(\beta, q^2, m^2, L_p\)

where

(3.40) \quad T(\beta, q^2, m^2, L_p) = \int_0^\infty dz_1 \int_0^\infty dz_2 \frac{\beta^{2-n}}{(z_1 + z_2)^n}
\[
\begin{pmatrix}
\frac{n-1}{z_1 + z_2} + \text{i}m^2 - \text{i}q^2 \frac{z_1 z_2}{(z_1 + z_2)^2}
\end{pmatrix}
\]

\[.
\exp\left(\text{i}\beta \left\{ q^2 \frac{z_1 z_2}{z_1 + z_2} - m^2 (z_1 + z_2) \right\} \right)
\]

\[.
\exp\left(\frac{\text{i}L_p^2}{4\beta} (z_1^{-1} + z_2^{-1}) \right)
\]

The term \(S(q^2, m^2, L_p)\) is independent of \(\beta\) and hence,

\[(3.41) \quad \frac{\partial S}{\partial \beta}=0.\]

Therefore,

\[(3.42) \quad T(\beta, q^2, m^2, L_p) = R(\beta, q^2, m^2, L_p).\]

Again rescaling the variables, \(z_1\) and \(z_2\) by \(\beta^{-1}\) i.e.

\[(3.43) \quad z_1 \rightarrow z_1 / \beta,\]

one obtains
\[ T_{\text{rescaled}}(q^2, m^2, L_p) = R_{\text{rescaled}}(q^2, m^2, L_p) \]

\[ = \Pi_0^{(2)}(q, L_p). \]

So, we have obtained that the gauge non-invariant part of the vacuum polarization tensor is a finite quantity and vanishes as

\[ L_p \to 0. \]

3.3 **Electron Self Energy:**

It is also obvious that the interaction of the electron field with photon field modifies the free electron propagator. The electron propagator of momentum \( p \) with one-loop correction reads

\[ i S'_{\text{F}}(P) = i S_{\text{F}}(\phi) + i S_{\text{F}}(p) \]

\[ (-i \sum(p) i S_{\text{F}}(p)), \]
where $\sum(p)$, a 4-spinor, be the self energy function and $S_F(p)$ as the free-electron propagator. In view of the Feynman rules in momentum space, one obtains

$$\sum(p) = -4\pi i e^2 \int \frac{d^4k}{(2\pi)^4} \gamma^\mu (\gamma^\nu p_\nu - \gamma^\nu k_\nu + m)$$

$$\gamma_\mu G_F^p(k) G_F^p(p-k).$$

In view of eq. (3.4), the eq. (3.47) assumes the form

$$\sum(P) = \frac{e^2}{4\pi^2} \int_0^1 dz (2m_0 - \gamma^\mu p_\mu z) J_o(\xi)$$

where

$$\xi^2 = \frac{L^2_{\mu}}{z(1-z)} (m_0^2 z - p^2 z (1-z)).$$

In view of eq. (3.11), by expanding $J_o(\xi)$, the lower order terms corresponding to conventional quantum electrodynamics results and
higher order terms as quantum fluctuations of the spacetime to the self energy of the electron. Hence, one obtains

\[ z_2 (\gamma^\mu p_\mu - m_0 - \sum (p)) = \gamma^\mu p_\mu - m + \text{finite terms}. \]

By equating terms proportional to \( p \) in eq. (3.50), the electron wave function renormalization factor is obtained as

\[ z_2^{-1} - 1 = \frac{e^2}{8\pi^2} \left[ \gamma + \ell n2 - \ell n (L_{\mu} m_0) + O(1) \right]. \]

The last term in the above expression is finite and is of the order of one. The shift in the mass reads

\[ \frac{\delta m}{m_0} = -\frac{e^2}{8\pi^2} \left[ 3 \ell n (L_{\mu} \frac{m_0}{2}) + 3\gamma + O(1) \right]. \]

Hence, one obtains i.e. scale factor \( z_2 \).
The fractional shift in the mass reads

\[ \delta m \sim \frac{\alpha}{\pi} \ln m_0 L_p \]

\[ \sim 0.1. \]

In the evaluation of the renormalization factor $z_2$, the usual infrared divergence is neglected. Hence, we observe that the mass renormalisation factor and the mass shift are of the same order as the charge renormalisation factor i.e. 0.1.

### 3.4 Vertex Correction:

Let us define the current density for a free Dirac field

\[ J^\mu = \overline{\psi} \gamma^0 \gamma^\mu \psi. \]
The radiative corrections may modify the vertex to the one-loop corrections as

\[ -ie \wedge_\mu = -ie \gamma_\mu - ie \Gamma_\mu, \]

where \( \Gamma_\mu \) be the vertex function. In view of Feynman rules, we get

\[ \Gamma_\mu (p', p) = (-ie_o)^2 \int \frac{d^4k}{(2\pi)^4} \]

\[ \left[ \gamma_\mu (\gamma_\rho p'^\rho - \gamma_\rho k^\rho + m_o) \gamma_\mu 
    \right. \]

\[ \left. (\gamma_\sigma p'^\sigma - \gamma_\sigma k^\sigma + m_o) \right] \]

\[ \times \ G_F^p (k) G_F^p (p' - k) G_F^p (p - k). \]

