Quantizing Electromagnetic Waves and Gravitational Waves

Abstract for Invited Presentation for "Physics Beyond Relativity 2019"

Akira Kanda
Omega Mathematical Institute / University of Toronto*
Mihai Prunescu
University of Bucharest, Romanian Academy of Science †
Renata Wong
Nanjing University, Department of Computer Science and Technology ‡

1 Electromagnetic waves

Electromagnetic wave equations were derived purely mathematically from Maxwell's "classical" (non-relativistic) axioms of electromagnetic field equations with no electric current. Actual wave functions, which are solutions to these wave equations, were obtained from Maxwell's axioms with "accelerating" electric current.

Putting aside the disturbing fact that the concept of electromagnetic field, which is the spatial distribution of electromagnetic force per unit charge, is not physical reality but a counter-factual modality instead, which makes electromagnetic waves not a physical, real wave but an imaginary modal wave, we do have various fundamental issues regarding this "entity" called electromagnetic waves.

A most disturbing concern is the speed of this wave. It was mathematically shown that the speed of light in vacuum without any electric current is constant c. Unfortunately the theory also showed that without accelerating current, there are no electromagnetic waves. This issue was never brought to the attention until very recently by us. When confronted, the typical response was that may be so but if we consider very far away from the source of the emission of the wave, we could safely assume that the conducting current is 0 and the speed of the electromagnetic wave is c. This astounding answer shows the fundamentally

*kanda@cs.toronto.edu
†mihai.prunescu@gmail.com
‡renata.wong@protonmail.com

questionable nature of the discipline called theoretical physics. The theory certainly claims that the speed is c all over the light goes.

As the axioms of Maxwell all came from the experiments at labs, it may well be the case that unless we encounter an application that covers all aspects of this theory, empirically this theory may work rather safely. But Maxwell's axioms form a mathematical theory. Then it transcends the listing of some experimental results. The deficiency of this theory due to Maxwell, as expected, hits some very serious problems for which physicist produced *ad hoc* highly questionable "solutions".

The first problem they encountered was the so-called black-body radiation problem. Here the theory and experiment diverged. The patch up solution was presented by Planck and it was to assume that the energy electromagnetic waves carry is of the form $E = nhf$ where n is a natural number, f is the frequency of the wave and h is the so-called Planck constant. The number hf is considered as the minimum energy an electromagnetic wave of frequency f carries.

2 Relativistic theory of photon

Following Einstein's opinion, this hf is considered to be a particle called photon. Naturally it was expected that this photon travels with speed c as the speed of electromagnetic wave is c. This photon violates the assumption of the Special Theory of Relativity in which it is declared that no particle will travels with speed c. Moreover this particle makes its relativistic energy

$$e = mc^2 = m_0c^2/\sqrt{1-(v/c)^2}$$

diverge. To resolve the second problem, Einstein took liberty to decide that the rest mass of photon is 0 as he thought that $0/0$ is "any number". Obviously he got this wrong idea from the equation $0x = 0$. This equation has any number as its solution. What he did not understand was that these solutions do not involve division by 0 while $0/0$ involves division by 0. In mathematics it is clear that we can "not" divide any number by 0 at the pain of contradiction. If $0/0$ is a number it has to obey the laws of fraction and we have the following problem:

$$(0/0) \times 3 = 1 \times 3 = 3 \qquad (0/0) \times 3 = (0 \times 3)/0 = 0/0 = 1.$$

Anyhow in the end Einstein took liberty to claim that $0/0$ for photon is hf.

This problem does not stay within pure mathematics. It has a sever consequence in theoretical physics too. We do have the following devastating contradiction:

$$E = \sqrt{(cp)^2 + (m_0)^2c^4} = cp = m_0vc/\sqrt{1-vc^2} = (0/0)cv = c^2h\nu = h\nu.$$

After all, the derivation of the famous $e = mc^2$ also is invalid. The $m = m_0/\sqrt{1-(v/c)^2}$ here is called "*relativistic* mass" which is introduced so that relativistic collision conserves momentum. This was done under the assumption

that motions are inertial as restricted by the STR kinematics. So, v here is constant, not time varying. Under this assumption the derivation of the famous $e = mc^2$ is invalid and the correct result is $e = 0$ which none of us wants to have. The correct derivation follows the following steps: (1) $p = mv$. (2) $f = dp/dt = 0$ as p is constant. (3) So, in the end $e = 0$ instead. It was Einstein who correctly said "if $e = mc^2$ fails, the entire theoretical physic of the 20th century fails." He was correct except that he never thought that his proof for $e = mc^2$ is invalid.

Moreover, Einstein's proposal that hf is a particle called photon of frequency f which carries energy hf brings us to an unexpected mathematical difficulty, which theoretical physicists fail to detect. As f is a frequency of an electromagnetic wave and f varies over all positive real numbers, there must be uncountably many particle called photons which violates the ontology that there are only countably many particles in the universe. As Newton made it extremely clear the particle and a geometric point are entirely different things. *A particle (point mass) can move but a geometric point can not move.* So, even putting aside the contradictions above, Einstein's proposal of photons is invalid. In summary, the fateful attempt of quantizing electromagnetic waves fails. Do we need to proceed the issue of quantization any further? The "pilot project" of quantizing continuum failed. If one understands the amazingly intricate structure of real continuum such as the real number line, all of this was totally expected. The tragic divorce between physics and mathematics created more than one century long waste of time and resources.

3 The problem with special theory of relativity

As a resistance against absolutism in the global movement of religious revolution and Capitalism, the followers of revolutionary Galileo promoted the concept of relativism in which a reference frame can move inside the other. In this way they tried to remove the reference to the absolute frame of Newton.

Despite apparent appeal to the die hard anti-absolutism philosophers, this idea had some fundamental flows. Galileo failed to understand that reference frame F1 as geometric space move inside other frame F2 means at each moment a point in F1 is also a point in F2.

So, the following fatal contradiction kills the concept of moving reference frames, inertial or not. Assume a train runs and when the tip of the power pole touches the power line at point P spark occurs at this point. An observer standing right below the point P which is the point of the train will observe that the light comes straight down to him. Moreover, as P is a stationary point on the power line he will observe that the light comes diagonally from the point P of the power line. This is a contradiction. As Galileo relativity theory is inconsistent, logically speaking the extension of this theory by adding the constancy of the speed axiom yields an inconsistent theory. Any extension of inconsistent theory is inconsistent. It is called the monotonicity of logic in the discipline of logic.

There are two versions of the special theory of relativity, namely STR kinematics and STR dynamics. As both of them relies upon the concept of relatively moving reference frames, they are inconsistent. If physicists listened to logicians and mathematicians the entire one century of waste of time which massively damaged the credibility of theoretical physics could have been avoided. Where there is no logic, there is no science. Ancient Greek knew it very well. Many mathematical logicians noticed some fatal errors of logical nature in relativity theory and its derivative quantum mechanics. Considering the political implication, they decided not to make waves and more than a century was wasted with unmeasurable financial loss too. Prof. Urquhart, a prominent logician, said "Physicists have no logic". Considering the delicate balance physics has to maintain between reasoning and empiricism, what happened is understandable but not justifiable. Logic must govern physics and there is no objection to this basic most principle. In fundamental sciences no contradiction is allowed.

Regarding the STR dynamics in which Einstein allowed accelerating frames "deliberately" violating the most fundamental principle of all relativity theory that all relative motions of reference frames must be inertial so as not to violate the Principle of Relativity which demands that all laws of physics must be invariant under the choice of reference frame, the most famous and "important" equation of the universe $e = mc^2$ as a natural consequence of the inconsistent theory STR dynamics is false. The consequence of this is devastating. Basically the entire modern physics is false. As Einstein said, if this equation fails the entire physics fails.

4 Quantum mechanics and quantum electrodynamics

Motivated by the "successful" attempt of Einstein to quantize electromagnetic waves in terms of photons, de Broglie and Schrödinger launched a project of quantizing Hamiltonian mechanics. This lead to the development of what we now call Quantum Mechanics. Using STR of Einstein, *which we now know is inconsistent*, de Broglie obtained *a general "relativistic" correspondence between "waves" and "particles"*.

He considered the so-called relativistic waves whose phase is invariant under the Lorentz transformation. He then obtained the following wave transformation

$$k'_x = (\omega - v\frac{\omega}{c^2})/\sqrt{1 - v^2/c^2}, \quad k'_y = k_y, \quad k'_z = k_z, \quad \omega' = (\omega - vk_x)/\sqrt{1 - v^2/c^2}.$$

Using an *"analogy"* to the momentum-energy transformation

$$p'_x = (\omega - v\frac{E}{c^2})/\sqrt{1 - v^2/c^2}, \quad p'_y = p_y, \quad p'_z = p_z, \quad E' = (E - vp_x)/\sqrt{1 - v^2/c^2}.$$

he *"obtained"* the following duality between waves and particles

$$\mathbf{p} = \hbar\mathbf{k} \qquad E = \hbar\omega.$$

So, a wave with wave propagation vector p and angular frequency ω now has a particle counterpart with relativistic momentum p and relativistic energy E. Over massive questionings which is perfectly understandable Nobel Committee decided to offer him a Nobel Physics Prize and particle wave-duality became a common sense in theoretical physics.

There are several issues here to be discussed.

1. This "fancy result" is obtained from nothing but "analogy" between phase wave transformation and momentum energy transformation. The question of the validity of such deduction from analogy is scientifically acceptable or not is a legitimate one but was politically suppressed in the main stream theoretical physics.

2. The entire development is based upon Einstein's STR, which we now know is undoubtedly inconsistent. It is false.

3. Though this resembles to Planck-Einstein's particle-wave duality

$$E = h\omega = pc \quad p = h/\lambda$$

where λ is the wave length, there is fundamental difference. Unlike the photon-light duality where the speed of photon and that of light are equal, the phase speed of matter wave and the speed of particle can be different. De Broglie further "assumed" that, associated with a particle with speed V, was a wave having "phase speed" $w = \omega/k$. He also assumed that "the energy in the wave travelled along with a group speed $v_g = d\omega/dk$ which was identical to the particle's speed V." Here it is not quite clear what did he mean by "energy" in the wave. As in **1**. the so called de Broglie relation above is nothing but a wild hypothesis based upon just the above mentioned analogy of "wave vector-frequency" transformation and "momentum-energy" transformation. Certainly this does not yield the concept of "energy in the wave".

Anyhow, it is easy to show that $c^2(\omega/c^2 - k^2)$ is invariant under the relativistic transformation as an analogy to the relativistic invariance of $c^2(E/c^2 - p^2)$. We set $c^2(\omega/c^2 - k^2) = constant = C$. From this, we have $2\omega/c^2 d\omega/dk - 2k = 0$. This leads to

$$v_g = d\omega/dt = c^2 k/\omega.$$

As the phase speed is $w = \omega/k$, we have

$$v_g = c^2/w.$$

It now follows that the either phase speed w or group speed v_g could exceed c but not both. We do not know what this means to the special theory of relativity which asserts that nothing moves faster than speed c. According to de Broglie, "as a convention the energy in a wave travels with group speed." *After all all of this is in vain as we know STR is inconsistent. As Einstein rightly said, if $e = mc^2$ fails, the entire modern physics fails.*

All of this "mathematical complication" is relative to the *"hypothesis"* that *A particle with speed v has a wave dual called "matter wave" whose group speed is $w = \omega/k$.* A particle in motion carries energy and so it is expected

that the wave dual of this particle also carries energy of the same amount if the *energy conservation law* is to be respected. But for a wave to carry energy, it has to have wave medium. A concern we have is that de Broglie's wave is a mathematical wave which appears to have no wave medium. One may say that electromagnetic wave carries energy without having wave medium. We have already pointed out that electromagnetic field which carries electromagnetic waves is a fiction, counter-factual modality which plays no ontological role in physics. This means that the so called electromagnetic waves are fallacies which should have no role in physics. So, what happened to the energy issue of the matter wave? This question was answered by Schrödinger in a limited context.

Remark 1 *After all, it is shocking that theoretical physics has been nothing but a grand accumulation of wild hypothesis like "A particle with speed v has a wave dual called 'matter wave' whose group speed is $w = \omega/k$." We wonder what really happened to the "empiricism" tradition of physics. Physicists should understand that some far fetched mathematical consequence of a hypothesis like this in a context of a bigger theory does not verify this hypothesis. It was Dr. Phippe who described the contemporary practice of theoretical physics like this , building a Spanish castle upon a dung heap.*

5 Schrödinger's wave mechanics

Schrödinger used Hamilton's energy dynamics for the particle theory and applied de Broglie's pilot wave theory to produce a satisfactory wave-particle duality which looks after the energy issue of de Broglie's relation.

All wave propagated along the $x-$axis obey the following wave equation

$$\frac{\partial^2 \Psi}{\partial x^2} = \frac{1}{\omega^2} \frac{\partial^2 \Psi}{\partial t^2}$$

where $\Psi(x,t)$ is the wave function and ω is the wave speed.

Here, we consider the wave function Ψ whose square yields the probability of locating a particle at any point in the space. We consider only systems whose total energy E is constant and whose particle move along the $x-$axis and are bound in space. Then the frequency associated, via "de Broglie relation" which is totally hypothetical and relativistic, with the bound particle is also constant, and we can take the wave function $\Psi(x,t)$ to be $\Psi(x,t) = \psi(x)f(t)$. As the frequency is assumed to be precisely defined, $f(t) = \cos 2\pi\nu t$. So, we have

$$\frac{\partial^2 \psi}{\partial x^2} = -\left(\frac{2\pi}{\lambda}\right)^2 \psi = -\left(\frac{p}{h}\right)^2 \psi$$

where the wave length is $\lambda = \omega/\nu$ and the momentum of the particle is $p = h/\lambda$.

We take the particle of mass m to be interacting with surroundings through a potential-energy function $V(x)$. The total energy of the system is given by

$$E = E_k + V = \frac{p^2}{2m} + V$$

where E_k is the kinetic energy of the particle. Then we have $p^2 = 2m(E - V)$ and we have

$$-\frac{\hbar^2}{2m}\frac{\partial^2\psi}{\partial x^2} + V\psi = E = i\hbar\frac{\partial\psi}{\partial t}.$$

This equation, is called (non-relativistic) Schrödinger wave equation as the "energy equation" involves non-relativistic mass m and it is not invariant under the Lorentz transformation. Oddly this does not mean that quantum mechanics is a non-relativistic theory. The derivation of Schrödinger wave equation involved de Broglie relation which is nothing but a relativistic theory.

Nevertheless, Schrödinger knew this problem and he tried to make his wave equation relativistic without success. This problem was *"resolved"* by Gordon-Klein-Dirac in the development of the quantum electrodynamics.

The first quantum "relativistic" basis

$$-\hbar^2\frac{\partial^2\psi}{\partial t^2} + (\hbar c)^2\nabla^2\psi = (m_0c^2)^2\psi$$

was obtained by Gordon-Klein by "inserting the energy operator and momentum operator into the relativistic energy-momentum relation":

$$E^2 - (pc)^2 = (m_0c^2)^2.$$

Unfortunately here the energy operator and the momentum operators do not commute. More over we can not associate probability to these operators. As usual, as this result "solved" the difficulty, all of these questions were ignored and quantum electrodynamics moved on. What is astounding here is that now "*the so-called quantization is reduced to the simpler process of replacing classical variables with operators*". Certainly Schrödinger never said so. *Now relativistic quantization simply means replacing variables of relativistic equations with corresponding operators! So what about what happened to Schrödinger's formalism? Should we call all of this spectacular development "theoretical pragmatism"?*

Here is a possible explanation which may well indicate that quantum electrodynamics researchers did things wrong. It is plausible to say that Gordon-Klein borrowed the idea from Heisenberg-Jordan's operator based formalism of quantum mechanics. The fact is that this "solution" did not make Schrödinger's wave equation relativistic. So, their claim that Heisenberg-Jordan formalism and Schrödinger's formalism are never equivalent at all. Yet in effect, from here on they mixed up these two different formalisms together under the illusion that they are the same thing. Another good example of how their ignorance of logic and mathematics hurt them.

