Original Research Article

Quanton fields : evolution and degrees of freedom.

Abstract

The concept of spacetime had been the subject of debate for so long, here another version will be discussed in the form of space and time fields where a new concept of energy constraining can explain the interactions between those fields.

This model comes in three parts : energy constraining , where the evolution of the quanton fields and their different transitions are discussed, the second part ,energy fields, their degrees of freedom and the third part electromagnetic waves as relativistic quantons and the generic form of Maxwell equations in terms of space and time fields.

This work shows that the origin many of the physical phenomena can be traced back to the quanton based world .

Key words

Energy density expansion, space and time varying fields, energy degrees of Freedom, CMB thermodynamic origin.

Introduction

This model deals with an evolutionary process of the quaton fields out of a singularity event.

Given our state of knowledge, it is rather premature to determine whether it was an initial expansion out of a singularity event or it was rather a single quanton in a recursive inflationary – contraction process.

Yet ,a process of quanton evolution out of singularity was provided to allow for a comprehensive review of the behaviour those fields and their interactions.

There are cosmological implications based on this model which were dealt with previously [1] , [2]

while it is not the first time to deal discuss the concept of quantized space

time[3] [4] [5] [6] , however this work provides new aspects in the sense that it employs the concept of energy degrees of freedom as a unification origin of all space and time fields.
It is understandable that there would be a certain lack in providing adequate references and the main reliance is on the basic concepts in physics.

1. The physical basis of this model

This model is based on the following two concepts

a-The relationship between quanton energy density ϱ_q and its parameters (defined in terms of parameters: k , ω , or r_q (quanton radius)) is an energy degree of freedom relationship.

b- The complex nature of the energy expansion in the form of space varying and time varying fields.

As energy expands from a singularity state (energy non varying in space or time) , It creates fields with symmetric nature of variation in space and in time and as a result of this symmetry, the relationship between those space and time varying fields is governed by energy degrees of Freedom.

2-Definition of the model

2.a Quantons

1-Quantons are two complex orthogonal fields, each one is composed of space and time varying energy fields, as those fields vary at periodic rate , they possess wave like behaviour.

Each quanton is composed of two different type of energy fields (free and constrained) which interact to form a binding relationships.

Quantons vary in their energy content with time as they expand and split.

As a result quantons have statistically distributed frequencies vs the energy

density.

This statistical distribution ensures equi-partition of energy throughout space.

Quanton stability is ensured due to the effect of inter and intra- quanton interactions of energy fields.

Though the quantons are stable but due to the imbalance of these interactions the quantons expand , then split up which is at the origin of expanding universe.

2.b.Anti quantons

anti quantons are similar to quantons but the dominant nature of their fields (constrained type)differs from that of the quanton (free type) , the anti quanton fields are mirror symmetric to those of the quanton.

Both quantons and anti quantons exist in pairs as they become a quantum entity of the form Q+AQ

Fig.1 provides a representation of quanton –antiquanton fields

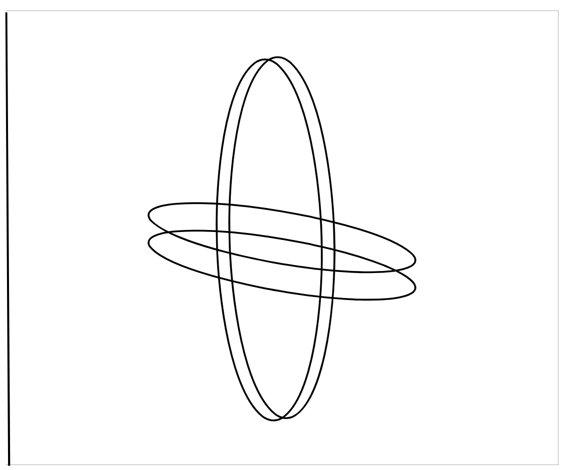
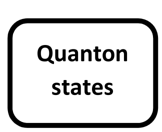


Fig.1 a representation of the quanton –antiquanton (Q+AQ) fields , note here that the radius of the quanton denotes only the decaying manner of the field intensity and does not outline the quanton physical domain

fig.2 provides a summery of various states which quanton goes through.



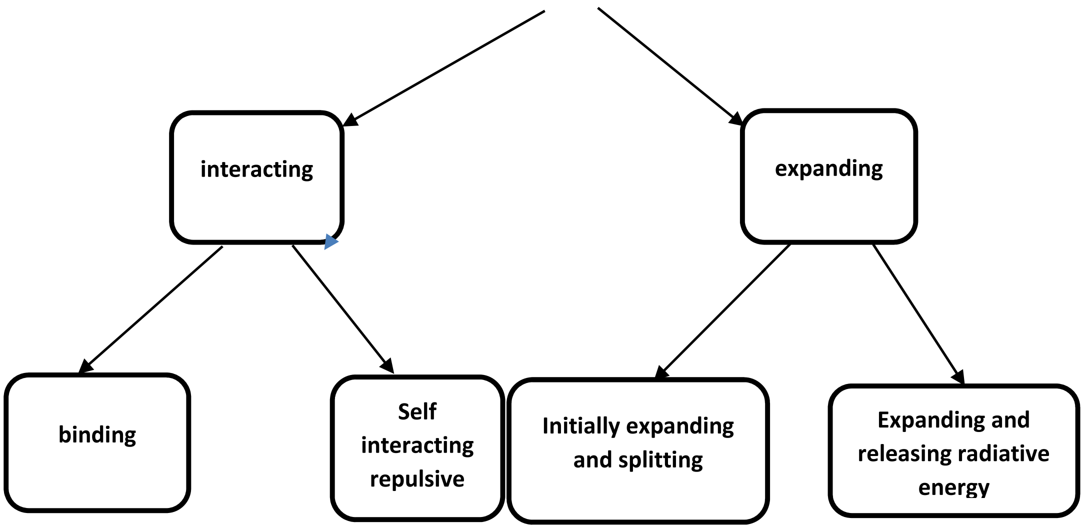


Fig.2. summary of the quanton states

3. Mathematical brief

$E_{sf} = \frac{\partial E}{\partial s}$: free space varying field (1-3)

$E_{tf} = \frac{\partial E}{\partial t}$: free time varying field (2-3)

$E_{sc} \int E \ ds$: space varying constrained field (3-3)

$E_{tc} \int E \ dt$: time varying constrained field (4-3)

$E_s = E_{sf}E_{sc}$, $E_t = E_{tf}E_{tc}$ (5,6-3)

Energy fields are vector quantities which have direction as well as magnitude and can be defined as (for the case of space varying free field)

$E_{sf} = K_{sf}D_{sf}\psi_{sf}$ (7-3)

where D_{sf} : energy field strength (degree of freedom parameter – in exponential terms of the constant (c) or $c^{Dof_{sf}}$

K_{sf} : field intensity parameter which is defined in terms of the quanton total energy divided by four degrees of freedom.

ψ_{sf} is reserved for variation parameter of space varying energy field.

The two types of quanton energy fields are the free dominated field

$E_{qf} = E_{sf}E_{tc}$ (8-3)

and the constrained $E_{qc} = E_{sc}E_{tf}$ (9-3)

and can be expressed by the one-dimensional PDE

$(E_{qf})_{tt} = c^2(E_{qf})_{xx}$ or $(E_{qc})_{tt} = c^2(E_{qc})_{xx}$ **(10-3)**

Energy density ϱ_q represents the product of E_{qf} , E_{qc} or

$\varrho_q = E_{qf}\, E_{qc}$ **(11-3)**

$E = E_s E_t$ **(a singularity – energy not varying in space** **(12-3)**

or time with no associated fields) which is generated by energy constraining

4. variation parameters of energy fields

quanton (or anti quanton) energy density defined as the multiplication of field strengths and intensities of four types of energy fields which takes the form

$\varrho_q = (E_{sf}E_{tc})(E_{sc}E_{tf})$ **(1-4)**

Each of those four fields experiences the change of either space or time defined by the variation parameters follows

$\psi_{sf} = e^{+\frac{jr}{2r_q}}$ **which defines change of free energy field in space (r:x,y or z) (2-4)**

ψ_{sc} = $e^{-j\frac{jr}{2r_q}}$ **defines change of constrained space varying energy field (3-4)**

$\psi_{tf} = e^{+j\omega t}$ **: that expresses variation of free time varying energy field (4-4)**

$\psi_{tf} = e^{-j\omega t}$ **: parameter of constrained time varying energy field (5-4)**

5. Energy constraining

Energy constraining describes evolution and interactions of energy fields which is summarized as

a-Containment free energy fields (E_{sf}, E_{tf})

(this will be discussed in the section : Maxwell equations role in the evolution of quantons)

b-appearance of constrained energy fields $(E_{sc}E_{sc})$

c- Evolution of the quanton fields' degrees of freedom.

d-Energy fields expansion and their subsequent splitting.

e- Release of radiation energy as a result of the quanton expansion.

As energy expands in space in the form of space and time varying fields, it's said to have free degrees of freedom, and it must express these degrees of freedom in a symmetric way with respect to all spatial and temporal dimensions.

Energy expands not only by variation in space but by variation in time as well, hence the appearance of energy fields E_{sf} , E_{tf} (free energy fields that vary in space and in time) ,such expansion takes the form

$$\frac{\partial}{\partial s}\frac{\partial}{\partial t}(E) = \frac{\partial}{\partial s}\frac{\partial}{\partial t}(E_s E_t) = \frac{\partial E}{\partial s}\frac{\partial E}{\partial t} = E_{sf}E_{tf} \quad \text{(1-5)}$$

Free fields cannot vary in space and time simultaneously as no energy field is in the form $E_{sf,tf} = fn\,(r\,,t)$,but rather $E = E_{sf}(r)\ E_{tf}(t)$ hence the emergence of two distinct fields not just one and this is because the relationship between the expansion of space varying and time varying fields is orthogonal, as the time varying field (curls) the free space varying field (will be discussed in the section :Maxwell equations role in the evolution of the quanton).

Appearance of quanton (anti quanton) constrained energy fields is due to the fact that free energy fields(E_{sf} E_{tf}) seek to form a more stable binding interactions with these newly appeared constrained fields (E_{sc} , E_{tc}) under inflationary conditions rather than the less stable repulsive self-interactions [3]

As space varying field (E_{sf}) expands , it must have a constrained time varying field (E_{tc}) such that $E_{qf} = E_{sf}E_{tc}$, so the field E_{qf} is a predominantly free type due to free space varying energy field (E_{sf}) having more degrees of freedom (field strength)compared to field (E_{tc}).

Similarly , time varying energy expands (E_{tf}) by variation in space as well , hence the appearance of space varying constrained energy field (E_{sc}) such that $E_{qc} = E_{sc}E_{tf}$ which is neutral as both space and time fields having the same field strength.

As energy expands from a singularity state $(E = E_s E_t)$, it possesses four degrees of freedom, and for the quanton (or anti quanton) to exist as an independent energy entity, it must possess all of those four degrees of freedom .

Based on the previous point, energy fields E_{qf} or E_{qc}cannot exist independently in the form $\varrho_q = E_{sf}E_{tc}$ or of the form $\varrho_{aq} = E_{sc}E_{tf}$ alone

Now , the emerging fields for the quanton become

$$\varrho_q = (E_{sf}E_{tc})(E_{sc}\,E_{tf}) = E_{qf}\,E_{qc} \quad \text{(2-5)}$$

and for anti quanton

$$\varrho_{aq} = \left(\frac{E_{sf}E_{tc}}{c}\right)(c\, E_{sc}\, E_{tf}) = \left(\frac{E_{qf}}{c}\right)(cE_{qc}) \quad \textbf{(3-5)}$$

Quanton energy density equation represents two fields : one of them is free dominated field or $E_{qf} = (E_{sf}E_{tc})$, and the other is neutral $E_{qc} = (E_{sc}E_{tf})$

The anti quanton's energy density equation is the same as the energy density equation of quanton's , but degrees of freedom of various fields are mirror symmetric to those of the quanton (this will be discussed later in the sections : quanton and anti quanton evolution and their energy degrees of freedom)

The fields E_{qf} , E_{qc} are orthogonal to each other.

For free energy fields E_{sf} , E_{tf} , differentiation is the mathematical expression of free energy expansion by variation in space or time , while integration is the corresponding mathematical expression of constraining of free fields varying in space or time

a-for free space varying field , expansion in space

$$\frac{\partial}{\partial s}(E_{sf}) = \frac{\partial E}{\partial s} = E_{sf} \qquad \text{(same type of field)} \quad \textbf{(4-5)}$$

b-Constraining of free energy fields takes the form

$$\int E_{sf}\, ds = \int \left(\frac{\partial E}{\partial s}\right) ds = E_s \quad \textbf{(5-5)}$$

(free space varying field becomes a singularity- a non-varying state

b- for free time varying field

$$\frac{\partial}{\partial t}(E_{tf}) = \frac{\partial E}{\partial t} = E_{tf} \quad \text{(same type of field)} \quad \textbf{(6-5)}$$

and constraining $\int E_{tf}\, dt = \int \frac{\partial E}{\partial t} dt = E_t$ **(7-5)**

For constrained energy fields E_{sc} , E_{tc} , integration is the mathematical expression of expansion by variation in space or time, and differentiation is the corresponding mathematical expression of energy constraining in space or time.

c-For constrained space varying field, expansion in space is defined as

$$\int E_{sc}\, dt = E_{sc} \qquad \text{(same type of field)} \quad \textbf{(8-5)}$$

constraining takes the form

$$\frac{\partial}{\partial s}(E_{sc}) = \frac{\partial}{\partial s}\left(\int E_s\, ds\right) = E_s \quad \textbf{(9-5)}$$

(reduction of constrained space varying field into a singularity state-non varying in space or time),

d- For time varying field

expansion in time $\int \mathbf{E_{tc}}\ \mathbf{dt} = \mathbf{E_{tc}}$, and when being constrained (10-5)

$$\frac{\partial}{\partial t}(\mathbf{E_{tc}}) = \frac{\partial}{\partial t}\left(\int \mathbf{E_t}\ \mathbf{dt}\right) = \mathbf{E_t} \qquad (11\text{-}5)$$

Expansion of energy fields (free-constrained) is more or less a process of differentiating two variables and follows differentiation of two variables rule.

$$\frac{\partial}{\partial x}[f(x)g(x)] = \frac{\partial f}{\partial x}\ g(x) + \frac{\partial g}{\partial x}\ f(x) \qquad (12\text{-}5)$$

Results of an energy density expansion process = expansion of the (free -constrained fields) +constraining of (free- constrained fields)

Let's consider the case of expansion of free space varying field $\mathbf{E_{sf}}$

$$\frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s}\right) = \frac{\partial E}{\partial s} + \int \mathbf{E_{sf}}\quad \mathbf{ds} = \mathbf{E_{sf}} + \mathbf{E_s} \qquad (13\text{-}5)$$

Similarly for the case of free time varying field $\mathbf{E_{tf}}$

$$\frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) = \frac{\partial E}{\partial t} + \int \left(\frac{\partial E}{\partial t}\right)\quad \mathbf{dt} = \mathbf{E_{tf}} + \mathbf{E_t} \qquad (14\text{-}5)$$

Expansion of constrained space varying field $\mathbf{E_{sc}}$

$$\int \mathbf{E_{sc}}\quad \mathbf{ds} = \int \mathbf{E_{sc}}\quad \mathbf{ds} + \frac{\partial}{\partial s}\left(\int \mathbf{E_s}\quad \mathbf{ds}\right) = \mathbf{E_{sc}} + \mathbf{E_s} \qquad (15\text{-}5)$$

For the case of constrained time varying field $\mathbf{E_{tc}}$

$$\int \mathbf{E_{tc}}\quad \mathbf{dt} = \int \mathbf{E_t}\quad \mathbf{dt} + \frac{\partial}{\partial t}\left(\int \mathbf{E_{tc}}\quad \mathbf{dt}\right) = \mathbf{E_{tc}} + \mathbf{E_t} \qquad (16\text{-}5)$$

Now the quanton energy density expansion equation

$$\frac{\partial}{\partial s}\frac{\partial}{\partial t}\left(\varrho_q\right) = \frac{\partial}{\partial s}\frac{\partial}{\partial t}\left[\left(\frac{\partial E}{\partial s}\int \mathbf{E}\ \mathbf{dt}\right)\left(\int \mathbf{E}\ \mathbf{ds}\ \frac{\partial E}{\partial t}\right)\right] = (\mathbf{E_{sf}}\,\mathbf{E_{tc}})(\mathbf{E_{sc}}\,\mathbf{E_{tf}}) + \mathbf{E_s}\,\mathbf{E_t} \qquad (17\text{-}5)$$

table 1. provides a summary for expansion / constraining and the corresponding mathematical operations

process	Free energy	Constrained energy field
expansion	differentiation	integration
constraining	integration	differentiation

table 1. mathematical expression of energy expansion /constraining

a-Expansion term : differentiating free energy fields *integration of constrained energy fields

b-Constraining term : integrating free energy fields * differentiating constrained fields

While differentiation of two functions involves differentiating only one at a time and maintaining the other as constant, in real world this is not possible since an expanding energy fields must vary either in space or in time .

