Quanton based model of field interactions

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Abstract

the mechanism of the universe's inflation is variation of energy in space and in time , the relationship between space and time varying energy fields is governed by energy constraining inside a quantum entity : the quanton

as energy varies in space or in time, it creates associated fields and through their interactions, inflationary momentum and the fundamental forces are generated

this model comes in three parts : energy constraining , where the evolution of the quanton and its different transitions are discussed the second part , electromagnetic waves in terms of space and time varying energy fields and role of Maxwell equations in the evolution of the quanton

the third part , energy fields and their interactions , while using basic physics concepts , this model shows that the origin many of the physical phenomena can be traced back to the quanton based world

<u>Key words</u>

space and time varying fields , energy degrees of freedom

Contents

1. The physical basis of this model

This model is based on the following two concepts

a-the relationship between energy density inside the quanton

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

the following points will be discussed throughout the model

1-as energy expands from a packet state (energy non varying in

space or time) , It creates associated fields that vary in space and

in time

2- the symmetric nature of this variation in space and in time

3- 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 an accumulation of space and time varying energy fields , as those fields vary at periodic rate , they possess wave like behaviour, (it will be later discussed why those fields do not interact directly with electromagnetic waves ,and when and how such waves leave the quanton)

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

2-they exist in lattice form which constitutes the space fabric

3-quantons are spherical in shape due to equi-partition of energy (here it will be called :dimensional energy symmetry) but may vary in their energy content (packet or total energy) and in volume with time as they expand and split

4-quantons are held in a quasi equilibrium state under the effect

of Internal and external interactions of energy fields

5-due to the imbalance of these interactions the quantons expand , then split up , the resulting pair share up the original energy content , fig.1. provides a summery of various states which quanton goes through

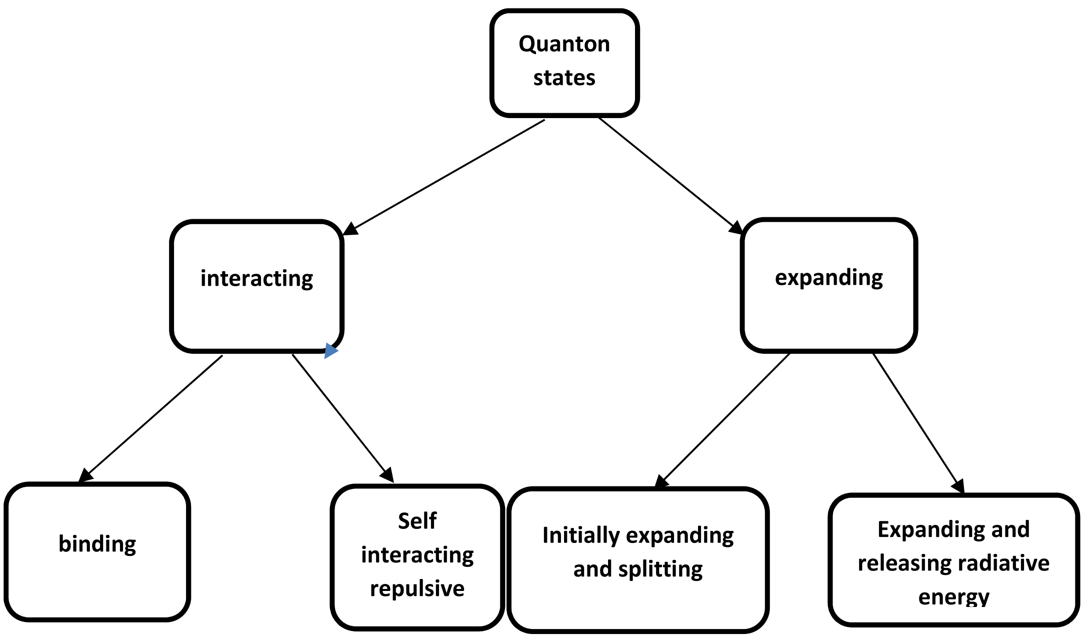


Fig.1. summary of the quanton states

2.b.Anti quantons

anti quantons are similar to quantons but the dominant nature of their energy differs from that of the quanton

2.b.1 Anti quanton generation

anti quntons are generated from quantons , quantons and anti quantons exist in pairs as they become a quantum entity of the form Q+AQ

3. Mathematical brief

1-The following formulations for various energy fields inside or outside the quanton (anti quanton) ,

$E_{sf} = \frac{\partial E}{\partial s}$: 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)

2-quanton and anti quanton energy density equation is in the form of $E_q = E_{sf}\, E_{sc}\, E_{tf}\, E_{tc}$ and neither in the form (7-3)

E_q = $\sqrt{E_{sf}{}^2 + E_{sc}{}^2 + E_{tf}{}^2 + E_{tc}{}^2}$ nor the form $E_q = E_{sf} + E_{sc} + E_{tf} + E_{tc}$

3-energy fields are vector quantities which have direction as well as magnitude.

4 -an energy field like free space varying energy can be defined as

$E_{sf} = K_{sf} D_{sf} \psi_{sf}$ (8-3)

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

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

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

5-the two types of quanton energy fields are the free energy

dominated E_{qf} $=E_{sf}E_{tc}$ (9-3)

and the constrained energy dominated E_{qc} = $E_{sc}E_{tf}$ 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)**

6- $E = E_s E_t$ **(an energy packet state – energy not varying in space or time , no associated fields) (11-3)**

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

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

Each of those four functions expresses the change of either space or time as follows ,

$1 - \psi_{sf} = e^{+\frac{jr}{2r_q}}$ **which defines change of free energy field in space , r = (x, y, z) , (2-4)**

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

$3 - \psi_{tf} = e^{+j\omega t}$ **: that expresses variation of free energy field in time**

$4 - \psi_{tf} = e^{-j\omega t}$ **: variation parameter of constrained energy field in time**

5. <u>Energy constraining</u>

1-Energy constraining describes evolution , interaction of energy fields which is summarized as

a-the act of containment free energy fields (E_{sf}, E_{tf}) **inside quantons (this will be discussed in the section : Maxwell equations role in the evolution of quantons)**

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

c- evolution of the quanton fields' degrees of freedom

d-energy field expansion inside the quanton and its subsequent

splitting

e- the release of radiation energy as a result of the quanton expansion

2-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 dimensions ,and this is only possible inside a spherical structure, a quanton , so , dimensional energy symmetry (DES) is behind the evolution of the quantons as a spatially symmetric shape

3-as energy is released , it must expand , 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 that varies in space and free Energy that varies in time) ,such expansion takes the form

$\frac{\partial}{\partial s}$ (E) = $\frac{\partial}{\partial s}(E_s\ E_t)$ = $\frac{\partial E}{\partial s}\frac{\partial E}{\partial t}$ = $E_{sf}\ E_{tf}$

4-energy fields cannot vary in space and time simultaneously

, so no energy field is in the form $E_{sf,tf} = fn\ (s\ , t)$

, but rather $E = E_{sf}\ (x, y, z)\ \ E_{tf}\ (t)$

and this is because the relationship between the expansion of space varying and time varying fields is diametric , as the time varying field (curls) the free expansion of space varying field hence the appearance of the quanton (this point will be further discussed in the section Maxwell equations of energy fields)

5-Energy fields can either be free in space varying

($E_{sf} = \frac{\partial E}{\partial s}$) **or free in time varying field** ($E_{tf} = \frac{\partial E}{\partial t}$)

or space constrained ($E_{sc} = \int E_s\ ds$) **or time constrained**

($E_{tc} = \int E\ \ dt$) , **while non space or time varying energy in the form (E=** $E_s\ \ E_t$ **) can be defined as an energy packet state**

:energy that does not change in space or in time

6-the appearance of constrained energy fields inside the quanton (anti quanton) , 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 (discussed in detail in the section : space fabric field interactions and why space fabric generates binding interactions)

7-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 space varying energy field (E_{sf})

8-as time varying energy expands (E_{tf}) , it must be expand in part by variation in space as well , hence the appearance of space varying constrained energy field (E_{sc}) such that $E_{qc} = E_{sc} E_{tf}$, so (E_{qc}) is a predominantly constrained type due to the field (E_{sc})

9-as energy expands from a packet 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 (needless to say one of them varies in time)

10- based on the previous point, inside the quanton (anti quanton) energy fields cannot expand by free variation in space and in time in the form $E_q = E_{sf} E_{tc}$ or of the form $E_{aq} = E_{sc} E_{tf}$ alone

the emerging fields for the quanton now become

$$E_q = (E_{sf} E_{tc})(E_{sc} E_{tf}) = E_{qf} E_{qc} \qquad (1\text{-}5)$$

and for anti quanton

$$E_{aq} = \left(\frac{E_{sf} E_{tc}}{c}\right)(c\, E_{sc} E_{tf}) = \left(\frac{E_{qf}}{c}\right)(c E_{qc}) \qquad (2\text{-}5)$$

This quanton energy density equation represents two fields

(discussed in the section : wave model inside the quanton) one of them is free energy dominated or $\mathbf{E_{qf}} = (\mathbf{E_{sf}E_{tc}})$,and the

other is constrained energy dominated $\mathbf{E_{qc}} = (\mathbf{E_{sc}E_{tf}})$

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 different from those of the quanton (this will be discussed later in the sections : quanton and anti quanton evolution and their energy degrees of freedom)

11- the fields $\mathbf{E_{qf}}$, $\mathbf{E_{qc}}$ are orthogonal (will be discussed further in the section: Maxwell's equations of energy fields)

12- for free energy fields $\mathbf{E_{sf}}$, $\mathbf{E_{tf}}$, 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 space varying field , full expansion in space

$\frac{\partial}{\partial x}\frac{\partial y}{\partial y}\frac{\partial}{\partial z}(\mathbf{E_s}) = \frac{\partial \mathbf{E}}{\partial s}$ $=\mathbf{E_{sf}}$ (energy expands from a packet state to

become a space varying field)

b-constraining of free energy fields takes the form

$\iiint \mathbf{E_{sf}}$ **dx dy dz =** $\mathbf{E_s}$ **(free space varying field is packetized-**

reduced into a non varying state) , **(3-5)**

c- for free time varying field

$\frac{\partial}{\partial t}(\mathbf{E_t}) = \frac{\partial \mathbf{E}}{\partial t} = \mathbf{E_{tf}}$ **, and constraining** $\int \mathbf{E_{tf}} = \mathbf{E_t}$ **(4-5)**

13- for constrained energy fields $\mathbf{E_{sc}}$ **,** $\mathbf{E_{tc}}$ **, integration is the mathematical expression of free energy expansion by variation in space or time, and differentiation is the corresponding mathematical expression of energy constraining in space or time**

a- for constrained space varying field , expansion in space is defined as $\iiint \mathbf{E_s}$ **dx dy dz =** $\mathbf{E_{sc}}$ **(expansion of constrained space varying field)**

b- while constraining takes the form

$\frac{\partial}{\partial x}\frac{\partial y}{\partial y}\frac{\partial}{\partial z}(E_{sc}) = \frac{\partial}{\partial s}(E_{sc}) = E_s$ (reduction of constrained space

varying field into a packet state-non varying in space or time),

(5-5)

c- for time varying field

expansion in time $\int E_t \, dt = E_{tc}$, and when being constrained

$$\frac{\partial}{\partial t}(E_{tc}) = E_t \quad (6\text{-}5)$$

14- energy field (free-constrained) expansion inside the quanton is

more or less a process of differentiating two variables

15- expansion of (free- constrained) energy fields by variation in

space or time follows differentiation of two variables rule

$$\frac{\partial}{\partial x}(f(x)\, g(x)) = \frac{\partial f}{\partial x}\, g(x) + \frac{\partial g}{\partial x}\, f(x)$$

results of an energy expansion process inside the quanton =

expansion of the (free -constrained fields) +

constraining of (free- constrained fields)

let's consider the case of expansion of free space varying field E_{sf}

inside the quanton or $\frac{\partial}{\partial s}(\frac{\partial E}{\partial s}) = \frac{\partial E}{\partial s}\int E \ dt = E_{sf}\ E_{tc}$ (7-5)

(this step will be further elaborated in the chapters : quanton degrees of freedom and the role of Maxwell equations in the evolution of the quanton)

16- similarly for the case of free time varying field

$$\frac{\partial}{\partial t}(\frac{\partial E}{\partial t}) = \frac{\partial E}{\partial t}\int E \ ds = E_{sc}\ E_{tf} \quad (8\text{-}5)$$

Now the quanton energy density equation

$$E_q = (\frac{\partial E}{\partial s}\int E \ dt)(\int E \ ds \frac{\partial E}{\partial t}) = (E_{sf}\ E_{tc})(E_{sc}\ E_{tf}) \quad (9\text{-}5)$$

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 inside the quanton

17- 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

$\mathbf{Dof_q} = \mathbf{Dof_{sf}} + \mathbf{Dof_{sc}} + \mathbf{Dof_{tf}} + \mathbf{Dof_{tc}} = 4$ **(10-5)**

18- it is understood that the space varying energy fields (free and constrained) have three degrees of freedom or

$\mathbf{Dof_{sf}} + \mathbf{Dof_{sc}} = 3$ **(11-5)**

while time varying energy fields (free and constrained) have one degree of freedom or $\mathbf{Dof_{tf}} + \mathbf{Dof_{tc}} = \text{one}$ **(12-5)**

19–energy fields $\mathbf{E_{sf}}$, $\mathbf{E_{tf}}$, $\mathbf{E_{sc}}$, $\mathbf{E_{tc}}$ **do not have the dimensions of energy , but their product (**$\mathbf{E_q}$ **) does have the dimensions of energy density which is defined as energy divided by three dimensional volume** $[\mathbf{E_q}] = [\frac{\text{energy}}{\text{volume}}] = \mathbf{M\ L^{-1}T^{-2}}$

(later , it will be shown that this energy density is in fact four dimensional that expands in 3 D space)

