ANALYSIS OF THE MATERIAL UNIVERSE

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Abstract: In part-I, based on the new theory of particles developed, a new model of cosmos is derived from the electromagnetic wave equations which integrate the well established big bang model of the cosmology with the cyclical model. Since the universe is proved to be a second order automatic feedback control system, big bang of the early universe or transient universe is proved to be oscillatory with very high frequency of oscillation within the finite volume of the universe till the universe had reached it's steady state of oscillation. When the universe reached the steady state of oscillation, it had cooled down to produce the matter particles. In part-II, material Universe is analyzed based on the energy theoretical methods. This method of analysis gives better insights into the nature of evolution of the material universe as compared with the field theoretical method of analysis. The space is proved to be in discrete form. The assumption in the general theory of relativity that the space and the field are one and the same is proved to be responsible for the origin of singularity in the relativistic model of cosmology. The big bang theory of cosmology is integrated with the steady state cyclical theory of cosmology. The universe is proved to be a second order feedback control system with transient and steady state oscillations

Key Words: **Field theory, Energy, Cosmology, Unification, Discrete space, Transient and Steady States.**

I. INTRODUCTION

In the present day theory of early universe, evolution of matter particles from energy particles is not yet understood properly and the special theory of relativity which was developed in linear space is not integrated with the general theory of relativity. Due to improper understanding of the early universe, forces of nature are not united properly. Structure of particle is very much related to how the particles formed in the early stages of development of the material universe. Therefore, understanding of the structure of particles is very much useful to understand the evolution of particles from the radiation dominated universe. Recently, a better theory of particles was developed and based on that theory structure and dynamic of the particles were better understood [1 2 3 4]. Therefore, in part-I, a new theory of material universe is formulated based on the modified theories of special theory of relativity and quantum mechanics. This new theory proves that Universe is a second order feedback control system [5] and integrates the standard model of cosmology [6] with the cyclical model (Steady state model) [7].

In electrical circuit theory, analysis is carried out either in terms of currents and voltages or in terms of power and energy. Always analysis in terms of power and energy is very much simpler and leads to different insights and interpretation, even though current and voltage analysis has got it's own merits like phase angle determination of current and voltages. In the case of high frequency engineering, analysis is carried out either in terms of electric and magnetic fields or currents and voltages. The choice is made based on what parameters are to be determined and the simplicity of analysis. Again in both cases, analysis in terms of power and energy is simpler and leads to different insights and interpretations. Moreover, modern electromagnetism includes both the developments in the field of continuum electromagnetism and quantum electromagnetism. Quantum mechanics was developed from quantum electromagnetism. In quantum electromagnetism and mechanics, analysis is carried out in terms of quantum/particle energy and power, whereas in continuum electromagnetism and mechanics, analysis is carried out in terms of electric and magnetic fields, electromagnetic power and energy. Waves associate with the particles are interpreted as probability waves. In electromagnetic theory, fields behave as waves and energy behaves as particles and lead to wave particle dual nature of light and matter particles. In the recently submitted papers [1 2 3 4], quantum mechanics and electromagnetism were derived from continuum mechanics and electromagnetism. As per the new theory, analysis in physics could be carried out either in continuum domain or in discrete or quantum domain depending upon simplicity and the nature of analysis. In the part-I, evolution of the material universe was analyzed by solving electromagnetic wave equation for the conditions of material universe and many new insights and interpretations on the evolution of the universe was traced. Therefore, in part-II, evolution of the material universe is analyzed by applying the principles and the theories of electromagnetic energy and power. There are two methods of analysis developed and explained in this letter. Both field theoretical analysis and the energy theoretical analysis leads to the same conclusion on the way the material universe evolved and developed.

II. PART-I: A FIELD THEORETICAL ANALYSIS OF THE MATERIAL UNIVERSE

2.1. Qualitative theory of the early universe [8]

As per the standard model of cosmology [6] and the radiation theory of quantum mechanics [9] electromagnetic energy originated from a impulse charge of very high charge density from the center of the universe and the electromagnetic waves were in the form of pieces of positive and negative wavelets (pockets of energy which are the basic unit particles of a photon). As the electromagnetic wavelets spread out from the center like the radiation from a isotropic radiator, high power density declined from the center and therefore, the universe cooled down to the normal temperature of the universe as seen now. The positive and negative wavelets generated at the center of the universe combined to produce charged and matter particles.