When dealing with expansion of constrained energy fields integration is the physical equivalent to mathematically maintaining one function as a constant Quanton energy density equation $\varrho_q = \left(\frac{\partial E}{\partial s}\frac{\partial E}{\partial t}\right)(\int E\, ds \int E\, dt)$**,expresses two physical entities (free energy fields :** $\left(\frac{\partial E}{\partial s}\frac{\partial E}{\partial t}\right)$ **and constrained energy fields** $(\int E\, ds \int E\, dt)$ **and each of those types of fields behave as single physical entity (ie single variable) , so the four different energy fields , are in fact representing only two variables instead of four (energy field interactions will be based on this particular point)**

The quanton's four degrees freedom are the sum of free energy fields' degrees of freedom plus the constrained energy fields' degrees of freedom or

$$Dof_q = Dof_{sf} + Dof_{sc} + Dof_{tf} + Dof_{tc} = 4 \qquad (18\text{-}5)$$

It is understood that the space varying energy fields (free and constrained) have three degrees of freedom or $Dof_{sf} + Dof_{sc} = 3$ **(19-5)**

While time varying energy fields (free and constrained) have one degree of freedom or $Dof_{tf} + Dof_{tc} = \text{one}$ **(20-5)**

Energy fields $E_{sf}, E_{tf}, E_{sc}, E_{tc}$ **do not have the dimensions of energy , but their product (**ϱ_q **) does have the dimensions of energy density which is defined as energy divided by three dimensional volume**

$$[\varrho_q] = \left[\frac{\text{energy}}{\text{volume}}\right] = ML^{-1}T^{-2}$$

As free energy fields expand, constraining of the expanding fields takes place

$$\frac{\partial}{\partial s}\frac{\partial}{\partial t}\left(\varrho_q\right) = \left[\frac{\partial}{\partial s}(E_{sf})(\int E_{tc})d\right][\int (E_{sc})\, ds\ \frac{\partial}{\partial s}(E_{tf})]$$

$$= \left(\frac{\partial E}{\partial s}\int E\, dt\right)\left(\int E\, ds\, \frac{\partial E}{\partial t}\right) = (E_{sf}\, E_{tc})(E_{sc}\, E_{tf}) + E_s\, E_t \qquad (21\text{-}5)$$

= expansion term +constraining term

so on for successive expansion processes

expansion of the free energy by variation in space or time which must be accompanied by constraining.

and expansion of constrained energy fields must also be accompanied by constraining of those fields.

When energy is released from a field constraining process for free or constrained energy field as in (16-5), it is released in the singularity state $E = E_s\, E_t$ **(energy non varying in space or time) which expands in the**

form of electromagnetic radiation .

A cycle of expansion and constraining is not a reversible process due to losses and effect of entropy (irreversible process) (will be further clarified in the section energy constraining and the Release of radiative energy)

Since the quanton is a quantum entity, its total energy content is governed solely by the Planck –Einstein relationship so, quanton energy is determined by its wave parameters (k , ω or r_q) , while an energy degree of freedom- which is defined in terms of the constant (c) , is just a mechanism of division of energy between the various space and time varying fields.

Fields of the following forms do not exist independently

a- $\frac{\partial E}{\partial s}\ \frac{\partial E}{\partial t}$ $\quad b - (\int E\ \ ds \int E\ \ dt)$

(free or constrained energy field cannot expand in space and in time simultaneously without having a complimentary type of field)

Though quanton includes both field of both types (free and constrained), but there is a dominant type of energy field, this is based on which type of field has the majority of Dof's (higher field strength).

For the quanton , the free energy field is the dominant while for anti-quanton , the constrained type of field is the dominant type.

A quanton volume is an equivalent volume since quanton fields are infinite in range and expanding at the rate of (c) ,and the equivalent volume can be estimated indirectly

as $E_p = \frac{h}{2\pi}\omega = \int \varrho_q\ dV$ **(22-5)**

6. Energy Degrees of freedom

As energy density expands in space or in time, it is said to have an energy degree of freedom where quanton energy density can be defined in terms of the degrees of freedom of its wave parameters ($\omega, k, \text{or } r_q$ **)**

ϱ_q **(quanton energy density)will be shown to be directly proportional to**

ω^4 **,** k^4 **or** $\frac{1}{r_q{}^4}$ **.**

While the energy density of the quanton is defined in terms of

ω^4 , k^4 or $\frac{1}{r_q{}^4}$, the energy fields are defined in terms of field strength or in terms of the constant (c) as follows

D_{sf} = $c^{Dof_{sf}}$, Dof_{sf} : degrees of freedom of free space varying field (transformation from formulation in terms of wave parameters, to degrees of Freedom formulation in terms of (c))

For space varying and time varying energy fields , where the resultant energy density is in the form ϱ_q = $(E_{sf}\ E_{tc})(E_{sc}E_{tf}\ )$ and not in the square root form

$$\varrho_q = \sqrt{E_{sf}{}^2 + E_{sc}{}^2 + E_{tf}{}^2 + E_{tc}{}^2}$$

This multiplier form allows the constant (c) to become an energy degree of freedom in an exponential form , where energy is divided up symmetrically, between the space and time varying fields, hence the uniform and symmetric expansion of energy across all dimensions.

The constant (c) plays a bigger role than being the velocity of light or the velocity of transmission of the fundamental forces, as it plays the role of ratio between space and time varying fields, this is based on the relationship between energy field expansion by variation in space and in time , for the wave parameters ψ_{tc} , ψ_{sf} of the fields E_{tc} , E_{sf} where

$$\psi_{tc} = e^{-j\omega t} \quad , \ \psi_{sf} = e^{+jkr} \qquad (1\text{-}6),(2\text{-}6)$$

$$\psi = \psi_{tc}\ \psi_{sf} \qquad (3\text{-}6)$$

$$\frac{\partial\,\psi_{tc}}{\partial t} = -j\omega\ \psi_{tc} \quad , \ \frac{\partial\,\psi_{sf}}{\partial x} = jk\ \psi_{sf} \qquad (4\text{-}6),(5\text{-}6)$$

$$\left(\frac{\partial\,\psi}{\partial t}\right) = \frac{\partial}{\partial t}(\ \psi_{sf}\ \ \psi_{tc}) = \ \psi_{sf}\frac{\partial\,\psi_{tc}}{\partial t} = -j\omega\ \ \psi_{sf}\psi_{tc} \qquad (6\text{-}6)$$

$$\left(\frac{\partial\,\psi}{\partial x}\right) = \frac{\partial}{\partial x}(\ \psi_{sf}\ \ \psi_{tc}) = \frac{\partial\,\psi_{sf}}{\partial x}\ \psi_{tc} = jk\ \ \psi_{sf}\psi_{tc} \qquad (7\text{-}6)$$

$$-\frac{\left(\frac{\partial\,\psi}{\partial t}\right)}{\left(\frac{\partial\,\psi}{\partial x}\right)} = \frac{j\omega\ \ \psi_{sf}\psi_{tc}}{jk\ \ \psi_{sf}\psi_{tc}} = \frac{\omega}{k} = c \qquad (8\text{-}6)$$

Which is the relationship between rate of field variation in space and in time

Recalling the Lagrangian (L) of an action as $\frac{d}{dt}(\frac{\partial L}{\partial x\prime}) = -\frac{\partial L}{\partial x} = 0$ (9-6)

Given that momentum P= $\frac{\partial L}{\partial x\prime}$ (10-6)

We get $\frac{\partial P}{\partial t} = \frac{\partial L}{\partial x}$ or alternatively $\frac{\partial L}{\partial P} = \frac{\partial x}{\partial t} = c$ (11-6),(12-6)

An energy degree of freedom: the rate of change of the total energy of the

system with respect to its momentum.

The same result can be obtained directly from the energy

momentum relationship $E^2 = P^2c^2 + m_o{}^2c^4$ **(13-6)**

differentiating both sides $2\,EdE = 2PdP$ **(14-6)**

$\frac{dE}{dP} = (\frac{P\,c}{E})$ **c , and** $\frac{dE}{dP} = c$

Where for space fabric case ($m_o = zero$ **) , E= P c (15-6),(16-6)**

which is an alternative definition of the energy degree of freedom.

Both results of (a) and (c) are equivalent , given that

$\psi = \psi_{sf}\,\psi_{tc}$

Using the Schrödinger equation for time and space derivatives

$$-\frac{\partial\psi}{\partial t} = -\frac{jE}{2\pi h}\psi \qquad \textbf{(17-6)}$$

$$\nabla\psi = \frac{jp}{2\pi h}\psi \qquad \textbf{(18-6)}$$

$$\frac{\frac{\partial\psi}{\partial t}}{\nabla\,\psi} = \frac{E}{p} = c \qquad \textbf{(19-6)}$$

Based on the above points, the division of energy density between space and time varying fields can be done where strength of space and time varying energy fields (Dof) is expressed in terms of the constant (c) that defines the relationship between their rate of variation.

It is worth noting that energy field degrees of freedom (field strength) is not related to the total energy of the quanton , as it is only a mechanism for the division of the quanton energy density between the various space and time varying energy fields, and what differs the total energy content of any quanton from another is only the rate of variation of fields with time and space according to Planck Einstein relationship $E_p = \frac{h}{2\pi}\omega$ **(20-6)**

The energy degrees of freedom can be classified as follows

1-Active (actual degrees of freedom) that belong to the energy fields(field strength) .

2- Kinetic degree of freedom which expresses the propagation of energy fields (in the form of electromagnetic waves) in one direction , this kinetic degree of freedom is subtracted from the existing four degrees of energy freedom for space and time varying fields (discussed in the section : electromagnetic waves as space and time fields) , where Dof's = (2)+1 instead of (3)+(1)

7.The superposition principle for energy fields

The linear superposition [7], [8] of energy fields still applies with a resultant Field which equals to the addition of the individual field intensities on condition that

a-Those fields must be of the same type (free or constrained) and

b- Have the same degree of freedom

$$E_{sfi} + E_{sfj} = K_{sfi}D_{sf} + K_{sfj}\ D_{sf} \qquad (1\text{-}7)$$

$$= (K_{sfi} + K_{sfj})\ D_{sf} \qquad (2\text{-}7)$$

$$(E_{sfi} + E_{tci}) + (E_{sfj} + E_{tcj}) = (K_{sfi}D_{sf})(K_{tci}D_{tc}) + (K_{sfj}\ D_{sf})(K_{tcj}D_{tc}) \qquad (3\text{-}7)$$

$$= (K_{sfi}K_{tci})(D_{sf}D_{tc}) + (K_{sfj}\ K_{tcj})(D_{sf}D_{tc})$$

$$= (K_{sfi} + K_{sfj})\ (K_{tci} + K_{tcj})\ (D_{sf}D_{tc})$$

(4-7)

While for the case of fields of different nature (free / constrained) or fields that do have different energy Dof's the superposition is then done by adding their field strength (ie exponential degree of freedom) and multiplying their intensities.

The exponential form of superposition applies, as energy fields are defined in terms of energy degree of freedom (Dof), which is expressed as the exponent of (c^{Dof})

The resulting superposition   will not be a linear one instead it is an exponential superposition where

$$E_{sfi}\ E_{scj} = (K_{sfi}D_{sf})(K_{scj}\ D_{sc}) \qquad (5\text{-}7)$$

$$= (K_{sfi}\ K_{scj})\ (D_{sf}\ D_{sc}) \qquad (6\text{-}7)$$

$$E_{sf}\ E_{tc} = (K_{sf}D_{sf})(K_{tc}\ D_{tc}) \qquad (7\text{-}7)$$

$$= (K_{sf}\ K_{tc})\ (D_{sf}\ D_{tc}) \qquad (8\text{-}7)$$

And for the quanton as a whole

$$\varrho_q = (E_{sf}\ E_{tc})(E_{sc}\ E_{tf}) = (K_{sf}D_{sf})(K_{tc}D_{tc})(K_{sc}D_{sc})\ (K_{tf}D_{tf}) \qquad (9\text{-}7)$$

$$= (K_{sf}\ K_{tc}\ K_{sc}\ K_{tf})\ c^{Dof_{sf}+Dof_{tc}+Dof_{sc}+Dof_{tf}} = (K_{sf}\ K_{tc}\ K_{sc}\ K_{tf})\ c^4 \qquad (10\text{-}7)$$

For energy fields , instead of the addition of the same type of energy, the exponential addition can be between two different types of energy fields (space and time varying fields) and of two different natures (free / constrained) to give a complex energy field.

The main reason behind this is that free and constrained fields cannot be considered as an independent energy entity individually, since neither of them does possess four degrees of freedom and hence their individual Dof's must be added exponentially to obtain either a complex field equivalent to the total energy density of the quanton if the addition is for all four energy fields .

8.Definition of directional field directional components

For free space / time constrained field

$$E_{sf}E_{tc} = \sqrt{(E_{sf}E_{tc})_x^{\ 2} + (E_{sf}E_{tc})_y^{\ 2} + (E_{sf}E_{tc})_z^{\ 2}} \qquad (1\text{-}8)$$

and space constrained / time free field

$$E_{sc}E_{tf} = \sqrt{(E_{sc}E_{tf})_x^{\ 2} + (E_{sc}E_{tf})_y^{\ 2} + (E_{sc}E_{tf})_z^{\ 2}} \qquad (2\text{-}8)$$

Those are 6 components, 3 are constrained space / time free and and 3 are free space / time constrained , It is worth noting that

1-Spatial and time varying energy fields cannot exist independently of each other , as discussed previously

2- The quanton fields E_{sf}, E_{sc} , E_{tf}, E_{tc} neither have the dimensions of energy nor the energy density but their product has the dimension of energy divided by three dimensional volume .