20- as free energy fields expand , constraining of the expanding

fields takes place

$$\frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s}\right) = \frac{\partial E}{\partial s} + \int \left(\frac{\partial E}{\partial s}\right) ds \text{ or}$$

$$\frac{\partial}{\partial s}\left(E_{sf}\right) = \frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s}\right) = \frac{\partial E}{\partial s} + \text{constraining term}$$

$$\text{and } \frac{\partial}{\partial t}\left(E_{tf}\right) = \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) = \frac{\partial E}{\partial t} + \int \left(\frac{\partial E}{\partial t}\right) dt \text{ or}$$

$$\frac{\partial}{\partial t}\left(E_{tf}\right) = \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) = \frac{\partial E}{\partial t} + \text{constraining term}$$

and so on for higher order derivatives, and this process represents the expansion of the free energy by variation in space or time which must be accompanied by constraining while inside the quanton

21- as constrained energy fields expand , constraining of the expanding fields takes place

$$\int \left(\int E \ ds\right) ds = \int E \ ds + \frac{\partial}{\partial s}\left(\int E \ ds\right) \text{ or}$$

$$\int \left(\int E \ ds\right) ds = \left(\int E_{sc} \ ds\right) ds = \int E \ ds + \text{constraining term , and}$$

$\int\ (\int E\ \ dt)\ dt\ =(\int\ E_{tc}\ \ dt)\ dt\ =\int E\ \ dt\ +\frac{\partial}{\partial t}(\int E\ dt)$ **or**

$\int\ (\int E\ \ dt)\ dt\ \ =(\int\ E_{tc}\ \ dt)\ dt\ =\int E\ \ dt$ **+constraining term ,**

this means that expansion of constrained energy fields must also be accompanied by constraining of those constrained energy fields

22- when energy is released from a field constraining process

For free or constrained energy field as in (20) or (21) , it is released in the packet state $E= E_s\ E_t$ (energy non varying in space or time) in other words , released energy cannot take the form of E_s or E_t as either of those forms of energy do not exist independently

23- 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)

24- energy degree of freedom must be identical in spatial dimensions for (E_{sx}, E_{sy} , E_{sz}) for each field otherwise energy field is deemed to be unstable

25- an energy field expansion process results in an expanding field plus energy constraining , so it is expected that the total energy content of the quanton (or anti quanton) to decrease during the process of expansion

26- since the quanton is a quantum entity , its packet energy – total energy content of the quanton – 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

27- recalling point (7) , fields of the following forms do not exist independently

a- $\frac{\partial E}{\partial s}\ \frac{\partial E}{\partial t}$ (energy field can not expand in space and in time simultaneously without having a constrained part)

$\boldsymbol{b-(\int E\ \ ds \int E\ \ dt\,)}$ **(constrained energy field expand in space and in time simultaneously without having an free expansion part)**

28- 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*

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

30- the packet in this model assumes two roles

a-the packet energy : total energy of the quanton which is defined

as $E_p = \frac{h}{2\pi}\omega = \int \ E_q \ dV$ (13-5)

b- packet state which is the result from constraining process

and defined as E = $E_s \ E_t$

(energy nonvarying in space or in time)

6. Bridging the gap between mathematics physics of energy constraining

1-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

2-when dealing with expansion of constrained energy fields

integration is the physical equivalent to mathematically

maintaining one function as a constant

3-expansion of two energy fields of the form

$$\frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s} \ \frac{\partial E}{\partial t}\right) = \left(\frac{\partial E}{\partial s} \ \frac{\partial E}{\partial t}\right)\left(\int E \ ds \int E \ dt\right)$$

Could not be in the form $(\frac{\partial E}{\partial s} \quad \frac{\partial E}{\partial t})+(\int E\ ds \int E\ dt\ )$

Since the energy fields $(\frac{\partial E}{\partial s} \quad \frac{\partial E}{\partial t})$ or $(\int E\ ds \int E\ dt)$

are unstable in this form as the quanton is in the process of

formation and free or constrained energy fields could not exist

independently

4-The quanton energy density equation

$E_q = (\frac{\partial E}{\partial s} \frac{\partial E}{\partial t}) (\int E\ ds \int E\ dt)$,expresses two physical entities

(free energy fields : $(\frac{\partial E}{\partial s} \frac{\partial E}{\partial t})$ 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)

5-recalling points (13), (14) from previous section , for complex

Energy fields (free /constrained)

$E_q = E_{sf}\ E_{sc}\ E_{tf}\ E_{tc}$ energy constraining which happens through

Quanton expansion in space is defined as

$\frac{\partial}{\partial s}(E_q) = \frac{\partial}{\partial s}((E_{sf}\ E_{tc})(\ E_{sc}\ E_{tf}))$

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

$= (E_{sf}\ E_{tc}\ \ E_{sc}\ \ E_{tf}) + E_s E_t$ **(1-6)**

6- when dealing with Energy field expansion inside the quanton

there would be two terms as a result of the expansion

a-expansion term : differentiating free energy fields *integration of

constrained energy fields

b-constraining term : integrating free energy fields * differentiating

constrained fields

7- energy expansion process inside the quanton , involves

both free and constrained energy fields , and to avoid confusion

while using the gradient operator (∇) for both types of field

expansion ,the use of the differential / integral operators will be

maintained as ($\frac{\partial}{\partial s}$) for expansion of free energy fields and ($\int$) for

the expansion of constrained energy fields inside the quanton

8- when dealing with energy expansion we will use the

wave like form E_q = $(E_{sf}\ E_{tc})(E_{sc}E_{tf})$

while when dealing with fields and energy interactions

the form E_q = $(E_{sf}\ E_{tf})(E_{sc}E_{tc})$ will be used

7. Energy Degrees of freedom

1-as energy is allowed to vary in space or in time, it is said to have

an energy degree of freedom

2- the quanton energy density is defined in terms of the degrees

of freedom of its wave parameters (ω, k , or r_q)

3-E_q (quanton energy density)will be shown to be directly

proportional to ω^4 , k^4 or $\frac{1}{{r_q}^4}$

4- while the energy density of the quanton is defined in terms of

ω^4 **,** k^4 **or** $\frac{1}{{r_q}^4}$ **, however the energy fields are defined in terms of**

Field strength or in terms of the constant (c) in the form of

D_{sf} **=** $c^{Dof_{sf}}$ **,** Dof_{sf} **: degrees of freedom of free space varying**

field (transformation from degrees of freedom from formulation in

terms of wave parameters , to degrees of freedom in terms of (c))

5-for space varying and time varying energy fields , where the

resultant energy density is in the form

$E_q = (E_{sf}\ E_{tc})(E_{sc}E_{tf})$ **and not in the square root form**

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

this multiplier form allows (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

6-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 following

a- the constant (c) represents the relationship between energy

field expansion by variation in space and in time , for the wave

parameters of the fields $\mathbf{E_{tc}}$, $\mathbf{E_{sf}}$

ψ_{tc} , ψ_{sf} where $\psi_{tc} = e^{-j\omega t}$, $\psi_{sf} = e^{+jk(x+y+z)}$

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

$$\frac{\partial\, \psi_{tc}}{\partial t} = -\, j\omega\, \psi_{tc} \ , \qquad , \frac{\partial\, \psi_{sf}}{\partial x} = jk\ \psi_{sf}$$

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

$$\left(\frac{\partial\, \psi}{\partial x}\right) = \frac{\partial}{\partial x}\left(\psi_{sf} \quad \psi_{tc}\right) = \frac{\partial\, \psi_{sf}}{\partial x}\ \psi_{tc} = \ jk\ \ \psi_{sf}\psi_{tc}$$

$$-\frac{\left(\frac{\partial\, \psi}{\partial t}\right)}{\left(\frac{\partial\, \psi}{\partial x}\right)} = \frac{j\omega\ \ \psi_{sf}\psi_{tc}}{jk\ \ \psi_{sf}\psi_{tc}} = \frac{\omega}{k} = c \qquad \textbf{(1-7)}$$

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

b- recalling the Lagrangian (L) of an action as $\frac{d}{dt}\frac{\partial L}{\partial x'}$ - $\frac{\partial L}{\partial x}$ = 0

given that momentum P= $\frac{\partial L}{\partial x'}$

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

an energy degree of freedom: the rate of change of the total energy of the system with respect to its momentum

c-the same result can be obtained directly from the energy momentum relationship $E^2 = P^2c^2 + {m_o}^2c^4$

differentiating both sides 2 E dE = 2 P dP

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

where for space fabric case (m_o= zero) , E= P c

which is an alternative definition of the energy degree of freedom

6-both results of (a) and (c) are equivalent , given that

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

using the Schrödinger equation ,for time and space derivatives

$$-\frac{\partial \psi}{\partial t} = -\frac{jE}{2\pi h}\psi$$

$$\nabla \psi = \frac{jp}{2\pi h}\psi$$

$$\frac{\frac{\partial \psi}{\partial t}}{\nabla \psi} = \frac{E}{p} = c \qquad (2\text{-}7)$$

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

1-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 $E_p = \frac{h}{2\pi}\omega$

2- the energy degrees of freedom can be classified as follows

a- active (actual degrees of freedom) that belong to the energy fields inside or outside the quanton

b- kinetic degree of freedom which expresses the propagation of energy fields (outside the quanton 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 out of quanton) , where Dof's = (2)+1 instead of (3)+(1)

c- scalarized degrees of freedom : when a degree of freedom of an

energy field becomes part of its intensity parameter instead of its strength parameter (discussed in the section : normal mater quantons)

8.The superposition principle inside the quanton

1-the linear superposition of energy fields still applies inside and outside the quanton 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 / constrained) and

b- have the same degree of freedom

$$E_{sfi} + E_{sfj} = K_{sfi} D_{sf} + K_{sfj} D_{sf}$$

$$= (K_{sfi} + K_{sfj}) D_{sf} \qquad (1\text{-}8)$$

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

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

$$= (K_{sfi} + K_{sfj})(K_{tci} + K_{tcj})(D_{sf} D_{tc}) \qquad (2\text{-}8)$$

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

2- 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 inside the quanton will not be a linear one instead , it is an exponential superposition where

$$E_{sfi}\ \ E_{scj} = (K_{sfi} D_{sf})(\ K_{scj}\ \ D_{sc})$$

$$= (K_{sfi}\ K_{scj})\ (\ D_{sf}\ D_{sc}\ ) \quad (3\text{-}8)$$

$$E_{sf}\ \ E_{tc} = (K_{sf} D_{sf})(\ K_{tc}\ \ D_{tc})$$

$$= (K_{sf}\ K_{tc})\ (\ D_{sf}\ D_{tc}\ ) \quad (4\text{-}8)$$

and for the quanton as a whole

$$E_q = (E_{sf}\ \ E_{tc})(\ E_{sc}\ \ E_{tf}) = (K_{sf} D_{sf})(K_{tc} D_{tc})(K_{sc} D_{sc})\ (K_{tf} D_{tf})$$

$$=(K_{sf}\ K_{tc}\ K_{sc}\ K_{tf})\ c^{Dof_{sf}+Dof_{tc}+Dof_{sc}+Dof_{tf}} = (K_{sf}\ K_{tc}\ K_{sc}\ K_{tf})\ c^{4}$$

(5-8)

3- inside the quanton , 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

9.<u>Definition of directional field directional components</u>

For free space varying fields

$$E_{sf}=\sqrt{E_{sfx}{}^{2}+E_{sfy}{}^{2}+E_{sfz}{}^{2}} \quad (1\text{-}9)$$

and space varying constrained field

$$E_{sc}=\sqrt{E_{scx}{}^{2}+E_{scy}{}^{2}+E_{scz}{}^{2}} \quad (2\text{-}9)$$

for spatially varying fields

$$E_{sx}=E_{sfx}\,E_{scx}\quad,\quad E_{sy}=E_{sfy}\,E_{scy} \quad (3\text{-}9)$$

$$E_{sz}=E_{sfz}\,E_{scz}\quad, \quad (4\text{-}9)$$

And for time varying fields,

$$E_{t}=E_{tf}\,E_{tc} \quad (5\text{-}9)$$

Those are 8 components , 6 that vary in space and 2 that vary in time 3 are constrained space varying and one is constrained time varying , and 3 are free space varying and one is free in time , 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

10.Dimesional energy symmetry (DES)

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

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

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

$$\left(\int E_{sf}\ dx\ \frac{\partial E_{tc}}{\partial t}\right)\left(\frac{\partial E_{sc}}{\partial x}\int E_{tf}\ dt\right)$$ **, but it will be of the form**

$$\frac{\partial}{\partial x}(E_q) = \frac{\partial}{\partial x}(E_{sf}E_{tc}E_{sc}E_{tf}) =$$

$$\frac{\partial}{\partial x}\ (E_{sfx}E_{scx})\ \frac{1}{\frac{\partial x}{\partial t}}\frac{\partial y}{\partial t}\frac{\partial}{\partial y}\ (E_{sfy}E_{scy})\ \frac{1}{\frac{\partial x}{\partial t}}\frac{\partial z}{\partial t}\frac{\partial}{\partial z}\ (E_{sfz}E_{scz})\frac{1}{\frac{\partial x}{\partial t}}\frac{\partial}{\partial t}\ (E_{tf}E_{tc})$$

$$= (\ (\frac{\partial}{\partial x})(\frac{1}{\frac{\partial x}{\partial t}}\frac{\partial y}{\partial t}\frac{\partial}{\partial y})\left(\frac{1}{\frac{\partial x}{\partial t}}\frac{\partial z}{\partial t}\frac{\partial}{\partial z}\right)(\ E_{sf}\ )\int(E_{tc})\ dt\ )\ *$$

$$(\int\ \int\ \int(E_{sc})\ dx\ \ dy\ (\frac{1}{\frac{\partial y}{\partial t}}\frac{dx}{dt})\ dz(\frac{1}{\frac{\partial z}{\partial t}}\frac{dx}{dt})\ \left(\frac{1}{\frac{\partial x}{\partial t}}\frac{\partial}{\partial t}\right)(\ E_{tf}\ ))\ \ +$$

$$(\int\ \int\ \int(E_{sf})\ dx\ \ dy\ (\frac{1}{\frac{\partial y}{\partial t}}\frac{dx}{dt})\ dz(\frac{1}{\frac{\partial z}{\partial t}}\frac{dx}{dt}))\left(\frac{1}{\frac{\partial x}{\partial t}}\frac{\partial}{\partial t}\right)(\ E_{tc}))\ *$$

$$(\ (\frac{\partial}{\partial x})(\frac{1}{\frac{\partial x}{\partial t}}\frac{\partial y}{\partial t}\frac{\partial}{\partial y})\left(\frac{1}{\frac{\partial x}{\partial t}}\frac{\partial z}{\partial t}\frac{\partial}{\partial z}\right)(\ E_{sc}\ )(\int(E_{tf})\ dt\ \ \left(\frac{\partial x}{\partial t}\right))$$