Since the energy originated from the center of the universe in no time, initially the speed of electromagnetic wave was very high and reduced to 3×10^8 m/s when the charged and matter particles were formed. Therefore, the frequency of waves declined from a very high value to the present matter wave frequencies. Since $C = 1/\sqrt{\mu_0 \varepsilon_0}$, the electromagnetic properties of the space must

have changed from very high value to present values. Therefore, C must be treated as a function of space and time coordinates from a very high value to the present value in the electromagnetic wave equation and in other equations like equations of special theory of relativity, etc. As per the theory presented in the previous letters, high frequency electromagnetic waves could be described by 4 dimensional space and time discrete waves. Therefore, all particles are made up of periodic electromagnetic energy pockets with energy distributed over a band of frequencies.

Planck's quantum law was derived from the Poynting theorem of the classical electromagnetism [10]. Then the exact value of the photon energy and speed of a photon were calculated and accordingly, quantum mechanics and special theory of relativity were modified [1 2 3 4]. As per this modified theory, radiation and propagation of electromagnetic signal could be analyzed either by field theory of classical electromagnetism or by the energy theory of classical and quantum mechanics. Therefore, origin and the evolution of the universe is analyzed by applying field theoretical concepts in the following sections.

2.2. Field Theoretical Analysis of the Universe

As per the standard model of the cosmology, material universe originated from energy. Therefore, origin and the evolution of the radiation dominated universe could be studied by applying electromagnetic wave equation. For the sake of simplicity, one dimensional wave equation is solved for the conditions of early radiation dominated universe and the same analysis could be extended to three dimensional case also. The well known one dimensional wave equation for electric field intensity is

$$\partial^2 E_x(x, t)/\partial x^2 - (1/C^2).\partial^2 E_x(x, t)/\partial t^2 = 0 \tag{1}$$

Since $C = 1/\sqrt{\mu\varepsilon}$ where μ and ε are permeability and permittivity of free space in the early universe and the speed and the density of the energy were at very high values at time $t = 0$ and $x = 0$, value of C varied as a function of x and t, till the time the universe had cooled down to produce matter particles. At that normal temperature and thereafter, $C(x, t) = 3 \times 10^8$ m/s.

The full wave solution to the equation (1) could be found by applying the method of separation of variables and that solution is

$$E_x(x,t) = (A_x.Sin(kx) + B_x.Cos(kx)).(A_t.Sin(\omega t) + B_t.Cos(\omega t))/x \tag{2}$$

Where A_x B_x A_t and B_t are constants depends on initial and boundary conditions and k and ω are related by $(\omega/(C.\sqrt{x})) = k$ (3)

2.3. Interpretation of the solution and the evolution of the matter particles:

The solution clearly indicates that the universe is made up of electromagnetic waves with the angular frequency ω. This frequency declined with the declination of speed as the Universe expanded and both reached constant values, when the universe reached the steady state and sufficiently cooled down to produce matter particles. The solution also indicates that Universe is made up of travelling waves in positive and negative directions of x and t. The field is declining in the positive x direction and increasing in the negative x direction. Therefore, space of the universe is proved to be finite and the law of conservation of energy is satisfied and the energy of the entire universe is a constant since the energy was radiated only over a period of time required to cool down the universe to generate matter particles and make the universe to reach the steady state of oscillation. In short, dynamics of the universe is similar to the dynamics of a second order feedback control system [6]. The space period of this oscillation is 2.X where X is radius of the universe and the time period is $2X/C_a$ where C_a is the average speed of the field radiated from the center or origin of the universe. The speed was very high in the early universe and therefore, the frequency of oscillation was very high. The energy of the universe was declining with the high speed of oscillation and reaching the steady state of oscillation. Therefore, generalized solution of the wave equation is normal mode solution of a spherical dielectric waveguide.