In view of eq. (3.4), the eq. (3.57) assumes the form in terms of the vertex renormalization factor \( z_1 \) as
\begin{align}
(3.58) \quad \Gamma_\mu(p', p) &= (z^{-1} - 1) \gamma_\mu + \frac{(-ie_\circ)^2}{(4\pi)^2} \\
\int_0^1 dz \int_0^{1-z} dz' \xi / T_1 \\
\times [2\gamma_\mu (p' - p)^2 (1 - z') (1 - z) \\
- 4\text{im}z (1 - z - z') (p' - p)^\mu \sigma_{\mu\nu}],
\end{align}

\begin{align}
(3.59) \quad T_1 &= (zp' + z'p)^2 - 2p'^2 - z'p^2 + (z + z')m_0^2, \\
(3.60) \quad T_2 &= (1 - z - z')^{-1} + z^{-1} + z'^{-1}, \\
(3.61) \quad \xi^2 &= L_p^2 T_1 T_2.
\end{align}

Hence, the vertex renormalization factor \(z_1\) reads

\begin{align}
(3.62) \quad z_1^{-1} - 1 &= i \frac{(-e_\circ i)^2}{(4\pi)^2} \int_0^1 dz \int_0^{1-z} dz'
\end{align}
\[
[4 J_0 (\xi) + 2m_0^2 \frac{\xi}{T_1} J_1 (\xi) \{ -2 + 2 (z + z') \\
+ (z + z')^2 \}].
\]

But

\begin{equation}
(3.63) \quad J_0 (z) = -\gamma - \ell \ln (z / 2) - \frac{z^2}{4} [1 - \gamma - \ell \ln (z / 2)] + \ldots .
\end{equation}

and

\begin{equation}
(3.64) \quad J_1 (z) = \frac{1}{z} + \frac{z}{\ell} \left( \ell \ln (z / 2) + \frac{2\gamma - 1}{2} \right. \\
+ \frac{z^3}{16} \left( \ell \ln (z / 2) - \frac{5 - 4\gamma}{4} \right).
\end{equation}

In view of eqs. (3.63)-(3.64), the eq. (3.62) assumes the form

\begin{equation}
(3.65) \quad z_1^{-1} - 1 = i \frac{(-i e_o)^2}{(4\pi)^2} \int_0^1 \int_0^{1-z} dz \, dz'.
\end{equation}
\[
-4 \ln \left( \frac{\xi}{2} \right) - 4\gamma + \frac{2m_o^2}{T_1} \left\{ -2 + 2(z + z') + (z + z')^2 \right\}
\]

\[\approx -\frac{\alpha}{\pi} \ln (m_o L_p) \]

\[\approx 0.1 \text{ (roughly)} .\]

Hence, in view of the modified propagator, the evaluated renormalization factors \(z_1\) and \(z_2\) are not equal.

3.5 \textbf{Anomalous Magnetic Moment:}

The salient feature of quantum electrodynamics has been the precision test of electron anomalous magnetic moment. The experimental value of anomalous magnetic moment of an electron is in good agreement with the predicted perturbative evaluations. The vertex correction contribution to scattering of an electron in an external field reads

\[
(3.66) \quad \overline{u}(p') \Gamma^\mu (p', p) u(p) A_\mu^C (p' - p) ,
\]
where \( \bar{u} \) and \( u \) are spinor wave functions. Since we are interested to evaluate the radiative and quantum gravitational corrections to the Gyro-magnetic ratio of an electron, Hatfield [102] has shown the corresponding \( M \) matrix as

\[
M = \bar{u} (p') \gamma^m_\mu u (p)
\]

\[
= \bar{u} (p') 4m_o \frac{(ie_o)^2}{(4\pi)^2} \int_0^1 dz \int_0^{1-z} dz' z (1-z-z') (p'-p)^\nu \sigma_{\mu\nu} \frac{\xi}{T_1} J_1(\xi) u (p).
\]

In view of small momentum transfer i.e.

\[
(p'-p)^2 << m_o^2,
\]

and also by eq. (3.64), one obtains.

\[
M = -\bar{u} (p') \frac{\alpha}{m\pi} (p'-p)^\mu \sigma_{\mu\nu} \int_0^1 dz \int_0^{1-z} dz'.
\]
\[
\frac{z(1-z-z')}{(z+z')^2} u(p)
\]

\[-u(p') \frac{\alpha}{m \pi} \frac{L_p^2 m_0^2}{24} (p' - p)^\mu \sigma_{\mu\nu} \int_0^1 dz \int_0^{1-z} dz' \]

\[.z (1-z-z') T_n ((L_p m_0^2 (z+z')^2 T_2 / 4) u(p).\]

The first term in eq. (3.69) denotes to the usual quantum electrodynamics radiative vertex correction of the Gyro-magnetic ratio and the second term represents the quantum gravitational corrections to the Gyro-magnetic ratio of an electron. It is of the order of \[L_p^2 m^2 \approx 10^{-45}\]. Hence, it is not of practical importance.

3.6 **Concluding Remarks:**

We have presented the quantum gravitational corrections to three radiative corrections: to the vacuum polarization, electron self-
energy, and vertex function by using the modified propagator i.e. using the principle of path integral duality, in the first order of $\alpha$ in quantum electrodynamics. In the conventional quantum electrodynamics evaluations the divergent terms are absorbed into the physical parameters like mass, charge and spin, where as the modified propagator works as a regulator to the ultra-violet divergences. The modified propagator introduces two kinds of regulators in the radiative correction evaluations, which are logarithmic and power law. In the three radiative corrections the power law regulator is $O(L_p^2 m^2)$ and is very small. The three renormalization factors have the logarithmic corrections $O(\ln (L_p m))$. The value of $L_p^2 m^2 \approx 10^{-45}$, and $o(\ln (m L_p)) \approx 0.1$. The renormalisation factors $z_1 z_3$ are found different in this case. The use of modified propagator to the field theoretic evalution is a more proper approach towards the removal of the divergences in field theory based on the relevant physics, rather than a formalistis approach based on improper mathematical manipulations.