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

$$\frac{\partial}{\partial x}(\ E_q\ ) = (\ \frac{\partial\ E_{sf}}{\partial s}\ \int E_{tc}\ \ dt\ )(\int E_{sc}\ ds\ \ \frac{\partial E_{tf}}{\partial t}\ ) +$$

$$(\int E_{sf}\ ds\ \ \frac{\partial E_{tc}}{\partial t}\ )\ \ (\ \frac{\partial E_{sc}}{\partial s}\ \ \int E_{tc}\ \ \ dt\ )\ \ =\ \ \frac{\partial}{\partial s}(\ E_q\ ) \qquad \textbf{(1-10)}$$

<u>Note</u> : we applied the chain rule for differentiation and integration by change of variables

We can clearly see that as energy 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 ,

we conclude that

1-events in one direction are immediately reflected in the other spatial and temporal directions, and by the same magnitude

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

3-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

$$\mathbf{Dof_q} = \mathbf{Dof_{sf}} + \mathbf{Dof_{tf}} + \mathbf{Dof_{sc}} + \mathbf{Dof_{tc}} = 4 \qquad \textbf{(2-10)}$$

Energy field strength parameter $$\mathbf{D_q} = \mathbf{D_{sf}D_{tf}D_{sc}D_{tc}} = \mathbf{c^4} \qquad \textbf{(3-10)}$$

$$\mathbf{D_s = c^3 \quad , \quad D_{sf} = c^{Dof_{sf}} \quad , \quad D_{sc} = c^{Dof_{sc}} = c^{3-Dof_{sf}}} \qquad \textbf{(4,5,6,7-10)}$$

$$\mathbf{D_t = c \quad , \quad D_{tf} = c^{Dof_{tf}} \quad , \quad D_{tc} = c^{Dof_{tc}} = c^{1-Dof_{tf}}} \qquad \textbf{(8,9,10-10)}$$

$$\mathbf{Dof_{sfx} = Dof_{sfy} = Dof_{sfz}} \qquad \textbf{(11-10)}$$

4-the degree of freedom of constrained space varying field must be identical for spatial time varying components

$$\mathbf{Dof_{scx} = Dof_{scy} = Dof_{scz}} \qquad \textbf{(12-10)}$$

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.2. shows energy density expands uniformly inside the quanton as it's defined in terms of (c) instead of the quanton wave parameters

$$E_q = K_q{}^4\ c^4 \qquad\qquad E_q = h_q\ \omega^4$$

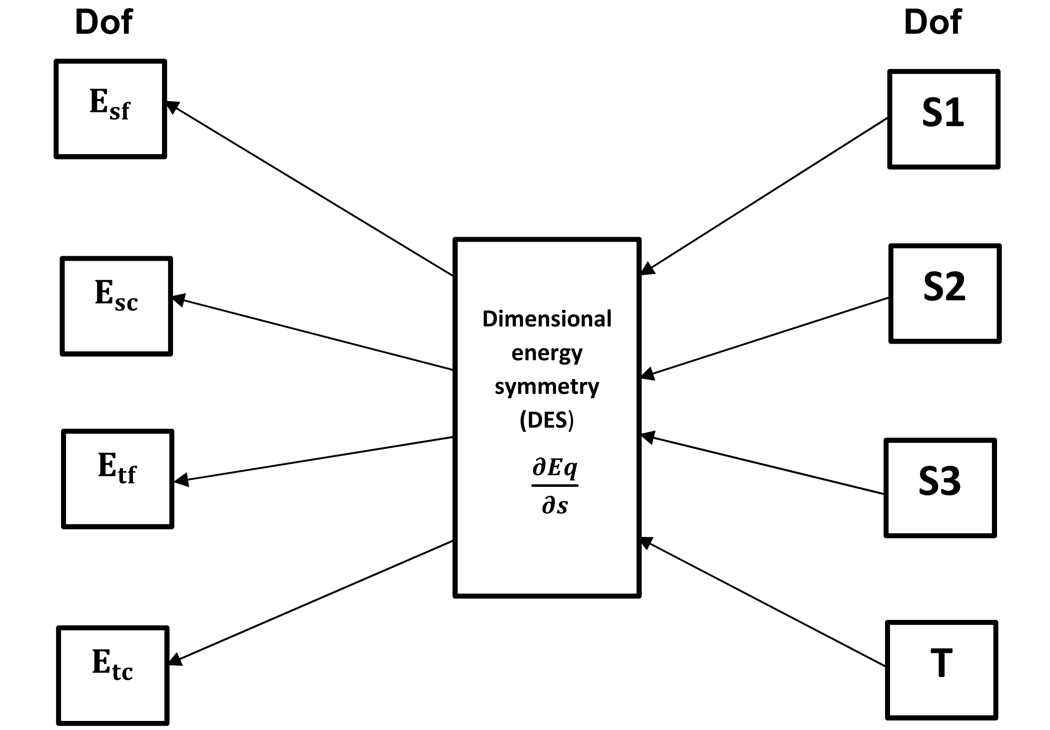


Fig. 2. role of dimensional energy symmetry in ensuring the uniformity of energy distribution inside the quanton

11. Energy density / Degree of freedom relationship

when assessing the relationship between the quanton energy density E_q and its wave parameters , two methods will be used , and as it turned out , the two are equivalent , first is the simplified method which is discussed here , and secondly , the analytical , which is dealt with in the section : energy field parameters

a-simplified method

based on two basic assumptions

1-high symmetry , the quanton volume can be

represented by a highly symmetric 3 dimensionally symmetric

shape (a sphere) given that ($2r_q = \lambda$) ,

2- the uniformity of the field inside the quanton

the total energy at any radius (a) can be defined as

$E(a) = \frac{hc}{2\,r_q}(\frac{a}{r_q})$, ($a < r_q$)

under such assumptions , the following relations would be used as

an approximation

$$E_p = \int_{V_q} E_q \, dV = E_q V_q = \frac{h}{2\pi} \omega \qquad \textbf{(1-11)}$$

where E_q is the average energy density inside the quanton

, E_p : packet energy ,

based on assumption of uniform energy density inside the

quanton , $V_q = \frac{4}{3}\pi\, r_q{}^3$

given that $\omega = kc = \frac{\pi c}{r_q}$, $k = \frac{2\pi}{\lambda} = \frac{\pi}{r_q}$, $r_q = \frac{\lambda}{2}$ (2-11)

$$V_q = \frac{4}{3}\pi\, r_q{}^3 = \frac{4}{3}\pi\left(\frac{\pi^3}{k^3}\right) = \frac{4}{3}\frac{\pi^4 c^3}{\omega^3} \qquad (3\text{-}11)$$

This shows that the quanton volume can be defined in terms of the parameters k , ω , this indicates that the relationship

$E_p = \int_{V_q} E_q\, dV = E_q\ V_q$ is not only a volumetric relationship but an energy degree of freedom as well , now the energy density can Be written as

$E_q = \frac{E_p}{\int_{V_q} dV} = \frac{h\omega}{(2\pi)(\frac{4\pi}{3} r_q{}^3)}$ ($r_q = \frac{\pi c}{\omega}$) , substituting for $r_q{}^3$

$$E_q = \frac{3h\omega}{(2\pi)(4\pi)}\left(\frac{\omega^3}{c^3}\right) = \frac{3h\,\omega^4}{8\pi^5 c^3} \qquad (4\text{-}11)$$

and this is a very important relationship since the term

$\frac{3h}{8\pi^5 c^3}$ = constant , in other words , (5-11)

Field energy density inside the quanton is linearly proportional to

the four degrees of freedom as expressed by either (ω^4,k^4 or $\frac{1}{r_q{}^4}$),

define $h_q = \frac{3h}{8\,\pi^5\;c^3}$ **(6-11)**

$E_q = h_q\,\omega^4 = h_q\,k^4c^4 = h_q\,\frac{\pi^4c^4}{r_q{}^4}$ **(7-11)**

substituting $E_p = E_q\,V_q = h_q\,V_q\,\omega^4$

from (2-11) and given that $\omega = kc = \frac{\pi c}{r_q}$

$\frac{V_{q2}}{V_{q1}} = (\frac{r_{q2}}{r_{q1}})^3 = \frac{\omega_1{}^3}{\omega_2{}^3}$ **and** $\frac{r_{q2}}{r_{q1}} = \frac{\omega_1}{\omega_2}$ **(8-11)**

12 -Energy constraining and the release of thermal energy

1-as the quantons expand , field constraining takes place

(transformation into a packet state – energy non varying in space

or time)

2-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)

b-expansion of constrained fields ($\int E_{sc}\ ds\ \int E_{tc}\ dt$)must be

accompanied by an constraining of part of the expanding field

in the form ($\frac{\partial E_{sc}}{\partial s}\ \frac{\partial E_{tc}}{\partial t}$)

c-In both cases , the result will be the release of energy in a packet

state (non varying in space or time) of the form $E = E_s\ E_t$

for the free type of energy as it expands

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

$+(\int E_{sf}$ ds $\frac{\partial E_{tc}}{\partial t})\ (\frac{\partial E_{sc}}{\partial s}\int E_{tf}\ dt)$

given that $\frac{\partial E_{sf}}{\partial s} = E_{sf}$, $\int E_{tc}\ dt = E_{tc}$, $\int E_{sc}\ ds = E_{sc}$, $\frac{\partial E_{tf}}{\partial t} = E_{tf}$

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

the results of field expansion inside the quanton can be defined as

a- expansion term :

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

Corresponds to the expanding fields which expand through

variation of energy in space and in time ,

the nature of expanding fields is the same as the original type of

fields (though with lesser energy content)

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

represents the release of energy in a packet state which is due to

the constraining of part of the free and constrained fields

this nonvarying energy expands and is released from the quanton

in the form of radiative energy , fig. 3. Shows the expansion of the

quanton and the subsequent release of radiative energy

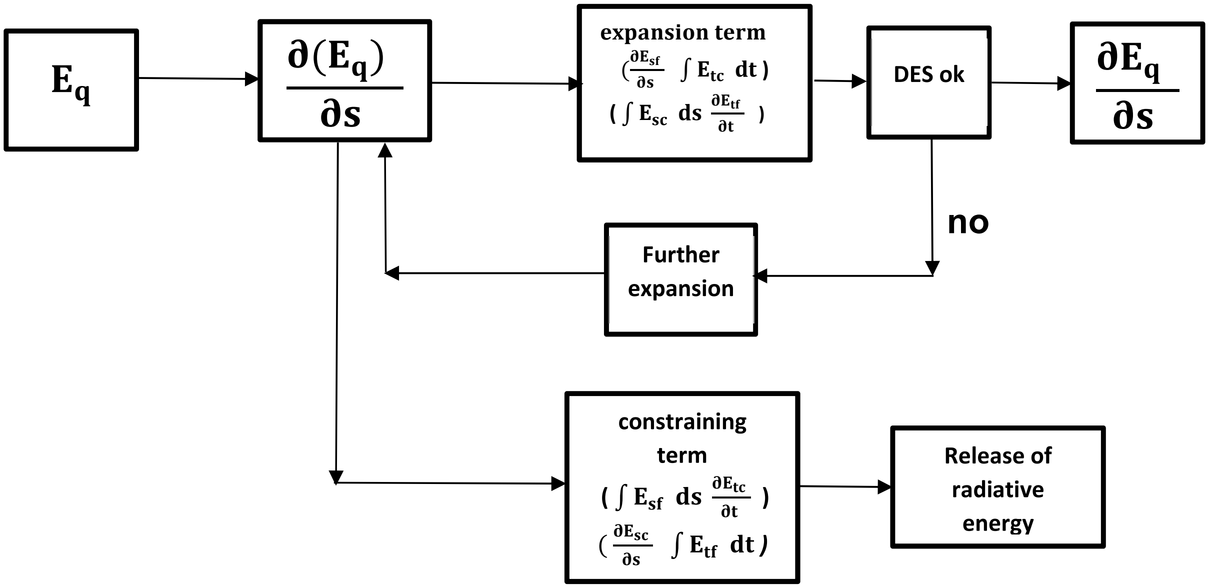


Fig. 3. Quanton energy density expansion process

13.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 it self as it releases radiation during the free expansion process , and , in fact energy constraining inside the quantons is behind that release of this radiation energy

14. 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

1- as the quanton expands from a 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 space

2- 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 in the form $\frac{E_{p2}}{E_{p1}} = \frac{\omega_2}{\omega_1} = \frac{k_2}{k_1} = \frac{\lambda_1}{\lambda_2} = \frac{r_{q1}}{r_{q2}}$

which means that the quanton radius (and the wave length

of its characteristic wave behaviour are inversely proportional

to its total (packet) energy content

3-recalling here the first concept upon which this model is based

namely the Dof relationship between energy density inside the

qauanton and its wave parameters

energy density inside the quanton can be assessed as

$E_p = E_q \ V_q$ or $E_q = \frac{E_p}{V_q}$, then

$\frac{E_{q2}}{E_{q1}} = \left(\frac{E_{p2}}{E_{p1}} \right)\left(\frac{V_{q1}}{V_{q2}} \right)$