Most importantly, the energy-momentum relation of Einstein is false as $e = mc^2$ is false. Anyhow *categorically energy is a modality and momentum is a physical reality.* How is it possible to have an equation which relates modality and reality? The situation is such that the development of theoretical physics at this stage grew way above anybody's capacity to keep track of, especially without strict mathematical and philosophical background which physicists looked

down upon. It appears that theoretical physicists have some difficulty in understanding that when we put many different equations together, we may end up with inconsistency which will make the theory totally meaningless. STR is a perfect example of this. If they think that these equations all came from experiments and so they are safe, they are not. *It means that the extraction of some of these equations from experiments went wrong, or some of the experiments went wrong.* Moreover, when they try to combine two different theories, they have to make sure that these two theories are not contradicting each other. Making sure of these things requires what the mainstream physics community do not appreciate and understand. Theoretical physics is not engineering and we are not working on one specific system. We are making a general very powerful theory, which requires expertise in logical and mathematical thinking.

6 Quantum electrodynamics

6.1 Harmonic oscillators: quantization of vacuum

As discussed above, following the questionable "quantization" of Gordon-Klein, Dirac quantized classical Hamiltonian H for harmonic oscillator, by replacing physical quantities in it with corresponding self-adjoint operators as

$$H_{osc} = p^2/2m + m\omega^2 q^2/2m$$

where p and q are operators which satisfy the commutation $[p, q] = i\hbar$. Though the connection between this purely "formal" quantization and de Broglie's (or Schrödinger-Heisenberg) quantization is not understood as well as it should be, this easy going formal quantization took over and became standard in contemporary quantum field theory

Notwithstanding, with p and q, we define the non-commuting operators

$$a = (m\omega p + ip)/\sqrt{2\hbar m\omega} \qquad a^+ = (m\omega p - ip)/\sqrt{2\hbar m\omega}.$$

It is clear that $[a, a^+] = 1$.Now we have

$$H_{osc} = (1/2)\hbar\omega(a^+a + aa^+) = \hbar\omega(a^+a + 1/2).$$

Define N as $N = a^+a$. It follows:

1. Eigenvalues of N are $n = 0, 1, 2, ...$
2. If $|n\rangle$ is normalized then so are $|n \pm 1\rangle$ defined as

$$a|n\rangle = \sqrt{n}|n-1\rangle \quad a^+|n\rangle = \sqrt{n+1}|n+1\rangle.$$

If $|0\rangle$ is normalized, the normalized eigen vectors of N are $|n\rangle = ((a^+)^n/\sqrt{n!})|0\rangle$, where $n = 0, 1, 2, ...$ These are also eigenvectors of H_{osc} with eigenvalues $E_n =$

$\hbar\omega(n+1/2) \quad n = 0, 1, 2, ...$The operators a and a^+ are called *annihilation operator* and *creation operator* respectively. This is because $|n\rangle$ represents a quantum state with n quanta.

In summary, the quantized Hamiltonian for harmonic oscillator can be expressed using creation operator a and annihilation operator a^+

$$H_{osc} = (1/2)\hbar\omega(a^+a + aa^+).$$

What is not clear here is the relation between quantum particles (quanta) derived from H_{osc} and the original particle which was described as H. Traditionally, the Hamiltonian represents a classical single particle system. Dirac produced many particles from it. Moreover, many particle systems are nonlinear and have no analytic solution. This problem was pointed out by Lehto. All of this means that *there is no clear ontological meaning to the quanta Dirac created from H_{osc}. This means that there is no ontology behind $|n\rangle$.*

6.2 Quantization of electromagnetic field: Dirac's aether theory

Planck quantized energy of electromagnetic waves to deal with the black-body radiation problem. Dirac went on to quantize the electromagnetic field which is supposed to be the medium for electromagnetic waves of Maxwell. This is called the *"second quantization"*.

6.2.1 Scalar and vector potential

Through Fourier expansion of the electromagnetic field represented by the vector potential field, he induced photons as harmonic oscillators in the space together with the creation and annihilation operator.

According to the classical electromagnetism theory, there are a scalar potential ϕ and a vector potential $\mathbf{A}$ such that the electric field $\mathbf{E}$ and magnetic field $\mathbf{B}$ of Maxwell can be obtained as

$$\mathbf{E} = -\frac{1}{c}\frac{\partial \mathbf{A}}{\partial t} - \boldsymbol{\nabla}\phi, \quad \mathbf{B} = \boldsymbol{\nabla} \times \mathbf{A}.$$

If there is no source of the field, we choose gauge (Coulomb gauge) such that $\phi = 0, \quad \boldsymbol{\nabla} \cdot \mathbf{A} = 0$. From these equations we can derive the Maxwell equation of electromagnetic fields.

From these, we have the following "wave equation of vector potential".

$$\nabla^2\mathbf{A} - \frac{1}{c^2}\frac{\partial^2 \mathbf{A}}{\partial t^2} = 0. \qquad (I)$$

This means that vector potential $\mathbf{A}$ for charge free space is a wave. But as $\mathbf{E}$ and $\mathbf{B}$ are modality, $\mathbf{A}$ is not physical reality but modality. So, $\mathbf{A}$ is not a physical wave but *a modal wave.* Let us call this wave "*(vector) potential wave"*. First question is that there are infinitely many vector potentials $\mathbf{A}$ which satisfy this wave equation. Which one are we going to discuss? *On what ground we make this decision*?

6.2.2 Quantization of electromagnetic field

Following Dirac, we make a Fourier expansion of the electromagnetic field in a large cube of volume $\Omega = L^3$ and take the Fourier coefficients as the field variables. We choose the boundary conditions to be periodic on the walls of the cube. This is

$$\mathbf{A}(L,y,z,t) = \mathbf{A}(0,y,z,t), \quad \mathbf{A}(x,L,z,t) = \mathbf{A}(x,0,z,t), \quad \mathbf{A}(x,y,L,t) = \mathbf{A}(x,y,0,t).$$

The Fourier series of $\mathbf{A}$ is given by

$$\mathbf{A}(\mathbf{x},t) = \sum_{\substack{\mathbf{k} \\ k_z>0}} \sum_{\sigma=1,2} \sqrt{2\pi\hbar c^2/\Omega\omega_k}\mathbf{u}_{\mathbf{k}\sigma}(a_{\mathbf{k}\sigma}(t)e^{i\mathbf{k}\cdot\mathbf{x}} + a_{\mathbf{k}\sigma}(t)e^{-i\mathbf{k}\cdot\mathbf{x}}) \qquad (II)$$

where $\mathbf{k}$ is a wave vector, $\omega_k = kc$ and $k = \langle \mathbf{k}\cdot\mathbf{k}\rangle$. The factor $\sqrt{2\pi\hbar c^2/\Omega\omega_k}$ is a normalization factor. $\mathbf{u}_{\mathbf{k}\sigma}$, $\sigma = 1,2$ are two unit orthogonal vectors. Due to the second condition of the Coulomb gauge, they must be orthogonal to the wave vector $\mathbf{k}$ which has the components $2\pi(n_x,n_y,n_z)/L$ where n_i are integers.

From (II) to (I), with

$$a_{\mathbf{k}\sigma}(0) = \textit{ if } k_z > 0 \textit{ then } a^{(1)}_{\mathbf{k}\sigma}(0) \textit{ else } a^{(2)}_{-\mathbf{k}\sigma}(0), \text{ where } a_{\mathbf{k}\sigma}(t)e^{i\mathbf{k}\cdot\mathbf{x}} = a_{\mathbf{k}\sigma}(0)e^{-i\mathbf{k}\cdot\mathbf{x}}$$

we have

$$\mathbf{A}(\mathbf{x},t) = \sum_{\mathbf{k},\boldsymbol{\sigma}} \sqrt{2\pi\hbar c^2/\Omega\omega_k}\mathbf{u}_{\mathbf{k}\sigma}[a_{\mathbf{k}\sigma}(t)e^{i\mathbf{k}\cdot\mathbf{x}} + a^{(1)^*}_{\mathbf{k}\sigma}(t)e^{-i\mathbf{k}\cdot\mathbf{x}})]$$

This leads to $da_{\mathbf{k}\sigma}(t)/dt = -i\omega_t a_{\mathbf{k}\sigma}$. This equation for all wave vector $\mathbf{k}$ and $\sigma = 1,2$ can be considered as "*the equation of motions of the electromagnetic field*".

Now the energy in the electromagnetic field (radiation Hamiltonian) is

$$H_{rad} = \frac{1}{8\pi}\int_\Omega d^3\mathbf{x}(E^2+B^2) = \int_\Omega d^3\mathbf{x}\left(\frac{1}{c^2}\left|\frac{\partial\mathbf{A}}{\partial t}\right|^2 + |\nabla\times\mathbf{A}|^2\right) = \frac{1}{2}\sum_{\mathbf{k},\sigma}\hbar\omega_k(a_{\mathbf{k}\sigma}a^*_{\mathbf{k}\sigma}+a^*_{\mathbf{k}\sigma}a_{\mathbf{k}\sigma}).$$

With this, we can consider the em field to be an infinite collection of harmonic oscillators Now we have

$$H_{rad} = \sum_{\mathbf{k},\sigma}\hbar\omega_k(\frac{1}{2} + a^*_{\mathbf{k}\sigma}a_{\mathbf{k}\sigma}) \qquad (III)$$

and $\frac{1}{2}\hbar\omega_k$ is the *zero-point energy* of an oscillator. Then the zero-point energy of the radiation field $\sum_{\mathbf{k},\sigma}\frac{1}{2}\hbar\omega_k$ is *infinite* as there are *infinitely* many oscillators. *As there are continuumly many wave vectors* $\mathbf{k}$, *the number of photons in the empty space is continuumly many.* This does not agree with physical ontology of particles.

This problem we have discussed is directly connected to the question of how many photons in the space? Photons are "supposed to be" physical particles.

The problem here is that *if photons are to create continuum then photons can not be physical particles*. A collection of ontological particles can not form continuum. Planck-Einstein's quantization of light waves shares the same problem. *As there are continuumly many wave length for electromagnetic waves there must be continuumly many photons of Planck-Einstein which is not possible.*

Remark 2 *Despite the indifference of quantum physicists this makes Planck-Einstein photon concept invalid. The mathematics they used violates the ontology. To begin with, as this theory is invalid what is the point of adding Dirac's quantization of em field to this theory.*

Here, Dirac carried out the quantization of (local) electromagnetic field expressed by the vector potential $\mathbf{A}$. This is to produce *"quanta of electromagnetic fields"* as harmonic oscillators and the total energy of such electromagnetic field as the summation (integration to be precise) of the energy of such harmonic oscillators. This result suffers from serious "category errors". Electromagnetic field is not a physical reality. It is a counter-factual modality. So, the produced quanta of harmonic oscillators must not be considered as physical reality. *They are just a fancy mathematical representation of this metaphysical world of electromagnetic fields which does not exist in physical reality.* How can the concept of the spacial distribution of electric force per unit charge be a physical reality. In Dirac's eccentric world where symbolic calculation is the only truth, "objects" defined from counter factual modality through formal symbol pushing produces physical reality of "photons" whose connection to Planck-Einstein's photons is not presented at all.

Moreover, there is yet another good reason to question Dirac's claim that photons are in essence the components wave functions which appears in the Fourier expansion of the electromagnetic field expressed by the vector potential $\mathbf{A}$. This means that Dirac's photon is an "infinite object" and this does not go quite well with the assumption that photons are "the most basic elementary particle".

Connection between Dirac's photons and Einstein-Planck's photons is not as clear as it should be. Dirac's photons are quantization of electromagnetic fields and Planck-Einstein's photons are quantization in terms of energy of electromagnetic waves of Maxwell. Certainly as a wave which "travels through" the counter-factual modality of electromagnetic field, electromagnetic waves are also counter factual modality, "not reality".

Furthermore, contrary to the belief of Dirac, they are not the same things. What we can see in common here is the issue of *"mathematically producing physical particles through quantizing non-physical entities such as electromagnetic fields and electromagnetic waves"*. More over Planck-Einstein photons are invalid as they lead to theoretical contradictions and empirical contradiction of violating the uncertainty principle as discussed above.

Recent study shows that electromagnetic fields should be represented as the system of monochromatic operators instead to prevent the problem of black-body radiation. Though this by itself will not provide a solution to the problem

of particle-wave duality which is a very deep mathematical and philosophical problem, it at least seems to "explain" the black-body radiation. After all, choosing harmonic oscillator or monochromatic oscillator for photon's mathematical representation has no ontological reasoning. So, this is a good example of how quantum theory violates the empiricism. *It is tragic that physicists who claim that mathematics is just a language abuse mathematics to deal with inconvenient empirical issues like this.*

The most fundamental issue is that *it is not the case that we empirically detected particles called photons and we found a mathematical representation of them.* Photons here are nothing but the creation of this rather elementary mathematical construction of Fourier expansions and Dirac decided that they are physical particles called "photons" without considering their connection to yet another kind of photons presented by Planck who refused to consider his photons particles.

6.2.3 Annihilation operator and creation operator

Again, following the steps of Gordon-Klein, Dirac further "*quantized*" the above presented quantization of the classical radiative field *by replacing the classical quantities* $a_{\mathbf{k}\sigma}$ *and* $a^*_{\mathbf{k}\sigma}$ *with self-adjoint operators.* We may write $a_\sigma(\mathbf{k})$ and $a^*_\sigma(\mathbf{k})$ for $a_{\mathbf{k}\sigma}$ and $a^*_{\mathbf{k}\sigma}$. We just consider $a_\sigma(\mathbf{k})$ and $a^*_\sigma(\mathbf{k})$ quantum operators. We assume that the operators refereeing to different oscillators commute, that is $[a_\sigma(\mathbf{k}), a^*_\sigma(\mathbf{k}')] = \delta_{\mathbf{k},\mathbf{k}'}\delta_{\sigma\sigma'}$.

Remark 3 *The malpractice of mechanically replacing classical variables with self-adjoint operators and call it quantization, as started by Gordon-Klein is sticking its ugly head again. It was a ad patch up job by them to "resolve" the difficulty of Schrödinger's wave equation not relativistic despite that it used relativity theory in the form of de Broglie relation.*

The operator $N_\sigma(\mathbf{k}) = a^*_\sigma(\mathbf{k}), a_\sigma(\mathbf{k})$ then has eigenvalues $n_\sigma(\mathbf{k}), n = 0, 1, 2, ...$ and eigenvectors defined as

$$a_\sigma(\mathbf{k})|n_\sigma(\mathbf{k})\rangle = \sqrt{n_\sigma(\mathbf{k})}|n_\sigma(\mathbf{k}) - 1\rangle, \quad a^*_\sigma(\mathbf{k})|n_\sigma(\mathbf{k})\rangle = \sqrt{n_\sigma(\mathbf{k})}|n_\sigma(\mathbf{k}) + 1\rangle.$$

Indeed,

$$|n_\sigma(\mathbf{k})\rangle = [[a^*_\sigma(\mathbf{k})]^{n_\sigma(\mathbf{k})}/\sqrt{n_\sigma(\mathbf{k})!}]|0\rangle.$$

The eigenvector of the radiation Hamiltonian given as equation (III) is a tensor product of such states, i.e.,

$$|\cdots n_\sigma(\mathbf{k})\cdots\rangle = \prod_{\mathbf{k},\sigma} |n_\sigma(\mathbf{k})\rangle \qquad (IV)$$

with the energy eigenvalues

$$E = \sum_{\mathbf{k},\sigma} \hbar\omega_k(n_\sigma(\mathbf{k}) + \frac{1}{2}). \qquad (V)$$

The interpretation of these equations is a straight forward generalization from one harmonic oscillator to a superposition of independent oscillators, one for each radiation mode $(\mathbf{k}, \sigma)$. $a_\sigma(\mathbf{k})$ operating on the state (IV) will render occupational numbers unchanged. Indeed, we have

$$|a_\sigma(\mathbf{k})|\cdots n_\sigma(\mathbf{k})\cdots\rangle = \sqrt{n_\sigma(\mathbf{k})}|\cdots n_\sigma(\mathbf{k})-1\cdots\rangle \qquad (VI).$$

Correspondingly, the energy (V) is reduced by $\hbar\omega_k = hc|\mathbf{k}|$.