This solution is $E_x(x,t) = \Sigma.(A_n.Sin(\pi nx/X) + B_n.Cos(\pi nx/X)).(A_t.Sin(\omega t) + B_t.Cos(\omega t))/x$ where, n varies from 0 to ∞ and $k = n\pi/X = (\omega/(C.\sqrt{x}))$ (4)

Equation (4) proves that k is a constant and therefore, $C.\sqrt{x} = \omega/k = \beta$ = constant. Therefore, $C = \beta/\sqrt{x} = 1/\sqrt{\varepsilon_0.\mu_0}$. Therefore, $\mu_0.\varepsilon_0$ is directly proportional to x. Therefore, electrical properties of the space varied highly in the early universe or transient world. This normal mode solution to the radiated field indicates very clearly that field and energy exists only at discrete states.

As per the law of conservation of energy, electromagnetic energy declined with the increasing level of matter particles generated. Therefore, all matter particles originated from the spherical dielectric medium or waveguide of radius X. Therefore, all matter particles are made up of electromagnetic waves with multiple folds within the size of the particles. Since energy density and temperature of the energy in the early universe was high, space or dielectric medium must have been broken into smaller pieces/cells of very smaller sizes with very high level of bondage between them and absorbed the electromagnetic energy to form matter particles. The universe reached the steady state of oscillation when the electromagnetic energy sufficiently declined and cooled down to form all matter particles. The outer layers of the radiation must have cooled down first since energy density was less at the outer layers and produced lighter particles and the heavy particles must have been produced from the inner layers of radiation since the energy density was higher. The matter particles must have been freed from smaller cells of the space when space cells shrank with the reduction of temperature and heat. The freed particles from the space cells must have been moved by the radiation pressure from the center of the universe. After the formation of elementary matter particles in their molten state at very high temperature and speed, particles must have fuse together to produce heavier particles like electrons, protons, neutrons, nucleus, atoms, molecules, etc. and must have absorbed large amount of energy and cooled down to current state of the universe. The bondage between the space cells must have

increased with the declination in heat and temperature and must have become continuous space. In short, absolute space of the universe behaved as a giant spherical cooker to generate matter particles.

Therefore, once the matter particles are generated, particles group together to form large scale particles, particle clouds and the generation of gravitational fields. This is how galaxies of different sizes and shapes were formed with large space gap between them. This accumulated movements of the matter particles to form large scale mass structures lead to disturb the radiation pressure of the early universe and generation of gravitational field. Radiation pressure originates from the acceleration of charged particles or charges. In the same way the acceleration of particles and accumulation of large number of particles and formation of large scale clouds generate gravitational fields. In this way, original electromagnetic energy was converted into energy of the rest mass of matter particles and the gravitational field energy.

This gravitational field is higher at the radial distances closer to the center of the universe since density of matter and energy is higher. Since the speed of the Universe is declining with radial distance, acceleration and force acting upon particles due to radiation pressure also declines. Therefore, gravitational pull towards the center increases with the increasing radial distance. As a consequence, energy is generated from the center of the universe, preserved in the form of matter and converted back to energy in the return journey of particles from the edge of the Universe towards the center, in the steady state universe. In the steady state universe, radius of the matter generating dielectric space must have been reduced since large amount of matter and energy at lower temperatures were produced in the outer layers of original dielectric sphere of radius X.

III. PART-II: AN ENERGY THEORETICAL ANALYSIS OF THE MATERIAL UNIVERSE

3.1. Energy Theoretical Analysis Method-I [11]:

The early universe was dominated by the electromagnetic radiation. Speed and Frequency of the electromagnetic waves were very high and were functions of space and time. Therefore,

The phase velocity of the wave = $C(r) = f(r). \lambda(r)$ where f is the frequency of the wave and λ is the wavelength of the wave.　　　(1)

Therefore, the group velocity or the velocity of the energy or photons = $C^2(r) = \partial\omega/\partial\beta$　　　(2)

Equation (2) could be typed as　　$\partial\omega/\partial\beta = (\partial\omega/\partial r)/(\partial\beta/\partial r) = C(r) + \beta(r). \partial C/\partial r = C^2(r)$　　　(3)

By integrating the equation (3), we get $\beta.D = (C-1)/C$, where D is integration constant　　　(4)

At r = 0, $C(r) = \infty$ and therefore, $\beta(0) = 1/D$ = constant.　　　(5)

Since $\beta(0) = \omega(0)/C(0)$ = constant, frequency f(0) and speed C(0) of the universe at the center of the world were finite. The universe began to expand at finite speed and energy. Therefore, there was no singularity in the beginning of the universe. Therefore, singularity in the relativistic model of cosmology originates due to unrealistic assumptions made. In general theory of relativity the assumption of space and the field are one and the same is responsible for the origin of singularity in the relativistic model of cosmology [7].