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

we get $\frac{E_{q2}}{E_{q1}} = \left(\frac{r_{q1}}{r_{q2}} \right)^4$ (1-14)

which deviates from what we would expect in a classical

volume / density relationship of the form $\frac{\varrho_2}{\varrho_1} = \frac{V_1}{V_2} = (\frac{r_1}{r_2})^3$

and this is due to the fact that energy density inside the quanton is

inversely proportional to $r_q{}^4$ and not to $r_q{}^3$

this previous relationship can be obtained directly from the

equation (6-11) , namely $E_q = \pi^4 h_q \frac{c^4}{r_q{}^4}$ or

$E_q = (\frac{constant}{r_q{}^4})$

so 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

15.Mechanism of quanton splitting

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

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

1-the two types of fields inside the quanton (free Dominated E_{qf}

and constrained dominated E_{qc}) interact , creating a binding

relationship but since the energy Dof's (i.e field strength) of both

fields 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 - discussed in the section :quanton field interactions)

2-the unbound field is at the origin of the quanton inflationary energy , which has a greater potential (in terms of the quanton total energy) than the quanton binding energy , as a result , it overcomes this binding and causes the quanton to the expand

3-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- to release thermal energy to maintain the relationship $E_p = \frac{h\omega}{2\pi}$ or

b- to split thereby reducing its overall energy content and allowing

for further expansion

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

$(r_{q3}) = (\frac{r_{q2}}{2}) = r_{q1}$, $E_{p3} = \frac{E_{p2}}{2} = \frac{E_{p1}}{2}$

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

stage(3) quanton expands further

following quanton splitting its packet (total energy) becomes

$E_{p3} = \frac{E_{p2}}{2}$, while wave parameters (ω, k) must expand further 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 thermal energy in the form of CMB photons , and to arrive at the final pseudo stable state

fig. 4. Provides an illustration of the quanton expansion , splitting

cycle while table 2. provides a summary of those stages and the

corresponding quanton parameters

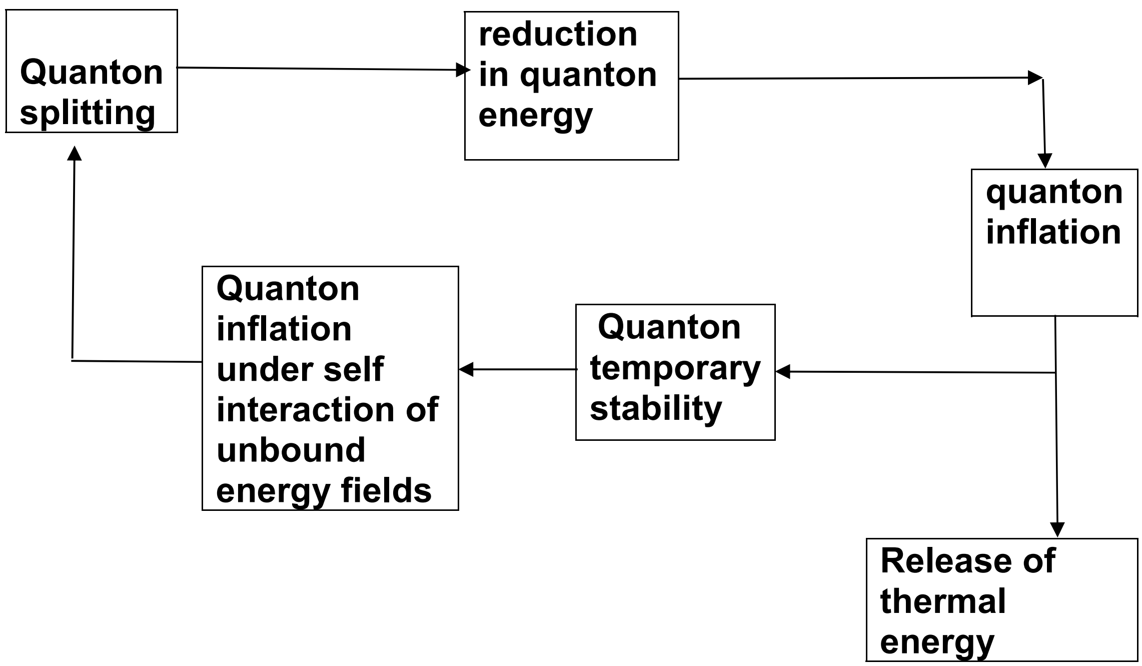


Fig. 4. cycle of quanton splitting and subsequent inflation

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 : E_q	E_{q1}	$\frac{E_{q1}}{x^3}$	$< \frac{E_{q1}}{16}$
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 this mechanism is such an inefficient one 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

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

a simple explanation lies in the fact that all the quanton energy fields are involved in different interactions , mainly binding ones while energy in a packet state 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

16.mathematics behind constraining

1- as the quanton forms , the nature of the energy field changes (from free to constrained)

2- to perform such an operation energy fields must transit through

a packet state (energy that does not vary in space or in time)

3-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

$$\frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s}\right) = \frac{\partial}{\partial s}\left(K_{sf}\, D_{sf}\ \psi_{sf}\right) = K_{sf}\, D_{sf}\,\frac{\partial}{\partial s}(\psi_{sf})$$

$$= K_{sf}\, D_{sf}\ \left[\left(e^{jks}\right)\left(e^{\frac{\partial}{\partial s}(jks)}\right)\right] \qquad \textbf{(1-16)}$$

$$=\left[K_{sf}\, D_{sf}\left(e^{jks}\right)\right]\left[K_{s}\, D_{s}\, e^{(jk)}\right]$$

$$= \left(\frac{\partial E}{\partial s}\right)\left(K_{s}\, D_{s}\, e^{(jk)}\right) = \left(\frac{\partial E}{\partial s}\right)\left(E_{s}\right)$$

$$\int\left(E_{s}\right)\, ds = \left(K_{s}\, D_{s}\, e^{-\int (jk)\, ds}\right) \qquad \textbf{(2-16)}$$

$$= \left[K_{tc}\, D_{tc}\left(e^{-jks}\right)\right] = \int E\, ds \qquad \textbf{(3-16)}$$

b-for the evolution of the constrained time varying field

$$\frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) = \frac{\partial}{\partial t}\left(K_{tf}\, D_{tf}\ \psi_{tf}\right) = K_{tf}\, D_{tf}\,\frac{\partial}{\partial t}(\psi_{tf})$$

$= K_{tf}\, D_{tf}\ \ [(\, e^{j\omega t})(\, e^{\frac{\partial}{\partial t}(j\omega t)})\,]$ **(4-16)**

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

$= (\frac{\partial E}{\partial t})\ (\ \ E_t)$

$\int(\ \ E_t\,)\, dt\ \ = [\, K_t\, D_t\, (e^{-\int(j\omega)\ dt})\ \ ]$ **(5-16)**

$=[(\, K_{tc}\, D_{tc}\, (e^{-\omega\, t})\,] = \ \int E\, dt$ **(6-16)**

while evolution of the type $\frac{\partial}{\partial s}(\frac{\partial E}{\partial s})\ = \frac{\partial E}{\partial s}\int E$ dt and

$\frac{\partial}{\partial t}(\frac{\partial E}{\partial t})\ = \frac{\partial E}{\partial s}\int E$ ds a more plausible, such a case will not result in a quanton field arrangement where the inflationary and the binding Dof's would not correspond to the existing values for dark energy and dark matter

and for the quanton expansion and constraining terms

<u>a-Expansion part</u>

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

$$\frac{\partial}{\partial s}(E_q) = \frac{\partial}{\partial s}((E_{sf}\ E_{tc})(\ E_{sc}\ \ E_{tf}))$$

$$= K_{sf}K_{tc}\ D_{sf}\ D_{tc}\frac{\partial}{\partial x}\ \psi_{sf}\int\ \ \psi_{tc}\,dt\,)(K_{sc}\ K_{tf}\ D_{sc}D_{tf}\int\ \ \psi_{sc}\,dx\frac{\partial}{\partial t}\ \ \psi_{tf}) \qquad \textbf{(7-16)}$$

$$= K_{sf}\ K_{tc}\ D_{sf}\ D_{tc}(\ \frac{jk}{-j\omega}\ \psi_{sf}\ \psi_{tc})\ (K_{sc}\ K_{tf}\ D_{sc}\ D_{tf})(\ \frac{j\omega}{-jk}\ \psi_{sc}\ \psi_{tf})$$

$$= K_{sf}\ \ \psi_{sf}D_{sf})(K_{tc}\ \ D_{tc}\ \ \psi_{tc})\ \ ((K_{sc}D_{sc}\ \psi_{sc}\ )(K_{tf}\ \ \ D_{tf}\ \ \psi_{tf}\ )$$

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

b- constraining term

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

$$=[(K_{sf}\ \ D_{sf}\ \ e^{\frac{\partial}{\partial s}(jks)})(\ K_{tc}\ D_{tc}e^{\frac{\partial}{\partial t}(-j\omega t)})][(\ K_{tf}\ D_{tf}\ \ e^{\frac{\partial}{\partial s}(-jks)})(K_{tf}\ D_{sc}D_{tf}\ \ e^{\frac{\partial}{\partial t}(j\omega t)})]$$

$$= (K_{sf}\ K_{tc}\ D_{sf}\ D_{tc}\ \ e^{\,(jk)}e^{\,(-j\omega)})\ (K_{sc}\ K_{tf}\ D_{sc}\ D_{tf}\ \ e^{\,(-jk)}e^{\,(j\omega)})$$

$$= K_s\ D_s\ K_t\ D_t\ =\ \ E_sE_t$$

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)

17. <u>Wave- like properties of space fabric</u>

Energy which varies in time and varies in space has wave like properties as it changes at periodic rate that equals ω rad /sec (= $2\,\pi\,f$) and the space varying field , where r_q (= $\frac{\pi}{k}$) , such that $\omega\, r_q$ = constant = πc , 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 $\psi_{sf} = e^{jkx}$, $\psi_{tc} = e^{-j\omega t}$, $\psi_{sc} = e^{-jkx}$, $\psi_{tf} = e^{j\omega t}$

the free energy dominated wave parameters

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

$$\frac{\partial \psi_{qf}}{\partial t} = \frac{\partial \psi_{tc}}{\partial t} \quad \psi_{sf} = -j\omega\, \psi_{sf}\psi_{tc}$$

$$\frac{\partial^2 \psi_{qf}}{\partial t^2} = \frac{\partial^2 \psi_{tc}}{\partial t^2} \quad \psi_{sf} = -\omega^2\, \psi_{sf}\psi_{tc}$$

while differentiating w.r.t (x)

$$\frac{\partial \psi_{qf}}{\partial x} = \frac{\partial \psi_{sf}}{\partial x} \quad \psi_{tc}$$

$$\frac{\partial^2 \psi_{qf}}{\partial x^2} = \frac{\partial^2 \psi_{sf}}{\partial x^2} \quad \psi_{tc} = -k^2\, \psi_{sf}\psi_{tc}$$

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**

$$\frac{\partial^2 \psi_{tc}}{\partial t^2} = c^2 \left(\frac{\partial^2 \psi_{sf}}{\partial x^2} \frac{\psi_{tc}}{\psi_{sf}}\right) \quad \text{or} \quad (E_{qf})_{tt} = c^2\, (E_{qf})_{xx} \ \text{ as before} \qquad (1\text{-}17)$$

which is the PDE forth free energy dominated field

similarly ,for the constrained energy dominated wave

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

$$\frac{\partial \psi_{qc}}{\partial t} = \frac{\partial \psi_{tf}}{\partial t} \quad \psi_{sc}$$

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

$$\frac{\partial \psi_{qc}}{\partial x} = \frac{\partial \psi_{sc}}{\partial x} \quad \psi_{tf}$$

$$\frac{\partial^2 \psi_{qc}}{\partial x^2} = \frac{\partial^2 \psi_{sc}}{\partial x^2} \quad \psi_{tf} \ ,$$

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

$$\frac{\partial^2 \psi_{tf}}{\partial t^2} = c^2 \left(\frac{\partial^2 \psi_{sc}}{\partial x^2} \frac{\psi_{tf}}{\psi_{sc}}\right) \quad \text{or} \quad (E_{qc})_{tt} = c^2 \, (E_{qc})_{xx} \qquad \text{(2-17)}$$

this PDE for the constrained energy dominated field,

which shows also how a wave equation of space and time

varying fields would look like, but does the quanton energy

density equation in its differential / integral form really represent

two wave equations ?

a-For the free energy dominated term ($\frac{\partial E}{\partial s} \int E \ dt$)