We interpret $a_\sigma(\mathbf{k})$ an "annihilation operator" which annihilates one photon in the model $(\mathbf{k}, \sigma)$, i.e. with momentum $\hbar\mathbf{k}$, energy $\hbar\omega_k$ and linear polarization vector $\mathbf{u}_{\mathbf{k}\sigma}$. Similarly, $a^*_\sigma(\mathbf{k})$ is interpreted as a "creation operator" of such a photon. We have

$$|a_\sigma(\mathbf{k})|\cdots n_\sigma(\mathbf{k})\cdots\rangle = \sqrt{n_\sigma(\mathbf{k})}|\cdots n_\sigma(\mathbf{k})+1\cdots\rangle \qquad (VII).$$

The state of the lowest energy of the radiation field is the "vacuum state" $|0\rangle$ in which all occupational numbers $n_\sigma(\mathbf{k})$ are zero. In lieu of (V), this state has energy $\frac{1}{2}\sum_{\mathbf{k},\sigma}\hbar\omega_k$.

Quantum field theory works only for the systems for which the zero-point energy of the radiative field cancels. *For "many cases", this infinite energy of vacuum cancels out when physically meaningful quantities are calculated. So, we "assume"* $H_{rad} = \sum_{\mathbf{k},\sigma}\hbar\omega_k a^*_{\mathbf{k}\sigma}a_{\mathbf{k}\sigma}$.

Remark 4 *Is this diverging zero-point energy as a part of the formal mathematical representation of the classical electromagnetic field not an indication of the deficiency of Dirac's theory of quantization of electromagnetic field? This problem comes from a very serious and deep issues we have in theoretical physics which transcends the opportunistic conventionalism which comes from the empirical tradition of physics. It is hard to imagine that a serious mathematical and conceptual development we are engaged in here could lead to this kind of opportunistic conclusion. If so, theoretical physics is nothing but an embarrassment.*

Remark 5 *Later, quantum field physicists took this problem seriously and Tomonaga-Schwinger presented a more general less ad hoc answer to this divergence problem which they called "renormalization problem". Still this is not a complete solution and all they did was to replace "many cases" by "all known cases". Mathematical point of view suggests that all of this implies that the fundamental idea of quantization a la Dirac is problematic, unattainable.*

The eigenvalues of this operator are $E = \sum_{\mathbf{k},\sigma}\hbar\omega_k n_\sigma(\mathbf{k})$. The momentum operator is $\mathbf{P} = \sum_{\mathbf{k},\sigma}\hbar\mathbf{k}(a^*_{\mathbf{k}\sigma}a_{\mathbf{k}\sigma}) = \sum_{\mathbf{k},\sigma}\hbar\mathbf{k}(N_\sigma(\mathbf{k}))$ whose eigenvalues are $\sum_{\mathbf{k},\sigma}\hbar\mathbf{k}(n_\sigma(\mathbf{k}))$.

In conclusion, the following picture of the electromagnetic field emerges: It consists of photons each of which has energy $\hbar\omega_k$ and momentum $\hbar k$: $n_{\mathbf{k}\sigma}$ is

the number of photons with momentum $\hbar\mathbf{k}$.The polarization is given by the vector $\mathbf{u}_{\mathbf{k}\sigma}$. Annihilation operator $a_{\mathbf{k}\sigma}$ decreases the number of photons with the momentum $\hbar\mathbf{k}$ by one and the creation operator $a^*_{\mathbf{k}\sigma}$ increases the number of photon with the momentum $\hbar\mathbf{k}$ by one.

6.3 Dirac's "quantization" of Schrödinger's wave equation (the second quantization)

Without knowing any of these fatal issues with his quantization of electromagnetic fields, Dirac went on to apply the same idea to the Schrödinger's wave equations. If this was Dirac's final answer to the frustrating problem of the failure to make Schrödinger's wave equation relativistic is not quite clear.

Consider Schrödinger's equation

$$-\frac{\hbar}{i}\frac{\partial\Psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\Psi + V(\mathbf{x})\Psi$$

for a particle in a potential $V(\mathbf{x})$. Let Ψ_n and E_n be the eigenvectors and eigenvalues of the operator $-\frac{\hbar^2}{2m}\nabla^2 + V(\mathbf{x})$. This is to say

$$\left(-\frac{\hbar^2}{2m}\nabla^2 + V(\mathbf{x})\right)\Psi_n = E_n\Psi_n.$$

The "Fourier expansion" of the wave function is,

$$\Psi(\mathbf{x},t) = \sum_n b_n(t)\Psi_n(\mathbf{x}).$$

Substituting this to the Schrödinger's equation yields

$$\frac{d}{dt}b_n = -\frac{1}{h}E_n b_n.$$

The expected value of energy is

$$H = \int d^3x\Psi^*(\mathbf{x},t)\left[-\frac{\hbar^2}{2m}\nabla^2 + V(\mathbf{x})\right]\Psi(\mathbf{x},t).$$

Putting all of these equations together and the orthogonality of Ψ_n we have $H = \sum_n E_n b_n^* b_n$. This is the Hamiltonian for a collection of harmonic oscillators with frequencies $E_n/\hbar$. If we consider b_n as an operator then b_n^* can be considered as the adjoint of b_n, in, symbols b_n^+ Under the commuting relations

$$[b_n, b_{n'}] = [b_n^+, b_{n'}^+] = 0, \qquad [b_n, b_n^+] = 0$$

from Heisenberg's equation $-\frac{\hbar}{i}\frac{d}{dt}b_n = [b_n, H]$ we can derive Fourier version of the Schrödinger equation as planned.

In this way a Schrödinger wave equation which is obtained from Hamiltonian is represented by an infinite system of oscillating particles, as Dirac planned.

Remark 6 (Schrödinger/Heisenberg) *Clearly, Dirac is using the claimed "empirical equivalence" between Heisenberg-Jordan's quantum mechanics and Schrödinger's quantum mechanics here. Putting aside the validity of this claimed equivalence, it is a highly irregular mathematical and logical exercise to mix up two different theories under empirical equivalence in general. This concern is material especially because the empirical equivalence here is of probabilistic nature. This seems to be a seriously disturbing invasion of probabilistic gambling "reasoning" to precise reasoning.*

Remark 7 *Despite the claim above by Dirac, it still is the case that we have not been shown that Schrödinger's formalism is relativistic despite that it came from de Broglie's relation which is relativistic. In the end, we now know that as STR is inconsistent, it could be a blessing for Schrödinger that he failed to establish that his theory is relativistic. Nevertheless the tragedy is that despite this, his theory used de Broglie relation which is invalid due to failure of STR. It is a tough reality for all modern physicists. It all started as The Times news paper and Royal Society of Britain decided to promote Einstein's relativity theory.*

The operators $b_n^+ b_n$ have the eigenvalues $N_n = 0, 1, 2, ...$, indicating that any natural number of particles may occupy the eigenstate Ψ_n. The eigenvalue of H then is $E = \sum_n E_n N_n$.This theory obeys Bose-Einstein statistics and these particles are called *bosons*.

This theory excludes particles which obey Fermi-Dirac statistics. These particles are called *Fermions*. A minor change of the theory above will derive a theory of Fermions, we keep Hamiltonians as $H = \sum_n E_n b_n^* b_n$. We expect the Heisenberg equation of motion to yield $db_n/dt = -E_n b_n/\hbar$. The only change involved is the commuting relations

$$[b_n, b_{n'}] = [b_n^+, b_{n'}^+] = 0, \qquad [b_n, b_n^+] = 0$$

to the commuting relations

$$[b_n, b_{n'}]_+ = [b_n^+, b_{n'}^+]_+ = 0, \qquad [b_n, b_n^+]_+ = \delta_{n,n'}$$

where $[A, B]_+ = AB + BA$. Now we have

$$-\frac{\hbar}{i}\frac{d}{dt}b_n = [b_n, H] = \sum_m E_m\{b_n b_m^+ b_m - b_m^+ b_m b_n\} = \sum_m E_m \delta_{nm} b_m = E_n b_n.$$

So, we have obtained Heisenberg equation of motion. Note that

$$(b_n^+ b_n)b_n^+ b_n = b_n^+(1 - b_n^+ b_n)b_n = b_n^+ b_n - b_n^+ b_n b_n^+ b_n = b_n^+ b_n.$$

If λ is an eigenvalue of $b_n^+ b_n$ then

$$b_n^+ b_n|\lambda\rangle = \lambda|\lambda\rangle \qquad b_n^+ b_n b_n^+|\lambda\rangle = \lambda^2|\lambda\rangle = \lambda|\lambda\rangle.$$

Thus $\lambda^2 = \lambda$. This is to say $\lambda = 1$ or $\lambda = 0$. This means that *at most one particle can occupy the eigenstate* Ψ_n. We may write $|n\rangle$ to denote this eigenstate. This theory obeys Fermi-Dirac statistics.

To express all of this on λ, we may write $b_n^+ b_n |N_n\rangle = N_n |N_n\rangle$ where $N_n = 0, 1$. Now we have

$$b_n^+ b_n b_n^+ |N_n\rangle = b_n^+ (1 - b_n b_n^+)|N_n\rangle = (1 - N_n) b_n^+ |N_n\rangle.$$

This implies that $b_n^+|N_n\rangle$ is an eigenvector of $b_n^+ b_n$ with the eigenvalue $1-N_n$. It can only differ from $|1-N_n\rangle$ only by a constant. We write $b_n^+|N_n\rangle = C_n|1-N_n\rangle$. The constant C_n can be evaluated by taking the inner product of $b_n^+|N_n\rangle$ with itself.

$$\langle b_n^+|N_n\rangle, b_n^+|N_n\rangle\rangle = (1 - N_n) = C_n^* C_n.$$

Thus we have $C_n = \theta_n\sqrt{1 - N_n}$ where θ_n is a phase factor of modulus unity. This leads to

$$b_n^+|N_n\rangle = \theta_n\sqrt{1 - N_n}|1 - N_n\rangle \qquad b_n|N_n\rangle = \theta_n\sqrt{N_n}|1 - N_n\rangle.$$

In summary we have

1. For bosons:

$$b_n|\cdots, N_n, \cdots\rangle = \sqrt{N_n}|\cdots, N_n{-}1, \cdots\rangle b_n^+|\cdots, N_n, \cdots\rangle = \sqrt{N_n}|\cdots, N_n{+}1, \cdots\rangle$$

2. For Fermions:

$$b_n|\cdots, N_n, \cdots\rangle = \theta_n\sqrt{N_n}|\cdots, 1{-}N_n, \cdots\rangle \qquad b_n^+|\cdots, N_n, \cdots\rangle = \theta_n\sqrt{1 - N_n}|\cdots, 1{-}N_n, \cdots\rangle$$

where $N_n = 0, 1$.
In both cases, b_n is annihilation operator and b_n^+ is a creation operator.

Remark 8 *One more question remains to be answered. Why Dirac started with second quantizing Schrödinger's wave equations? Why he did not start directly with Hamiltonians? Was it because Hamiltonians are just classical equations of energies? Dirac wanted to quantize energy fields in general as he did to electromagnetic fields so that the same theoretical frame allies to energies in general. He thought that waves are fields (mediums). There is a vicious circularity in his reasoning. Waves assume mediums but not vice versa. The ideological hatred of logic and mathematics is sticking its ugly head here.*

6.4 Interactions of quantum particles

We can add the Hamiltonians for several free particle fields and introduce appropriate interaction terms to study interacting particle fields. The most common such interaction is that of photons with charged particles. We use the theory

of second quantization to represent a charged particle field by the following Hamiltonian:

$$\int d^3x\Psi^+(\mathbf{x},t)\left[-\frac{\hbar^2}{2m}\nabla^2+V\right]\Psi(\mathbf{x},t).$$

The quantized electromagnetic field is represented by the following radiation (photon) Hamiltonian: $\int d^3x\frac{1}{8\pi}(E^2+B^2)$.The interaction of these two fields will be obtained by adding these two Hamiltonians and prescribing the following replacement:

$$\frac{\hbar}{i}\nabla \Longrightarrow \frac{\hbar}{i}\nabla-\frac{e}{c}\mathbf{A}(\mathbf{x}).$$

This leads to

$$H=\int d^3\mathbf{x}\Psi^+(\mathbf{x},t)\left[-\frac{\hbar^2}{2m}\left|\frac{\hbar}{i}\nabla-\frac{e}{c}\mathbf{A}(\mathbf{x})\right|^2+V\right]\Psi(\mathbf{x},t)+\int d^3x\frac{1}{8\pi}(E^2+B^2)=H_P+H_{rad}+H_I$$

where

$$\int d^3x\Psi^+(\mathbf{x},t)\left[-\frac{\hbar^2}{2m}\nabla^2+V\right]\Psi(\mathbf{x},t)=\sum_n E_n b_n^+ b_n$$

is the particle Hamiltonian,

$$H_{rad}=\int d^3\mathbf{x}\frac{1}{8\pi}(E^2+B^2)=\sum_{k,\sigma}\hbar\omega_k a^+_{\mathbf{k},\sigma}a_{\mathbf{k},\sigma}$$

is the Hamiltonian for the radiation field, and

$$H_I=\int d^3x\Psi^+(\mathbf{x},t)\left[-\frac{\hbar^2}{imc}\mathbf{A}\cdot\nabla^2+\frac{e^2}{2mc^2}A\right]\Psi(\mathbf{x},t)$$

is the interaction Hamiltonian. We can divide H_I into a part H' proportional to A and a part A' proportional to A^2 such that $H_I=H'+H"$. Expanding A and Ψ in terms of $a_{\mathbf{k},\sigma}$ and b_n gives

$$H'=\sum_{\mathbf{k},\sigma}\sum_n\sum_{n'}\left[M(\mathbf{k},\sigma,n,n')b_n^+b_{n'}a_{\mathbf{k},\sigma}+M(-\mathbf{k},\sigma,n,n')b_n^+b_{n'}a^+_{\mathbf{k},\sigma}\right]$$

and

$$\begin{aligned}H" \quad = \quad & \sum_{\mathbf{k}_1,\sigma_1}\sum_{\mathbf{k}_2,\sigma_2}\sum_n\sum_{n'}M(\mathbf{k}_1,\sigma,\mathbf{k}_2,\sigma_2,n,n')a_{\mathbf{k}_1,\sigma_1}a_{\mathbf{k}_2,\sigma_2}+M(\mathbf{k}_1,\sigma_1,-\mathbf{k}_2,\sigma_2,n,n')a_{\mathbf{k}_1,\sigma_1}a^+_{\mathbf{k}_2,\sigma_2}\\ & +M(-\mathbf{k}_1,\sigma_1,\mathbf{k}_2,\sigma_2,n,n')a^+_{\mathbf{k}_1,\sigma_1}a_{\mathbf{k}_2,\sigma_2}+M(-\mathbf{k}_1,\sigma_1,-\mathbf{k}_2,\sigma_2,n,n')a^+_{\mathbf{k}_1,\sigma_1}a^+_{\mathbf{k}_2,\sigma_2}\end{aligned}$$

where

$$M(\mathbf{k},\sigma,n,n')=\sqrt{\frac{2\pi\hbar c^2}{\Omega\omega_k}}\int d^3\mathbf{x}\Psi_n^*\left[-\frac{e\hbar}{imc}e^{i\mathbf{k}\cdot\mathbf{x}}\mathbf{u}_{k,\sigma}\cdot\nabla\right]\Psi_{n'}$$

and

$$\begin{aligned} & M(\mathbf{k}_1,\sigma,\mathbf{k}_2,\sigma_2,n,n') \\ = & \sqrt{\frac{2\pi\hbar c^2}{\Omega\omega_k}}\sqrt{\frac{1}{\omega_{\mathbf{k}_1}\omega_{\mathbf{k}_2}}}\int d^3\mathbf{x}\Psi_n^*\left[-\frac{e\hbar}{2mc^2}e^{i\mathbf{k}\cdot\mathbf{x}}\mathbf{u}_{\mathbf{k}_1,\sigma_1}\cdot\mathbf{u}_{\mathbf{k}_2,\sigma_2}e^{i(\mathbf{k}_1+\mathbf{k}_2)\cdot\mathbf{x}}\right]\Psi_n. \end{aligned}$$

The part of the Hamiltonian $H_p + H_{rad}$ can be considered the unperturbed part with eigenvectors and eigenvalues .

$$|\cdots N_n\cdots\rangle_p\,|\cdots n_{\mathbf{k},\sigma}\cdots\rangle_{rad},\ \sum_n E_nN_n + \sum_{\mathbf{k},\sigma}\hbar\omega_{\mathbf{k}}n_{\mathbf{k}\sigma}$$

respectively.