3.2. Interpretation of the initial conditions and the Evolution of the Universe[7 6]

Since the speed of the universe declined from a very high value to $3X10^8$ m/s when the universe cooled down to produce matter particles, the speed of light in free space is only approximately constant in the steady state Universe. The equation (2) indicates that expansion rate of the Universe could be positive or negative quantities. Therefore, in the early stages of the universe, the universe vibrated with a very high forward and reverse rate of expansions till the time the universe cooled down to produce matter particles. This conclusion leads to the fact that the universe is finite and the space worked as a dielectric spherical waveguide of finite volume. Since $C(r) = 1/\sqrt{\mu\varepsilon}$, the electrical properties of the space must have varied with the radial distance. Since the energy density was very high in the early universe, dielectric breakdown of the space must have occurred and energy must have been absorbed by the broken pieces of the space, while the electromagnetic energy was expanding and contracting in the positive and negative radial directions till the time, the universe cooled down to produce matter particles in the beginning of the steady state universe. As the universe cooled down to steady state temperature of the universe, the space must have been integrated into almost a continuous space at large scale distances. Therefore, space itself is in discrete form and the volume of each discrete cell of the space depends on the temperature of the space. Therefore, space in the early universe, just acted like a spherical dielectric electromagnetic cooker to convert the electromagnetic energy into matter dominated universe. Once the universe cooled down sufficiently, the matter particles must have been ejected out of the space cells as and when the space cells shrank to become an almost continuous space. The discrete nature of the space may be the reason for the quantum behavior of the matter, energy and fields. Therefore, space itself is interacting with the matter, energy and the fields to build larger particles like atoms, molecules, biological cells, etc. from the elementary particles. Therefore, the entire universe had evolved to the present state from the elementary particles due the discrete nature of the space and the interaction of the discrete space with the matter, energy and the fields. All forces which link smaller particles to build larger particles are result of interaction of the discrete space with matter, energy and fields. The structure and the dynamics of the particles as explained in the recent publications [4 5] proves that all particles are made up of electromagnetic waves in the form of Fourier modes. Fourier modes are produced by waves with opposite phases and equal amplitudes as per Euler's trigonometric theorem. This fact

confirms that all particles were produced by the waves travelling in opposite directions. This model and the theory of the universe also comply with the first law of the thermodynamics.

3.3. Energy Theoretical Analysis Method-II [11 9 12]

Power radiated from the center of the universe at time t = o is $P_0/4\pi r^2$ where P_0 is the power radiated and r is the radial distance from the center of the world (1)

Therefore, photon energy at the center of the world at t = 0 is Lt. r $\rightarrow$0 ($P_0/4\pi r^2$) = h.f$_0$ where h is Planck's constant and f_0 is frequency of the radiation at the point of origin of the universe (2)

Therefore, P_0 is proportional to r^2 and $P_0 = k.r^2$ at r = 0 where k is proportionality constant (3)

By combining equations (2) and (3), we get $k = 4\pi h.f_0$ (4)

Therefore, the photon energy at any point in space and time is $= h.f(r) = P_0/4\pi r^2$ (5)

As per the special theory of relativity the photon energy $= m_0 C^2(0)/\sqrt{(1 - (C(r)/C(0))^2)}$, where m_0 is the rest mass of the photon which is $h/(\lambda_0 C^2(0))$, where λ_0 is the wavelength of the photon at rest and C(r) is the velocity of the electromagnetic wave at r (6)

Therefore, by combining equations (5) and (6), we get $h.f(r) = P_0/4\pi r^2 = m_0 C^2(0) /\sqrt{(1-(C(r)/C(0))^2)}$ (7)

By solving the equation (7) for C(r), we get $C(r) = \pm C(0)(1 - (m_0 C^2(0)4\pi r^2/P_0)^2)^{1/2}$ (8)