9.Dimesional energy symmetry (DES)

Dimensional energy symmetry is the mechanism which ensures the uniformity and homogeneity of energy under inflationary conditions as it expresses the uniform energy density expansion in 3 dimensional space or the equipartition of energy

given that $\varrho_q = (E_{sf}E_{tc})(E_{sc}E_{tf})$ energy as it expands in along the x- axis will not only give as the result of the expansion

$$\frac{\partial}{\partial x}\left(\varrho_q\right) = \left(\frac{\partial E_{sf}}{\partial x}\int E_{tc}\ dt\right)\left(\int E_{sc}\ dx\ \frac{\partial E_{tf}}{\partial t}\right) + \left(\int E_{sf}\ dx\ \frac{\partial E_{tc}}{\partial t}\right)\left(\frac{\partial E_{sc}}{\partial x}\ \int E_{tf}\ dt\right)\ ,$$

but it will be of the form $\frac{\partial}{\partial x}\frac{\partial}{\partial t}(\varrho_q) = \frac{\partial}{\partial x}\frac{\partial}{\partial t}(E_{sf}E_{tc}E_{sc}E_{tf}) =$

$$\left[\frac{\partial}{\partial x}(E_{sf})\ \frac{\partial x}{\partial t}\int(E_{tc})\ dt\right]\left[\int(E_{sc})\ dx\ \frac{1}{\frac{\partial x}{\partial t}}\frac{\partial}{\partial t}\ (E_{tf})\right] +$$

$$[\frac{1}{\frac{\partial x}{\partial t}}\frac{\partial y}{\partial t}\frac{\partial}{\partial y}(\mathbf{E_{sf}})\ \frac{\partial x}{\partial t}\int(\mathbf{E_{tc}})\ \mathbf{dt}][\frac{\partial x}{\partial t}\ \frac{1}{\frac{\partial y}{\partial t}}\int(\mathbf{E_{sc}})\ \mathbf{dy}\ \frac{1}{\frac{\partial x}{\partial t}}\frac{\partial}{\partial t}\ (\mathbf{E_{tf}})] +$$

$$[\frac{1}{\frac{\partial x}{\partial t}}\frac{\partial z}{\partial t}\frac{\partial}{\partial z}(\mathbf{E_{sf}})\frac{\partial x}{\partial t}\ \int(\mathbf{E_{tc}})\ \mathbf{dt}][\frac{\partial x}{\partial t}\ \frac{1}{\frac{\partial z}{\partial t}}\int(E_{sc})\ \mathbf{dz}\ \frac{1}{\frac{\partial x}{\partial t}}\frac{\partial}{\partial t}\ (\mathbf{E_{tf}})] \quad \textbf{(1-9)}$$

Given that $\frac{\partial x}{\partial t} = \frac{\partial y}{\partial t} = \frac{\partial z}{\partial t} = c$

$$\frac{\partial}{\partial x}\left(\varrho_q\right) = \left(\frac{\partial\, \mathbf{E_{sf}}}{\partial s}\int \mathbf{E_{tc}}\ \mathbf{dt}\right)\left(\int \mathbf{E_{sc}}\,\mathbf{ds}\frac{\partial \mathbf{E_{tf}}}{\partial t}\right) + \left(\int \mathbf{E_{sf}}\ \mathbf{ds}\ \frac{\partial \mathbf{E_{tc}}}{\partial t}\right)\left(\frac{\partial \mathbf{E_{sc}}}{\partial s}\int \mathbf{E_{tc}}\ \ \mathbf{dt}\right)$$

$$= \frac{\partial}{\partial s}\frac{\partial}{\partial t}(\varrho_q) \quad \textbf{(2-9)}$$

<u>Note</u> : The chain rule was applied for differentiation and change of variables For the case of integration.

As energy density expands along one axis it must not only expand along other spatial and temporal axes but be constrained along the spatial and temporal axes as well, this leads to the conclusion that events in one direction are immediately reflected in the other spatial and temporal directions.

The uniformity and the homogeneity of space fabric is ensured through the role time plays as the link between all the three spatial varying fields and via the constant (c)

To satisfy dimensional energy symmetry for quanton , the degrees of freedom must be symmetric with respect space and time varying energy fields.

Define the $\mathbf{Dof_q}$ **,** $\mathbf{D_q}$ **(in terms of c) where the degree of freedom parameter**

$$\mathbf{Dof_q} = \mathbf{Dof_{sf}} + \mathbf{Dof_{tf}} + \mathbf{Dof_{sc}} + \mathbf{Dof_{tc}} = 4 \quad \textbf{(3-9)}$$

Energy field strength parameter $\mathbf{D_q} = \mathbf{D_{sf}D_{tf}D_{sc}D_{tc}} = \mathbf{c^4}$ **(4-9)**

$$\mathbf{D_s = c^3}\quad , \quad \mathbf{D_{sf} = c^{Dof_{sf}}}\quad , \quad \mathbf{D_{sc} = c^{Dof_{sc}} = c^{3-Dof_{sf}}} \quad \textbf{(5,6,7,8-9)}$$

$$\mathbf{D_t = c}\quad , \quad \mathbf{D_{tf} = c^{Dof_{tf}}}\quad , \quad \mathbf{D_{tc} = c^{Dof_{tc}} = c^{1-Dof_{tf}}} \quad \textbf{(9,10,11-9)}$$

In other words,for free and constrained fields the degree of freedom must be expressed in a symmetric way across all spatial and time varying fields

Fig.3. shows energy density expands uniformly as it’s defined in terms of (c) instead of the quanton wave parameters.

$\varrho_q = \mathbf{K_q}^4\mathbf{c^4}$ $\qquad\qquad$ $\varrho_q = \ \mathbf{h_q}\ \boldsymbol{\omega}^4$

Dof $\qquad\qquad$ **Dof**

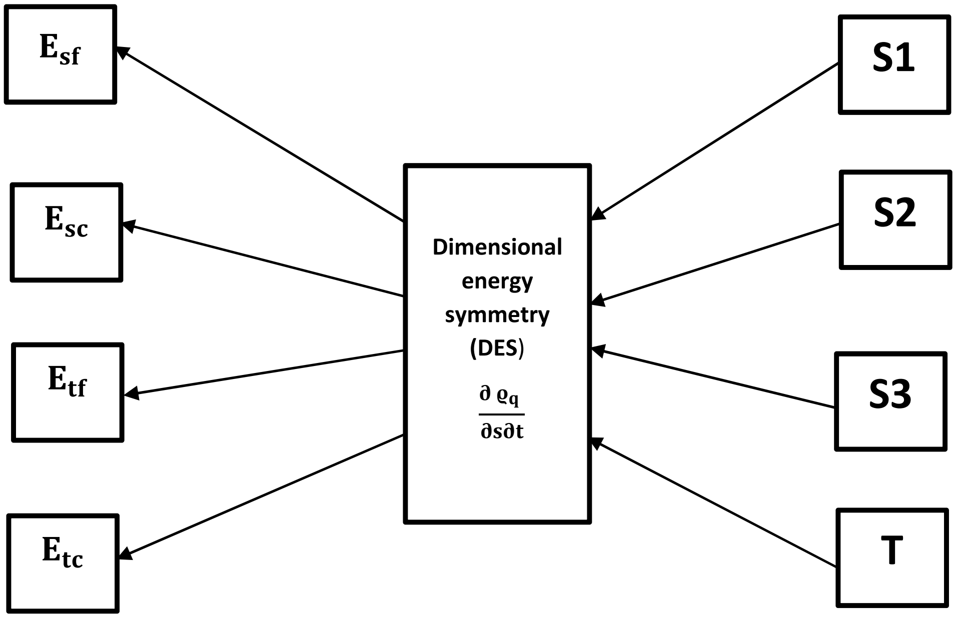


Fig. 3. role of dimensional energy symmetry in ensuring the uniformity of energy density distribution

10. Energy density / Degree of freedom relationship

Quanton frequencies have a statistical distribution vs energy density

This statistical distribution is an open question but here we can

Provide an initial formulation of such distribution

$$\varrho_q = C_s \int_0^\infty \frac{h\,\omega^3 d\omega}{c^3 (e^{\frac{\omega}{\omega_m}} - 1)} \tag{1-10}$$

C_s : statistical constant , ω_m : mean angular frequency

The analytical value of the statistical constant is unknown for now , however an alternative method to assess the energy density and to arrive at the density degree of freedom relationship can be made in terms of mean wave parameters.

Recalling first that the quanton fields are infinite in range, and the definition of the variation parameters of E_{qf} , E_{qc} fields which corresponds to an exponentially decaying field away from the quanton , the free and constrained fields can be put as

$$E_{qf}\,(x) = E_{qf} e^{-j(\frac{x}{2r_q})} \text{ (free dominated field)} \tag{2-10}$$

$$E_{qc}\,(x) = E_{qc}\, e^{-j(\frac{x}{2r_q})} \text{ (constrained field)} \tag{3-10}$$

quanton energy density is in the form

$$\varrho_q = (E_{sf}E_{tc})(E_{sc}E_{tf}) = E_{qf}\,E_{qc} = \varrho_q\, e^{-j(\frac{x}{r_q})} \qquad \textbf{(4-10)}$$

ϱ_q **: represents the average energy density over time .**

To assess the entire energy stored in both fields , the quanton total energy would be equal to the volumetric integration.

$$\varrho_q = \frac{h\omega}{2\pi} = \iiint_{-\infty}^{\infty} E_q\ e^{-j(\frac{x+y+z}{r_q})} dx\, dy\, dz\ = \qquad \textbf{(5-10)}$$

$$= (2)^3 \iiint_0^{\infty} E_q\ e^{-j(\frac{x+y+z}{r_q})} dx\, dy\, dz \quad \textbf{(symmetric integration)} \qquad \textbf{(6-10)}$$

x, y, z=∞

$$= 8(r_q)^3\ \varrho_q\ e^{-j(\frac{x+y+z}{r_q})}\Big| \qquad = 8\,(r_q)^3\,\varrho_q \qquad \textbf{(7-10)}$$

x, y, z=0

$$\varrho_q = \frac{h\omega}{16\pi {r_q}^3} = \frac{h\,\omega^4}{16\,\pi^4\,c^3}\,, \qquad \textbf{(8-10)}$$

Where $\frac{h}{16\pi^4\,c^3} = h_q$ **(energy density constant)** **(9-10)**

the quanton is represented by an equivalent volume = $8\,{r_q}^3$ **(10-10)**

While in terms of the wave parameter (k), or the quanton radius ,the quanton energy density takes the form:

$$\varrho_q = \left(\frac{h}{16\,\pi^4\ c^3}\right) k^4\ c^4 = \frac{h\,c}{16\ {r_q}^4} \qquad \textbf{(11-10)}$$

This relationship is very important since the term $\frac{h}{16\pi^4\,c^3} = \text{constant.}$

in other words , Quanton field energy density is linearly proportional to the four degrees of freedom as expressed by either (ω^4,k^4 **or** $\frac{1}{{r_q}^4}$ **)**

$$\varrho_q = h_q\,\omega^4\ =\ h_q\,k^4c^4 = h_q\,\frac{\pi^4c^4}{{r_q}^4} \qquad \textbf{(12-10)}$$

The same result can be reached alternatively, when calculating the vacuum energy density ϱ_v **at any point in space as the summation of individual energy density contributions of (** N_q**) quantons.**

$\varrho_v = \sum_i^{N_q} \varrho_{vi}$ **, which leads to the same integration and the same energy density constant, and in general the vacuum energy density is equivalent to the quanton average energy density**

$$\varrho_v = \varrho_q \qquad \textbf{(13-10)}$$

To relate the average energy density ϱ_q to it maximum value (ϱ_{qo}) over time, we use the quanton /anti quanton wave model.

$$\varrho_q = \frac{1}{2}(E_{qf} + cE_{qc}) * \frac{1}{2}(\frac{E_{qf}}{c} + E_{qc}) \quad (14\text{-}10)$$

and since $E_{qfo} = cE_{qco}$ **(15-10)**

$$\varrho_q = E_{qfo} \cos\left(\frac{\pi r}{2r_q} - \omega t\right) E_{qco} \cos\left(\frac{\pi r}{2r_q} - \omega t\right) = E_{qo}\cos^2(\frac{\pi r}{2r_q} - -\omega t) \quad (16\text{-}10)$$

The average value of a periodic function is defined as

$$\varrho_q = \frac{1}{T}\int_0^T E_{qo} \, dt \quad (17\text{-}10)$$

$$\varrho_q = \frac{E_{qo}}{T}\int_0^T \cos^2(\frac{\pi r}{2r_q} - \omega t) \, dt \quad (18\text{-}10)$$

The value of this integration equals to $(\frac{1}{2})$

$$\varrho_{qo} = 2\varrho_q = \frac{h\,\omega^4}{8\pi^4 c^3}, \quad (19\text{-}10)$$

11 -Energy constraining and the release of radiative energy

As the quantons expand , field constraining takes place (transformation into a singularity state – energy non varying in space or time)

Energy constraining during quanton inflation as follows

a-Expansion of free energy fields $(\frac{\partial E_{sf}}{\partial s} \frac{\partial E_{tf}}{\partial t})$must be accompanied by constraining of part - of the expanding free energy fields in the form

$$\int E_{sf} \, ds \int E_{tf} \, dt = (E_s E_t)$$

b-expansion of constrained fields $(\int E_{sc} \, ds \int E_{tc} \, dt)$must be accompanied by a constraining of part of the expanding field in the form $\frac{\partial E_{sc}}{\partial s} \frac{\partial E_{tc}}{\partial t} = E_s E_t$

c-In both cases, the result will be the release of energy in a singularity state (non-varying in space or time) of the form $E = E_s \; E_t$

for the free /constrained type of energy field as they expand

$$\frac{\partial}{\partial s \partial t}[(E_{sf} \, E_{tc})(E_{sc} \, E_{tf})] = (\frac{\partial E_{sf}}{\partial s}\int E_{tc} \, dt)(\int E_{sc} \, ds \, \frac{\partial E_{tf}}{\partial t})$$

$$+(\int E_{sf} \, ds \frac{\partial E_{tc}}{\partial t})(\frac{\partial E_{sc}}{\partial s}\int E_{tf} \, dt) \quad (1\text{-}11)$$

Given that $\frac{\partial E_{sf}}{\partial s} = E_{sf}$, $\int E_{tc} \, dt = E_{tc}$, $\int E_{sc} \, ds = E_{sc}$, $\frac{\partial E_{tf}}{\partial t} = E_{tf}$ **(2,3,4,5-11)**

and ($\int E_{sf} \, ds \frac{\partial E_{tc}}{\partial t}) = E_s \; E_t$, $(\frac{\partial E_{sc}}{\partial s}\int E_{tf} \, dt) = E_s \; E_t$ **(6,7-11)**

The results of field expansion can be defined as

a- expansion term:

$$\left(\frac{\partial E_{sf}}{\partial s}\int E_{tc}\,dt\right)\left(\int E_{sc}\,ds\,\frac{\partial E_{tf}}{\partial t}\right) = (E_{sf}\,E_{tc})(E_{sc}\,E_{tf}) \qquad (8\text{-}11)$$

Corresponds to the expanding space and time varying fields.

The nature of expanding fields is the same as the original type of fields (though with lesser energy content)

b- The constraining term: $\left(\int E_{sf}\,ds\frac{\partial E_{tc}}{\partial t}\right)\left(\frac{\partial E_{sc}}{\partial s}\int E_{tf}\,dt\right) = E_s\ E_t$ **(9-11)**

which represents the release of energy in a singularity state due to the constraining of part of the free and constrained fields.

This non varying energy expands and it is released from the quanton in the form of radiative energy , fig. 4. Shows the expansion of the quanton and the subsequent release of radiative energy .

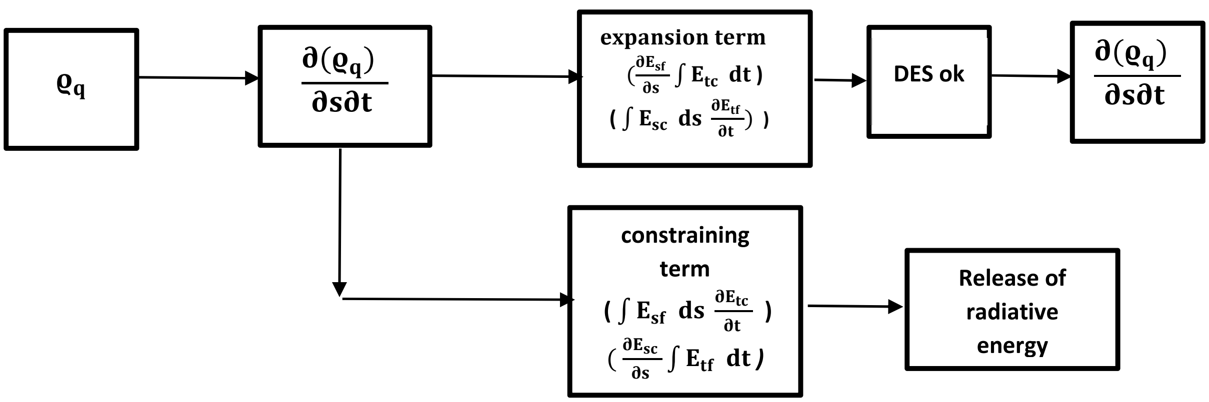


Fig. 4. Quanton energy density expansion process

12.energy constraining -a possible origin of cosmic microwave back ground (CMB)

Inflation of the universe (expansion of space fabric) is a free expansion process and is accompanied by the release of thermal energy.