The interaction Hamiltonian H_I induces transitions between these states as follows:

1. the term $b_n^+b_{n'}a_{\mathbf{k},\sigma}$ in $H^{'}$: (1) annihilates a photon of momentum $\hbar\mathbf{k}$ and polarization σ, (2) annihilates a particle in state $|n'\rangle$, (3) creates a particle in state $|n\rangle$.

2. the term $b_n^+b_{n'}a_{\mathbf{k},\sigma}$ in $H^{'}$: (1) creates a particle in state $|n\rangle$, (2) annihilates a particle in state $|n'\rangle$, (3) annihilates a photon of momentum $\hbar\mathbf{k}$ and polarization σ.

3. the term $b_n^+b_{n'}a_{\mathbf{k},\sigma}$ in $H^{''}$: (1) creates a particle in state $|n'\rangle$, (2) annihilates a particle in state $|n\rangle$, (3) annihilates a photon of momentum $\hbar\mathbf{k}_1$ and polarization σ_1, (4) annihilates a photon of momentum $\hbar\mathbf{k}_2$ and polarization σ_2.

4. the term $b_n^+b_{n'}Ma_{\mathbf{k}_1,\sigma_1}a^+_{\mathbf{k}_2,\sigma_2}$ in $H^{''}$: (1) creates a particle in state $|n\rangle$, (2) annihilates a particle in state $|n'\rangle$, (3) annihilates a photon of momentum $\hbar\mathbf{k}_1$ and polarization σ_1, (4) create a photon of momentum $\hbar\mathbf{k}_2$ and polarization σ_2.

5. the term $b_n^+b_{n'}Ma^+_{\mathbf{k}_1,\sigma_1}a_{\mathbf{k}_2,\sigma_2}$ in $H^{''}$: (1) creates a particle in state $|n\rangle$, (2) annihilates a particle in state $|n'\rangle$, (3) create a photon of momentum $\hbar\mathbf{k}_1$ and polarization σ_1, (4) annihilates a photon of momentum $\hbar\mathbf{k}_2$ and polarization σ_2.

6. the term $b_n^+b_{n'}Ma^+_{\mathbf{k}_1,\sigma_1}a_{\mathbf{k}_2,\sigma_2}$ in $H^{''}$: (1) creates a particle in state $|n\rangle$,(2) annihilates a particle in state $|n'\rangle$, (3) create a photon of momentum $\hbar\mathbf{k}_1$ and polarization σ_1, (4) create a photon of momentum $\hbar\mathbf{k}_2$ and polarization σ_2.

6.5 Renormalization

6.5.1 Renormalization in fluid dynamics

Stokes, the 19th century fluid mechanist introduced the *renormalized mass* m for a mass m_0 moving in a fluid with speed v as $m = m' + m_0$. This m' is a

constant determined by the geometry of the system expressed by the boundary condition of the system and the density of the fluid. With this he decided that the kinetic energy of this body is $K = mv^2/2$. The extra mass m' is nothing but the manifestation of kinetic energy of the fluid pushed by the moving body.

6.5.2 Renormalization in classical electrodynamics

Thomson, a student of Stokes, observed an analogy between the motion of a solid body through an incompressible fluid and motion of a body through its own electromagnetic field (or through *aether*). Through this analogy, he introduced the notion of *electromagnetic mass* of a charge. There were two reasons behind this concept.

1. If a charge which also is a mass moved through the aether which is a fluid, according to the fluid dynamics, it should acquire an additional mass as per Thomson.

2. According to the Maxwell's theory, a moving charge creates a magnetic field which possesses energy coming from the force which accelerates the charge from speed 0 to v. This extra energy manifests as an additional inertia possessed by the charge, which we observe as the additional mass, which is called *electromagnetic mass* denoted by m'.

For a spherical charge of radius r and charge e, Thomson calculated the kinetic energy as

$$K = \left(m + 4\mu e^2/15r\right) v^2/2$$

where μ is the electric permittivity of the medium and v is the speed of the body. The electromagnetic mass is $4\mu e^2/15r$. In vacuum where $\mu = \mu_0 = 1/\epsilon_0 c^2$ where ϵ_0 is the electric permittivity, for a uniformly charged sphere of radius r, the electromagnetic mass is

$$m' = 2e^2/3rc^2.$$

Clearly all of this is based upon the assumption of aether which is a material manifestation of electromagnetic field which we now know is *counter-factual modality* which Thomson did not understand.

This idea of Thomson was further developed by his successor Lorentz who over wrote Thomson on the most fundamental understanding of aether. Thomson believed the Newtonian "materiality" of aether but for Lorentz despite that aether exerts force upon charges, the charges do not exerts force upon the aether. In this way, Lorentz's aether violates the third law. Despite his rejection of Einstein's anti-Newtonian physics, namely relativity theory, Lorentz also rebelled against Newton's classical view. His aether was anti-Newtonian aether.

Remark 9 *We pointed out a closely related issue in many places that the concept of electromagnetic field (or any force field more generally) violates the third law. Force field exerts force upon physical body but not the other way around. Indeed this is why Newton rejected the concept of any force field in the end.*

To Lorentz, an electron is a finite distribution of charge with finite boundaries. So, all-pervasive aether and electromagnetic field must be inside charges. This view leads to an outstanding distinction between external fields and internal fields. The external field is created by the external sources and the self field is created by the interaction between the internal charge distribution and the aether. The way how this interaction manifests depends upon the motion of electrons through the stationary aether. If there is no outside charge, the electron must move exactly like a point charge with a constant speed. This excludes spin of such electrons.

Upon this development and the conservation law, Lorentz obtained the force an electron experiences when moving through the aether (or field) as $F = (2e^2/3rc^2)(d^3x/dt^3)$ under the assumption that the distribution of the charge is spherically symmetric. Interestingly Thomson's theory and Lorentz's theory agree on the electromagnetic mass of a spherical charge which is $m' = (2e^2/3rc^2)$.

6.5.3 Kramer's renormalization

Kramer's criticism on the standard quantum electrodynamics was that they start with the un-renormalized Hamiltonians and try to remove the problem of divergent terms by absorbing them into later introduced renormalized mass or renormalized charge. He criticized this practice as a "band aid solution". He stressed that we must quantize the correct classical picture. He pointed out that as Thomson and Lorentz already dealt with the renormalization of mass, we should quantize their theory rather. In this sense he strongly criticized Dirac's quantization of un-renormalized (not having electromagnetic mass) Maxwell's electrodynamics.

According to Kramer, the basic equation in the spirit of Lorentz is

$$m_0(d^2x/dt^2) = \mathbf{K} + \mathbf{F}_{ext} + \mathbf{F}_{self}$$

where m_0 is the material (mechanical) mass, F_{ext} is the external force, F_{self} is the self-force and K is the non-electromagnetic force. According to the Lorentz theory,

$$\mathbf{F}_{self} = -\frac{2}{3c^2}\frac{d^2x}{dt^2}\iint d^3x d^3x' \frac{\rho(x)\rho(x')}{|x-x'|} + \frac{2e^2}{3rc^2}\frac{d^3x}{dt^3} + g\frac{re^2}{c^4}\frac{d^4x}{dt^4} + \cdots$$

where r is the radius of the charge distribution $\rho(x)$. The term

$$-\frac{2}{3c^2}\iint d^3x d^3x' \frac{\rho(x)\rho(x')}{|x-x'|}$$

is the electrostatic self-energy of the charge distribution $\rho(x)$ and it is the electromagnetic mass m'. This term diverges as $r \to 0$. Now we have the experimental

mass $m_{\rm exp} = m_0 + m'$,and we have

$$\begin{aligned}(m_{\rm exp} - m')\frac{d^2x}{dt^2} &= \mathbf{K} + \mathbf{F}_{ext} - \frac{2}{3c^2}\frac{d^2x}{dt^2}\iint d^3x d^3x' \frac{\rho(x)\rho(x')}{|x-x'|} + \frac{2e^2}{3rc^2}\frac{d^3x}{dt^3} + g\frac{re^2}{c^4}\frac{d^4x}{dt^4} + \cdots \\ &= \mathbf{K} + \mathbf{F}_{ext} - m'\frac{d^2x}{dt^2} + \frac{2}{3c^2}\frac{d^3x}{dt^3} + g\frac{re^2}{c^4}\frac{d^4x}{dt^4} + \cdots\end{aligned}$$

Therefore,

$$\begin{aligned}m_{\rm exp}\frac{d^2x}{dt^2} &= \mathbf{K} + \mathbf{F}_{ext} + \frac{2}{3c^2}\frac{d^3x}{dt^3} + g\frac{re^2}{c^4}\frac{d^4x}{dt^4} + \cdots \\ &= \mathbf{K} + e\left(\mathbf{E}_{ext} + \frac{[\mathbf{v}\times\mathbf{B}_{ext}]}{c}\right) + \frac{2e^2}{3c^2}\frac{d^2x}{dt^2}.\end{aligned}$$

For Kramer, this was a perfect solution as it contains directly observable experimental mass and observable external field.

His plan was to quantize this equation to construct a satisfactory quantum electrodynamics. Of course in his equation above, $m_{\rm exp}$ contains m', the model dependent divergent electromagnetic mass.

However he observed that this problematic divergence is somehow contained. It indeed is hidden in the experimental mass which we always observe finite. Here is yet another example of highly debatable issue of covering up the deficiency of theory using empiricism.

After all, Kramer's program included the following elements:

(1) A Hamiltonian for classical spherical charge of radius r interacting with a given external electromagnetic field.

(2) Separation of electromagnetic field into a self-field and an external field.

(3) Separation of mechanical and electromagnetic mass into those of mathematics which resembles the problem with Dirac's argument where he mixes up Heisenberg-Jordan theory of quantum mechanics and Schrödinger's Hamiltonian which leads to a dynamical formulation which contains both structure-dependent and structure-independent terms.

(4) The elimination of the structure-dependent terms through a series of canonical transformations as absorption into empirical parameters without such terms appearing as dynamic variables.

(5) On the structure-independent formulation, in principle, limit $r \to 0$ should converge.

(6) The second quantization of a structure-independent formulation should gives us a satisfactory quantum theory of radiation.

Kramer's program was never completed. One of the most important and interesting contribution of Kramer was the concept of *cut off*. In the Fourier decomposition of the electromagnetic field, only Fourier components which have the length $\lambda > r$ were considered. This technically offers a dramatically simplified *"mathematical treatment"* of diverging terms.

Moreover, Kramer's project was more in aliment with the "classical ontology of electrodynamics" than that of Dirac. Dirac did not consider the inside of an

electric charge. In aliment with Newton's philosophy his charge was a point charge. After all, he was one of the more mathematically minded physicists. *As Einstein's relativistic physics prevailed, the issue of electromagnetic mass was transformed into the issue of relativistic mass and vanished from scientific scene.*

Remark 10 *To be objective, not taking side in this highly politicized religious dispute, we will have to also point out that the "good old" classical electrodynamics has its own short fall which should not be kept from the perspective of pure mathematical science. Electrodynamics is the first unacceptable combining of particle physics and continuum physics. It is notable that fluid dynamics stepped out of the boundary of what we call "theoretical physics" started by Newton who for totally legitimate reason rejected the concept of continuum force field. This discipline considered continuum matter called fluid and tried to apply the concept of force and motion upon it (the continuum matter). The end product is logically incoherent "engineering science" which""works" in engineering reality. All of this is due to the fact that as Newton made it clear force is a vector (pointed arrow) and so it can be applied only to a point object. However, at least fluid dynamic is conceptually coherent in its avoidance of particles.*

Remark 11 *The above mentioned peculiarity of classical electrodynamics leads us to understand why electrodynamics, either classical or quantum produced so much confusion. The historic fact that Thomson adopted his renormalization problem for classical electrodynamics from Stokes's original renormalization problem in classical fluid dynamics clearly supports this understanding. It now is clear the reason why electrodynamics classical or quantum had hard time till now is due to this mixing up of continuum and particles. Particle dynamics and fluid dynamics do not work together well as pure mathematical science due to the disjointness of "continuum fluid" and "discrete particles". Certainly there is no point matter in fluid dynamics. Stroke's renormalized mass appears not inside a point mass but inside a mass which has geometric continuum shape and geometric dimension. It is the summation of all effects the massive body gets from the fluid and it appears inside the massive body. Original Coulomb electromagnetism theory, following the philosophy of Newton, considered only point charges. In short, particle physics and continuum physics are entirely different categories as Newton and Coulomb rightly stated. It is the pragmatic engineering science of industrial revolution which derailed theoretical physics to this confusion. This is the confusion which has been tolerated for centuries up until recent closure of CERN. Finally the confusion we are in because of the mixing up of the above discussed different categories reached the critical point where we have to review the whole situation we are in now in order to move forward.*

Remark 12 *There is one more important factor to be discussed regarding the peculiarity of electrodynamics. Despite that this theory started with almost identical beginning of Newtonian dynamics, it under the strong influence of Heaviside and Hertz upon Maxwell was twisted into the theory of force field, namely electromagnetic field, which is a serious category error, as force field is not a*

physical reality but it is a counter-factual modality. The spacial distribution of force per a unit charge is not a physical reality. It is impossible physically to place unit charge everywhere in the space.

Remark 13 *Moreover, if we want to bring in continuum physical bodies, we must mathematically reconcile such constructs and particles. This most important issue of physics was totally ignored as it was too much mathematical work for "theoretical physicists". Particle systems, no matter how much packed, are not even dense. So they are not continuum as we can always find a gap in between two particles in physical reality. Real continuum is dense which means that in between two particles, we can always find another particle. The continuum of original "continuum physics", however, is real continuum. This is why we can not integrate "particle physics" and "continuum physics".*

Interestingly, it was Gödel who pointed out that one of the reasons why the set theory is in trouble is because of the lack of ordering in a subset of a set which results in the too fast growth of sets size under the power construction. He called the needed extra condition the "surveyability".

After all of this, Kramer's project was completed by Feynman to which we will turn in what follows.

6.5.4 Tomonaga-Schwinger renormalization

In relativistic theory which starts with relativistic wave equations, the negative energy states are not available for constructing a wave packet to represent a positive energy electrons as they are full. It is as if the electron has a finite size approximately equal to its Compton length. This limit on the size of the electron wave packet makes the divergence of self-energy logarithmic instead of linear. For logarithmically divergent integrals, we can separate diverging components from meaningful converging components.