Differentiating with respect to time $\frac{\partial}{\partial t} \left(\frac{\partial E}{\partial s} \int E \ dt \right) =$

$$\left[\left(\frac{\partial x}{\partial t}\right) \frac{\partial}{\partial x} \left(\frac{\partial E}{\partial s}\right) \int E \ dt\right] + \left[\frac{\partial E}{\partial s} \ \frac{\partial}{\partial t}\left(\int E \ dt\right)\right]$$

$$= \left[c \ \frac{\partial}{\partial x} \left(\frac{\partial E}{\partial s}\right) \int E \ dt\right] + \left[\frac{\partial E}{\partial s} \ \frac{\partial}{\partial t}\left(\int E \ dt\right) \right]$$

differentiating again with respect to time

$$\frac{\partial}{\partial t}[c\ \frac{\partial}{\partial x}(\frac{\partial E}{\partial s})\int E\ dt] + \frac{\partial}{\partial t}[\frac{\partial E}{\partial s}\ \frac{\partial}{\partial t}(\int E\ dt)]$$

$$= [c\ (\frac{\partial x}{\partial t})\ \frac{\partial^2}{\partial x^2}\ (\frac{\partial E}{\partial s})\int E\ dt] + [c\ \frac{\partial}{\partial x}\ (\frac{\partial E}{\partial s})\ \frac{\partial}{\partial t}(\int E\ dt)]$$

$$+[(\frac{\partial x}{\partial t})\ \frac{\partial}{\partial x}(\frac{\partial E}{\partial s})\ \frac{\partial}{\partial t}(\int E\ dt)] + [\frac{\partial E}{\partial s}\ \frac{\partial^2}{\partial t^2}(\int E\ dt)] =$$

$$[c^2\ \frac{\partial^2}{\partial x^2}(\frac{\partial E}{\partial s})\int E\ dt] + 2\ c\ [\frac{\partial}{\partial x}(\frac{\partial E}{\partial s})\ \frac{\partial}{\partial t}(\int E\ dt)] + [\frac{\partial E}{\partial s}\ \frac{\partial^2}{\partial t^2}(\int E\ dt]\ )$$

for the same energy type differentiating with respect to x

$$\frac{\partial}{\partial x}(\frac{\partial E}{\partial s}\ \int E\ dt) = [\frac{\partial}{\partial x}(\frac{\partial E}{\partial s})\int E\ dt] + [\frac{\partial E}{\partial s}\ \frac{1}{\frac{\partial x}{\partial t}}\frac{\partial}{\partial t}(\int E\ dt)]$$

$$= [\frac{\partial}{\partial x}(\frac{\partial E}{\partial s})\int E\ dt] + [\frac{\partial E}{\partial s}\ \ \frac{1}{c}\frac{\partial}{\partial t}(\int E\ dt)]$$

differentiating again with respect to x

$$\frac{\partial}{\partial x}[\frac{\partial}{\partial x}(\frac{\partial E}{\partial s})\int E\ dt] + \frac{\partial}{\partial x}[\frac{1}{c}\frac{\partial E}{\partial s}\ \ \frac{\partial}{\partial t}(\int E\ dt)]$$

$$=[\frac{\partial^2}{\partial x^2}(\frac{\partial E}{\partial s})\ \int E\ dt] + [\frac{\partial}{\partial x}(\frac{\partial E}{\partial s})\ \frac{1}{\frac{\partial x}{\partial t}}\ \frac{\partial}{\partial t}(\int E\ dt)] +$$

$$[\frac{1}{c}\ \frac{\partial}{\partial x}(\frac{\partial E}{\partial s})\ \frac{\partial}{\partial t}(\int E\ dt)] + [\frac{1}{c}\frac{\partial E}{\partial s}\ \ \frac{1}{\frac{\partial x}{\partial t}}\ \frac{\partial^2}{\partial t^2}(\int E\ dt)\ ]$$

$$=[\frac{\partial^2}{\partial x^2}\ (\frac{\partial E}{\partial s})\int E\ dt] + 2\ \frac{1}{c}\ [\frac{\partial}{\partial x}(\frac{\partial E}{\partial s})\frac{\partial}{\partial t}(\int E\ dt)] + (\frac{1}{c})^2\ [\frac{\partial E}{\partial s}\ \ \frac{\partial^2}{\partial t^2}\ (\int E\ dt)\ ]$$

by comparing the results of both double differentiation

$$\frac{\partial^2}{\partial t^2} \left(\frac{\partial E}{\partial s} \int E\, dt \right) = c^2 \frac{\partial^2}{\partial x^2} \left(\frac{\partial E}{\partial s} \int E\, dt \right)$$

which is customary form of for a wave relation

b- For the constrained energy dominated wave

$E_{qc} = \int E\, ds \frac{\partial E}{\partial t}$ **, expanding in x direction**

$$\frac{\partial}{\partial x}\left(\int E\, ds \frac{\partial E}{\partial t} \right) = \left[\frac{\partial}{\partial x}\left(\int E\, ds\right) \frac{\partial E}{\partial t}\right] + \left[\int E\, ds \frac{\partial}{\partial x}\left(\frac{\partial E}{\partial t}\right) \right]$$

$$= \left[\frac{\partial}{\partial x}\left(\int E\, ds\right)\frac{\partial E}{\partial t}\right] + \left[\int E\, ds \frac{1}{\frac{\partial x}{\partial t}} \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) \right]$$

$$= \left[\frac{\partial}{\partial x}\left(\int E\, ds\right)\frac{\partial E}{\partial t}\right] + \left[\frac{1}{c} \int E\, ds \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) \right]$$

differentiating again with respect to x- axis

$$\frac{\partial}{\partial x}\left[\frac{\partial}{\partial x}\left(\int E\, ds\right)\frac{\partial E}{\partial t}\right] + \frac{\partial}{\partial x}\left[\frac{1}{c} \int E\, ds \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) \right]$$

$$= \left[\frac{\partial^2}{\partial x^2}\left(\int E\, ds\right)\frac{\partial E}{\partial t}\right] + \left[\frac{\partial}{\partial x}\left(\int E\, ds\right) \frac{1}{\frac{\partial x}{\partial t}} \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) \right] +$$

$$\left[\frac{1}{c} \frac{\partial}{\partial x}\left(\int E\, ds\right) \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right)\right]) + \left[\frac{1}{c} \int E\, ds \frac{1}{\frac{\partial x}{\partial t}} \frac{\partial^2}{\partial t^2}\left(\frac{\partial E}{\partial t}\right) \right] =$$

$$= \left[\frac{\partial^2}{\partial x^2}\left(\int E\, ds\right)\frac{\partial E}{\partial t}\right] + 2\left(\left[\frac{1}{c} \frac{\partial}{\partial x}\left(\int E\, ds\right) \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right)\right] + \left(\frac{1}{c}\right)^2 \left[\int E\, ds \frac{\partial^2}{\partial t^2}\left(\frac{\partial E}{\partial t}\right)\right]$$

when differentiating with respect to time

$$\frac{\partial}{\partial t}\left(\int E\ ds\ \frac{\partial E}{\partial t} \right) = \left[\left(\frac{\partial x}{\partial t}\right) \frac{\partial}{\partial x}\left(\int E\ ds\right) \frac{\partial E}{\partial t} \right) + \left[\int E\ ds\ \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) \right]$$

$$= \left[c\ \frac{\partial}{\partial x}\left(\int E\ ds\right) \frac{\partial E}{\partial t} \right] + \left[\int E\ ds\ \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) \right]$$

differentiating again with respect to time

$$\frac{\partial^2}{\partial t^2}\left(\int E\ ds\ \frac{\partial E}{\partial t} \right) = \frac{\partial}{\partial t}\left[c\ \frac{\partial}{\partial x}\left(\int E\ ds\right)\frac{\partial E}{\partial t} \right] + \frac{\partial}{\partial t}\left[\int E\ ds\ \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) \right]$$

$$= \left[c\left(\frac{\partial x}{\partial t}\right)\frac{\partial^2}{\partial x^2}\left(\int E\ ds\right)\frac{\partial E}{\partial t} \right] + \left[c\ \frac{\partial}{\partial x}\left(\int E\ ds\right) \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) \right] +$$

$$\left[\left(\frac{\partial x}{\partial t}\right) \frac{\partial}{\partial x}\left(\int E\ ds\right)\frac{\partial E}{\partial t} \right) + \left[\int E\ ds\ \frac{\partial^2}{\partial t^2}\left(\frac{\partial E}{\partial t}\right) \right] =$$

$$= \left[c^2\frac{\partial^2}{\partial x^2}\left(\int E\ ds\right)\frac{\partial E}{\partial t} \right] + 2\left[c\ \frac{\partial}{\partial x}\left(\int E\ ds\right) \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) \right] + \left[\left(\int E\ ds\right) \frac{\partial^2}{\partial t^2}\left(\frac{\partial E}{\partial t}\right) \right]$$

by comparing the results of both double differentiations

$$\frac{\partial^2}{\partial t^2}\left(\int E\ ds\ \frac{\partial E}{\partial t} \right) = c^2\frac{\partial^2}{\partial x^2}\left(\int E\ ds\ \frac{\partial E}{\partial t} \right)$$

which is the usual form of the wave equation

18. quanton evolution and degrees of freedom

evolution of the quanton takes place as both free fields

(E_{sf}) and (E_{tf}) coexist

1-as free energy field expands by variation in space It must vary in

time , so , a constrained time varying field appears

$$\frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s}\right) = \left[\frac{\partial}{\partial s}\left(\frac{\partial E}{\partial s}\right)\right]\left[\int\left(\frac{\partial E}{\partial s}\right) ds\right] = \left(\frac{\partial E}{\partial s}\right)\left(\int E\ dt\right) \qquad (1\text{-}18)$$

2-as the time varying field (E_{tf}) expands , a part of it must vary in

space in the form of constrained space varying energy field

$$a - \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right) = \frac{\partial}{\partial t}\left(\frac{\partial E}{\partial t}\right)\left(\int\frac{\partial E}{\partial t}\ dt\right) = \left(\frac{\partial E}{\partial t}\int E\ \ ds\right) \qquad (2\text{-}18)$$

and since non of the fields possesses all four Dof's neither field

can exist independently , now the quanton energy density

equation becomes

$$E_q = \left(\frac{\partial E}{\partial s}\int E\ \ dt\right)\left(\int E\ \ ds\frac{\partial E}{\partial t}\right) = (E_{sf}E_{tc})(E_{sc}E_{tf}) = E_{qf}E_{qc} \qquad (3\text{-}18)$$

which expresses two apparently separate (but otherwise linked) fields

3-for time constrained energy field $(\mathbf{E_{tc}})$,its energy Dof equals one third of the corresponding free energy field ($\mathbf{E_{sf}}$)

4-for free time varying energy field($\mathbf{E_{tf}}$) , its energy degree of freedom equals one third of the corresponding space constrained energy field ($\mathbf{E_{sc}}$) , 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

$\mathbf{Dof_{sf} = 3\ Dof_{sc}}$, $\mathbf{Dof_{tfc} = 3\ Dof_{tc}}$

$\mathbf{Dof_{sf} + Dof_{sc}}$ **= 3** , $\mathbf{Dof_{tf} + Dof_{tc}}$**=1** ,

which gives the following results

$\mathbf{Dof_{sf}}$ **=** $\mathbf{2.25}$, $\mathbf{Dof_{sc}}$ **=** $\mathbf{0.75}$

$\mathbf{Dof_{tf}}$ **=** $\mathbf{0.75}$, $\mathbf{Dof_{tc}}$ **=** $\mathbf{0.25}$

Fig. 5. Shows the evolution of DOF's of various fields of the quanton as it forms

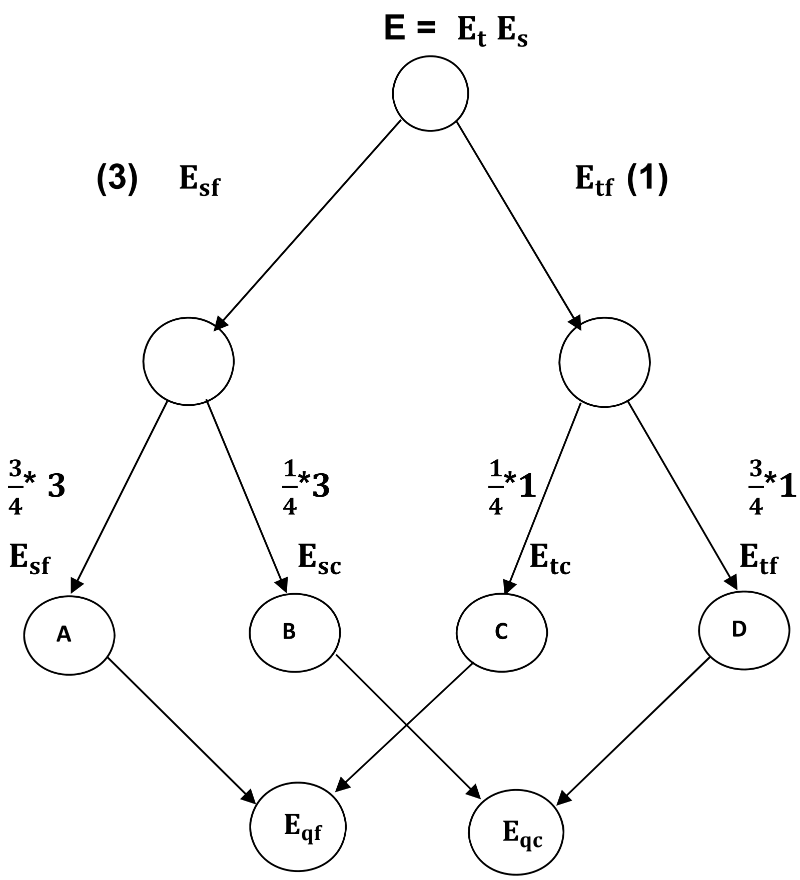


Fig. 5.tree diagram for the evolution of the degrees of freedom of quanton's energy fields

5-for the quanton system 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

6-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)

7- (unbound) free field is manifested in the form of quanton inflation

$\mathbf{D_{sfu}}\ \ \mathbf{D_{tfu}}$ **(unbound field strength)=** $\frac{(\mathbf{D_{sf}}\ \mathbf{D_{tf}})}{(\mathbf{D_{sc}}\ \mathbf{D_{tc}})}$ **=** $\frac{\mathbf{c^{2.25} c^{0.25}}}{\mathbf{c^{0.75} c^{0.25}}}$ **=** $\mathbf{c^{2.0}}$ **(6-18)**

unbound free Dof =($\sum(\mathbf{free\ Dof}) \ - \sum(\mathbf{constrained\ \ Dof})$

= $[\ (\ \mathbf{Dof_{sf}}) + (\ \mathbf{Dof_{tf}})] - [(\ \mathbf{Dof_{sc}}) + (\ \mathbf{Dof_{tc}}\ )]$ **= (3.0-1.0)=** $+2$

19.Variation of quanton energy fields with time

not only the unbound energy fields $\mathbf{E_{sfu}}\,\mathbf{E_{sfu}}$ **of the quanton** ***(or*** $E_{scu}\ \ E_{scu}$ **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 inside the quanton

19.a-Variation of space varying energy with time

$$\frac{\partial E_{sf}}{\partial t} = \frac{\partial E_{sf}}{\partial x}\frac{\partial x}{\partial t} = c\,\frac{\partial E_{sf}}{\partial x} \qquad (1\text{-}19)$$

$$\frac{\partial E_{sf}}{\partial x} = j\,k\,E_{sf} \qquad (2\text{-}19)$$

$$\frac{\partial E_{sf}}{\partial t} = j\,kc\,E_{sf} \qquad (3\text{-}19)$$

b- time varying energy field variation

$$\frac{\partial E_{tf}}{\partial t} = j\ \omega\ E_{tf} \qquad (4\text{-}19)$$

c-Relative rate of Variation between different energy fields

$$\frac{\partial E_{sf}}{\partial E_{tf}} = \frac{\partial E_{sf}}{\partial x}\left(\frac{\partial x}{\partial t}\right)\frac{1}{\left(\frac{\partial E_{tf}}{\partial t}\right)} = (jkcE_{sf})\left(\frac{1}{j\,w\,E_{tf}}\right) = \frac{E_{sf}}{E_{tf}} = \frac{D_{sf}}{D_{tf}} \qquad (5\text{-}19)$$