The idea that a free expansion process gives off heat is rather odd , since expansion is closely related to reduction in temperature, in fact any release of thermal energy is more than offset by the effects of inflation, so the net result would be a reduction in temperature (observed as thermal degradation of CMB photons)

This free expansion process of the universe, which according to the second law of thermodynamics, is an irreversible process, this irreversibility is due to losses in the form of space fabric giving off heat during expansion.
The origin of this release of thermal energy : is energy constraining.
Based on the previous results, we can conclude that the CMB origin is due to release of thermal energy during free expansion of the space fabric itself .
The extraordinarily high degree of CMB homogeneity with variation of the order of (10^{-5}) , reflects the high degree of homogeneity of space fabric itself as it releases radiation during the free expansion process and, in fact energy constraining is behind that release of this radiation energy.

13. why do quantons split ?

The question how the quantons split is discussed in the following section , but why this happens resides in the fast that the quanton energy density is four dimensional , as the quanton expands from an equivalent volume (V_{q1}) to (V_{q2}) , the quanton radius r_q and its volume V_q should change in the following manner $\frac{V_{q2}}{V_{q1}} = (\frac{r_{q2}}{r_{q1}})^3$ which is expected in case of an expansion in three dimensional energy density.
Quanton energy fields change periodically with time, this variation at the rate of ω rad /sec , and vary in space at the rate of $k = (\frac{\pi}{r_q})$, the total energy of the quanton (as a quantum entity) is governed by Planck Einstein relationship (function only in its wave parameters) , namely $E_p = hf = \frac{hkc}{2\pi} = \frac{hc}{2r_q}$
the relationship between quantons of different energy content can be put as

$$\frac{E_{p2}}{E_{p1}} = \frac{\omega_2}{\omega_1} = \frac{k_2}{k_1} = \frac{\lambda_1}{\lambda_2} = \frac{r_{q1}}{r_{q2}} \qquad \textbf{(1-13)}$$

which means that the quanton radius and the wave length of its characteristic wave behaviour are inversely proportional to its total energy content.
Recalling here the Dof relationship between quanton energy density and its wave parameters, energy density can be assessed as

$$E_p = \varrho_q V_q \quad \text{or} \quad \varrho_q = \frac{E_p}{V_q}$$

$$\frac{\varrho_{q2}}{\varrho_{q1}} = (\frac{E_{p2}}{E_{p1}})(\frac{V_{q1}}{V_{q2}}) \qquad \textbf{(2-13)}$$

substituting for $\left(\frac{E_{p2}}{E_{p1}}\right) = (\frac{r_{q1}}{r_{q2}})$ **, and** $(\frac{V_{q1}}{V_{q2}}) = (\frac{r_{q1}}{r_{q2}})^3$

We get $\frac{\varrho_{q2}}{\varrho_{q1}} = (\frac{r_{q1}}{r_{q2}})^4$ **(3-13)**

Which deviates from what we would expect in a classical volume / density relationship of the form $\frac{\varrho_2}{\varrho_1} = \frac{V_1}{V_2} = (\frac{r_1}{r_2})^3$

This is due to the fact that energy density is inversely proportional to $r_q{}^4$ **and not to** $r_q{}^3$ **and this relationship can be obtained directly from the equation (14-11) , namely** $\varrho_q = \pi^4 h_q \frac{c^4}{r_q{}^4}$ **or** $\varrho_q = (\frac{constant}{r_q{}^4})$

As quantons expand into a three dimensional space, they have to release energy, in the form of radiation but energy release from such a process would be excessive.

Instead , the quantons , as they expand , do split , to allow for subsequent expansion , put this time with minimal release of thermal energy.

14.Mechanism of quanton splitting and expansion.

This model for quanton splitting serves as preliminary and introductory one since the CMB radiation has a statistically distributed frequencies indicating that the quanton frequencies are also statistically distributed and the splitting occurs non symmetrically.

There are two mechanisms that can cause the quantons to expand, namely

a-Splitting action of the quantons due dimensional energy asymmetry

b-The sole release of energy from the quantons as for the first mechanism

14.a. stage(1-2) expansion under the effect of self interacting repulsive field

The two types of quanton fields (free Dominated E_{qf} **and neutral** E_{qc} **) interact , creating a binding relationship but since the energy Dof's (i.e field strength) of both types are not the same, the field of the dominant type of energy self-interact creating a repulsive interaction that causes the quantons to expand, the self-interacting (unbound) field is (** $E_{sfu}\ E_{tfu}$ **) for quantons and (** $E_{scu}\ E_{tcu}$ **) for anti quantons [9]**

The unbound field is at the origin of the quanton inflationary energy

overcomes this binding and causes the quanton to the expand.

As the quanton expands its wave parameters (ω , k) are altered , while its energy content remains the same since there's no energy release from the quantons at this stage, as a result the quanton has either to

a- Release radiative energy to maintain the relationship $E_p = \frac{h\omega}{2\pi}$ or

b- Split thus reducing its overall energy content and allowing further expansion

14.b. stage (2-3) dimensional energy asymmetry occurs and quanton splits

Since the quanton parameters (ω , k) do not reflect its energy content , ($\frac{E_{p2}}{E_{p1}}$ must be equal to $\frac{r_{q1}}{r_{q2}} = \frac{\omega_2}{\omega_1} = \frac{k_2}{k_1}$ while E_{p2} still equals E_{p1}) , this conflict causes quanton to split as a mechanism to restore the relationship ($r_{q2}) = \left(\frac{r_{q3}}{2}\right) = r_{q1}$, $E_{p3} = \frac{E_{p2}}{2} = \frac{E_{p1}}{2}$

, the splitting corresponds to a quanton radius $r_{q2} = x\, r_{q1}$, x >1

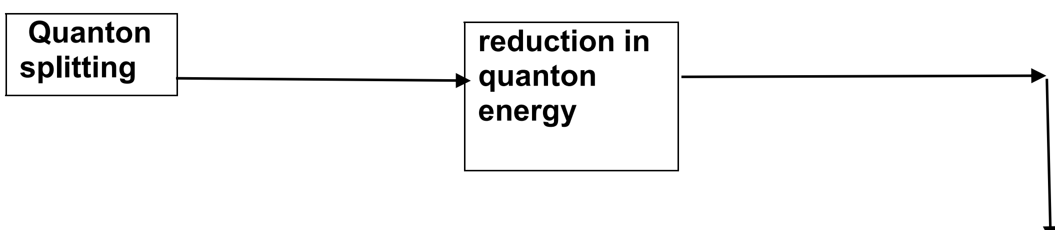
14.c. stage(3) quanton expands further

Following quanton splitting its total energy becomes

$E_{p3} = \frac{E_{p2}}{2}$, while wave parameters (ω, k) must altered to satisfy the relationship $\frac{E_{p4}}{E_{p2}} = \frac{\omega_4}{\omega_1} = \frac{k_4}{k_1} = \frac{r_{q1}}{r_{q4}} = \frac{1}{2}$

as the quantons expand , they release radiative energy in the form of CMB photons, and to arrive at the final stable state.

fig. 5. Provides an illustration of the quanton expansion , splitting cycle ,while table 2. provides a summary of those stages and the corresponding quanton parameters



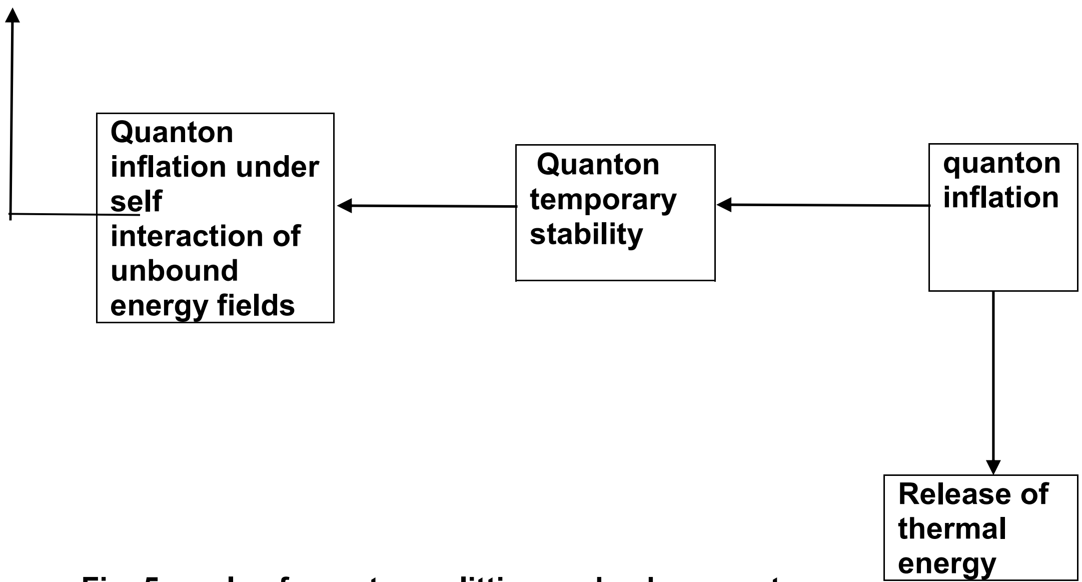


Fig. 5. cycle of quanton splitting and subsequent inflation

stage	(1)	(2)	(3, 4)
Total quanton energy : E_p	E_{p1}	E_{p1}	$< \frac{E_{p1}}{2}$
Wave parameter ω	ω_1	$\frac{\omega_1}{x}$	$< \frac{\omega_1}{2}$
quanton energy density : ϱ_q	ϱ_{q1}	$\frac{\varrho_{q1}}{x^3}$	$< \frac{\varrho_{q1}}{16}$
Quanton radius r_q	r_{q1}	$x\, r_{q1}$	$> 2\, r_{q1}$
Quanton volume V_q	V_{q1}	$x^3 V_{q1}$	$> 8\, V_{q1}$
Number of quantons	one	one	two

table 2. Summary of the stages of the quanton splitting and expansion x > 1

The second method is the pure release of thermal energy followed up by a subsequent quanton expansion which is such an inefficient mechanism in comparison to the fore described method of quanton splitting and subsequent expansion .

Given the high efficiency of the splitting process as a mechanism to manage the expansion of the quanton through both inflation and multiplication while on the other hand minimizing the thermal energy release, it is clear that quanton splitting and subsequent expansion is the actual mechanism of space fabric expansion.

QUANTON FIELDS : EVOLUTION AND DEGREES OF FREEDOM

The release of the radiative energy during the process of expansion of the quanton is not related to the re-establishment of the wave parameter relationship with the quanton energy.

An explanation lies in the fact that all the quanton energy fields are involved in different interactions , mainly binding ones ,while energy in a singularity state which expand as radiation is not involved in any of those binding interactions , and already possesses four degrees of freedom, as a result , small part of this energy escapes in the form of radiative energy.

15.mathematics behind constraining

As the quanton forms , the nature of the energy field changes (from free to constrained) , to perform such an operation energy fields must transit through a singularity state (energy that does not vary in space or in time) and as energy field strength is in terms of Dof's , its operator(integration / differentiation) has to be applied at an exponential level, thus the exponent of field variation parameter which is operated upon.

a−For evolution of constrained space varying field

$$\frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s}\right) = \frac{\partial}{\partial s}\left(K_{sf}\, D_{sf}\, \psi_{sf}\right) = K_{sf}\, D_{sf} \frac{\partial}{\partial s}\left(\psi_{sf}\right) \quad (1\text{-}15)$$

$$= K_{sf}\, D_{sf}\, [\, e^{jks})(e^{\frac{\partial}{\partial s}(jks)}) \,] \quad (2\text{-}15)$$

$$= [\, K_{sf}\, D_{sf}(e^{jks})][\, K_s\, D_s\, e^{(jk)}] \quad (3\text{-}15)$$

$$= \left(\frac{\partial E}{\partial s}\right)\left(K_s\, D_s\, e^{(jk)}\right) = \left(\frac{\partial E}{\partial s}\right)\left(E_s\right) \quad (4\text{-}15)$$

$$\int (E_s)\, ds = (K_s\, D_s\, e^{-\int (jk)\, ds}) \quad (5\text{-}15)$$

$$= [\, K_{tc}\, D_{tc}\, (e^{-jks})] = \int E\, ds \quad (6\text{-}15)$$

b-For the evolution of the constrained time varying field

$$\frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) = \frac{\partial}{\partial t}\left(K_{tf}\, D_{tf}\, \psi_{tf}\right) = K_{tf}\, D_{tf} \frac{\partial}{\partial t}\left(\psi_{tf}\right) \quad (7\text{-}15)$$

$$= K_{tf}\, D_{tf}\, [(e^{j\omega t})(e^{\frac{\partial}{\partial t}(j\omega t)}) \,] \quad (8\text{-}15)$$

$$= [\, K_{tf}\, D_{tf}(e^{j\omega t})][\, K_t\, D_t \left(e^{(j\omega)}\right) \,] \quad (9\text{-}15)$$

$$= \left(\frac{\partial E}{\partial t}\right)\left(E_t\right) \quad (10\text{-}15)$$

$$\int (E_t)\, dt = [\, K_t\, D_t \left(e^{-\int (j\omega)\, dt}\right)] \,] \quad (11\text{-}15)$$

$$=[(K_{tc}\, D_{tc}\, (e^{-\omega\, t})] = \int E\, dt \quad (12\text{-}15)$$

c-Expansion term

As mentioned earlier the expansion of constrained fields is handled by integration process

$$\frac{\partial}{\partial s \partial t}(\varrho_q) = \frac{\partial}{\partial s}((E_{sf}E_{tc})(E_{sc}\ E_{tf})) \qquad (13\text{-}15)$$

$$= [K_{sf}D_{sf}\frac{\partial}{\partial s}(\psi_{sf})\ K_{tc}\ D_{tc}(\int \psi_{tc}\,dt)][(K_{sc}D_{sc}\left(\int \psi_{sc}\,dx\right)K_{tf}\ D_{tf}\frac{\partial}{\partial t}(\psi_{tf})] \qquad (14\text{-}15)$$

$$= [\frac{jk}{-j\omega}(K_{sf}D_{sf}\ \psi_{sf})(\ K_{tc}\ D_{tc}\psi_{tc})][\frac{j\omega}{-jk}(K_{sc}D_{sc}\ \psi_{sc})(\ K_{tf}D_{tf}\ \psi_{tf})] \qquad (15\text{-}15)$$

$$= [(K_{sf}\ D_{sf}\ \psi_{sf})(K_{tc}\ D_{tc}\ \psi_{tc})][(K_{sc}D_{sc}\ \psi_{sc})(K_{tf}\ D_{tf}\ \psi_{tf})] \qquad (16\text{-}15)$$

$$= (E_{sf}\ E_{tc})(E_{sc}\ E_{tf}) = \varrho_q$$

b- constraining term

$$(\int E_{sf}\,ds\frac{\partial E_{tc}}{\partial t})(\frac{\partial E_{sc}}{\partial s}\int E_{tf}\,dt) \qquad (17\text{-}15)$$

$$= \left[\left(K_{sf}\ D_{sf}\ e^{\frac{\partial}{\partial s}(jks)}\right)(\ K_{tc}\ D_{tc}e^{\frac{\partial}{\partial t}(-j\omega t)}\Big)\Big\}][\left(K_{sc}\ D_{sc}e^{\frac{\partial}{\partial s}(-jks)}\right)\left(K_{tf}\ D_{tf}e^{\frac{\partial}{\partial t}(j\omega t)}\right)] \qquad (18\text{-}15)$$

$$= (K_{sf}\ K_{tc}\ D_{sf}\ D_{tc}e^{(jk)}e^{(-j\omega)})(K_{sc}\ K_{tf}\ D_{sc}\ D_{tf}e^{(-jk)}e^{(j\omega)}) \qquad (19\text{-}15)$$

$$= K_s\ D_s\ K_t\ D_t = E_sE_t \qquad (20\text{-}15)$$

To summarize, the exponential differentiation / integration would be applied in either of the following cases

1-Change of the nature of the energy field (free / constrained) or (space varying / time varying) and vice versa.