Consider $f(x) = \int_1^\infty dy/(x+y)$. As y gets large, the integral becomes like $1/y$ and approaches to zero. However, not fast enough to keep the integral from diverging logarithmically. So, $f(x)$ is divergent at all x. In quantum electrodynamics, the variables x and y represent energy variables the integral represents one of the sums over virtual states to be considered. Now

$$f(x)-f(0) = \int dy[1/(x+y)-1/y] = \int dy[(y-x-y)/y(x+y)] = -x\int_1^\infty dy/y(x+y).$$

Let $\bar{f}(x) = f(x) - f(0)$. Despite the divergence of $f(x)$ and $f(0)$, the difference $\bar{f}(x)$ converges. This is to say that the diverging integral $f(x)$ can be separated into two parts $f(x) = A + \bar{f}(x)$ where A is the infinite constant $f(0)$. It is the converging part $\bar{f}(x)$ which carries physical meaning.

In quantum electrodynamics, we also have linearly diverging integrals. In what follows, we will show that such divergence can also be separated into

diverging parts and converging parts. Consider $g(x) = \int ydy/(x+y)$.The integrand is a constant as $y \to \infty$. Thus the integral is linearly divergent. Now

$$g(x)-g(0) = \int ydy[1/(x+y)-1/y] = -x \int ydy/(x+y) = -x \int dy/(x+y) = -xf(x) = -x[A+\bar{f}(x)].$$

Though Ax diverges, $x\bar{f}(x)$ is converges. Therefore

$$g(x) = g(0) - Ax - x\bar{f}(x) = g(0) - A\bar{f}x + \bar{g}(x) = B - Ax + \bar{g}(x)$$

where B is divergent and integrals $g(0)$ and $\bar{g}(x) = -x\bar{f}(x)$ is convergent. We have separated the physically meaningful convergent term $\bar{g}(x)$ from divergent integral $g(x)$.

As it is known that the only divergence we meet in QED are either logarithmic or linear, these prototypes we presented above serves as a general scheme to isolate the divergent components to extract meaningful information from the theory.

In what follows we we present an interesting and "moving" history of active and positive interaction between different approaches which is unique in the history of theoretical physics.

(1) Under the influence of Heisenberg, Tomonaga studied the effect of a field upon its own source which is the first explicit attempt to address the issue of the violation of the third law by the introduction of force field. Despite its positive side, this created a vicious circle which was inevitable. To be precise, we still have no clear answer to this dilemma. This is a deep philosophical issue which can not be resolved by equational calculus of QED. Unfortunately for QED experts the issue is far too philosophical and they pay no attention at all, which is one of the major cause of the crisis physics is in. Nobody can beat logic and philosophy. Mathematics is not just a language for physics.

(2) Anyhow in this context, Tomonaga adopted Sakata's proposal that a conjectured field, namely "C-meson field", might interact with the electron which created the quantum field and produce a negative infinite electron mass to cancel the positive infinite mass produced by the electromagnetic field. To push this idea, Tomonaga developed a theory for a completely covariant QED based upon "super-many-time theory" and turned to Dancoff's theory of the elastic scattering which indicated the logarithmic divergence of energy in Dirac's relativistic relativistic theory with spinners. This theory of Tomonaga was a generalization of Dirac-Fock-Podolsky's "many time theory" which treated space time theory of each particle in an interacting system separately, contrary to the formalism based upon Hamiltonian theory.

1. Tomonaga described electrons and photons as quantum fields with infinite number of degrees of freedom, he had to assume a time for each space point.

2. Tomonaga then found an error in Dancoff's calculation on Dirac's electron. The then showed that the result was not infinite, it is finite. Thus there is no need for C-meson field. Which was a good relief for physics indeed.

3. Further study processes in QED such as elastic scattering lead Tomonaga to the conclusion that all diverging integrals in QED can be removed by covariant subtraction.

6.5.5 Feynman's renormalization

The general and powerful result of Tomonaga did not deter Feynman from attempting a new and more desirable renormalization theory using Kramer's suggestions.

Feynman when he was a graduate student of Wheeler expressed his view that the cause of the infinite energy of electron could be removed simply by reformulating classical electrodynamics so that the field produced by the electron did not interact with the electron itself. He was proposing to convert electrodynamics as a theory of delayed action at a distance, going back to the good old time of Gauss and Wheeler.

Though he did not come to the realization that the concept of electromagnetic field is not a physical reality but a counter factual modality and this is the real deepest cause of the confusion spread all over theoretical physics, Feynman rightly pointed finger at the role of force field which caused the divergence problem of the QED despite the short fall that the concpet of force field is not in the domain of physical reality. This view was already articulated by Newton 200 years before Feynman who rejected the usage of gravitational force field opposing the view of Leibniz.

It appears that the response from Wheeler to Feynman was a misleading one typical of contemporary theoretical physics of the time. First he pointed out that without self-interaction, there would be no radiative reaction, so that a radiating charge could not loose energy or momentum. He also suggested that this could be resolved, at least in classical setting, by replacing the interaction which is normally delayed because of the finite speed of light, by an interaction which was half advanced and half retarded. Putting momentum aside, we have shown that the concept of energy is ill-defined. Just like force field it is not a physical reality. It is a modality as it is defined as the "potential" to do work. When it comes to momentum, it is not clear how the absence of self- interaction will loose momentum. To begin with, classical momentum conservation law is assumed only for colliding masses with constant speed motion. It appears that the classical dynamics has been twisted into something unacceptable through a mountain of conventions introduced original theory which banned them. We are saying that the real problem lies in the sad reality that the classical theories turned into completely useless, logically inconsistent theories and the pinnacle of it was the dreaded electrodynamics. It is a miracle if the quantization of such inconsistent theories can produce a desirable theory. The anti-logic religion of physics derailed itself. The development of QED is mostly the activity of logic and mathematics. With the attitude of claiming that mathematics is just a language for physics, theoretical physics got what they deserved.

In his attempt to create a quantum version of the above mentioned idea, Feynman realized that it was needed to keep track of particles having their

own time variables. Therefore, he replaced the standard Hamiltonian method by the Lagrangian time-space integral. This developed into the path integral method. In classical theory, time and space are not physical entities. They are metaphysical entities. Physics is expressed upon these untouchable metaphysical entities. Feynman certainly made the same categorical error as Einstein in violating this sacred status of the category of time. In case of Einstein the violation of the category of space is also present. It is a philosophical and logical trivia that once we violate this category hierarchy, we immediately encounter contradictions. Certainly, his theory ended up with the paradox of a matter moving backward in time as its anti-matter.

Tragically, all of these issues did not register as contradictions in the "over creative mind" of creativity loving contemporary theoretical physicists. Theoretical physics is not an upstart religion or pseudo art activity. No matter how much physicists hate Aristotelian logicism for political reasons, in all human intellectual activity, logic rules and physicists should get used to that.

It is this fame seeking "genius" dominating culture of theoretical physics who call themselves the King of Science, which produced this outrageous intellectual mess costing trillions of tax payers money. Violation of logic and mathematics has no role in theoretical physics no matter how "creative" some fancy ideas are.

Compare all of this hype with what is happening in mathematics. Mathematicians wisely draw a fine line between themselves and popular science. What we see in theoretical physics is nothing but a political-economic show business in the community of popular science. How many people talked about Hawkins cosmology and how many of them understood what it was about at all?

The next phase of Feynman was to go back to the old idea of delayed action at a distance, as par Newton and Coulomb with a "relativistic twist". He tried to redefine the classical electromagnetic interaction using the relativistic version of principle of the least action. This resulted in a relativistically invariant modification of electromagnetism theory which did not use the infinite self-mass.

For this project, he used a relativistic version of the cut off introduced by Kramer. As Feynman's theory is momentum based, he used "momentum cut off" instead. With the cut off set arbitrary large but finite number, dealing with infinity was excluded. For Feynman, cut off meant the separation of the lower momentum knowable world and the higher momentum unknowable world. For Kramer cut off meant the separation of the observable external world and unobservable internal world. This strange view of Kramer all came from the ill fated introduction of charges which are not point charges in violation of the most basic assumption of electrodynamics. This move was to accommodate the needs from electrical engineering, thanks to the British pragmatism.

6.5.6 Dyson's unification

To sum up the whole development of the renormalization in QED, Dyson showed that Feynman's result is obtainable from Tomonaga-Schwinger formulation of

QED. He proved that the renormalization of mass and charge will guarantee the finiteness of QED corrections to any finite order of perturbation theory though it would not guarantee the convergence of the infinite series. His view was that renormalization is essentially associated with averaging out the large fluctuation of quantum fields which is equivalent to blurring exact point model of quantum field.

With this result of Dyson, the realistic aspects of Feynman's cutoff approach became obsolete. By taking the cut off to infinity, all high energy processes are taken cared of and all of their effects upon low energy oppresses are absorbed by redefining the parameters as Tomonaga did. We can no longer consider cutoff as the threshold energy at which the theory stops being valid and unknown new theories are required. Taking the cutoff to the infinity implies that the theory is valid at any energy level. Ironically this implies that the basic idea of renormalization is not needed at all.

After decades of neglect, the realistic aspect of cut off was attended again with the devastating conclusion that the taking cut off to infinity reduces the role of cut off to Tomonaga-Schwinger's formalistic method to deal with the infinity.

What is more distressing is the bias against Tomonaga-Schwinger's simpler and more general result. Even to this day, very few know about this result of Dyson which placed Feynman's theory just a special case of Tomonaga-Schwinger's result. As a folk lore, Feynman and renormalization of QED became synonymous, as usual. To make the matter even more distressing, *very few appreciate a great achievement of Feynman that he went back to the action-at-a-distance electrodynamics*. These things, so political, we do not observe in pure mathematics nor in analytic philosophy. Being the King makes physics more political, we presume. It is so nice not to have cheer leader, popular science, behind mathematics and analytic philosophy.

Considering what happened to relativity theory and quantum mechanics, it is now high time to re-examine the corrupted culture of physics. Relativity theory was an absolute mathematical and physical nonsense which ruled not only physics but also the entire human culture as the "ultimate truth". This "ultimate truth" was based upon the "mathematics" in which $0/0 = hf$ and $e = mc^2$ as the most important equations in the entire universe. All of this pure nonsense came not from mathematics but relativity theory in which reference frames move with acceleration, the so called relativistic dynamics of Einstein which is a serious violation of the Principle of Relativity which is supposed to govern all moving reference frames. The other factor behind relativity theory is philosophical incompetence. Only a fool will believe that [speed] which is defined as [length]/[time] will alter [length] and [time] as in length contraction and time dilation. This is what common sense calls "contradiction", "shooting oneself in their own foot".

The mess of quantum mechanics came from using relativity theory to resolve the black-body problem which was not the problem of classical electrodynamics but that of statistical mechanics.

7 Quantum field theory?

The reason why we spent a considerably long time in analysing QED is because of the current trend of applying the process of electromagnetic field to gravitational field, the so called quantum gravity. However, contrary to the common belief, quantum gravity is just a special example of a more general category called *quantum field theory*. This is because gravity is treated as force field instead of action at a distance force. Physicists may think that this is a minor point, irrelevant to the essence of the theory. However, carelessness in this kind of issues lead theoretical physics to serious category errors.

The generalization of QED into QFT started ontologically through high energy particle collision experiments using particle detectors. The real irony of this development is that the theory of quantum mechanics on the one hand predicts that there should be no trajectories of particles in any experiment because of the momentum-location uncertainty. This uncertainty asserts that once we localize a particle we will not be able to find the next location the particle will appear. Ironically, what we do in our particle experiment always show the trajectories of the particles in the particle detection chamber such as the Wilson chamber. In short, all quantum field theories are experimentally refuted and for some "political or religious" reason the "principle of experimental refutation" which says that a theory refuted experimentally is invalid and has to be rejected has never been applied there. This is an interesting issue of the "sociology of physics".

At the early stage of the development, this paradox was discussed but the questioning was considered non-patriotic and silenced as usual. To be precise, this is not a paradox. It is much worse. This phenomena is nothing but *ultimate empirical refutation of the theory of quantum mechanics*. A most fundamental principle governing physics, which is that when a theory and the experiment disagrees, it is the theory which should be abandoned is violated. *The enterprising of physics has reached to the point where this most fundamental principle was compromised for the occupational interest of enterprise*. Theoretical physics has turned into a big business.

There are more irregularities associated with the development of quantum field theory. As a quantum theory which is relativistic, QFT naturally rejected the action-reaction law; the concept of reference frames violates action-reaction law. It was Yukawa who explicated the π-meson connecting positron and neutron using action-reaction law. Opportunism?

In the end, QFT turned into just a cataloguing of the particles discovered in the experimental data of particle collisions which are not supposed to be there according to the theory. To gross, this vast area of quantum physics is called the Standard Model. This turned into the most expensive research field in physics in history.

Among the subjects of this vast area of quantum field theory, a most spectacular one is the so called *Quantum Gravity Theory*, to which we will turn in what follows.

8 Quantum gravity theory: history

8.1 Classical field theory

Gravitational wave theory was started as an analogy to the em wave theory of Maxwell. The researchers in neither of the fields realize that a gravitational (or electric) force field which is a spacial distribution of gravitational force (or electric force) force per unit mass (or charge) is not a physical entity. It is a (counter factual) modality not a physical reality. They wrongly take it as physical entity like water for water waves, which is a physical reality. It is astounding that mathematicians and logicians have to inform the king of empiricism, physicists.

The King status of physics made the discipline isolated and unaware of the further development of other equally substantial fields such as mathematics and philosophy. For example in "The secret of gravitational waves/American Scientist" March-April, 2018, Rothman wrote

> "$\cdots$ a [force] field is a continuously varying plane of action through which disturbances propagate, eliminating the conceptual knot of action at a distance. Today no one doubts the reality of [force] fields, anyone who has sprinkled iron filings on a piece of paper above a bar magnet has perceived a field pretty directly. Back then, the existence of [force] field was less obvious."

May be so it was back then in physics but in logic and philosophy researchers are well aware of the ancient Aristotelian-Augustian modal logic which was further developed by Vatican theologians to try to prove the necessity of God. Modal logic is a study of logic in which we study the logic of necessity and possibility. Now it is a most advanced branch of logic. Logicians clearly understand that what physicists call force field is nothing but a special case of what we call *"counter-factual modality"* as we discussed above. Rothman's description of force field as a physical reality clearly proves that he has not sufficient background in the modal logic to understand the modality of force field. We can not physically distribute "force per unit charge (or mass)" all over the continuum space, can we? We can not even directly "see" force exerted at a position in a space. How can we see the force field?

It also is quite clear that just like most other physicists, he does not understand what is continuum and how physical continuum is different from mathematical continuum. Mathematical continuum is *dense*. In between two points, there are infinitely many other points. Moreover, mathematical continuum is closed under limit. It means that for each sequence of elements, there is an element which is the "limit of the sequence". *This structure can never be realized by using what physicists call particles!* As long as one keeps the arrogant attitude of claiming that mathematics is just a language for physics, the person will never understand mathematical continuum correctly. *How can one use a theory which they do not understand as their language? Mathematics is not "calculating". It is for deep understanding which is essential for theoretical physics.* His understanding of physical also is questionable. When we place charges on

every point of the field space, this certainly changes the field itself. So, we can not observe the field structure in the way he describes.

Just like the Michelson-Morley experiment, typical "rush to fancy conclusions" culture is pulling the legs of theoretical physics. *The so-called em waves and gravitational waves are "transmission" of the "variation of the physical status" of charge or mass at a distance.* As there is no physical medium which propagate such "waves", they are not waves. Philosophically, it is much more desirable to consider just the action (change) at a distance than hypothetical spatial change due to the local change.