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

$$\frac{\partial\,\psi_{tf}}{\partial\,\psi_{sf}} = \left(\frac{\partial\,\psi_{tf}}{\partial t}\right)\left(\frac{1}{\frac{\partial x}{\partial t}}\right)\left(\frac{1}{\frac{\partial\,\psi_{sf}}{\partial x}}\right) \qquad (6\text{-}19)$$

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

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

$\frac{\partial \psi_{tf}}{\partial \psi_{sf}} = \frac{1}{c}\frac{\omega}{k} = 1 =$ constant , **(7-19)**

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

$\frac{\partial E_{tf}}{\partial E_{sf}} = \frac{1}{c}\frac{\omega}{k}\frac{E_{tf}}{E_{sf}} = \frac{E_{tf}}{E_{sf}} = \frac{D_{tf}}{D_{sf}}$ **, which means that** **(8-19)**

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

20. Energy field parameters

while the energy degrees of freedom of the quanton total energy (packet energy E_p) are in terms of the wave parameters (k , ω , r_q) , the energy degrees of freedom for the energy fields are in terms of

the constant (c) as pointed out earlier , this is because the constant (c) is what determines the relationship between the rate of variation of space and time varying fields , previously , the energy density constant (h_q) was determined while using an approximative method, now the analytical method shall be used to assess it

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

$E_{qc}(x) = E_{qc}\ e^{-j(\frac{x}{2r_q})}$ (constrained energy dominated field)

and the quanton energy density is in the form

$$E_q = (E_{sf}E_{tc})(E_{sc}E_{tf}) = E_{qf}\ E_{qc} = E_q\ e^{-j(\frac{x}{r_q})} \qquad (1\text{-}20)$$

E_q : represents the average energy density over time

to assess the entire energy stored in both fields , the quanton

packet energy would be equal to the volumetric integration

$$E_p = \frac{h\omega}{2\pi} = \iiint_{-\infty}^{\infty} E_q \; e^{-j(\frac{x+y+z}{r_q})} \, dx\, dy\, dz = \qquad (2\text{-}20)$$

$$= (2)^3 \iiint_{0}^{\infty} E_q \; e^{-j(\frac{x+y+z}{r_q})} \, dx\, dy\, dz \qquad \text{(symmetric integration)}$$

$$= 8\,(r_q)^3\, E_q \;\; e^{-j(\frac{x+y+z}{r_q})} \Big|_{x,\,y,\,z=0}^{x,\,y,\,z=\infty} = 8\,(r_q)^3\, E_q$$

$$E_q = \frac{h\omega}{16\pi {r_q}^3} = \frac{h\,\omega^4}{16\,\pi^4\,c^3}\,, \qquad (3\text{-}20)$$

where $\frac{h}{16\pi^4\,c^3} = h_q$ (energy density constant) (4-20)

to relate the average energy density E_q to it maximum value

E_{qo} over time, we use the quanton /anti quanton wave model

$$E_q = \frac{1}{2}(E_{qf} + cE_{qc})^* \frac{1}{2}(\frac{E_{qf}}{c} + E_{qc})$$

and since $E_{qfo} = cE_{qco}$

$E_q = E_{qfo}$ cos $(\frac{\pi r}{2r_q} - \omega t)$ E_{qco} cos $(\frac{\pi r}{2r_q} - \omega t)$ = $E_{qo} \cos^2(\frac{\pi r}{2r_q} - \omega t)$ **(5-20)**

the average value of a periodic function is defined as

$E_q = \frac{1}{T}\int_0^T E_{qo}\, dt$ **(6-20)**

$E_q = \frac{E_{qo}}{T}\int_0^T \cos^2(\frac{\pi r}{2r_q} - \omega t)\, dt$ **(7-20)**

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

$E_{qo} = 2E_q = \frac{h\,\omega^4}{8\pi^4\, c^3}$, **(8-20)**

here , the quanton is represented by an equivalent volume = 8 $r_q{}^3$

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**

$\varrho_v = E_q$ **(8-20)**

while in terms of the wave parameter (k), or the quanton radius

the quanton energy density takes the form

$$E_q = \left(\frac{h}{16\ \pi^4\ c^3}\right) k^4\ c^4 = \frac{h\ c}{16\ {r_q}^4} \qquad (9\text{-}20)$$

energy as it expands by variation in space and time , it has four

degrees of freedom, this can be used to define the various

space and time varying fields

$$E_q = \frac{h}{16\ \pi^4\ c^3}\ k^4\ c^4 = \text{constant} * \left(\frac{2\pi}{\lambda}\right)^4 c^4 = \frac{\text{constant}}{4\,D\ \text{volume}} * c^4 \qquad (10\text{-}20)$$

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

can be put in terms of the wave parameters (k ,ω , $\frac{1}{r_q}$)

table 3. shows the main differences between the analytical and the

approximative method , and shows that both methods are

equivalent and this is mainly due to the homogeneity and uniformity of space fabric

parameter	Analytical method	Approximative method
Integration volume	Universe volume	N/A
Equivalent volume	$\frac{\text{Universe volume}}{\text{number of quantons}}$	$\frac{4\pi}{3} r_q^{\ 3}$
Quanton shape	cubic	spherical
Quanton dimensions	Each side = 2 r_q	Radius = r_q
Density constant h_q	$\frac{h}{16\,\pi^4\,c^3}$	$\frac{3\,h}{8\,\pi^5 c^3}$
Energy density inside the quanton	E_q (=$\frac{E_{qo}}{2}$)	$(\frac{6}{\pi})E_q$
Free and constrained field	Inside and outside quanton (both Propagate throughout space)	Inside quanton only
Vacuum energy density ϱ_v	E_q	E_q

Table 3. difference between the analytical and approximative method of determining the quanton energy density constant h_q

the energy degrees of freedom which can be put as

$D_q = c^4 = D_{sf}\, D_{sc}\, D_{tf}\, D_{tc}$ = the field strength parameter of energy

fields

where $D_{sf} = c^{Dof_{sf}}$, $D_{sc} = c^{Dof_{sc}}$ (11, 12-20)

$D_{tf} = c^{Dof_{tf}}$, $D_{tc} = c^{Dof_{tc}}$ (13, 14-20)

$E_q = \frac{h}{16\,\pi^4\,c^3}\ k^4\, c^{\ 4} = K_q^{\ 4}\ c^{\ 4}$ (15,16-20) 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)

(16-20)

where $K_{sf} = K_q = \sqrt[4]{\frac{h}{16\ \pi^4\ c^3}}\ k$ (17-20)

$$K_{sc} = K_q = \sqrt[4]{\frac{h}{16\ \pi^4\ c^3}}\ k\ ,\ K_{tf} = K_{tc} = K_q = \sqrt[4]{(\frac{h}{16\ \pi^4\ c^3})}\ \frac{\omega}{c} \qquad (18\text{-}20)$$

it must be noted that while $\frac{E_q}{\omega^4} = (\frac{h}{16\ \pi^4\ c^3}) = h_q$ = constant ,

its fourth root is not a constant , $\sqrt[4]{\frac{E_q}{\omega^4}}$ or $\sqrt[4]{\frac{E_q}{k^4}} \neq$ 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 $K_{sf} = K_q{}^{Dof_{sf}} = K_q{}^2$, or

$K_{tf} = K_q^{\,Dof_{tf}}$, but since there are no wave parameters in nature of

k^2 or $\omega^{\,0.5}$ due to the symmetry of the wave behavior between

various fields which is previously defined as $\frac{\partial\,\psi_{tf}}{\partial\,\psi_{sf}} = \frac{1}{c}\frac{\omega}{k} =$ 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 : $K_{sf} = K_{sc} = K_{tf} = K_{tc} = K_q$ (19-20)

Finally , we can write the energy fields themselves as

$$E_{sf} = E_{sfo}\ \psi_{sf} = K_q\ D_q^{\,Dof_{sf}}\ \psi_{sf} = \sqrt[4]{\frac{h}{16\,\pi^4\,c^3}}\,k\,c^{2.25}\psi_{sf} = \sqrt[4]{\frac{h}{16\,c^3}}\,\frac{c^{2.25}}{r_q}\ \psi_{sf}$$

(20-20)

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

(21-20)

$$E_{tc} = E_{tco}\ \psi_{tc} = K_q\ D_q^{\,Dof_{tc}}\ \psi_{tc} = \sqrt[4]{\frac{h}{16\,\pi^4\,c^3}}\,\frac{\omega}{c}\,c^{0.25}\ \psi_{tc} = \sqrt[4]{\frac{h}{16\,c^3}}\,\frac{c^{0.25}}{r_q}\ \psi_{tc}$$

(22-20)

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

(23-20)

$$\frac{E_{sf}}{E_{tc}} = \frac{K_q\ D_q^{\,Dof_{sf}}\ \psi_{sf}}{K_q\ D_q^{\,Dof_{tc}}\ \psi_{tc}} = \frac{D_q^{\,Dof_{sf}}\ \psi_{sf}}{D_q^{\,Dof_{tc}}\ \psi_{tc}} = c^{2.0}\,\frac{\psi_{sf}}{\psi_{tc}}$$ (24-20)

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)

21.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 volume (V_q)are not constant but rather inversely proportional to its packet energy content , and consequently its energy fields while V_q = fn(${r_q}^3$) = fn(λ^3) = fn($\frac{1}{\omega^3}$)

and E_q =E_{sf} E_{sc} $E_{tf} E_{tc}$ =$\left(\frac{h}{16\,\pi^4\,c^3}\right)$ ω^4= constant *ω^4

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

dimensions of individual energy fields are expected to be as follows

$$(E_{sf}) = [\sqrt[4]{(\frac{h}{16\,\pi^4\,\,c^3})}\ k\ c^{2.25}\quad \psi_{sf}]$$

$$[E_{sf}] = M^{0.25}\ L^{0.5-0.75-1+2.25}\ T^{-0.25+0.75-2.25} = M^{0.25}\ L^{1.00}\ T^{-1.75} \qquad \textbf{(1-21)}$$

$$[E_{sc}]=[\sqrt[4]{(\frac{h}{16\,\pi^4\,\,c^3})}\ k\ c^{0.75}\quad \psi_{sc}] = M^{0.25}\ L^{-0.50}\ T^{-0.25}\ , \qquad \textbf{(2-21)}$$

$$[E_{tf}] = [\sqrt[4]{\left(\frac{h}{16\,\pi^4\ c^3}\right)}\ \frac{w}{c}\ c^{0.75}\quad \psi_{tf}] = M^{0.25}\ L^{-0.50}\ T^{-0.25} \qquad (3\text{-}21)$$

$$[E_{tc}] = [\sqrt[4]{\left(\frac{h}{16\pi^4\ c^3}\right)}\ \frac{w}{c}\ c^{0.25}\quad \psi_{tc}] = M^{0.25}\ L^{-1.00}\ T^{0.25} \qquad (4\text{-}21)$$

21 b. effect of fixed relative ratio between space and time varying fields

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)

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

for time varying energy fields

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

the relative ratio between space and time varying energy fields

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

very high values of (k , ω) corresponding to relatively high percentage for the share of the time varying fields, as the universe expands , this percentage drops while the percentage of the space varying energy fields increases comparatively

22. field represention inside the quanton

While free and constrained fields extend beyond the quanton radius , yet an expression for those fields inside the quanton can be provided

2- under condition of equipartition of energy in spatial axes quanton energy fields must be at any instant symmetrically expressed in all three dimensional space , based on this , each of the quanton fields is represented by concentric toroidal solenoid

while in the proper (own) frame of reference the free dominated field components can be defined as

$$E_{qfxi}{}^{*} = 0 \qquad (1\text{-}22)$$

$$E_{qfyi}{}^{*} = E_{qfi}\ \sin(\omega t) \qquad (2\text{-}22)$$

$$E_{qfzi}{}^{*} = E_{qfi}\ \cos(\omega t) \qquad (3\text{-}22)$$

and the constrained energy dominated field components

$$E_{qcxi}{}^{*} = E_{qci}\ \cos(\omega t) \qquad (4\text{-}22)$$

$$E_{qcyi}{}^{*} = E_{qci}\ \sin(\omega t) \qquad (5\text{-}22)$$

$$E_{qfzi}{}^{*} = 0 \qquad (6\text{-}22)$$

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)

$$\begin{vmatrix} E_{qfxi}{}^{*} \\ E_{qfyi}{}^{*} \\ E_{qfzi}{}^{*} \end{vmatrix} = [T] \begin{vmatrix} E_{qfxi} \\ E_{qfyi} \\ E_{qfzi} \end{vmatrix} \qquad (7\text{-}22)$$

$$\begin{vmatrix} E_{qcxi}{}^{*} \\ E_{qcyi}{}^{*} \\ E_{qczi}{}^{*} \end{vmatrix} = [T] \begin{vmatrix} E_{qcxi} \\ E_{qcyi} \\ E_{qczi} \end{vmatrix} \qquad (8\text{-}22)$$

The matrix (T) which has the angles θ , φ , ψ (Euler's angles)

as its elements

and the resultant fields are $E_{qfx} = \sum_i^n E_{qfxi}$ **(9-22)**

$E_{qfy} = \sum_i^n E_{qfyi}$, $E_{qfz} = \sum_i^n E_{qfxi}$ **(10, 11-22)**

$E_{qcx} = \sum_i^n E_{qcxi}$, $E_{qcy} = \sum_i^n E_{qcyi}$, $E_{qcz} = \sum_i^n E_{qczi}$ **(12,13,14-22)**