2- Change in the degrees of freedom of any energy field (Dof rearrangement of Dof's between fields)

16. Wave- like properties of space fabric

Energy which varies in time and varies in space has wave like properties as it changes at periodic rate that equals ω rad $\sec^{-1}$ $(= 2\,\pi\,f)$ and the space varying field , where $r_q = (\frac{\pi}{k})$, such that $\omega\ r_q = \text{constant} = \pi c$, in fact the quanton (or anti quanton) is represented by two (wave like) equations.

To show how the wave equations would look like for the free and constrained energy fields, first remembering that

$$\psi_{sf} = e^{jkx},\quad \psi_{tc} = e^{-j\omega t},\ \psi_{sc} = e^{-jkx},\quad \psi_{tf} = e^{j\omega t}$$

The free dominated wave parameters:

$\psi_{qf} = (\psi_{sf}\psi_{tc})$ **differentiating both sides w.r.t time**

$$\frac{\partial\psi_{qf}}{\partial t} = \frac{\partial\psi_{tc}}{\partial t}\psi_{sf} = -j\omega\ \psi_{sf}\psi_{tc} \quad (1\text{-}16)$$

$$\frac{\partial^2\ \psi_{qf}}{\partial t^2} = \frac{\partial^2\ \psi_{tc}}{\partial t^2}\psi_{sf} = -\omega^2\ \psi_{sf}\psi_{tc} \quad (2\text{-}16)$$

While differentiating w.r.t (x)

$$\frac{\partial\psi_{qf}}{\partial x} = \frac{\partial\psi_{sf}}{\partial x}\psi_{tc} \quad (3\text{-}16)$$

$$\frac{\partial^2\ \psi_{qf}}{\partial x^2} = \frac{\partial^2\ \psi_{sf}}{\partial x^2}\psi_{tc} = -k^2\ \psi_{sf}\psi_{tc} \quad (4\text{-}16)$$

For a wave equation $\frac{\partial^2\ \psi_{qf}}{\partial t^2} = c^2\frac{\partial^2\ \psi_{qf}}{\partial x^2}$ **to be satisfied**

$$\frac{\partial^2\ \psi_{tc}}{\partial t^2} = c^2\left(\frac{\partial^2\ \psi_{sf}}{\partial x^2}\frac{\psi_{tc}}{\psi_{sf}}\right) \quad \text{or} \quad (E_{qf})_{tt} = c^2(E_{qf})_{xx} \text{ as before} \quad (5\text{-}16)$$

which is the PDE forth free dominated field.

Similarly for the neutral field E_{qc}

$\psi_{qc} = (\psi_{sc}\psi_{tf})$ **, differentiating both sides w.r.t time**

$$\frac{\partial\psi_{qc}}{\partial t} = \frac{\partial\psi_{tf}}{\partial t}\psi_{sc} \quad (6\text{-}16)$$

$\frac{\partial^2\ \psi_{qc}}{\partial t^2} = \frac{\partial^2\ \psi_{tf}}{\partial t^2}\psi_{sc}$ **, while differentiating w.r.t x**

$$\frac{\partial\psi_{qc}}{\partial x} = \frac{\partial\psi_{sc}}{\partial x}\psi_{tf} \quad (7\text{-}16)$$

$$\frac{\partial^2\ \psi_{qc}}{\partial x^2} = \frac{\partial^2\ \psi_{sc}}{\partial x^2}\psi_{tf} \quad (8\text{-}16)$$

For a wave equation $\frac{\partial^2\ \psi_{qc}}{\partial t^2} = c^2\frac{\partial^2\ \psi_{qc}}{\partial x^2}$ **to be satisfied**

$$\frac{\partial^2\ \psi_{tf}}{\partial t^2} = c^2\left(\frac{\partial^2\ \psi_{sc}}{\partial x^2}\frac{\psi_{tf}}{\psi_{sc}}\right) \quad \text{or} \quad (E_{qc})_{tt} = c^2(E_{qc})_{xx} \quad (9\text{-}16)$$

This PDE for the constrained field.

17. Quanton evolution and degrees of freedom

Evolution of the quanton takes place as both free fields (E_{sf}) **and (** E_{tf}) **coexist**

As free energy field expands by variation in space part of this field becomes a constrained space varying field .

$$a - \frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s}\right) = \left[\frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s}\right)\right]\left[\int\left(\frac{\partial E}{\partial s}\right) ds\right] = \left(\frac{\partial E}{\partial s}\right)((E_s\ ) \quad (1\text{-}17)$$

$$b - \left[\int(E_s\ )\ ds\right] = \int(E)\,ds = \int\ E\ \ ds = E_{sc} \quad (2\text{-}17)$$

While as the time varying field (E_{tf} **) expands , a part of it becomes constrained time varying energy field.**

c- $\frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) = \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right)\left(\int \frac{\partial E}{\partial t}\ \ dt\right) = \frac{\partial E}{\partial t}\ (E_t\ )$ **(3-17)**

$b - \ [\int(E_t\ )\ dt] = \int(E)\,dt = \int\ E\ \ dt = \ E_{tc}$ **(4-17)**

And since non of the fields possesses all four Dof's neither field can exist independently, now the quanton energy density equation becomes

$\varrho_q = (\frac{\partial E}{\partial s}\int E\ \ \ dt\ )(\int E\ \ ds\frac{\partial E}{\partial t})$ **=**$(E_{sf}E_{tc})(E_{sc}E_{tf})$ **=** $E_{qf}E_{qc}$ **(5-17)**

Which expresses two apparently separate (but otherwise linked) Fields.

For space constrained energy field (E_{sc})**,its energy Dof equals one third of the corresponding free energy field** $(\ E_{sf})$

For constrained time varying energy field$(\ E_{tc}\ )$ **, its energy degree of freedom equals one third of the corresponding space constrained energy field** $(\ E_{tc})$**.**

The previous discussion can be summarized in the following 4 equations by solving them the quanton Dof's for the four energy fields can be obtained

$Dof_{sf} = 3\ Dof_{sc}\quad ,\qquad Dof_{tf} = 3\ Dof_{tc}$ **(4-17),(5-17)**

$Dof_{sf} + Dof_{sc} = 3\quad ,\qquad Dof_{tf} + Dof_{tc} = 1$ **(6-17),(7-17)**

Which gives the following results

$Dof_{sf} = 2.25\quad ,\quad Dof_{sc} = 0.75$ **(8-17) , (9-17)**

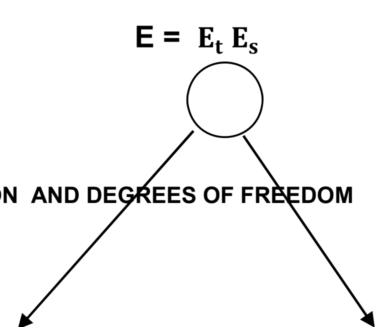
$Dof_{tf} = 0.75\quad ,\quad Dof_{tc} = 0.25$ **(10-17),(11-17)**

For the case of electromagnetic quantons which are released from the constraining process

E **=**$E_s\ E_t$ **, and the expansion of this energy packet in space is different from That of space fabric quantons namely**

$\varrho_q = \frac{\partial}{\partial s}(E_sE_t\ ) = c\varepsilon_o\left(\ \frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)(\frac{E_{sc}\ E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}) = c\varepsilon_oEB$ **(12-17)**

Fig. 6. Shows the evolution of DOF's of various fields of the quanton as it forms



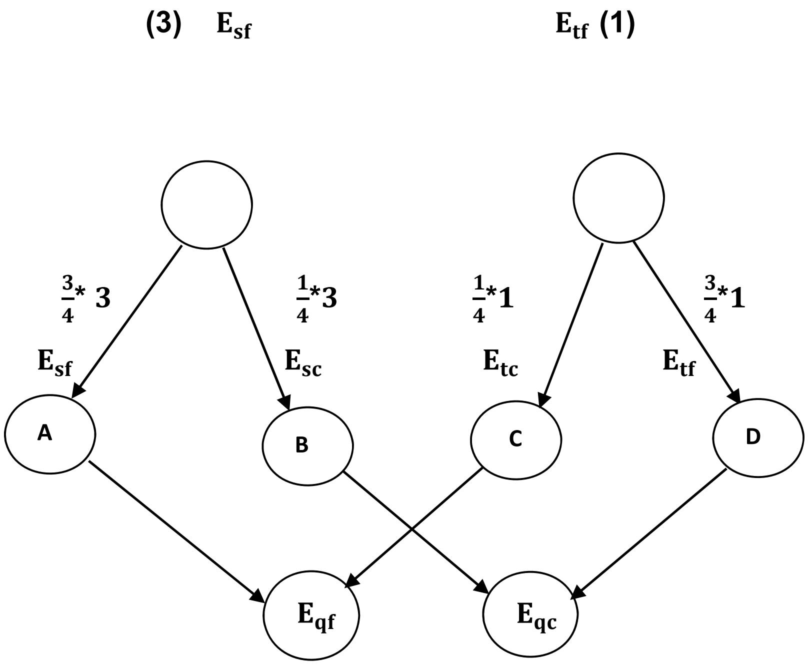


Fig.6. tree diagram for the evolution of the degrees of freedom of quanton's energy fields

For the quanton despite having a constrained energy fields, it is dominated by the free energy field of the form ($\frac{\partial E}{\partial s}\frac{\partial E}{\partial t}$) since this energy term represents 3.0 degrees of freedom while the constrained type ($\int E\ ds \int E\ dt$) constitutes 1.0 Dof out of four.

The number of (unbound) degrees of freedom of free energy fields is equivalent to the number of free energy degrees of freedom (space plus time varying) minus the energy constrained degrees of freedom (space and time varying)

Unbound free field is manifested in the form of quanton inflation

$$\mathbf{D_{sfu}D_{tfu}\ (\,unbound\ field\ strength\,) = \frac{(D_{sf}\ D_{tf}\,)}{(D_{sc}\ D_{tc}\,)} = \frac{c^{2.25}c^{0.25}}{c^{0.75}c^{0.25}} = c^{2.0}} \quad \textbf{(13-17)}$$

$$\mathbf{unbound\ free\ Dof = \ \sum(free\ Dof) - \sum(constrained\ \ Dof)} \quad \textbf{(14-17)}$$

$$\mathbf{= [\ (\ Dof_{sf}) + (\ Dof_{tf})] - [(\ Dof_{sc}) + (\ Dof_{tc}\ )] = (3.0 - 1.0) = +2.0} \quad \textbf{(15-17)}$$

18.Variation of quanton energy fields with time

Not only the unbound energy fields $\mathbf{E_{sfu}\,E_{sfu}}$ of the quanton *(or* $\mathbf{E_{scu}\,E_{scu}}$ for anti quanton) which change with time as the quanton (or anti quanton)

expands , but rather all the other energy fields , and this is so , to ensure the uniformity of energy density.

18.a-Variation of space varying energy with time

$$\frac{\partial E_{sf}}{\partial t} = \frac{\partial E_{sf}}{\partial x}\frac{\partial x}{\partial t} = c\frac{\partial E_{sf}}{\partial x} \qquad (1\text{-}18)$$

$$\frac{\partial E_{sf}}{\partial x} = j\,k\,E_{sf} \qquad (2\text{-}18)$$

$$\frac{\partial E_{sf}}{\partial t} = j\,kc\,E_{sf} \qquad (3\text{-}18)$$

18.b- time varying energy field variation

$$\frac{\partial E_{tf}}{\partial t}\ j\,\omega\,E_{tf} \qquad (4\text{-}18)$$

18.c-Relative rate of Variation between different energy fields

$$\frac{\partial E_{sf}}{\partial E_{tf}} = \frac{\partial E_{sf}}{\partial x}\left(\frac{\partial x}{\partial t}\right)\frac{1}{\left(\frac{\partial E_{tf}}{\partial t}\right)} = (jkcE_{sf})\left(\frac{1}{j\,w\,E_{tf}}\right) = \frac{E_{sf}}{E_{tf}} = \frac{D_{sf}}{D_{tf}} \qquad (5\text{-}18)$$

the same results can be reached when considering the wave parameters of energy fields

$$\frac{\partial\,\psi_{tf}}{\partial\,\psi_{sf}} = \left(\frac{\partial\,\psi_{tf}}{\partial t}\right)\left(\frac{1}{\frac{\partial x}{\partial t}}\right)\left(\frac{1}{\frac{\partial\,\psi_{sf}}{\partial x}}\right) \qquad (6\text{-}18)$$

Given that $\psi_{tf} = e^{+j\omega t}$, $\frac{\partial\,\psi_{tf}}{\partial t} = j\omega\,\psi_{tf}$

$\psi_{sf} = e^{+jk(x)}$, $\frac{\partial\,\psi_{sf}}{\partial x} jk\,\psi_{sf}$

$$\frac{\partial\,\psi_{tf}}{\partial\,\psi_{sf}} = \frac{1}{c}\,\frac{\omega}{k} = 1 = \text{constant} \qquad (7\text{-}18)$$

While from before $\frac{\partial\,E_{tf}}{\partial t} = j\omega\ E_{tf}$, $\frac{\partial\,E_{sf}}{\partial x} = jk\ E_{sf}$

$$\frac{\partial\,E_{tf}}{\partial\,E_{sf}} = \frac{1}{c}\frac{\omega}{k}\frac{E_{tf}}{E_{sf}} = \frac{E_{tf}}{E_{sf}} = \frac{D_{tf}}{D_{sf}}, \qquad (8\text{-}18)$$

which means that

1-The rate of variation of energy fields wave parameters with respect to each other is constant (=1) (same rate of variation for all energy fields)

2-Relative rate of variation in time of all energy fields is equal to the ratio between their degrees of freedom and this is due to the uniformity of their variation parameters.

19. Energy field parameters

As energy density expands by variation in space and time, it has four degrees

of freedom, this can be used to define quanton space and time varying fields

$$\varrho_q = \frac{h}{16\,\pi^4\, c^3} k^4 c^4 = \text{constant} * \left(\frac{2\pi}{\lambda}\right)^4 c^4 = \frac{\text{constant}}{4\text{ D volume}} * c^4 \qquad (1\text{-}19)$$

This relationship does not only expresses a volumetric relationship of energy density as it expands into a 4 D volume, but it expresses an energy density – degree of freedom relationship as it.

Instead of formulating the density degree of freedom relationship in terms of the wave parameters (k ,ω , $\frac{1}{r_q}$) , from now on the formulation of the energy fields will be in terms of the constant (c)

$$D_q = c^4 = D_{sf}\, D_{sc}\, D_{tf}\, D_{tc} \qquad (2\text{-}19)$$

= the field strength parameter of energy fields

Where $D_{sf} = c^{Dof_{sf}}$, $D_{sc} = c^{Dof_{sc}}$ (3,4-19)

$D_{tf} = c^{Dof_{tf}}$, $D_{tc} = c^{Dof_{tc}}$ (5,6-19)

$$\varrho_q = \frac{h}{16\,\pi^4\, c^3} k^4\, c^{\,4} = K_q^{\;4}\, c^{\,4} \qquad (7,8\text{-}19)$$

The quantity $K_q^{\;4} = (\frac{h}{16\,\pi^4\, c^3} k^4)$ can be put as

$K_q^{\;4} = h_q\, k^4 = K_{sf}\, K_{sc}\, K_{tf}\, K_{tc}$ (= energy field intensity parameter) (9-19)

Where $K_{sf} = K_q = \sqrt[4]{\frac{h}{16\,\pi^4\, c^3}}\; k$ (10-19)

$$K_{sc} = K_q = \sqrt[4]{\frac{h}{16\,\pi^4\, c^3}}\; k \;,\; K_{tf} = K_{tc} = K_q = \sqrt[4]{\left(\frac{h}{16\,\pi^4\, c^3}\right)}\; \frac{\omega}{c} \qquad (11\text{-}19)$$

It must be noted that while $\frac{\varrho_q}{\omega^4} = \left(\frac{h}{16\,\pi^4\, c^3}\right) = h_q = \text{constant}$, its fourth root is not a constant , $\sqrt[4]{\frac{\varrho_q}{\omega^4}}$ or $\sqrt[4]{\frac{\varrho_q}{k^4}}$ ≠ constant .