It appears that Feynman is one of very few modern physicists who understood this. He rejected force field in his QED. However, what is disappointing is that he failed to recognize that then the so called electromagnetic waves are not waves. All of this is the consequence of the lack of adequate training in analytical thinking.

As a natural consequence of not understanding what em waves and gravitational waves are correctly, *they appear to have some difficulty in explaining why electromagnetic waves get "absorbed" as it travels through matters and yet gravitational waves do not.* It is interesting to learn that for them this triviality is a big issue which apparently makes the gravitational wave theory an "extremely challenging" final frontier. Of course this kind of myth is a big boost for the popular science enterprise of theoretical physics (cosmology)

There is no physical medium for gravity, is there? According to the empiricists, they have medium through which electromagnetic force and electromagnetic waves travel. As empiricists, they are not interested in why the parameters ε and μ for such mediums. They say that these numbers are obtained from experiments one for each medium they used. It was Russell who warned physicists that empiricism is a vicious circle at best. To experimentally verify a theory, we use the theory to be verified to make the apparatus for the experiment.

This is the reason why empiricism failed. It appears that they are not concerned with that what they call the em medium is nothing but a massive sea of charged particles, yes that view material scientists (engineers) developed following the very old Greek philosophy of atomism. This is why the em waves are affected by the "medium". The trick here is that these tiny particles are strong enough in charges to affect the so called em waves.

Certainly the same thing happens to the gravitational forces (gravitons). But due to the G, for tiny mass of particle consisting what we call mass, this effect of gravity upon the gravitational wave (graviton) is negligible. This is why the gravity wave dose not get "absorbed" by the "massive body".

The problem is that as Newton made it clear that if we want to maintain our sanity we reduce mass and charge to point object to avoid this problem. Then we have no head ache of the interference between mass (charge) and gravitational (electromagnetic) waves. *All of this is to say, that in correct dynamics, there is noting but point masses or point charges.* According to the theory, there is no such thing as objects (bodies) through which em waves or gravitational waves travel. Opportunistic and undisciplined mixing up of different categories, typical of the heritage of physics coming from empiricism is sticking its ugly

head again.

What has been discussed here is a short but incisive issues and solutions to the early stage gravitational wave theory initiated by Heaviside and further developed by prominent researchers such as Poincarè and Einstein. Though very short, we summed up the issues (and confusions) in the "discussions" by these early pioneers of the field. One of the main problems is that theoretical physicists still have serious difficulty in understanding the difference between physical reality and modality.

8.2 Early works on gravitational waves

Heaviside, using analogy between Newton's law of gravity and Coulomb's law of electromagnetic force suggested the possibility of gravitational waves.

Poincaré, due to the Lorentz transformation in classical electromagnetism theory of Maxwell, which came from the ill fated MM experiment which also is a result of Maxwell's em theory, at least in the context of electromagnetism theory, one can not consider a body which moves faster than c. Due to the "algebraic analogy" between Coulomb's law and Newton's law, Poincaré proposed that the acceleration of a mass should produce gravitational waves as that of a charge produces electromagnetic wave.

One interesting question is what if we close our eyes to the invalidity of STR dynamics of Einstein which considered acceleration in the frame of STR which is limited only kinematics for an obvious reason (the violation of the Principle of Relativity) and studied the gravitational waves in STR dynamics. For some reason, Einstein did not work on this problem. As we will discuss in the next section, he went straight into the gravitational wave theory within GTR. It is plausible that he did not see needs for the gravitational wave theory within the context of STR dynamics as he was developing the general theory of relativity which is supposed to be a relativistic theory of generalized gravitational field.

8.3 General relativistic gravitational wave theory

Einstein who published the general theory of relativity in 1915 pointed out that the analogy between Coulomb and Newton breaks down at the dipole, unlike magnetic dipole, there is no gravitational dipole. After all, he explored the idea and came up with the proposal of three different kinds of gravitational waves; namely longitudinal-longitudinal, transverse-longitudinal, and transverse-transverse.

Eddington showed that the first two types of waves of Einstein can propagate at any speed by choosing appropriate coordinate system. He also showed that the third type of Einstein always propagate with speed c regardless of the choice of the coordinate system. Considering the first two types of waves, the physicality of the third case became questionable.

Einstein and Rosen discovered that in full generality of GTR, solutions of gravitational wave equations have singularity. Robertson argued that such sin-

gularity comes from the element of the theory which has no relevance to physicality.

In 1956, Pirani pointed out that all of these confusions associated with the relativistic gravitational wave theory coming from the choice of coordinate systems can be resolved by reformulating the gravitational waves in terms of manifestly observable Riemann curvature tensor.

Next year, Feynman presented a thought experiment which suggests that the gravitational wave carries energy by generating heat using gravitational waves.

8.4 Experimental results

Here is a short history of the experimental results on gravitational wave research.

1. In 1969 and 1970, Weber built the world first gravitational wave detector and detected gravitational waves from the Milky Way's, "Galactic Centre". This result predicted that the life of our galaxy is to be much shorter its inferred age.

2. In 1974, Hulse-Taylor discovered the first binary pulsar. Their pulsar showed a gradual decay of the orbital period which agreed with the momentum and energy loss in the gravitational radiation as predicted by the GTR.

3. Despite the apparent setback of Weber's usage of gravitational wave detector, further development were done on this line. In the 1970's Forward-Rainwe made the first notable detector which was followed by the construction of CEO600, LIGO and Virgo.

4. In 2015, LIGO made the first detection of gravitational waves. It was inferred that the signal, dubbed GW150914, coming from the merger of two black holes with masses $36^{+5}_{-4}M\odot$ and $29^{+4}_{-4}M\odot$ resulting in a $62^{+4}_{-4}M\odot$ black hole. They concluded that the detected gravitational wave carried roughly three solar masses or about 5×10^{47}joules.

9 Quantum gravity theory: general review

Beyond the impressive development theoretically and experimentally, there are still some issues to be discussed.

9.1 Gravitational waves of Heaviside-Poincare

In Maxwell's electromagnetic field theory, the two EM wave equations were obtained simultaneously as follows:

$$\frac{\partial}{\partial t}\nabla \times \mathbf{H} = -\frac{1}{c^2}\frac{\partial^2 \mathbf{H}}{\partial t^2} = -c\nabla \times \nabla \times \mathbf{E}\frac{\partial^2 \mathbf{E}}{\partial t^2} \Longrightarrow \nabla^2 \mathbf{E} = \frac{1}{c^2}\frac{\partial^2 \mathbf{E}}{\partial t^2}$$

Similarly we have

$$\nabla^2 \mathbf{H} = \frac{1}{c^2}\frac{\partial^2 \mathbf{H}}{\partial t^2}.$$

In Maxwell's theory of electromagnetism, the interaction between $\mathbf{E}$ and $\mathbf{H}$ came from the current vector $\mathbf{J}$ as the generalized Ampere law:

$$\nabla \times \mathbf{H} = \frac{1}{c}\frac{\partial \mathbf{E}}{\partial t} + \frac{4\pi}{c}\mathbf{J}.$$

Maxwell's EM wave equation is derived under the assumption $\mathbf{J} = 0$. This equation shows that the speed of em wave in vacuum is c. What is puzzling is that the speed of EM wave according to this theory is c only when the wave is created in vacuum without current.

Maxwell later showed that accelerating charges generate electromagnetic waves. However such charges create current $\mathbf{J}$ and then there is no reason to think that the em waves created in this way moves with speed c. So there is something bizarre about Maxwell's theory of EM waves.

Remark 14 *Radio engineers say that when we have a closed circuit, it generates an electromagnetic wave whose frequency is one cycle of the current.*

In case of the gravitational waves, we do not see the "claimed analogy" to em waves. There is only one gravitational field $\mathbf{G}$. It seems that the only analogy comes from the acceleration creating waves. But this analogy is weak as we have no such thing as the continuum flow (current) of masses in dynamics. *Moreover the speed c comes not from the nature of the mass but from the ill-fated Lorentz transformation which causes contradictions.*

Remark 15 *If we develop STR version of the gravitational wave theory, there are at least two issues to be considered. First, In principle STR rejects gravitation as it is acceleration and thus causes the violation of the Principle of Relativity, which relativists uphold or ignore opportunistically. Second, considering the close tie between STR and Poincaré's em field theory, it is well expected that the STR version of the gravitational wave theory will encounter similar difficulties to the difficulties Poincaré's theory encountered.*

9.2 Feynman's QED and gravitational wave theory

Considering that Feynman went back to action at a distance electrodynamics to formulate quantum electrodynamics, it is surprising that nobody in gravitational wave theory considered the possibility of action at a distance gravitational wave theory. This might well open up a door to the right theory of gravitational waves and its quantization.

9.3 Gravitational wave theory based on general relativity theory

9.3.1 Principle of equivalence

Einstein thought that if an accelerating reference frame can be reduced to an inertial frame in which acceleration induces "gravitational field", it is possible to treat accelerating frames as inertial frames inside the 'theory of relativity" which rejects reference frames which are under acceleration for a legitimate reason. He called this the **Principle of Equivalence.**

Assume a spaceship is in inertial motion in our reference frame. Moreover a force accelerates this spaceship with rate $\boldsymbol{\alpha}$. A body m in the spaceship experiences a force $\mathbf{f}$ which is due to the acceleration of the spaceship which makes the body m move with an acceleration of rate $\mathbf{a}$ in the frame of the spaceship. Putting aside what the force $\mathbf{f}$ is, this means $\mathbf{f} = m\mathbf{a}$. Then from our perspective, m in the space ship experiences the acceleration with rate $\boldsymbol{\alpha} + \mathbf{a}$. So, m will experience $\mathbf{f} = m(\boldsymbol{\alpha} + \mathbf{a})$. Therefore,

$$\mathbf{f} - m\boldsymbol{\alpha} = m\mathbf{a} \qquad \text{(IF)}$$

This means that "from our perspective" the acceleration $\boldsymbol{\alpha}$ on the spaceship induces an "additional" force $-m\boldsymbol{\alpha}$ on m, which he called "inertial force" upon the mass m and the equation (IF) yields the force m experiences in the accelerating spaceship. This Einstein called the second law in the accelerating frame of the spaceship. According to Einstein, upon the modification of $\mathbf{f}$ to $\mathbf{f} - m\boldsymbol{\alpha}$, the second law is conserved under the choice of accelerating reference frames.

There are many issues to be discussed. Here we will list some of them. In our paper *"Logical Analysis of Relativity Theory" Abstract presented for "Physics Beyond Relativity 2019", Praha,* we presented a thorough analysis of the above mentioned idea of Einstein. Here we will present a short version of it.

1. According to the special theory of relativity, relativistic addition of speeds is not $v \oplus v'$ classical addition. So, how can the addition of acceleration be the same as classical addition.

2. This inertial force is also closely bound up with the issue of *"fictitious force"* on a mass inside an orbiting object. Fictitious force means a "force in fiction", not reality. The reason why we have a problem with the fictitious force for an orbiting spaceship is because orbiting spaceship is under centripetal acceleration. It is not an inertial frame. The "creation" of "fictitious force" called centrifugal force does not make the orbiting spaceship becomes an inertial reference frame.

Even more fundamental issue here is considering the spaceship (or train). In the theory of dynamics as Newton made it clear, theoretically there is no such thing as a spaceship (or a train). All physical bodies must be reduced to point mass as Newton rightly said. So, there is no such thing as a mass m inside a spaceship for this reason.

The most fundamental reason why Newton correctly reduced all moving mass to point masses is simple. It is for purely mathematical and conceptual reason.

Newton correctly observed that the best we can do is to consider a physical body as a point object with size of geometric point. Without this assumption, how can we define motion mathematically?

Moreover, for dynamics, we have yet another important reason to reduce a mass to a point mass; it is because force is a vector, a pointed entity. So, the only entity to which we can exert a force is a point object (mass).

There are some more issues to be discussed regarding the "gravitational field" Einstein introduced to a space which is under acceleration. The concept of force field, in general, violates the action reaction law, in turn violate the Principle of Relativity. Moreover, the gravitational field Einstein introduced to an accelerating space is a force field which has no source for the gravitational forces spreading all over the space. This is yet another violation of the third law in a different sense.

9.3.2 Light bend?

Classically the rest mass 0 photon under constant acceleration. He considered a photon moving with speed c in the x-direction while it is in a frame which is under acceleration a in the y-direction. So, we have

$$x\prime = ct \qquad y\prime = -(at^2)/2.....(1)$$

If θ is the angle made by a tangent of the light ray to the x-axis we have $tan(\theta) = -ax'/c^2$,and we can assume that θ is very small. So we have

$$\theta \doteqdot -ax'/c^2.....(2)$$

But the GTR predicts otherwise, i.e.

$$\theta = -(3a/2c^2)x'^2.....(3)$$

It is clear that *all of this uses nothing but the kinematic concept of acceleration and in kinematics there is no concept of mass.* Photon is a point mass of mass 0. Having no mass and having mass 0 are entirely different category. The problem with considering a point object whose mass is 0 is that the second law fails for the mass 0 point object. *So, it makes no sense to say that the light (trajectory of photon) bends due to the "gravitational force" of sun.* So, Einstein's argument here "diverted" this difficulty by replacing the "gravitational force upon mass 0 photon" with the "reference frame of photon accelerated by sun's gravitation". It is truly astounding that this even worse confusion was never detected until now. *The reference frame of this photon can not be accelerated unless there is some mass stationary in it!* Second law was never meant to be applied to mass zero object. More basically it is a famous conclusion of Einstein that *there is no such thing as a reference frame for light (or photon) because of the LT.* It is this kind of sloppy reasoning which will not be tolerate at all in analytical philosophy or mathematics which lead contemporary theoretical physics to current crisis.

So, the only "apparently" appropriate thing to say here that the light bends due to the acceleration of the reference frame caused by the gravitation force is also false. In the end, we do not know what is really happening here. If the curved 4D spacetime GTR predicts the equation (3), clearly there is something which went wrong in the development of 4D spacetime GTR. Unfortunately, Einstein's rest mass 0 particle which moves with speed c was brought in to physics with serious consequences. How ever, it is not surprising at all.

9.3.3 General space-time coordinate system

The equivalence principle appears to apply to only local situations such as space ship as an accelerating frame. Unaware of the problem that the equivalence principle is false, Einstein made a move to represent all accelerating reference frames as "local inertial frames" in which acceleration is replaced by the induced gravitational field. *This ill fated idea lead Einstein to consider the general coordinate system upon which all accelerating frames are treated as local inertial frames with induced gravitational field.* Hence force, Einstein moved on to develop the concept of general absolute reference frames to which we will turn in what follows.

For considering the cosmos with time as a most fundamental coordinate, Einstein assumed that whole cosmos is occupied by a fluid whose molecules are "clocks" of any variety. This fluid can flow freely provided that there is no turbulence, so that neighboring molecules always have almost equal "speed" and the velocity of the flow is a continuous function. This means that Einstein assumes a universal time and a universal space upon which clocks move.

Each clock is allocated three coordinates (x_1, x_2, x_3) in such a manner that:

1. No two clocks will have the same coordinate.
2. Neighboring clocks have neighboring coordinate, therefore, coordinates are also continuous with respect to spacial displacement.
3. The coordinate of each clock remains the same through time. As time elapses at each clock its readings assumed to increase but the rate of increase is not necessary uniform as compared with a local standard clock. No attempt is made to synchronize distant clocks, neighboring clocks are assumed to be "sufficiently synchronized" so that the clocks readings are continuous with respect to spatial displacement.
4. The reading of a clock will be denoted by x_0.