<u>23. what maintains the integrity of the quanton ?</u>

1-Free and constrained energy dominated fields E_{qf} **and** E_{qc}

are interacting through free / constrained energy field interaction

this interaction creates a binding relationship that maintains

the integrity of the quanton

2- any radiative energy that leaves the quanton must have four degrees of freedom (transmission of energy through space can only take place while fields varying in space and time have those four Dof's)

under such a condition , no individual field (E_{qf} or E_{qc}) can leave the quantton completely and independently , instead , both fields can leave the quanton conjointly in the form of electromagnetic waves

<u>24.quanton wave form : (Q+AQ) pair</u>

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 but not 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)

$(E_{qc})_{aq} = (E_{qf})_q$ **or** $(Dof_{qc})_{aq} = (Dof_{qf})_q$ **(1-24)**

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

$(E_{qf})_{aq} = (E_{qc})_q$ **or** $(Dof_{qf})_{aq} = (Dof_{qc})_q$ **(2-24)**

a model for the energy fields given that $E_q = E_{sf}E_{tc}E_{sc}E_{tf} = E_{qf}\, E_{qc}$

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

higher Dof $E_{wf} = \frac{1}{2}[\,(E_{qf})_q + (E_{qc})_{aq}\,]$ **(3-24)**

lower Dof : $E_{wc} = \frac{1}{2}\,[\,(E_{qc})_q + (E_{qf})_{aq}]$ **(4-24)**

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

$$= \frac{1}{2} K_q{}^2 c^{2.5} \cos\left(\left(\frac{\pi x}{2r_q}\right) - \omega t\right) \qquad (5\text{-}24)$$

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

$$= \frac{1}{2} K_q{}^2 c^{1.5} \cos\left(\left(\frac{\pi x}{2r_q}\right) - \omega t\right) \qquad (6\text{-}24)$$

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

$$E_q = \frac{1}{2}[(E_{qf})_q + (E_{qc})_{aq}] * \frac{1}{2} [[E_{qc})_q + (E_{qf})_{aq}]$$

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

$$[E_{qc})_q = (E_{qf})_{aq}$$

$$E_q = \frac{1}{4}\frac{1}{c} E_{qf}{}^2 + 2 * \frac{c}{4} \ E_{qf} \ E_{qc} + \frac{c}{4} \ E_{qc}{}^2$$

$$= \frac{1}{4} (\frac{E_{qf}{}^2}{c} + 2 \ E_{qf} \ E_{qc} + c \ E_{qc}{}^2) = E_{qf} \ E_{qc}$$

25.Electromagnetic waves as space and time varying fields

The difference between quanton – anti quanton pair and electromagnetic waves lie in the fact that electromagnetic waves propagate in linear directions, and consequently, one degree of freedom is subtracted from space varying fields (free and constrained) , as it becomes a kinetic degree of freedom , this relativistic effect is split equally between free and constrained fields or each of the free and the constrained waves have one half of Dof less than the corresponding quaton fields,

radiative (electromagnetic) energy is released from the quanton in the following one dimensional form

Propagation of electromagnetic energy long the x- direction

The formulation of electromagnetic waves in terms of energy fields depends on the system of units

under the (Esu) system U (volumetric electromagnetic energy

density) = E^2 = c^2 B^2

(ε)= 1 , μ = $\frac{1}{c^2}$, under such system

electric and the magnetic fields are defined as follows

$$E_f(x) = \frac{E_{qf}(x)}{\sqrt{c}} = \frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}} \quad , \quad B_c\ (x) = \frac{E_{qc}(x)}{\sqrt{c}} = \frac{E_{sc}(x)\ E_{tf}}{\sqrt{c}} \qquad \textbf{(1-25)}$$

where $E_f(x)$ is the electric field due to the free energy dominated

field, $B_c(x)$ is the magnetic field due to the constrained field

propagating along x- axis

given that cos(kx-ωt) = $\frac{1}{2}$ ($e^{j(kx-\omega t)}$ + $e^{-j(kx-\omega t)}$)

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

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

$$= \frac{1}{2}\ (\frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}} + \sqrt{c}\ E_{sc}(x)\ E_{tf}\ ) \qquad \textbf{(3-25)}$$

$$B\ (x) = \frac{1}{2}(B_c(x) + \frac{1}{c}\ E_f(x)) = \frac{1}{2}[\ \frac{(E_{qc})_q}{\sqrt{c}} \ +(\frac{(E_{qf})_{aq}}{\sqrt{c}}] \qquad \textbf{(4-25)}$$

$$= \frac{1}{2}\left(\frac{E_{sc}(x)\ E_{tf}}{\sqrt{c}} + \frac{1}{c}\ \frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}}\right) \quad (5\text{-}25)$$

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

$$U = \varepsilon_o E^2 = \frac{1}{\mu_o} B^2$$

$$E_f(x) = \frac{E_{qf}(x)}{\sqrt{c}} = \frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}} \quad , \quad B_c(x) = \frac{E_{qc}(x)}{\sqrt{c}} = \frac{E_{sc}(x)\ E_{tf}}{\sqrt{c}} \quad (6\text{-}25)$$

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

$$E(x) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\left(E_f(x) + c\ B_c(x)\right) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\left[\frac{(E_{qf})_q}{\sqrt{c}} + \left(\frac{(E_{qc})_{aq}}{\sqrt{c}}\right]\right. \quad (7\text{-}25)$$

$$= \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\left(\frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}} + \sqrt{c}\ E_{sc}(x)\ E_{tf}\right) \quad (8\text{-}25)$$

$$B(x) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\left(B_c(x) + \frac{1}{c}E_f(x)\right) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\left[\frac{(E_{qc})_q}{\sqrt{c}} + \left(\frac{(E_{qf})_{aq}}{\sqrt{c}}\right]\right. \quad (9\text{-}25)$$

$$\frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\left(\frac{E_{sc}(x)\ E_{tf}}{\sqrt{c}} + \frac{1}{c}\ \frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}}\right) \quad (10\text{-}25)$$

$$B(x) = \frac{1}{2}\left(\frac{E_{qc}(x)}{\sqrt{\varepsilon_o}\sqrt{c}} + \sqrt{\mu_o}\ \frac{E_{qf}(x)}{\sqrt{c}}\right) \quad (11\text{-}25)$$

and as a magnitude, $E_o(x) = \left(\frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{h}{16\ \pi^4\ c^3}}\right)(k^2\ c^2)$ **(Dof = 2) (12-25)**

$$B_o(x) = \left(\frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{h}{16\ \pi\ c^3}}\right)(k^2\ c) \quad (\text{Dof} = \text{one}) \quad (13\text{-}25)$$

To note that

1-space and time varying energy fields leave the quanton in the form of electromagnetic waves , where there is no field component along the direction of the wave propagation , this absence of fields in the wave propagation direction is translated into a kinetic degree of freedom which is subtracted from the free and constrained dominated fields Dof's ,in other words

$$\mathbf{Dof}_{\text{electric field}} + \mathbf{Dof}_{\text{magnetic field}} + \mathbf{Dof}_{\text{kinetic}} = 3+1 = 4 \qquad (14\text{-}25)$$

2 -energy leaves the quanton in the form of an energy packet $\mathbf{E} = \mathbf{E_s}\ \mathbf{E_t}$ **, and the expansion of this energy packet in space is different from that inside the quanton**

energy expansion inside the quanton is in the form

$\frac{\partial}{\partial s}(\mathbf{E_s}\ \mathbf{E_t}) = \mathbf{E_q} = \mathbf{E_{sf}}\ \mathbf{E_{tf}}\ \mathbf{E_{sc}}\ \mathbf{E_{tc}}$ **, while outside the quanton**

it takes the form $\mathbf{E_q} = \frac{\partial}{\partial s}(\mathbf{E_s}\ \mathbf{E_t}) = c\varepsilon_o \left(\frac{\mathbf{E_{sf}}\ \mathbf{E_{tc}}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)\left(\frac{\mathbf{E_{sc}}\ \mathbf{E_{tf}}}{\sqrt{\varepsilon_o}\sqrt{c}}\right) = c\varepsilon_o\ \mathbf{E}\ \mathbf{B}$

and as energy has to be ejected from the quanton , one degree of energy freedom became a kinetic degree of freedom , and so the quanton instead of being stationary becomes relativistic quanton anti quanton pair

3- the difference between the two cases of energy expansion , is due to the absence of the field component in the relativistic (Q+AQ) pair propagation direction which means that this quanton pair is a two dimensional one and must substitute this lost Dof with a relativistic Dof to maintain dimensional energy symmetry

4-electromagnetic waves leave quanton under two constraints

a-Integrity of the energy is maintained (no dispersion)

b-free and constrained fields (E_{qf} , E_{qc}) cannot leave the qunaton independently , as the electromagnetic waves are the mechanism of transmission of energy through 3D space , they must have energy fields which are varying in space and time

whose energy Dof = 4 (one of them a kinetic Dof)

this is achieved by cross linking free and constrained fields in the form for sinusoidal waves

$$\mathbf{E}\,(\mathbf{x}) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\Big[\frac{(E_{qf})_q}{\sqrt{c}} + (\frac{(E_{qc})_{aq}}{\sqrt{c}}\Big] \quad , \quad \mathbf{B}\,(\mathbf{x}) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}\Big[\frac{(E_{qc})_q}{\sqrt{c}} + (\frac{(E_{qf})_{aq}}{\sqrt{c}}\Big]$$

5- electromagnetic waves in the previous form can be seen as a relativistic two dimensional quanton anti quanton pairs , where one energy degree of freedom is replaced by a kinetic energy degree of freedom as the waves are formed ,

<u>dimensional analysis</u> ,

based on free and constrained energy field dimensions , the dimensions of electromagnetic field can be determined

the electric field [E] = $[\frac{E_{sf}E_{tc}}{\sqrt{c}}] = M^{+0.5}\,L^{-0.5}\,T^{-1}$ **(15-25)**

and the magnetic field [B] = $[\frac{E_{sf}E_{tc}}{c\sqrt{c}}] = M^{+0.5}\,L^{-1.5}\,T^{00.0}$ **(16-25)**

[U] = electromagnetic energy density = $[\frac{E}{V}] = [\varepsilon\,E^2] = M\,L^{-1}\,T^{-2}$

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

U= $(\mathbf{E_f} + \mathbf{c\,B_c})^{2}$ **=** $\frac{1}{4}(\frac{\mathbf{E_{sf}\,E_{tc}}}{\sqrt{c}} + \sqrt{c}\,\mathbf{E_{sc}\,E_{tf}})^{2}$

[U] =$\frac{1}{4}$ ***4**$(\sqrt{\frac{h}{16\ \pi^4\ c^3}}\ )^{2}\ (k^2\ c^2))^{2}$**=** $(\frac{hc}{16\ {r_q}^4})$ **=** $\frac{hc}{\lambda^4}$ **(17-25)**

=$[\frac{E}{V}] = $ **M** $L^{-1}\ T^{-2}$ **, this is the generic <u>non statistical</u> form of**

Electromagnetic energy density while in terms of the magnetic

Field

[U]= $[\ \frac{B^2}{\mu}]$ **=**$c^2\ (B_c + \frac{1}{c}\ E_f)^{2}$ **=** $c^2(\frac{E_{sc}\,E_{tf}}{\sqrt{c}} + \frac{1}{c}\ \frac{E_{sf}\,E_{tc}}{\sqrt{c}})^{2}$**= M** $L^{-1}\ T^{-2}$

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

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

Table.4 provides details of the Dof's for various space and time

varying fields of the electromagnetic waves

	Dof_x (kinetic)	Dof_s	Dof_t	Total Dof
E (x)	0.5	$E_{sf}(x)$=1.75	E_{tc}=0.25	2.50
B (x)	0.5	$E_{sc}(x)$=0.25	E_{tf}=0.75	1.50
total	1.00	2.00	1.00	4.00

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

25.b. Differences between quanton and electromagnetic waves

The following table 5. Illustrates the major differences

Between quanton and electromagnetic fields

parameter	Quanton waves	electromagnetic
Kinetic degrees of freedom	none	one
Nature of fields	three dimensional	Two dimensional
Dof_{sf} , Dof_{sc}	2.25, 0.75	1.75 , 0.25
Field energy density	4-Dimensional	3D+relativistic Dof
Wave vector (pointing vector)	static	one directional translation
Viewed as	Static three dimensional (Q+AQ) pair	Relativistic two dimensional (Q+AQ) pair

Table 5. Comparison between quanton (free /constrained) waves and electromagnetic waves

26.Maxwell equations of energy fields

as energy variation in space and time creates dynamic fields, so

we can relate the four Maxwell equations for electromagnetism to

their original form for energy fields

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

$$\mathbf{E} = \frac{1}{2}\left(\left(\frac{\mathrm{E}_{sf}\ \mathrm{E}_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \left(\frac{\mathrm{E}_{sc}\ \mathrm{E}_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}}\right)_{aq}\right)$$

$$\mathbf{B} = \frac{1}{2}\left(\left(\frac{\mathrm{E}_{sc}\ \mathrm{E}_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \left(\frac{\mathrm{E}_{sf}\ \mathrm{E}_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_{aq}\right)$$

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>

$$\nabla.\mathbf{E} = \frac{\varrho_c}{\varepsilon_o}$$

ϱ_c **: charge density**

$$\nabla.\mathbf{E} = \nabla.\left[\left(\frac{\mathrm{E}_{sf}\ \mathrm{E}_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \left(\frac{\mathrm{E}_{sc}\ \mathrm{E}_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}}\right)_{aq}\right] = 2\left(\frac{\varrho_c}{\varepsilon_o}\right) \qquad \textbf{(1-26)}$$

$(\mathrm{E}_{tc}\nabla.\ \mathrm{E}_{sf})_q + (\mathrm{E}_{tf}\ \nabla.\ \mathrm{E}_{sc})_{aq}=0$ **(for electromagnetic waves and**

space fabric case)

where $\nabla. E_{tf}$= 0 , $\nabla. E_{tc}$ =0 (E_{tf} , E_{tc} are function of time only)

Or $(E_{tc} \nabla. E_{sf})_q = - (E_{tf} \nabla. E_{sc})_{aq}$ **(2-26)**

2-Gauss law of magnetic field

∇.B =0

$$(\frac{E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}} \nabla. E_{sc})_q + (\frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}} \nabla. E_{sf})_{aq} = 0 \quad \textbf{(3-26)}$$

$$(E_{tc} \nabla. E_{sf})_{aq} = -(E_{tf} \nabla. E_{sc})_q \quad \textbf{(4-26)}$$