At r = r$_0$, C(r) = 0. Therefore, $r_0 = \pm(P_0/4\pi m_0 C^2(0))^{1/2}$ (9)

Equation (9) indicates that for r < r$_0$, C(r) is real and r> r$_0$, C(r) is imaginary. At r = r$_0$, C(r) =0. Therefore, electromagnetic wave stops moving at that point and becomes matter particles. Therefore, r = r$_0$ is the boundary which divides the radiation dominated world from the matter dominated world. The propagation factor $\beta(r) = \omega(r)/C(r) = \infty$ at r = r$_0$ (10)

Therefore, at r = r$_0$ a singularity is created in the value of $\beta(r)$. Singularities are created in physical formulas and equations due to the unrealistic assumptions made. The unrealistic assumption made in equation (10) is obviously C(r) = 0. If C(r) = 0, electromagnetic waves are converted into matter particles. Therefore, propagation of electromagnetic waves cease to exists as indicated by $\beta(r) = \infty$. The matter dominated universe contains matter particles and energy. Maximum observed speed of electromagnetic waves in the steady state universe is $3x10^8$ m/s. From the equation (1) we get $P(r) = P_0/4\pi r^2$ = Average time rate of change of energy at the point r = r. Therefore, this is equal to the velocity of the energy flow or group velocity or velocity of the photon. Therefore, $C^2(r) = P_0/4\pi r^2$ (11)

So, $C(r) = \pm (P_0/4\pi r^2)^{1/2}$ (12)

By combing equations (12) and (5), we get $\beta(r) = \omega(r)/C(r) = \pm (\pi P_0)^{1/2}/h$ (13)

Therefore, Electromagnetic field in the universe could be typed as

$E(r,t) = (\eta P_0/4\pi r^2)^{1/2} e^{-j(\beta r - \omega t)}$ where $\eta(r)$ is intrinsic impedance of the space (14)

Equation (13) proves that $\beta(r)$ is a constant and the frequency and speed of the radiated electromagnetic waves are functions of r. Positive and negative values of β proves the propagation of electromagnetic waves in positive and negative directions of r. Therefore, space of the material universe is proved to be finite and the early universe was expanding and contracting at a very high speed within the spherical dielectric space. From such vibrations, matter particles were produced by the discrete space which became discrete due to high energy density of the early universe as explained in the previous analysis. This theory is proved mathematically as in the following lines.

From equation (12), $C(r) = \pm (P_0/4\pi r^2)^{1/2} = dr/dt$ (15)

By solving the equation (15) for r, we get $r = \pm (P_0/\pi)^{1/4}t$ or $\pm j(P_0/\pi)^{1/2}t$ (16)

Therefore, equation (16) gives 4 solutions to r. Two are real and the other two are imaginary. If these solutions are substituted into the equation (14), we get transient and steady state solutions for the origin and evolution of the material universe. Therefore, the universe is proved to be a second order automatic feedback control system [5].

IV. CONCLUSION

In part-I, Universe is proved to be a second order automatic feedback control system. Therefore, early universe or transient universe was oscillatory with very high frequency of oscillation within the finite volume of the universe. The matter particles are proved to be generated from the vibration or oscillation of high density energy at very high speed in the early radiation dominated universe. The absolute and continuous space or dielectric material of the universe which existed before the birth of the material world

is proved to be converted into a discrete space and became responsible for the quantum behavior of matter and energy particles. The big bang cosmology is integrated with the steady state cyclical model. In part-II, Velocity and the frequency of the Universe at the point of origin in the 4 dimensional space - time structure is proved constant. Space – tine structure of the universe is proved to be discrete and responsible for the quantum behavior of matter and energy. The assumption in the general theory of relativity that the space and the field are one and the same is proved to be responsible for the origin of singularity in the relativistic model of cosmology. Again the Universe is proved to be highly oscillatory with very high frequency of oscillation till the time the universe cooled down to produce matter particles and reached the steady state of oscillation. Therefore, the universe is proved to be a second order feedback control system with transient and steady state oscillations. In this way, the big bang theory of cosmology is integrated with the steady state cyclical theory of cosmology. Field theoretical analysis also leads to similar conclusions.

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