It is unfortunate that this paradigm is not possible for the reasons we present in what follows:

a) No clock has any specific coordinate as it is not a point object. Newton reduced a "physical mass" to a "point mass" to give a specific position in the space at each time. This was possible as he classically assumed no internal physical structure in a "physical mass". Unfortunately "clocks" are complex engineering objects with complex internal physical structure.

b) In the continuum, there is no such thing as a point next to the other point. So, the concept of "neighboring point" to a point is invalid concept. There is no such thing as a real number number next to a given real number. This is because in between any two real numbers, we can always find a real number. This property is called the "density" of the set of real numbers.

c) As pointed out in **b**), there is no such thing as the coordinate of a clock in this setting. Clocks occupy continuumly many points in the space. They are by themselves very complex infinitary physical structure. In **1**) Einstein assumes the fluid of clocks and in **3**) he says that the coordinate of each clock remains the same. It is not clear what does it mean.

More generally, the following further questions remain outstanding.

(1) Upon what time and space the mechanics of such molecule clocks are defined? Each clock is a physical system and so, it is operating in a spacetime which is not the same as the spacetime defined by the clock. This is to say that the spacetime (x_0, x_1, x_2, x_3) does not define the inside dynamics of the clock at (x_0, x_1, x_2, x_3). Moreover, where is the clock which governs the spacetime in which this clock operates? According to the general theory of relativity, the time of this spacetime (x_0, x_1, x_2, x_3) and that of the spacetime in which this clock operates are not the same and how much they are synchronized depends upon the location of the clock which defines the spacetime which defines the clock. This problem is bound up with a more general problem associated with the instrumentalism view of time as clocks. This view falls into the following vicious circle: The clock which is supposed to define time must operate, as a dynamical system, upon some time and space. Then how this time and space are supposed to be defined? For Newton time is not to be defined by instruments.

(2) It is a common sense among researchers in "dynamical system theory" that time has a special status and different from all other coordinates of the system. This is in agreement with the idea of Newton in his classical dynamics. He said that time unlike other coordinates have natural flow which "moves" forward only. This makes it impossible to consider time as reading of clocks. Time is an entity which transcends empiricism and operationalism. The super creativity of modern physicists seem to defy this scientific common sense. This is how they consider things like "time travelling" with straight face as a pure scientists serving the appetite of the popular science. We wonder "how long" does it take to travel from now to 250 years ago? Once we violate the most fundamental assumption on time, anything can happen and relativity apparently made it happen.

(3) Clocks are physical entities. There are at most countably many clocks in this universe. No mater how closely we put clocks together, we can not form a continuum of clocks. No matter how one puts countably infinite particles together, he will not make mathematical continuum. This

is mathematically the same problem as the problem of photons which are supposed to exist for each frequency: as the frequency has continuum spectrum, there must be uncountably infinite particles called photons. Countably infinite points will never form real continuum. We need continuumly many points to form mathematical continuum.

(4) What does it mean to be sufficiently synchronized? The concept of synchronization presupposes external absolute time which contradicts the concept of relativism. Here, we have to check time of each clock at precisely the same moment in absolute time.

9.3.4 Minkowskian Local frame

Suppose, at a point P in a "gravitational field", which is a fluid of "infinitely many" clocks, a freely falling non-rotationional (relative to distant stars) local inertial frame is "constructed". We further assume that the axioms of special theory of relativity are valid within this frame as it is supposed to be an inertial reference frame. So, we can set up Cartesian coordinate system *(Px,Py,Pz)* at this point P. Further more we can distribute clocks over the frame all synchronized to the clock at P. Using this frame and clocks, events which occur in the vicinity of P over a suitably restricted time period, can be allocated space-time coordinates (t, x, y, z).

Remark 16 *(1) Rotation is a dynamical concept which is defined in terms of time. If time is defined in terms of sea of clocks, then how in the world is it possible to define the "rotation" of local inertial frame which apparently is also a sea of clocks? We may replace clocks by atomic clocks. Then it is not rotation but vibration. Still we have the same problem. (2) As we assumed that the universe is a sea of clocks which are not over all synchronized, such coordinate system (Px, Py, Pz) is not universal. It is a local coordinate system around P. (3) It is not quite clear why the time period must be restricted.*

Now suppose that in this local inertial frame a pair of neighborhood events have space-time coordinates (t, x, y, z) and $(t + dt, x + dx, y + dy, z + dz)$. Then, if $d(\tau)$ such that

$$(d(\tau))^2 = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2)$$

is Lorentz invariant. It also is called the *Minkowski distance*. This serves as the correct metric on the 4D Minkowskian spacetime.

Remark 17 *Unfortunately Lorentz transformation is irrelevantly to theoretical physics as the claim by Lorentz that this transformation maps wave equation to wave equation is false and Einstein's claim that all equational axioms of Maxwell are Lorentz invariant also is false. So, Minkowski distance also is irrelevant to physics. Though it is invariant under the LT, it is not invariant under the TD and LC.*

For a larger scale (temporal, as well as spatial) issues, it is necessary to use the general reference frames. If x_i are space-time coordinates relative to such general frame, transformations of the form $x_{i'} = \pi(x_0, x_1, x_2, x_3)$ must exist relating (x_0, x_1, x_2, x_3) to (t, x, y, z) [the local inertial frame] such that

$$t = \theta(x_0, x_1, x_2, x_3), \quad x = \pi(x_0, x_1, x_2, x_3), \quad y = \psi(x_0, x_1, x_2, x_3), \quad z = \gamma(x_0, x_1, x_2, x_3).$$

Then, if x_i are subjected to increments dx_i, the corresponding increments in t, x, y, z will be given by

$$dx = (\partial(\theta)/\partial(x_0))dx_0 + (\partial(\pi)/\partial(x_1))dx_1 + (\partial(\psi)/\partial(x_2))dx_2 + (\partial(\gamma)/\partial(x_3))dx_3$$

etc. and substitution in equation of proper time interval

$$(d(\tau))^2 = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2)$$

will results in an expression $d\tau^2$ which is quadratic in the increments dx, i.e. whose terms will either involve squares of the dx_i or product of two different dx_i. Thus

$$d\tau^2 = \sum_{i=0}^{3} \sum_{j=0}^{3} (g_{ij}) dx_i dx_j \qquad (R)$$

where the coefficients (g_{ij}) will be the functions of x_i. In general, a continuum in which the interval between neighboring points is given by a quadratic form like (R) is called a "*Riemannian space*" and the quadratic form like (R) is called its *metric*. Thus, the space-time continuum is a four-dimensional Riemannian space whose interval is everywhere identified with the proper time interval between neighboring events in a local inertial frame.

Remark 18 *All of this "impressive" relation to Riemann geometry is just a show to "impress" (or "intimidate") public. Putting aside the question of the mathematical value of Riemann geometry, the physical relevance of (R) above is in serious question. Minkowski distance is invariant under the LT which has little relevance to physics and to make the matter even worse, this distance is not invariant under TD and LC which are in the domain of relativistic physics and unfortunately they are inconsistent. So, we are in a no-win situation in every respect.*

Remark 19 *From philosophical and mathematical point of view, this proposal of Einstein is not articulate enough to be the foundation of the most fundamental science. Articulation needed here is not just typical "symbolism". It appears that what we discussed above is beyond any formalism to articulate. Especially with the level of understanding that mathematics is just a language typical of theoretical physics, it is clear that the issue will not be properly dealt with. It*

appears that Einstein was not ready for the project both mathematically and philosophically. Both mathematics and philosophy require more disciplined and articulate reasoning. Nearly a century has passed since GTR was developed and still we have not produced anything worthwhile to be recognized scientifically.

Remark 20 *Unfortunately Lorentz transformation is irrelevantly to theoretical physics as the claim by Lorentz that this transformation maps wave equation to wave equation is false and Einstein's claim that all equational axioms of Maxwell are Lorentz invariant also is false. So, Minkowski distance also is irrelevant to physics. Though it is invariant under the LT, it is not invariant under the TD and LC.*

10 Geodesics

10.1 General equation of a geodesic

When we express a linear function of one variable on 2D space, then the function becomes a straight line graph. The coefficient of the first order variable is the slope of the line. This idea was extensively exploited by train companies to visualize the train's operation on a 2D space where one coordinate is time coordinate and the other coordinate is the location coordinate expressed at the distance from the origin station. It is called "operational diagram" and it was pure mathematicians who glorified it as 4D spacetime with a fancy name for the simple concept. In the 4D space time all constant speed 3D motions should be just straight lines and the slope of the line is the constant speed 3D motion.

So, in 4D spacetime geometry of 3D motions, the "Euclidean geometric distance" between two points $P_1(t_1, x_1, y_1, z_1)$ and $P_2(t_2, x_2, y_2, z_2)$ in the 4D spacetime is:

$$\overline{P_1P_2} = \sqrt{(t_1 - t_2)^2 + (x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}.$$

The slope of the line segment P_1P_2 is given as

$$((x_1 - x_2)/(t_1 - t_2),\ (y_1 - y_2)/(t_1 - t_2),\ (z_1 - z_2)/(t_1 - t_2))\,.$$

In general theory of relativity, this changes: the distance, as per Minkowski, between P_1 and P_2 is

$$\widetilde{P_1P_2} = \sqrt{(t_1 - t_2)^2 - (1/c^2)\,\{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2\}}.$$

It can be shown that this distance is smaller than any other "Euclidean distance" along any curve connecting between P_1 and P_2 in the 4D space. It follows as follows: Clearly, $\widetilde{P_1P_2} < \overline{P_1P_2}$. But for any path l_{P_1,P_2} between P_1 and P_2, $\overline{P_1P_2} \leq \overline{l_{P_1,P_2}}$ where $\overline{l_{P_1,P_2}}$ is the Euclidean length of l_{P_1,P_2}.

From this, relativists concluded that the 4D spacetime with Minkowski metric is not an Euclidean space but a Riemann space which is curved.

Nonetheless, under the guidance of Hilbert's school at Göttingen, Einstein continued to develop his theory as follows: Under the equivalence principle,

$$d\tau^2 = \sum_{i=0}^{3}\sum_{j=0}^{3}(g_{ij})dx_i dx_j = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2).$$

From this, he concludes that the free fall in the gravitational field is geodesics [in the 4D spacetime]. This is called "*geodesic principle*". Under this principle we obtain equations of motion for bodies falling freely in a gravitational field.

Using Riemannian geometry for the "general metric" $d\tau^2 = \sum_{i=0}^{3}\sum_{j=0}^{3}(g_{ij})dx_i dx_j$, we can show the following "general equation of a geodesic"

$$\frac{d}{d\tau}\left(\sum_{j=0}^{3} g_{ij}\frac{dx_j}{d\tau}\right) = \frac{1}{2}\sum_{j=0}^{3}\sum_{k=0}^{3}\frac{\partial g_{ik}}{\partial x_i}\frac{dx_j}{d\tau}\frac{dx_k}{d\tau} \qquad (i = 0, 1, 2, 3).$$

For the metric

$$(d(\tau))^2 = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2),$$

these equations reduce to

$$\frac{d^2x}{d\tau^2} = \frac{d^2y}{d\tau^2} = \frac{d^2z}{d\tau^2} = \frac{d^2t}{d\tau^2} = 0.$$

This is equivalent to

$$x = \frac{dx}{d\tau}t + a, \quad y = \frac{dy}{d\tau}t + b, \quad z = \frac{dz}{d\tau}t + c$$

But as we mentioned above, *this Minkowski metric is "irrelevant" to physics because Lorentz transformation has little to do with physics.* A "physical transformation" which tells us that time is determined by location, and a metric which is invariant under such "transformation" has no role in physics.

Remark 21 *What we see in this "mathematical development" is a disturbing trend of mathematics used as "means of intimidation and the distortion of truth". Historically this is a trend started with Maxwell's EM field theory which wrongly used mathematics to cover up the ontologically questionable concept of em fields which are not physical reality but counter-factual modality. After this point, the theory of electromagnetism left physical reality and we were presented with one of the most absurd concept of EM waves which we still do not know what it is at all. As EM fields are modal objects, one certain thing we can say is that it is not physical reality but it is modal wave. We still were not told what it means to observe modal waves. Vector analysis used in this development is a trivial generalization of mathematical analysis and very few theoretical physicists have mathematical background to understand this. What we have seen here as a presentation of Einstein's GTR is a pinnacle of this mathematically unimportant and physically meaningless grand result obtained from abuse of mathematics. Mathematicians avoided getting disturbed by this nonsense by keeping honorable distance. Real physicists just kept their head low and minded their own business. This scientific repression lasted for nearly a century.*

10.2 Light bending revisited

According to the general theory of geodesic, light coming from a distant star passing near our sun has a geodesic (4D) which bends near the sun due to the gravity of sun. As it is bending in the 4D spacetime, we can not graphically express this bending. But when we drop the time bending, the light path bends in our 3D path. This 3D bending is a phenomena which takes place in our 3D Euclidean space. As we are in this very 3D space, in theory, we will not be able to observe this bending. This was what Gamow warned us long time ago. He basically said that unless we are in the position of Newton out of the universe observing from the shoulder of God, we will not be able to observe this bending. This interesting question was never answered. Marmet presented a classical explanation of this bending observation by Eddington using no bending space. It was ignored as usual. The most fundamental issue here is that moving back into the absolute space brings back the problem of observation. Newton made it clear that unless we stay out of the universe standing on the shoulder of God, we will not observe the dynamics correctly.

So, we wonder what NASA, the most expensive research organization in human history, has been doing in their repeated claiming that they empirically verified Einstein's general theory of relativity through light bending. Do they really understand real theoretical physics? For experimentalists modern day physics has been becoming tougher as the theory has become so complex and obscure at the same time. Also repeatability of experimental verification has become next to impossible too as each experiment cost way too much public money.

10.3 Momentum-energy issue in GTR

According to GTR, the momentum-energy tensor T_{ij} which describes the distribution of mass, energy and momentum yields the corresponding g_{ij} enabling to calculate the geodesics of the system. It was Schwarzschild who first obtained an exact solution to the Einstein's equation for spherically symmetric field. He used the solutions to calculate the motion of a planet in the field of sun.

We have discussed that relativistic energy $e = mc^2$ is flawed and so is relativistic momentum $p = mv$ where m is the relativistic mass. This m is a relativistic adjustment of classical mass of Newton so that the conservation of the momentum holds under relativistic collision. As the STR is invalid at the pain of fundamental contradictions, this adjustment is invalid. Moreover, the famous relativistic energy-momentum relation of Einstein

$$e^2 = c^2p^2 + m_0^2c^4$$

is false as $e = mc^2$ is false.

More fundamentally, *the concept of energy is logically flawed even classically.* This is because the work needed to accelerate from $m0$ to mv is not necessarily $mv^2/2$. It depends upon how we accelerate.

All of this self-critical philosophical analysis, which theoretical physics badly needs now, indicates that no matter how "impressive" the usage of momentum-energy tensor T_{ij} is, it unfortunately is flawed and irrelevant to physics. "Advanced mathematics" will not compensate for the deficiency of fundamental errors in reasoning in any field of mathematical sciences.

"In case of doubt, make it sound convincing." Murphy's law

Though momentum is a legitimate physical concept, energy is not. The latter is a modal concept as it is "possibility" to do work. In the abstract domain of mathematics, by dropping these conceptual issues one can consider such thing as energy-momentum tensor. But this is not physics. There is more to physics than mathematics. Yes, many physicists say that mathematics is just a language for physics. They certainly should understand what they say and think about the hazard of covering up physical difficulties using abstract mathematics.

This conflict between energy and momentum plagued theoretical physics since Newton started physics which he rightly called "natural philosophy". He rejected energy and went for momentum while Leibniz used energy. This issue reappeared in the renormalization problem of QED. Going against the main stream Feynman chose momentum and Lagrangian over energy and Hamiltonian. However, his motive for this was not because of the obscurity of the concept of energy but because he realized that the concept of force field is invalid causing the self-energy problem. To avoid this problem he had to explicitly deal with time; for him, time was not just an agent to supply change. This is how he chose Lagrangian. After all Feynman was a great improvement to the mislead theoretical physics community who ignored the warning from the founder Newton.