The division of the field intensity parameter does not follow the energy degree of freedom but follows the division of field types (free / constrained and space or time varying fields) otherwise energy fields E_{sf} , E_{tc} or E_{sc} , E_{tf} could exist independently.

One can be drawn to think that the division of $(K_q^{\;4})$ between various energy fields such that $K_{sf} = K_q^{\;Dof_{sf}} = K_q^{\;2.25}$, or $K_{tf} = K_q^{\;Dof_{tf}} = K_q^{\;0.25}$, but since there are no wave parameters in nature of $k^{2.5}$ or $\omega^{\;0.25}$ due to the symmetry of the wave behavior between various fields which is previously defined as $\frac{\partial\, \psi_{tf}}{\partial\, \psi_{sf}} = \frac{1}{c}\frac{\omega}{k} = \text{constant}$ and $\frac{\partial\, E_{tf}}{\partial\, E_{sf}} = \frac{1}{c}\frac{\omega}{k}\frac{E_{tf}}{E_{sf}} = \frac{E_{tf}}{E_{sf}} = \frac{D_{tf}}{D_{sf}}$

This leads to the following result : $K_{sf} = K_{sc} = K_{tf} = K_{tc} = K_q$ (12-19)

Finally, we can write the energy fields themselves as

$$E_{sf} = E_{sfo}\,\psi_{sf} = K_q\ D_q^{Dof_{sf}}\psi_{sf} = \sqrt[4]{\frac{h}{16\,\pi^4\,c^3}}\ kc^{2.25}\psi_{sf} = \sqrt[4]{\frac{h}{16\,c^3}}\frac{c^{2.25}}{r_q}\ \psi_{sf} \quad (13\text{-}19)$$

$$E_{sc} = E_{sco}\,\psi_{sc} = K_q\ D_q^{Dof_{sc}}\ \psi_{sc} = \sqrt[4]{\frac{h}{16\,\pi^4\,c^3}}\,k\,c^{0.75}\psi_{sc} = \sqrt[4]{\frac{h}{16\,c^3}}\frac{c^{0.75}}{r_q}\ \psi_{sf} \quad (14\text{-}19)$$

$$E_{tc} = E_{tco}\,\psi_{tc} = K_q\ D_q^{Dof_{tc}}\ \psi_{tc} = \sqrt[4]{\frac{h}{16\,\pi^4\,c^3}}\frac{\omega}{c}\,c^{0.25}\psi_{tc} = \sqrt[4]{\frac{h}{16\,c^3}}\frac{c^{0.25}}{r_q}\,\psi_{tc} \quad (15\text{-}19)$$

$$E_{tf} = E_{tfo}\,\psi_{tf} = K_q\,D_q^{Dof_{tf}}\ \psi_{fc} = \sqrt[4]{\frac{h}{16\,\pi^4\,c^3}}\ \frac{\omega}{c}\ c^{0.75}\ \psi_{tf} = \sqrt[4]{\frac{h}{16\,c^3}}\frac{c^{0.75}}{r_q}\ \psi_{tf} \quad (16\text{-}19)$$

$$\frac{E_{sf}}{E_{tc}} = \frac{K_q\ D_q^{Dof_{sf}}\ \psi_{sf}}{K_q\ D_q^{Dof_{tc}}\ \psi_{tc}} = \frac{D_q^{Dof_{sf}}\ \psi_{sf}}{D_q^{Dof_{tc}}\ \psi_{tc}} = c^{2.0}\ \frac{\psi_{sf}}{\psi_{tc}} \quad (17\text{-}19)$$

A unified value of (K_q) for all energy fields ensures that the relationship between the different fields depends only on their degrees of freedom and not on the intensity of such fields.

In general a field energy can be seen as the product of two terms :

field energy = field intensity (defined in terms of : K_q) * field strength (D_q : defined in terms of energy degrees of freedom)

20.Dimensions of vector energy fields

While being a scalar quantity, energy as it expands in the form of space and time varying fields which are vector quantities.

individual energy content of various fields in the form

$E_p = \int_{V_q} E_{sf}\ dV$ does not exist .

and this is due to the fact that quanton energy fields are inextricably linked to the quanton volume in a dependence relationship, this does not make it possible to determine the total energy of each individual field .

The energy fields must be defined in terms of the quanton dimensions, in addition to energy dimensions and degrees of freedom for each energy field.

The quanton radius (r_q) and , its equivalent volume (V_q)are not constant but rather inversely proportional to its total energy content.

While $V_q = fn(r_q^3) = fn(\lambda^3) = fn(\frac{1}{\omega^3})$

and $\varrho_q = E_{sf}E_{sc}E_{tf}E_{tc} = \left(\frac{h}{16\,\pi^4\,c^3}\right)\omega^4 = \text{constant x }\omega^4$

hence $V_q = fn(\frac{\omega}{E_{sf}\,E_{sc}\,E_{tf}E_{tc}})$ this means quanton volume is dependent on the product of all four energy field densities.

Dimensions of individual energy fields are expected to be as follows

$$(E_{sf}) = [\sqrt[4]{\left(\frac{h}{16\,\pi^4\;c^3}\right)}\;k\,c^{2.25}\;\psi_{sf}] \quad (1\text{-}20)$$

$$[E_{sf}] = M^{0.25}\,L^{0.5-0.75-1+2.25}T^{-0.25+0.75-2.25} = M^{0.25}\,L^{1.00}T^{-1.75} \quad (2\text{-}20)$$

$$[E_{sc}] = \left[\sqrt[4]{\left(\frac{h}{16\,\pi^4\;c^3}\right)}\;kc^{0.75}\;\psi_{sc}\right] = M^{0.25}L^{-0.50}T^{-0.25}\;, \quad (3\text{-}20)$$

$$[E_{tf}] = \left[\sqrt[4]{\left(\frac{h}{16\,\pi^4\;c^3}\right)}\;\frac{w}{c}\;c^{0.75}\quad\psi_{tf}\right] = M^{0.25}L^{-0.50}\;T^{-0.25} \quad (4\text{-}20)$$

$$[E_{tc}] = \left[\sqrt[4]{\left(\frac{h}{16\pi^4\;c^3}\right)}\;\frac{w}{c}\;c^{0.25}\quad\psi_{tc}\right] = M^{0.25}L^{-1.00}T^{0.25} \quad (5\text{-}20)$$

As it had been mentioned previously, exponential degrees of freedom while in terms of the constant (c) , provide a mechanism for the division of energy density between the space and time varying energy fields so as to maintain a constant ratio between them , for space varying fields value (in magnitude)

$$E_s = E_{sf}\,E_{sc} = \left(K_q\,c^{\,2.25}\right)\left(\,K_q\;\;c^{\,0.75}\right) = K_q^{\;2}\,c^{\,3} = \sqrt[2]{\left(\frac{h\,c^3}{16\pi^4}\right)}\,k^{\,2} \quad (6\text{-}20)$$

for time varying energy fields

$$E_t = E_{tf}E_{tc} = \left(K_q\,c^{\,0.25}\right)\left(K_q\,c^{\,0.75}\right) = K_q^{\;2}\,c \;\; = \sqrt[2]{\left(\frac{h}{16\,\pi^4\;c}\right)}\,k^{\,2} \quad (7\text{-}20)$$

The relative ratio between space and time varying energy fields

$\frac{E_{sf}\,E_{sc}}{E_{tf}\,E_{tc}} = \text{constant} = \;c^{\,2}$, the ratio of the space and time varying energy fields does vary as the wave parameters change.

21. quanton field representation

Free and constrained fields extend beyond the quanton radius , as this radius represents the decaying manner of the quanton fields .

Based on the concept of dimensional energy symmetry, the quantons satisfy the equipartition of energy among spatial axis via their statistical distribution While in the proper (own) frame of reference the free dominated field components can be defined as

$$E_{qf} = E_{qfo}\, e^{j(kr-\omega t)} \quad (1\text{-}21)$$

$$E_{qfx}{}^{*} = 0 \quad (2\text{-}21)$$

$$E_{qfy}{}^{*} = E_{qf} \sin(\omega t) \quad (3\text{-}21)$$

$$E_{qfz}{}^{*} = E_{qf} \cos(\omega t) \quad (4\text{-}21)$$

And the constrained field components

$$E_{qc} = E_{qco}\, e^{-j(kr-\omega t)} \quad (5\text{-}21)$$

$$E_{qcx}{}^{*} = E_{qc} \cos(\omega t) \quad (6\text{-}21)$$

$$E_{qcy}{}^{*} = E_{qc} \sin(\omega t) \quad (7\text{-}21)$$

$$E_{qfz}{}^{*} = 0 \quad (8\text{-}20)$$

the proper frame of reference (x^*, y^*, z^*) is related to the observer frame of reference (x,y,z) via 3 dimensional transformation matrix (T)

$$\begin{vmatrix} E_{qfx}{}^{*} \\ E_{qfy}{}^{*} \\ E_{qfz}{}^{*} \end{vmatrix} = [T] \begin{vmatrix} E_{qfx} \\ E_{qfy} \\ E_{qfz} \end{vmatrix} \quad (9\text{-}21)$$

$$\begin{vmatrix} E_{qcx}{}^{*} \\ E_{qcy}{}^{*} \\ E_{qcz}{}^{*} \end{vmatrix} = [T] \begin{vmatrix} E_{qcx} \\ E_{qcy} \\ E_{qcz} \end{vmatrix} \quad (10\text{-}21)$$

The matrix (T) which has the angles θ , φ , ψ (Euler's angles) as its elements and the resultant fields are $E_{qfx} = \sum_i^n E_{qfxi}$ (11-21)

$E_{qfy} = \sum_i^n E_{qfyi}$, $E_{qfz} = \sum_i^n E_{qfxi}$ (12,13-21)

$E_{qcx} = \sum_i^n E_{qcxi}$, $E_{qcy} = \sum_i^n E_{qcyi}$, $E_{qcz} = \sum_i^n E_{qczi}$ (14,15,16-21)

22. (Q+AQ) pair wave form

This model illustrates that the quanton -anti quanton pair would create a form of quanton waves , later this concept would be used to develop a model for electromagnetic waves in terms of space and time varying fields .

Quantons and anti quantons exist in pairs in the form (Q+AQ)

This linear superposition form is due to the fact that either quanton or anti

quanton is a separate nor independent energy system,as the pair is considered to be a single quantum entity .

To fulfil the wave behaviour (linear supposition of fields), the Dof symmetry condition must be satisfied

a-For the higher degree of freedom field pair (2.5 Dof's)

$$(E_{qc})_{aq} = (E_{qf})_q \quad \text{or} \quad (Dof_{qc})_{aq} = (Dof_{qf})_q \qquad (1\text{-}22)$$

b-for the lower degree of freedom pair (1.5 Dof's)

$$(E_{qf})_{aq} = (E_{qc})_q \quad \text{or} \quad (Dof_{qf})_{aq} = (Dof_{qc})_q \qquad (2\text{-}22)$$

A model for the energy fields given that $\varrho_q = E_{sf}E_{tc}E_{sc}E_{tf} = E_{qf}E_{qc}$

and $\varrho_{aq} = (\frac{E_{sf}E_{tc}}{c})(cE_{sc}E_{tf})$ **wave form is as follows**

higher Dof $E_{wf} = \frac{1}{2}[(E_{qf})_q + (E_{qc})_{aq}]$ **(3-22)**

lower Dof : $E_{wc} = \frac{1}{2}\ [(E_{qc})_q + (\ E_{qf})_{aq}]$ **(4-22)**

$$E_{wh} = \frac{1}{2}\ K_q{}^2(\ D_{sf}D_{tc}\ \psi_{sf}\psi_{tc} + cD_{sc}D_{tf}\ \psi_{sc}\psi_{tf}) =$$

$$= \frac{1}{2}\ K_q{}^2c^{2.5}\ cos[\left(\frac{\pi x}{2r_q}\right) - \omega\ t] \qquad (5\text{-}22)$$

$$E_{wl} = \frac{1}{2}\ K_q{}^2\left(D_{sc}D_{tf}\ \psi_{sc}\psi_{tf} + \frac{1}{c}D_{sf}D_{tc}\ \psi_{sf}\psi_{tc}\right) =$$

$$= \frac{1}{2}\ K_q{}^2c^{1.5}cos[\left(\frac{\pi x}{2r_q}\right) - \omega\ t] \qquad (6\text{-}22)$$

The symmetry between free and constrained fields Dof's does not mean that (Q-AQ) would not expand or there would not be radiative energy release from the pair as the Q/AQ pair expands while the energy density of such a pair

$$\varrho_q = \frac{1}{2}[(E_{qf})_q + (E_{qc})_{aq}] * \frac{1}{2}\ [(E_{qc})_q + (\ E_{qf})_{aq}] \qquad (7\text{-}22)$$

and due to the symmetry of interaction where $(\ E_{qf})_q = (E_{qc})_{aq}$ **(8-22)**

$$(E_{qc})_q = (\ E_{qf})_{aq} \qquad (9\text{-}22)$$

$$\varrho_q = \frac{1}{4}\frac{1}{c}\ E_{qf}{}^2 + 2 * \frac{c}{4}\ \ E_{qf}\ \ E_{qc}\ + \frac{c}{4}\ \ E_{qc}{}^2 \qquad (10\text{-}22)$$

$$= \frac{1}{4}\left(\frac{E_{qf}{}^2}{c}\ + 2\ \ E_{qf}\ \ E_{qc}\ + c\ \ E_{qc}{}^2\right) = \ \ E_{qf}\ \ E_{qc} \qquad (11\text{-}22)$$

23. Anti quanton evolution and its degrees of freedom

The existence of anti quanton as a stable part of space fabric may seem to be problematic, however other evidence still weighs in its favour , namely

1-Its role in the electromagnetic wave generation and formation of the negatively charged particles (electrons , down quarks)

2-Anti quanton is stable under expansion conditions (no degeneration)

3-The interactions generated by anti quanton energy fields are symmetric to those of the quanton ,hence , it cannot affect the space fabric homogeneity and integrity

Fig.7 shows the evolution of antiquanton fields' degrees of freedom

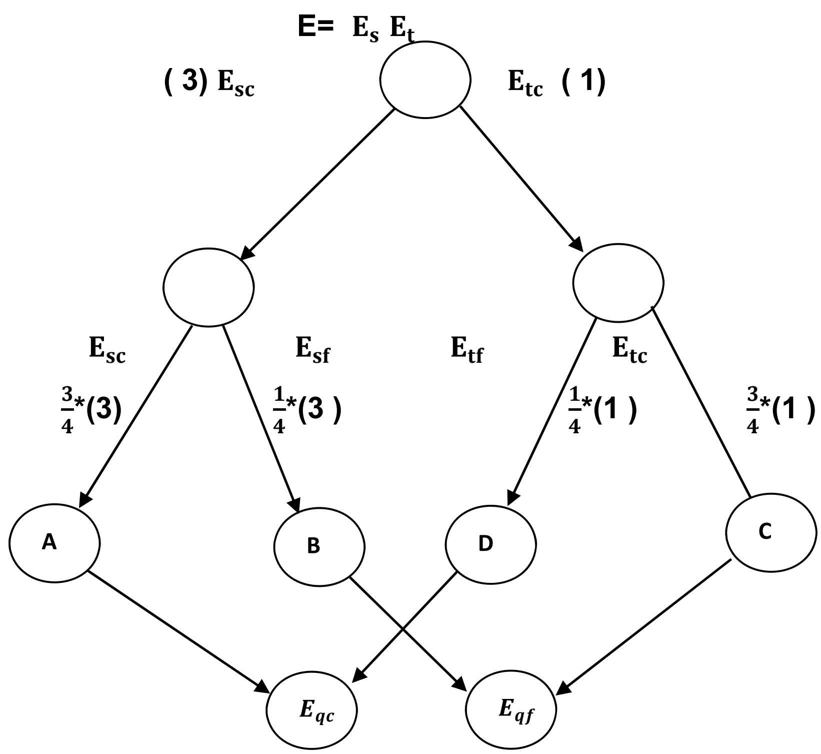


Fig.7.<u>hypothetical</u> tree diagram for the evolution and the degrees of freedom of anti quanton energy fields, and why the independent evolution of the anti quanton seems to be problematic in an inflationary scenario

From the above degree of freedom evolution diagram, the anti quanton would have evolved from energy fields E_{sc} , E_{tc} however, such space and time varying fields could not evolve independently under inflationary conditions, an alternative scenario is proposed, which is the evolution of the anti quanton form the qanton itself

a-Constraining of the free dominated field

$$\int (E_{qf})_q \, ds = \int E_{qf} \, ds = \int E_{sf} \, ds \, \frac{\partial E_{tc}}{\partial t} = E_s E_t \qquad \textbf{(1-23)}$$

Then expands as a constrained field

$$\int (E_s)\, ds \frac{\partial}{\partial t}(E_t) = \int E_s\, ds \frac{\partial\, E_{tf}}{\partial t} = E_{qc})_{aq} \quad (2\text{-}23)$$

b-For the quanton's constrained field

$$\int (E_{qc})_q\, ds = \frac{\partial}{\partial s}\,(E_{sc}) \int (E_{tf})\ dt = E_s E_t \quad (3\text{-}23)$$

Then expands as a free dominated field

$$\frac{\partial}{\partial s}(E_s) \int (E_t)\, dt = \frac{\partial\, E_s}{\partial t} \int E_t\, dt = (E_{qf})_{aq} \quad (4\text{-}23)$$

Anti quanton is the mirror image of the quanton's Dof's where the dominant field of the anti quanton system is constrained type

$$Dof_{sc} = 3\, Dof_{sf} \quad , \quad Dof_{tc} = 3\, Dof_{tf} \quad (5\text{-}23),(6\text{-}23)$$

$$Dof_{sf} + Dof_{sc} = 3 \quad , \quad Dof_{tf} + Dof_{tc} = 1 \quad (7\text{-}23),(8\text{-}23)$$

$$Dof_{sc} = 2.25 \quad , \quad Dof_{sf} = 0.75 \quad (9\text{-}23),(10\text{-}23)$$

$$Dof_{tc} = 0.75 \quad , \quad Dof_{tf} = 0.25 \quad (11\text{-}23),(12\text{-}23)$$

$$D_{net}(\text{unbound}) = \frac{\text{constrained fields Dof}}{\text{free fields Dof}} \quad (13\text{-}23)$$

$$D_{scu} D_{tcu}\,(unbound) = \frac{(D_{tc} D_{sc})}{(D_{sf} D_{tf})} = \frac{c^{2.25} c^{0.75}}{c^{0.75} c^{0.25}} = c^2 \quad (14\text{-}23)$$

$$(\text{unbound})\text{constrained Dof} = (\sum(\text{constrained Dof})$$

$$-\sum(\text{free Dof}) = [(Dof_{sc}) + (Dof_{tc})] - [(Dof_{sf}) + (Dof_{tf})] = 2.0 \quad (15\text{-}23)$$

24.Electromagnetic waves as relativistic quantons

The main difference between quanton – anti quanton pair (Q+AQ) and quantons of electromagnetic waves lie in the fact that electromagnetic waves propagate in linear directions, and consequently one degree of freedom is subtracted from space (free and constrained) fields, as it becomes a kinetic degree of freedom, this relativistic effect is split equally between free and constrained fields (E_{qf}, E_{qc}) in other words each of the free and the constrained space fields have one half of Dof's less than the corresponding quaton fields of space fabric,

Table.3 provides the main differences between space fabric and electromagnetic quantons , while table .4 provides the degree of freedom of each of the quanton space and time fields

subject	Space fabric quntons	Electromagnetic quantons
Kinetic degrees of freedom	none	one
Dominant fields Dof's Dof_{qf} , Dof_{qc}	2.5, 1.5	2 , 1
Field energy density	4-Dimensional	3D+relativistic Dof
Viewed as	Static (Q+AQ) pair	Relativistic (Q+AQ) pair

Table. 3 Comparison between space fabric and electromagnetic quantons

	Dof_x (kinetic)	Dof_s	Dof_t	Total Dof's
E (x)	0.50	$(D_{sf})_q = (D_{sc})_{aq}$ =1.75	$(D_{tc})_q = (D_{tf})_{aq}$ $= 0.25$	*2.00*
B (x)	0.50	$(D_{sc})_q = (D_{sf})_{aq}$ = 0.25	$(D_{tf})_q = (D_{tc})_{aq}$ $= 0.75$	1.00
total	1.00	2.00	1.00	

Table. 4 How degrees of freedom of freedom are shared among the different energy fields for the case of electromagnetic waves

25.Representation of EM field as space and time fields

Here , an integrated approach is provided for the treatment of electromagnetic Field as as a quantized phenomena which was attempted previously [10], [11] The formulation of electromagnetic waves in terms of energy fields depends on the system of units, under the (Esu) system volumetric electromagnetic energy density $\varrho_e = \mathrm{E}^2 = \mathrm{c}^2\,\mathrm{B}^2$ (1-25)

(ε)= 1 , $\mu = \frac{1}{c^2}$, under such system electric and the magnetic fields are defined as follows

$$\mathrm{E_f(x)} = (\frac{\mathrm{E_{qf}}}{\sqrt{\mathrm{c}}})_\mathrm{q} = (\frac{\mathrm{E_{sf}\,E_{tc}}}{\sqrt{\mathrm{c}}})_\mathrm{q} \quad , \quad E_c(\mathrm{x}) = (\frac{\mathrm{E_{qc}}}{\sqrt{\mathrm{c}}})_\mathrm{aq} = (\frac{\mathrm{E_{sc}\,E_{tf}}}{\sqrt{\mathrm{c}}})_\mathrm{aq} \qquad (2\text{-}25),(3\text{-}25)$$

$$\mathrm{B_c(x)} = (\frac{\mathrm{E_{qc}}}{\sqrt{\mathrm{c}}})_\mathrm{q} = (\frac{\mathrm{E_{sc}\,E_{tf}}}{\sqrt{\mathrm{c}}})_\mathrm{q} \quad , \quad \mathrm{B_f(x)} = (\frac{\mathrm{E_{qf}}}{\sqrt{\mathrm{c}}})_\mathrm{aq} = (\frac{\mathrm{E_{sf}\,E_{tc}}}{\sqrt{\mathrm{c}}})_\mathrm{aq} \qquad (4\text{-}25),(5\text{-}25)$$

where $\mathrm{E_f(x)}$ is the electric field due to the free dominated field $(\mathrm{E_{qf}})_q$ of the quanton while $\mathrm{E_c(x)}$ is the electric field due to the constrained field $(\mathrm{E_{qc}})_{aq}$ of

the anti quanton.

$B_f(x)$ **is the magnetic field due to the free dominated field** $(E_{qf})_{aq}$ **of the anti quanton ,** $B_c(x)$ **is the magnetic field due to the constrained field** $(E_{qc})_q$ **of the quanton**

While propagate along x- axis given that

$$(\psi_{sf}\psi_{tc})(\psi_{sc}\psi_{tf}) = \frac{1}{2}(e^{j(kx-\omega t)} - e^{-j(kx-\omega t)}) = cos(kx-\omega t) \qquad \textbf{(6-25)}$$

define the electromagnetic (sinusoidal waves) as $E(x)$ **,** $B(x)$

$$E(x) = \frac{1}{2}(E_f(x) + E_c(x)) = \frac{1}{2}[\left(\frac{E_{sf}\,E_{tc}}{\sqrt{c}}\right)_q + \left(\frac{E_{sc}\,E_{tf}}{\sqrt{c}}\right)_{aq}] \qquad \textbf{(7-25)}$$

$$B(x) = \frac{1}{2}(B_c(x) + B_f(x)) = \frac{1}{2}[\left(\frac{E_{sc}\,E_{tf}}{\sqrt{c}}\right)_q + \left(\frac{E_{sf}\,E_{tc}}{\sqrt{c}}\right)_{aq}] \qquad \textbf{(8-25)}$$

<u>for the (si) system of units</u>

$$U = \varepsilon_o E^2 = \frac{1}{\mu_o}B^2 \qquad \textbf{(9-25)}$$

$$E_f(x) = (\frac{E_{qf}}{\sqrt{c}})_q = (\frac{E_{sf}\,E_{tc}}{\sqrt{c}})_q \quad , \quad E_c(x) = (\frac{E_{qc}}{\sqrt{c}})_{aq} = (\frac{E_{sc}\,E_{tf}}{\sqrt{c}})_{aq} \qquad \textbf{(10-25),(11-25)}$$

$$B_c(x) = (\frac{E_{qc}}{\sqrt{c}})_q = (\frac{E_{sc}\,E_{tf}}{\sqrt{c}})_q \quad , \quad B_f(x) = (\frac{E_{qf}}{\sqrt{c}})_{aq} = (\frac{E_{sf}\,E_{tc}}{\sqrt{c}})_{aq} \qquad \textbf{(12-25),(13-25)}$$

define the electromagnetic (sinusoidal waves) as $E(x)$ **,** $B(x)$

$$E(x) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}[(E_f(x) + E_c(x)] \qquad \textbf{(13-25)}$$

$$= \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}[\left(\frac{E_{sf}\,E_{tc}}{\sqrt{c}}\right)_q + (\frac{E_{sc}\,E_{tf}}{\sqrt{c}})_{aq}] \qquad \textbf{(14-25)}$$

$$B(x) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}[B_c(x) + B_f(x)] = \qquad \textbf{(15-25)}$$

$$B(x) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}[(\frac{E_{sc}\,E_{tf}}{\sqrt{c}})_q + (\frac{E_{sf}\,E_{tc}}{\sqrt{c}})_{aq}] \qquad \textbf{(16-25)}$$

And in terms of the free and constrained fields (E_{qf}, E_{qc} **) of the quanton / anti quanton pair**

$$E(x) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}[\left(\frac{E_{qf}}{\sqrt{c}}\right)_q + (\frac{E_{qc}}{\sqrt{c}})_{aq}] \qquad \textbf{(17-25)}$$

$$B(x) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}[\left(\frac{E_{qc}}{\sqrt{c}}\right)_q + (\frac{E_{qf}}{\sqrt{c}})_{aq}] \qquad \textbf{(18-25)}$$

and as a magnitude of the electric and the magnetic field intensities

$$E_o(x) = (\frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{h}{16\,\pi^4\,c^3}})\,(k^2\,c^2)\ \ \textbf{(Dof = 2)} \qquad \textbf{[10]} \qquad \textbf{(19-25)}$$

$$B_o(x) = (\frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{h}{16\pi^4\,c^3}})\,(k^2\,c)\ \ \textbf{(Dof = one)} \qquad \textbf{[10]} \qquad \textbf{(20-25)}$$

To note that electromagnetic space and time varying energy fields of the relativistic quanton , propagation direction is translated into a kinetic degree of freedom which is subtracted from the free and constrained fields Dof's ,in other words $\mathrm{Dof}_{\text{electric field}} + \mathrm{Dof}_{\text{magnetic field}} + \mathrm{Dof}_{\text{kinetic}} = 3 + 1 + 1 = 4$ **(21-25)**

26-dimensional analysis

The dimensions of electromagnetic field is determined based on dimensions of free and constrained field

the electric field $[E] = \left[\frac{E_{sf}E_{tc}}{\sqrt{c}}\right] = M^{+0.5}L^{-0.5}T^{-1}$ **(1-26)**

and the magnetic field $[B] = \left[\frac{E_{sf}E_{tc}}{c\sqrt{c}}\right] = M^{+0.5}L^{+1.5}\, T^{00.0}$ **(2-26)**

$[\varrho_e]$ **= electromagnetic energy density =** $\left[\frac{E}{V}\right] = [\varepsilon E^2] = \mathrm{M}L^{-1}\,T^{-2}$

(ε : can be chosen according to a system of units to be = 1)

$\varrho_e = (\,E_f \,+\, c\,E_c)^{\,2} = (\frac{E_{sf}\,E_{tc}}{\sqrt{c}} \,+ \sqrt{c}\,E_{sc}\,E_{tf})^{\,2}$ **(3-26)**

$[\varrho_q] = \frac{1}{4} * 4\left(\sqrt{\frac{h}{16\ \pi^4\ c^3}}\ \right)^2 (k^2\,c^2))^{\,2} = \left(\frac{hc}{16\ {r_q}^4}\right) = \frac{hc}{\lambda^4}$ **(4-26)**

$= [\frac{E}{V}] = \mathrm{ML}^{-1}T^{-2}$,

this is the generic form of electromagnetic energy density

while in terms of the magnetic field

$[\frac{E}{V}] = \left[\frac{B^2}{\mu}\right] = \mathrm{ML}^{-1}T^{-2}$ **(5-26)**

$[\varrho_e] = c^2(\,B_c \,+\, \frac{1}{c}\,B_f)^{\,2} = c^2(\frac{E_{sc}\,E_{tf}}{\sqrt{c}} \,+ \frac{1}{c}\ \frac{E_{sf}\,E_{tc}}{\sqrt{c}})^{\,2}$ **(6-26)**

(μ **: chosen according to a system of units to be =** $\frac{1}{c^2}$ **)**

$\varrho_e = \ [\sqrt{\frac{h}{16\,\pi^4\ \ c^3}}\ \ )^{\,2}(k^2\,c\,)]^{\,2} = \frac{hc}{16\,\pi^4}\ k^4 = [\frac{E}{V}] = \mathrm{M}L^{-1}T^{-2}$ **(7-26)**

27.Maxwell equations of energy fields

We can relate the four Maxwell equations for electromagnetism to their original form for space and time energy fields.