11 Relativistic gravitational waves revisited

After showing that the entire project of GTR carried out by Einstein and Göttingen University is fundamentally flawed, let us go back to the modern day gravitational wave theory which is based upon the concept of gravity which this ill-fated GTR offers.

11.1 Singularity problem

Einstein and Rosen discovered that in full generality of GTR, solutions of gravitational wave equations have singularity. Robertson argued that such singularity comes from the element of the theory which has no relevance to physicality. This is an interesting development. At least Robertson agreed that GTR is governed by *physically irrelevant mathematical elements*. Now the question unanswered is if isolating such undesirable elements will yield consistent physically meaningful theory. The record shows that there is no research done to answer this

question. *Typical cultural problem of do not miss the bus, get "quick results" to impress the public* diverted researchers from digging into these real problems.

11.2 Source of the confusion: Riemann curvature tensor?

In 1956, Pirani pointed out that all of these confusions associated with the relativistic gravitational wave theory coming from the choice of coordinate systems can be resolved by reformulating the gravitational waves in terms of manifestly observable Riemann curvature tensor. Again, this observation is highly questionable. Such analysis should follow only after resolving fundamental logical and mathematical inconsistencies of GTR. In an inconsistent theory which is not a theory to begin with, there is no issue of confusion. It is not the matter of tensor. It is the matter of the "momentum-energy" which the tensor is to represent. We strongly wonder what kind of basic logical education these "researchers" were given. It is astounding that the prestigious mathematical institute of Göttingen produced this kind of research. In applied mathematics, mathematics is never the issue. If something goes wrong, it is always the understanding of the issue to which we try to apply mathematics which goes wrong. It is very rare that mathematicians make errors in this way. Mathematics is a self-contained discipline and without any "input" from physicists, mathematicians will articulately figure out if their theory is correct or not.

11.3 Feynman on energy of gravitational waves

In 1957, Feynman presented a thought experiment which suggests that the gravitational wave carries energy by generating heat using gravitational waves. We wonder how he thinks about his own refusal of energy and adoption of momentum to deal with the divergence problem of QED. Is he not yet another example of opportunists?

11.4 Waves which carry momentum?

However, Feynman is not alone at all. Virtually all theoretical physicists became too specialized and look at things only through narrow windows of their hopelessly specialized highly questionable research. For example according to https://en.wikipedia.org/wiki/Gravitational_wave", water, waves, sound waves and electromagnetic waves are able to carry energy, momentum and angular momentum and by doing so, they carry those away from the source.

Anybody who studied wave mechanics correctly knows that no water wave which moves through water will carry momentum as there is no momentum in such waves. No mass moves in the direction of the motion of water waves. It is the local vibration of the medium which moves to the direction of the waves. No earth quake will move water as tsunami from the epicentre to many thousands of km away with the speed of 500km/h. The problem with the theoretical physics culture is that they become so "superior" and "removed" from the reality that they do not understand what the secondary school students

will readily understand any more. As we keep stressing, there is no such thing as EM waves as em field is not physical reality. It is a counter-factual modality. More fundamentally energy is not a legitimate physical concept as we discussed above. The work needed to accelerate from $m0$ to mv is not necessarily $mv^2/2$. It depends upon how we accelerate. What is more disappointing is that when we discuss these basic issues, the usual responses we get are typical arrogant and rather off the point "responses".

The idea of waves carrying momentum came in as the result of the false theory of relativity. Einstein's ill-fated $e = mc^2$. This lead to the wrong equation of momentum-energy which related momentum and energy. This lead to the wrong conclusion that as waves carry energy, they carry momentum. This is not only mathematically wrong but also conceptually false. Energy is a counter-factual modality and momentum is a physical reality. They are of different category.

It is disconcerting that the political dominance of relativity which lasted nearly a century eroded theoretical physics to the extent where theoretical physicist can not separate classical wave mechanics and relativistic wave theory. The culture of suppression of threatening facts put the physicists community in the dark, hampering the future development of physics.

11.5 Observable Riemann curvature tensor?

Einstein and Rosen discovered that in full generality of GTR, solutions of gravitational wave equations have singularity. Robertson argued that such singularity comes from the element of the theory which has no relevance to physicality. In 1956, Pirani pointed out that all of these confusions associated with the relativistic gravitational waves are coming from the choice of coordinate systems and can be resolved by reformulating the gravitational waves in terms of manifestly observable Riemann curvature tensor.

The problem here is not technical nature as Pirani thought. The question is what did he mean by "observable". Is it observable in the local Minkowski space or in the absolute space. If mathematicians are asked, they will certainly say that it must be in the absolute frame as the absolute space curvature is defined by the energy-momentum tensor.

So far so fine, but what about actual measurement? We have our own local Minkowski space according to Einstein and contingent upon the grand assumption that the relativity inside this local space is consistent and valid, we can legitimize our observation in this local space. There are two issues here. First, Minkowski local space time theory is inconsistent. This finishes the entire argument here. Second, the Riemann tensor defines the curvature of the absolute space. How local observation of local space can lead us to the global curvature of the absolute space.

11.6 Red shifting

It has been argued and accepted by the mainstream physics community that the electromagnetic wave shifts towards the red due to the relative velocities of the source and observer. The argument goes as follows: Assume we emit a light beam upward from the floor to the ceiling. Due to the downward acceleration of the room, by the time the light reaches the ceiling the ceiling is moving faster than the source on the floor was when light left it. In other words, the receiver at the ceiling is approaching the source (to be precise where it was when light left). Therefore we should expect the blue shift due to the Doppler effect. Therefore the observer in the room will notice the blue shift. This will make the observer notice the downward acceleration. This contradicts the Equivalence Principle which says that the free falling body will not notice its free falling. So, there must be a red shift due to the light moving upwards against the gravitational to compensate this blue shift. This is how Einstein obtained the red shift.

This argument is flawed. It is not the observer in the room who sees the ceiling falling towards where the floor used to be. It is an outside observer who will see that the ceiling is falling towards where the floor used to be. Einstein failed to understand that the inside observer is also subjected by the same acceleration due to the gravity. After all, all of this confusion is simply due to the simple fact that Einstein's argument for the Equivalence Principle is fundamentally flawed.

There is an even more elementary flaw in this argument of Einstein. Einstein's failed argument applies only for the accelerating velocity of the source and observer.

Notwithstanding, gravitational wave research community endorses the view that like em waves, gravitational waves exhibit shifting of the wave length due to the relative speed of the source and observer. To begin with this claim is false because the analogy must apply for the case where the source and receiver are not relative inertial motion but relative accelerating motion.

This issue shows the worst of the troubled relativity theory. Relativity theory has different faces depending upon the nature of the relative speed, either constant speed or time varying speed. It is shocking that no professional relativists paid enough attention to this subtle but important issue.

12 Quantum gravity theory

Among enthusiasts, there is a big urge to build "quantum gravity theory" which is analogous to the "quantum electrodynamics". They have some difficulty in dealing with the divergent terms. For some reason, they can not find a good way to deal with this.

12.1 Quantization of gravity waves

Considering the fact that in QED, we started with the quantization of EM waves as photons which are "rest mass" zero particle which "keeps moving with

constant speed c", may be the first thing to do in this direction here is to obtain the "quanta of gravitational wave".

However, we have some problem with Einstein's photon We wonder how is it possible that a particle which never stops, which always move with speed c has "rest mass". Having rest mass which is 0 and having no rest mass at all are entirely different category. Let us make this argument more concrete. Consider $x^2 + 1 = 0$. This equation has no real solution. Does this mean that $x = 0$ in a theory where we do not consider imaginary numbers.

As discussed in *[2] Relativistic theory of photon*, Einstein thought that the rest mass of photon is 0 as he thought that $0/0$ is "any number". But this immediately leads to contradictions.

After all, is it still a good idea to follow the step of what QED researchers did and bang out quantum version of gravity waves? As a typical cultural problem of theoretical physics, instead of rectifying wrong ideas and wrong results, researchers tend to push the old questionable ideas to push their frontier further forward. This following the trend continues till the next "revolution" of sensational scale appears. The entire history of the 20th century theoretical physics was this process of pushing wrong ideas and wrong method which created inconsistent theories to expand the kingdom of wrong thinking. We have argued with solid reasoning that QED is not the most successful theory of physics. It is one of the most questionable of physics in history. This is not surprising at all if we consider the dependence of this theory upon the completely false theory of relativity. What is lacking in contemporary theoretical physics is discernment.

The reason why QED appeared to be the most successful theory is mostly because it dealt with extremely small particles moving with incredibly fast speed. This makes it impossible to do what we are used to do as "experiments" impossible. It is clear that almost all experiments were measured applying theoretical formulas to trajectories produced "which are not even supposed to be there" according to the theory. Certainly the formulas used to measure are all verified It is what logicians call vicious circle. To make the matter even worse, probability theorists will remind quantum mechanists that there is no such thing as experimental verification or refutation for QM as it is a theory of probabilistic prediction and the relative frequency converges only at the limit.

It appears that physics community is still trapped in the mind set of good old industrial revolution age in their mind set and what we are dealing with in contemporary physics is way more advanced than the industrial revolution time physics. Physicists ought to open their eyes to this new situation and figure out the correct and new way to deal with today's issues in physics.

So, instead of wasting resources in pushing this wrong project based upon wrong ideas, we should go back to the source of problems and correct them. The first thing we must do is to understand the total invalidity of relativity theory and do something about it. This obviously leads to the correction of QM and eventually the theory of gravitation.

12.2 Renormalization problem

As we discussed in *6.5.4 Tomonaga-Schwinger renormalization*, in QED, the reason why they managed to find solutions to the problem of reorganization is because they treated the issue as a pure mathematical issue as Tomonaga did. He showed that for the problems which appear in QED, the diverging terms are always linear or logarithmic. So, he managed to show, for these problems, how to remove the diverging term problems. As Dyson showed, Feynman's solution to this problem, which he used Kramer's cut off, is a special case of the general solution of Tomonaga.

In case of quantum gravity theory, apparently this is not the case. But is this the weakness of quantum gravity theory? We do not know. We do not think that the solution Tomonaga presented is intrinsic. It was just a matter of luck that Tomonaga found that the diverging problems in QED are caused by the linear or logarithmic terms.

In the end the renormalization issue for QED is closely bound up with the good old issue of the electromagnetic mass which appeared in the classical em theory as closely studied by Thomson and Poincaré. *So, it had some ontological connection to reality*. We do not see this relation in quantum gravity theory. The difference here is that in case of QED, it was such that the em force field added extra mass to the charges. In case of gravitational field theory, there is only one force, gravity.

All of this is to say that contrary to the development of the theory of renormalization in QED, there is no ontological explanation of the problem of renormalization in the quantum gravity theory. It is a pure "mathematical" theory which has little relevance to physics.

The historic reality is such that the well-understood fundamental connection between classical em theory and QM was severed by the ultra creative theory of relativity by Einstein, as more and more theoretical physicists are recognizing, and this "grand mathematical abstraction" made theoretical physics drifted away from physical reality to the wonder land of popular science. From mathematical point of view it is highly questionable if mathematics used in modern physics such as relativity theory was really understood by those who used it. For example it appears that basically no specialists on GTR understands a basic mathematical fact that the manifold can exist only within the context of Euclidean geometric space. This lack of understanding made relativists attack Kant for his philosophy of the space. These trend following thinkers did not understand that without Kantian philosophy of space, there is no curved space. Among modern theoretical physicists, Feynmann seemed to have been one of the very few who rightly did not take relativity theory seriously. He also is known for rightly rejecting the highly controversial force field concept in theoretical physics for a very good reason. It is unfortunate that he has not been appreciated for really important things he did. As a popular science champion figure, he has been "known for the public image as a genius" created by the business interest of popular science. All of this is consistent with the disturbing fact that Einstein whose mathematics is mostly wrong has been known to be a

mathematical genius. In pure mathematics, we have no such thing as geniuses.

12.3 12.3 Gravitons?

Despite all of these difficulties and negative perspectives which are emanating from the mentioned conceptual and mathematical incoherence, dedicated Quantum Gravity researchers still hold a high hope in their future. They consider the project of building successful theory of quantum gravity to be a *harmonization* (*unification*) of gravitational theory and quantum mechanics: one for the understanding of large scale physics and the other for micro scale physics. From empirical point of view, this is highly questionable.

Astronomy is way too large for us man kind to do experiment in the way we do experiment for our size world. All we can do is to observe the far way starts relying upon em waves. As we know well, basically we know nothing about em waves and lights except that they are not physical reality. They are modal waves which travel through the modal fantasy of the em fields. Moreover, the only theoretical tool which gives us power to conclude something about distant stars is the so called Doppler effect. Despite so much trust we have on this effect, the logical reality is that we have no understanding of the connection between the frequency shift and the energy conservation. Frequency shift means the shift of energy and there seems to be no clear explanation of this observed energy shift and the total energy conservation. So, we are not sure if our calculating the speed of a distant star through the Doppler effect is trustworthy. On the top of it, once we get this speed correct, then we have to translate it to the relativistic one and clearly there is a vicious circularity in this argument. The problem of v in the gamma factor being classical speed is sticking its ugly head up.

Quantum particle world is way too small for our size world to do experiment. This is why in QM we ended up with the probabilistic theory with uncertainty. This killed entire quantum physics because the uncertainty principle asserts that we can never ever see trajectories. We wonder what then are these lines which appear in the particle detection chamber. This fatal problem has been completely covered up using the entire political power of the physics community. The difficulty we are experiencing is comes from this. We had to cover up the deadly truth that neither astronomical scale physics nor micro-scale physics can be handled by the so called "empirical method" anymore.

What is interesting is that in the so called quantum computing, more and more researchers are distancing themselves from QM thinking that this is an interesting parallel computing at the level of bits which should be realized out of the QM.

So, we wonder where is the minds of those quantum gravity researchers are when they dream about harmonizing these two extreme world which we have little control.

Putting aside this warning from empirical point of view, we wonder if it make any sense to dream about "meaningfully unifying" quantum physics and general relativity theory both of which are mathematically and logically inconsistent. Logic clearly tells us that an inconsistent theory can prove anything. It is

called deductive explosion in logic and mathematics. This is why we reject inconsistent theories. All of this simply means that already quantum theory and general relativity are harmonized, unified. The only draw back here is that the harmonized theory is meaningless and so totally useless. 500 years old ideological hatred of Greco-Catholic logicism by the Religious-Industrial Revolution is sticking its ugly head up.

13 Epilogue

After all of this, we still hear on day to day bases from the mainstream physicists that mathematics is "just a language". If so what they derived from using such language must be just a language, is it not?

As we pointed out, there are so many mathematical and logical holes in relativity theory upon which all modern physics is developed. As long as theoretical physicists think that mathematics is just a language for them, they will not detect the errors in the mathematization of their advanced theory of physics crated by their geniuses. Most of the experienced mathematicians just do not bother even pointing out these errors any more. Too much is enough. Up until recently even hinting this resulted in institutionalized personal attacks. On what ground institutional physicists protest what Vatican did 500 years ago? This might well be another reason why mathematicians distanced themselves from theoretical physics. That mathematicians kept distance from modern theoretical physics does not mean that they approved it. The indifference was the statement of disapproval. But this was a tragedy to mathematics too. Theoretical physics presented many very interesting and difficult issues which challenged mathematics. The tragic historic situation shut down needed communication between mathematics and theoretical physics. Considering the current status of mathematics, it is quite clear that *mathematics is reduced to picking fallen autumn leaves.*

It appears that there are some attempts to understand this new issue using some 11mathematical formalisms" as usual. But without relevant and correct conceptual analysis of the situation, we do not think that we can get anywhere.