We have defined the electromagnetic waves as the relativistic quantons / anti Quanton pair that is travelling through space at velocity (c) in the form

$$E = \frac{1}{2}[\left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\ \right)_q + (\frac{E_{sc}\ E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}})_{aq}] \quad (1\text{-}27)$$

$$B = \frac{1}{2}[(\frac{E_{sc}\ E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}})_q + (\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}})_{aq}] \quad (2\text{-}27)$$

substituting in the four Maxwell equations with the constituent energy fields corresponding to the electric and magnetic fields

<u>1-Gauss law of electric field</u>

$$\nabla . E = \frac{\varrho_c}{\varepsilon_o} \quad (3\text{-}27)$$

ϱ_c : charge density

$$\nabla . E = \nabla . \left[\left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\ \right)_q + \left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}}\right)_{aq})\right] = 2\left(\frac{\varrho_c}{\varepsilon_o}\right) \quad (4\text{-}27)$$

$$\nabla . (E_{sf}\ E_{tc})_q + \nabla . (E_{sc}\ E_{tf})_{aq} = 0 \quad (5\text{-}27)$$

(for electromagnetic waves and space fabric case ϱ_c =0)

$$\text{Or}\quad \nabla . (E_{sf}\ E_{tc})_q = -\nabla . (E_{sc}\ E_{tf})_{aq} \quad (6\text{-}27)$$

<u>2-Gauss law of magnetic field</u>

$$\nabla . B = 0 \quad (7\text{-}27)$$

$$\frac{1}{\sqrt{\varepsilon_o}\sqrt{c}}\nabla . (E_{sc}\ E_{tf})_q + \frac{1}{\sqrt{\varepsilon_o}\sqrt{c}}\nabla . (E_{sf}\ E_{tc})_{aq} = 0 \quad (8\text{-}27)$$

$$\text{Or}\quad \nabla . (E_{sf}\ E_{tc})_{aq} = -\nabla . (E_{sc}\ E_{tf})_q \quad (9\text{-}27)$$

$$\nabla . (E_{qc})_q = -\nabla . (E_{qf})_{aq} \quad (10\text{-}27)$$

3-<u>farday's law for electric field</u>

$$\nabla \times E = -\frac{\partial B}{\partial t} \quad (11\text{-}27)$$

$$\nabla \times E = \nabla \times (\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}})_q + \nabla \times (\frac{E_{sc}\ E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}})_{aq} \quad (12\text{-}27)$$

$$-\frac{\partial B}{\partial t} = -\frac{\partial}{\partial t}\left(\frac{E_{sc}\ E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \frac{\partial}{\partial t}(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}})_{aq} \quad (13\text{-}27)$$

By comparing eq 8 , 9 We get

$$\nabla \times (\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}})_q = -\frac{\partial}{\partial t}(\frac{E_{sc} E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}})_q \quad (14\text{-}27)$$

$$\nabla \times (E_{sf}\ E_{tc})_q = -\frac{\partial}{\partial t}(E_{sc}\ E_{tf})_q \quad \text{and} \quad (15\text{-}27)$$

$$\nabla \times (E_{qf})_q = -\frac{\partial}{\partial t}(E_{qc})_q \quad (16\text{-}27)$$

$$\nabla \times (\frac{E_{sc}\ E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}})_{aq} = -\frac{\partial}{\partial t}(\frac{E_{sf} E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}})_{aq} \quad \text{or} \quad (17\text{-}27)$$

$$\nabla x\,(\mathbf{E}_{sc}\ \mathbf{E}_{tf})_{aq} = -\frac{\partial}{\partial t}(\mathbf{E}_{sf}\ \mathbf{E}_{tc})_{aq} \qquad (18\text{-}27)$$

Which can be simplified further as

$$\nabla x\,(\ \mathbf{E}_{qc}\ )_{aq} = -\frac{\partial}{\partial t}(\mathbf{E}_{qf})_{aq} \qquad (19\text{-}27)$$

4-ampere's law for magnetic field

$$\nabla x\mathbf{B} = \mu_o(\ \mathbf{J} + \varepsilon_o \frac{\partial E}{\partial t}) \qquad (20\text{-}27)$$

Where $\mu_o\,\varepsilon_o = \frac{1}{c^2}$

$$\nabla x\mathbf{B} = \nabla x(\frac{\mathbf{E}_{sc}\,\mathbf{E}_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}})_q + \nabla x\,(\frac{\mathbf{E}_{sf}\,\mathbf{E}_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}})_{aq} \qquad (21\text{-}27)$$

$$\frac{1}{c^2}\frac{\partial E}{\partial t} = \frac{1}{c^2}\frac{\partial}{\partial t}\,[\left(\frac{\mathbf{E}_{sf}\,\mathbf{E}_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + (\frac{\mathbf{E}_{sc}\,\mathbf{E}_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}})_{aq}\,] \qquad (22\text{-}27)$$

$$= \frac{1}{c^2}\frac{\partial}{\partial t}(\frac{\mathbf{E}_{sf}\mathbf{E}_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}})_q + \frac{1}{c^2}\frac{\partial}{\partial t}(\frac{\mathbf{E}_{sc}\,\mathbf{E}_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}})_{aq} \qquad (23\text{-}27)$$

By comparing eq 13 , 15 we get

$$\nabla x(\ \mathbf{E}_{sc}\ \mathbf{E}_{tf})_q = \frac{1}{c^2}\frac{\partial}{\partial t}(\mathbf{E}_{sf}\mathbf{E}_{tc})_q \quad \text{or} \qquad (24\text{-}27)$$

$$\nabla x(\ \mathbf{E}_{qc})_q = \frac{1}{c^2}\frac{\partial}{\partial t}(\mathbf{E}_{qf})_q \quad \text{and} \qquad (25\text{-}27)$$

$$\nabla x(\ \mathbf{E}_{sf}\ \mathbf{E}_{tc})_{aq} = \frac{1}{c^2}\frac{\partial}{\partial t}(\ \mathbf{E}_{sc}\ \mathbf{E}_{tf})_{aq} \qquad (26\text{-}27)$$

$$\nabla x(\ \mathbf{E}_{qf}\ )_{aq} = \frac{1}{c^2}\frac{\partial}{\partial t}(\ \mathbf{E}_{qc})_{aq} \qquad (27\text{-}27)$$

It is worth noting that Maxwell equations remain invariant under relativistic effects as this effect is split equally between two fields $\mathbf{E}_{qf}$ **and** $\mathbf{E}_{qc}$

28.Role of Maxwell equations in the formation of the quanton

28.1 Quanton formation

Based on the previous results of Maxwell's equations which link the fields of both the quanton and the anti quanton together, the quanton 's own form of Maxwell equations can be deduced

1- the constrained field $(\mathbf{E}_{qc})$ **rate of variation Induces a curl in the free dominated field such that** $\nabla x\mathbf{E}_{qf} = -\frac{\partial \mathbf{E}_{qc}}{\partial t}$

2- the rate of variation of the free dominated field $\mathbf{E_{qf}}$ induces a a curl in the constrained space field $\mathbf{E_{qc}}$,*such that* $\nabla \mathrm{x}\, \mathbf{E}_{\mathbf{qc}} = \frac{1}{c^2}\frac{\partial\, \mathbf{E}_{\mathbf{qf}}}{\partial t}$

28.2 the anti quanton formation

1- the free dominated field ($\mathbf{E}_{qf}$) rate of variation Induces a curl in the Constrained field such that $\nabla \mathrm{x}\, \mathbf{E}_{\mathbf{qc}} = -\frac{\partial\, \mathbf{E}_{\mathbf{qf}}}{\partial t}$

2- the rate of variation of the constrained field $\mathbf{E_{qc}}$ induces a

a curl in the constrained space varying field E_{qf} ,*such* that $\nabla \mathrm{x}\, \mathbf{E}_{\mathbf{qf}} = \frac{1}{c^2}\frac{\partial\, \mathbf{E}_{\mathbf{qc}}}{\partial t}$

28.3- inter quanton relationship

the relationship between the quanton and anti quanton dominant fields is antisymmetric where

1-the gradient of the free dominated quanton field equals in magnitude with opposite sign the gradient of the constrained field of anti quanton field or

$$\nabla.(\mathbf{E_{qf}})_{\mathbf{q}} = -\ \nabla.(\mathbf{E_{qc}})_{\mathbf{aq}}$$

2-the gradient of the quanton constrained field equals in magnitude and opposite sign to the gradient of the free dominated field of the anti quanton

$$\nabla.(\mathbf{E_{qc}})_{\mathbf{q}} = -\ \nabla.(\mathbf{E_{qf}})_{\mathbf{aq}}$$

fig .8. shows the role of Maxwell equations in the formation of the quanton/ anti quanton fields

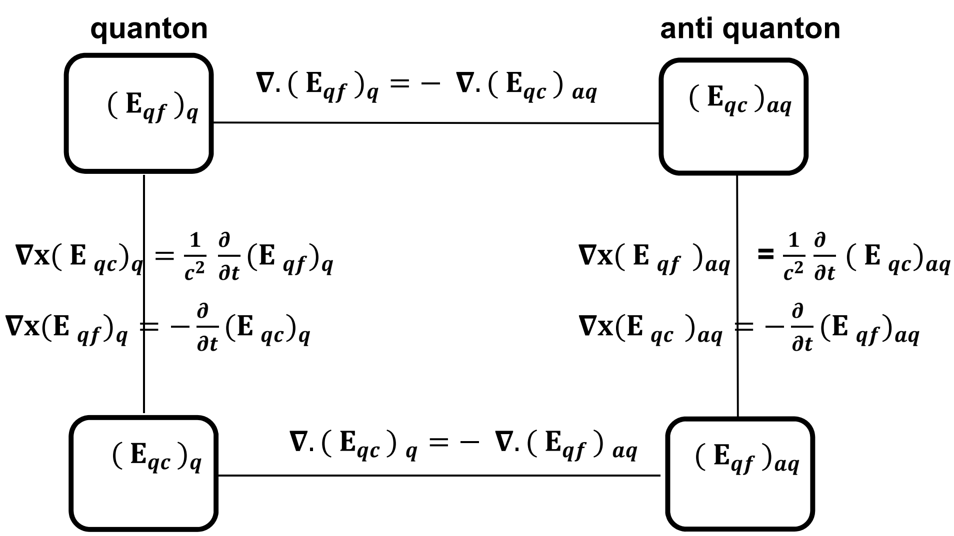


Fig.8 Maxwell equations fully define the space and time varying fields of both quanton and anti quanton

29.Lorentez transformation of energy fields

In the previous chapters we have discussed the concept of a relativistic quanton and how it is represented electromagnetic waves in the form of space and time varying fields

Here , the Lorentz transformation will be discussed , for the electromagnetic waves (this time in terms of the quanton Energy fields)

Considering the case when energy fields are seen by an observer traveling at relativistic velocity along x axis

2-for Lorentz transformation of electromagnetic waves , and while denoting (') for the case of a moving frame of reference , the transformation takes the form

$$E_x' = E_x \;,\; E_y' = \gamma(E_y + \beta c B_z) \qquad (1\text{-}29)$$

$$E_z' = \gamma(E_z + \beta c B_y) \;,\quad B_x' = B_x \qquad (2\text{-}29)$$

$$B_y' = \gamma\left(B_y - \frac{v E_z}{c^2}\right) \;,\; B_z' = \gamma\left(B_z - \frac{v E_y}{c^2}\right) \qquad (3\text{-}29)$$

$$\beta = \frac{v}{c} \quad , \quad \gamma = \frac{1}{\sqrt{\left(1-(\frac{v}{c})^2\right)}} = \frac{1}{\sqrt{(1-\beta^2)}} \qquad (4\text{-}29)$$

In this case the electric field is represented by the field $E_y(x)$, and the magnetic field is represented by the field $B_z(x)$

Using the same transformation for the case of free and constrained fields, where

$$E = \frac{1}{2}\left[\left(\frac{E_{sf}\; E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \left(\frac{E_{sc}\; E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}}\right)_{aq}\right] \qquad (5\text{-}29)$$

$$B = \frac{1}{2}\left[\left(\frac{E_{sc}\; E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \left(\frac{E_{sf}\; E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_{aq}\right] \qquad (6\text{-}29)$$

after substitution , we get for E and B

$$E_y' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}\left[\left(\frac{E_{sf}\; E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \left(\frac{E_{sc}\; E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}}\right)_{aq} + v\left(\frac{E_{sc}\; E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + v\left(\frac{E_{sf}\; E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_{aq}\right] \qquad (7\text{-}29)$$

Given that $c\left(\frac{E_{sf}\; E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_{aq} = \left(\frac{E_{sf}\; E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q = \left(\frac{E_{sf}\; E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_E$ **(8-29)**

And $c\left(\frac{E_{sc}\; E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q = \left(\frac{E_{sc}\; E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_{aq} = \left(\frac{E_{sc}\; E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_E$ **(9-29)**

$$E_y' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}\left[\left(\frac{E_{sf}\; E_{tc}}{\sqrt{c}}\right)\left(1 + \frac{v}{c}\right) + c\left(\frac{E_{sc}\; E_{tf}}{\sqrt{c}}\right)\left(1 + \frac{v}{c}\right)\right] \qquad (10\text{-}29)$$

$$E_y{}' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}\left[\left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\ \right)_E + \left(\frac{E_{sc}\ E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_E\right]\left(1+\frac{v}{c}\right) = \sqrt{\frac{\left(1+\frac{v}{c}\right)}{\left(1-\frac{v}{c}\right)}}\ E_y \qquad (11\text{-}29)$$

Where $\gamma\left(1+\frac{v}{c}\right) = \frac{\sqrt{\left(1+\frac{v}{c}\right)}\sqrt{\left(1+\frac{v}{c}\right)}}{\sqrt{\left(1+\frac{v}{c}\right)}\sqrt{\left(1-\frac{v}{c}\right)}} = \sqrt{\frac{\left(1+\frac{v}{c}\right)}{\left(1-\frac{v}{c}\right)}}$ **(12-29)**

$$B_z{}' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}\left\{\left[\left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_{aq}\right] - \left(\frac{v}{c^2}\right)\left[\left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\ \right)_q + \left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}}\right)_{aq}\right]\right\} \qquad (13\text{-}29)$$

Given that $\left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\ \right)_{aq} = \frac{1}{c}\left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\ \right)_q = \left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\ \right)_B$ **(14-29)**

And $\left(\frac{E_{sc}\ E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q = \frac{1}{c}\left(\frac{E_{sc}\ E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_{aq} = \left(\frac{E_{sc}\ E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_B$ **(15-29)**

$$B_z{}'\ \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}\left\{\left[\left(\frac{E_{sf}\ E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_B\left(1-\frac{v}{c}\right) + \left[\left(\frac{E_{sc}\ E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_B\left(1-\frac{v}{c}\right)\right]\right\} = \sqrt{\frac{\left(1-\frac{v}{c}\right)}{\left(1+\frac{v}{c}\right)}}\ B_z \qquad (16\text{-}29)$$

Where $\gamma\left(1-\frac{v}{c}\right) = \frac{\sqrt{\left(1-\frac{v}{c}\right)}\sqrt{\left(1-\frac{v}{c}\right)}}{\sqrt{\left(1+\frac{v}{c}\right)}\sqrt{\left(1-\frac{v}{c}\right)}} = \sqrt{\frac{\left(1-\frac{v}{c}\right)}{\left(1+\frac{v}{c}\right)}}$ **(17-29)**

For a comoving frame of reference at v where $\beta = \frac{v}{c}$ **and** $\gamma = \frac{1}{\sqrt{1-\beta^2}}$

The electromagnetic fields as viewed by moving observer are

$$E' = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\left(\frac{E_{sf}{}'\,E_{tc}{}'}{\sqrt{c}} + c\,\frac{E_{sc}{}'\,E_{tf}{}'}{\sqrt{c}}\right) = \frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{1+\beta}{1-\beta}}\ K_q{}^2\,c^2\cos(k'r' - \omega' t') \qquad (18\text{-}29)$$

$$B' = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\left(\frac{E_{sc}{}'\,E_{tf}{}'}{\sqrt{c}} + \frac{1}{c}\frac{E_{sf}{}'\,E_{tc}{}'}{\sqrt{c}}\right) = \frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{1-\beta}{1+\beta}}\ K_q{}^2\,c\ \cos(k'r' - \omega' t') \qquad (19\text{-}29)$$

Where $k' = \sqrt{\frac{1-\beta}{1+\beta}}\ k$, $r' = \sqrt{\frac{1-\beta}{1+\beta}}\ r$ **(20-29),(21-29)**

$\omega' = \sqrt{\frac{1-\beta}{1+\beta}}\ \omega$, $t' = \sqrt{\frac{1-\beta}{1+\beta}}\ t$ **(22-29),(23-29)**

to note that the product $E_y{}'B_z{}' = \sqrt{\frac{\left(1+\frac{v}{c}\right)}{\left(1-\frac{v}{c}\right)}}\ E_y\ \sqrt{\frac{\left(1+\frac{v}{c}\right)}{\left(1+\frac{v}{c}\right)}}\ B_z$ **(24-29),(25-29)**

= $E_y\,B_z = \text{constant}$ **, irrespective of the frame of reference**

30. Ethical statement

The author declares that this work fully complies with the ethical guidelines as had been stated by the journal.

31.Conclusions

Uniformity and homogeneity of CMB testifies to its origin which is the release of radiation from the space fabric as a direct result of the process of free expansion of the universe (second law of Thermodynamics) , this gives a gate way for further understanding of the quanton interactions.

33.References

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Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.