3-farday's law for electric field

$$\nabla \times E = -\frac{\partial B}{\partial t}$$

$$\nabla \times E = (\frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}} \nabla \times E_{sf})_q + (\frac{E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}} \nabla \times E_{sc})_{aq} \quad \textbf{(5-26)}$$

$$= (\frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}} \nabla \times E_{sf})_q + (\frac{E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}} \nabla \times E_{sc})_{aq} \quad \textbf{(6-26)}$$

$$-\frac{\partial B}{\partial t} = -\frac{\partial}{\partial t}(E_{sc} \frac{E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}})_q - (E_{sf} \frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}})_{aq} \quad \textbf{(7-26)}$$

$$= -(\frac{E_{sc}}{\sqrt{\varepsilon_o}\sqrt{c}} \frac{\partial E_{tf}}{\partial t})_q - (\frac{E_{sf}}{\sqrt{\varepsilon_o}\sqrt{c}} \frac{\partial E_{tc}}{\partial t})_{aq}$$

by comparing eq 6 , 7 We get

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

$$(E_{tc} \nabla \times E_{sf})_q = -(E_{sc} \frac{\partial E_{tf}}{\partial t})_q$$ and (8-26)

$$(\frac{E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}} \nabla x E_{sc})_{aq} = -(\frac{E_{sf}}{\sqrt{\varepsilon_o}\sqrt{c}} \frac{\partial E_{tc}}{\partial t})_{aq}$$ or

$$(E_{tf} \nabla x E_{sc})_{aq} = -(E_{sf} \frac{\partial E_{tc}}{\partial t})_{aq}$$ (9-26)

where $\frac{\partial}{\partial t}(E_{sf}) = 0$, $\frac{\partial}{\partial t}(E_{sc}) = 0$

(E_{sf} , E_{sc} are function of space only)

4-ampere's law for magnetic field

$$\nabla xB = \mu_o (j + \varepsilon_o \frac{\partial E}{\partial t})$$

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

$$\nabla xB = \nabla x(\frac{E_{sc}}{\sqrt{\varepsilon_o}\sqrt{c}} E_{tf})_q + \nabla x(\frac{E_{sf}}{\sqrt{\varepsilon_o}\sqrt{c}} E_{tc})_{aq}$$

$$= (\frac{E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}} \nabla x E_{sc})_q + (\frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}} \nabla x E_{sf})_{aq}$$ (10-26)

$$\frac{1}{c^2}\frac{\partial E}{\partial t} = \frac{1}{c^2}\frac{\partial}{\partial t}\left[\left(\frac{E_{sf}}{\sqrt{\varepsilon_o}\sqrt{c}} E_{tc}\right)_q + \left(\frac{E_{sc}}{\sqrt{\varepsilon_o}\sqrt{c}} E_{tf}\right)_{aq}\right]$$

$$= \frac{1}{c^2}\left[\left(\frac{E_{sf}}{\sqrt{\varepsilon_o}\sqrt{c}}\frac{\partial E_{tc}}{\partial t}\right)_q + \left(\frac{E_{sc}}{\sqrt{c}\sqrt{\varepsilon_o}}\frac{\partial E_{tf}}{\partial t}\right)_{aq}\right] \quad (11\text{-}26)$$

by comparing eq 10 , 11 we get

$$\left(E_{tf}\, \nabla x\, E_{sc}\right)_q = \frac{1}{c^2}\left(E_{sf}\frac{\partial E_{tc}}{\partial t}\right)_q$$ **and**

$$\left(E_{tc}\, \nabla x\, E_{sf}\right)_{aq} = \frac{1}{c^2}\left(E_{sc}\frac{\partial E_{tf}}{\partial t}\right)_{aq} \quad (12\text{-}26)$$

It is worth noting that

1- the equations (2 , 3) can be put in the following form

For quantons : $$\frac{\nabla x\, E_{sf}}{\frac{\partial E_{tf}}{\partial t}} = -\frac{E_{sc}}{E_{tc}} \quad (13\text{-}26)$$

For anti quantons : $$\frac{\nabla x\, E_{sc}}{\frac{\partial E_{tc}}{\partial t}} = -\frac{E_{sf}}{E_{tf}} \quad (14\text{-}26)$$

2- Maxwell equations remain invariant under relativistic effects

as this effect is split equally between two fields

<u>27.Role of Maxwell equations in the evolution of the quanton</u>

Based on the previous results of Maxwell's equations which link the

Free and constrained fields of both the quanton and the anti quanton together , the quanton 's own form of Maxwell equations can be deduced

1-the basic fields during the primordial time were in the form

E_{sf} , E_{tf} **(free energy field that varies in space and free energy field that varies in time) as the formation of the quanton took the path of the coexistence of both fields**

2-as energy expands by varying in time (E_{tf}) , its rate of variation Induces a curl in the space varying field such that

$\nabla x\, E_{sf} = -\frac{E_{sc}}{E_{tc}}\frac{\partial E_{tf}}{\partial t}$ **in other words , the rate of variation of** E_{tf} **causes** E_{sf} **to curl into the quanton as it is formed hence , the energy fields** E_{sf} E_{tc} **are contained into a quanton formation**

5- the rate of variation of the time varying field E_{tc} **induces a formation of a curl in the constrained space varying field** E_{sc} **,**

such that $\nabla \text{x}\, E_{sc} = \frac{1}{c^2} \frac{E_{sf}}{E_{tf}} \frac{\partial E_{tc}}{\partial t}$ **, such that fields** E_{sc} , E_{tf}

are also contained in the quanton as it formed

28. Anti quanton evolution and its degrees of freedom

Initially , this model proposed anti quanton to have evolved from free time varying energy (E_{tf} **) , however, through later work, many changes had to be made to match a more refined version of space fabric evolution from a single quanton , 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

(already discussed in electromagnetic section)

2-its role in the formation of the negatively charged particles

(electrons , down quarks)

3-anti quanton is stable under expansion conditions

(no degeneration)

4-the interactions generated by anti quanton energy fields are symmetric to those of the quanton ,hence , it can not affect the space fabric homogeneity and integrity

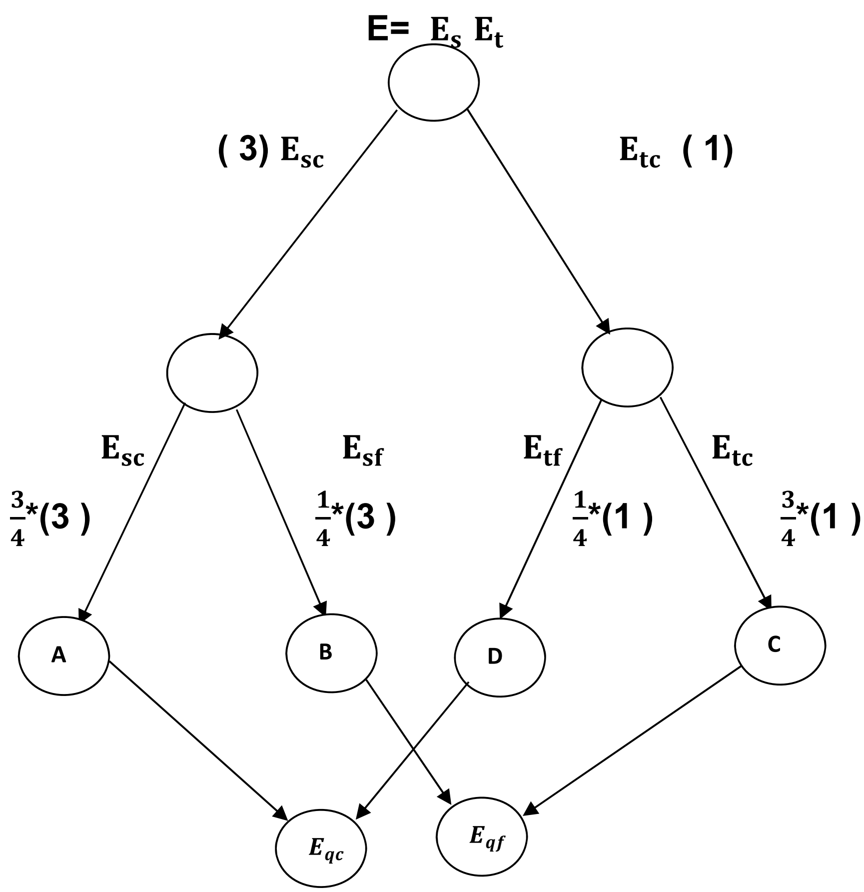


Fig. 6.hypothetical tree diagram for the evolution and the degrees of freedom of anti quanton energy fields, and why the independent evolution of the anti quanton seems to be problematic in an inflationary scenario

From the above degree of freedom evolution diagram , the anti quanton would have evolved from energy fields E_{sc} , E_{tc} such space and time varying fields could not evolve independently under inflationary conditions, an alternative scenario is offered, which is the evolution of the anti quanton form the quanton itself and through the pathways of Maxwell's equations , which are in its generalized form , links the variation of both space and time

a-free dominated field splits , reduced into a packet state

$$\int E_{qf}\, ds = \int E_{sf}\, ds \, \frac{\partial E_{tc}}{\partial t} = E_s\, E_t \qquad \textbf{(1-28)}$$

then expands as a constrained space -free time varying field

$$\int (E_s)\, ds\, \frac{\partial}{\partial t}(E_t) = \int E_s\, ds\, \frac{\partial\, E_{tf}}{\partial t} = (E_{qc})_{aq} \qquad \textbf{(2-28)}$$

b-for the quanton's constrained space dominated field

$$\int E_{qc}\, ds = \frac{\partial}{\partial s}\left(E_{sc}\right) \int (E_{tf})\, dt = E_s\, E_t \qquad \textbf{(3-28)}$$

then expands as a free space -constrained time varying field

$$\frac{\partial}{\partial s}(E_s) \int (E_t)\, dt = \frac{\partial E_s}{\partial t} \int E_t \, dt = (E_{qf})_{aq} \quad (4\text{-}28)$$

anti quanton is the mirror image of the quanton's Dof's

5-For the energy degrees of freedom inside anti quanton ,

they are governed by the Maxwell's equations

rate of variation of E_{tc} curls E_{sc} such that

$$(E_{tf}\ \nabla \times E_{sc})_{aq} = -(E_{sf}\frac{\partial E_{tc}}{\partial t})_{aq}$$

rate of variation of E_{tf} curls E_{sf} such that

$$(E_{tc}\ \nabla \times E_{sf})_{aq} = \frac{1}{c^2}(E_{sc}\frac{\partial E_{tf}}{\partial t})_{aq}$$

the relationship between Q/AQ pair is governed by

$$(E_{tf}\ \nabla .\ E_{sc})_{aq} = -(E_{tc}\nabla .\ E_{sf})_{q}$$

$$(E_{tc}\ \nabla .\ E_{sf})_{aq} = -(E_{tf}\nabla .\ E_{sc})_{q}$$

6-the dominant energy of the anti quanton system is constrained

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

$$D_{scu}\ D_{tcu}\ (\text{unbound}) = \frac{(D_{tc}D_{sc})}{(D_{sf}D_{tf})} = \frac{c^{2.25}c^{0.75}}{c^{0.75}c^{0.25}} = c^2 \quad (5\text{-}28)$$

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

$-\sum(\textbf{free Dof})$ **=**$[(\textbf{Dof}_{\textbf{sc}}) + (\textbf{Dof}_{\textbf{tc}})] - [(\textbf{Dof}_{\textbf{sf}}) + (\textbf{Dof}_{\textbf{tf}})]$ **=2.0**

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 also 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

$\mathbf{E_x}' = \mathbf{E_x}$, $\mathbf{E_y}' = \boldsymbol{\gamma}(\mathbf{E_y} + \boldsymbol{\beta} \mathbf{c} \mathbf{B_z})$

$$E_z' = \gamma (E_z + \beta c B_y) , \quad B_x' = B_x$$

$$B_y' = \gamma (B_y - \frac{v E_z}{c^2}) , \quad B_z' = \gamma (B_z - \frac{v E_y}{c^2})$$

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

energy dominated system , where

$$E = \frac{1}{2} \frac{1}{\sqrt{\varepsilon_o}} (E_f + c\, B_c) = \frac{1}{2} \frac{1}{\sqrt{\varepsilon_o}} (\frac{E_{sf}\ E_{tc}}{\sqrt{c}} + c \frac{E_{sc}\ E_{tf}}{\sqrt{c}})$$

$$B = \frac{1}{2} \frac{1}{\sqrt{\varepsilon_o}} (B_c + \frac{1}{c} E_f) = \frac{1}{2} \frac{1}{\sqrt{\varepsilon_o}} (\frac{E_{sc}\ E_{tf}}{\sqrt{c}} + \frac{1}{c} \frac{E_{sf}\ E_{tc}}{\sqrt{c}})$$

after substitution, we get for E and B

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

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

$$E_y' = \frac{\gamma}{2} \frac{1}{\sqrt{\varepsilon_o}} ((\frac{E_{sf}\ E_{tc}}{\sqrt{c}}) + c\left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}}\right)) \left(1 + \frac{v}{c}\right) = \sqrt{\frac{\left(1 + \frac{v}{c}\right)}{\left(1 - \frac{v}{c}\right)}}\ E_y \qquad (3\text{-}29)$$

Where $\gamma\left(1+\frac{v}{c}\right) = \frac{\sqrt{\left(1+\frac{v}{c}\right)}\sqrt{\left(1+\frac{v}{c}\right)}}{\sqrt{\left(1+\frac{v}{c}\right)}\sqrt{\left(1-\frac{v}{c}\right)}} = \sqrt{\frac{\left(1+\frac{v}{c}\right)}{\left(1-\frac{v}{c}\right)}}$ **(4-29)**

$$B_z{}' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}\left(\left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}}\right) + \frac{1}{c}\left(\frac{E_{sf}\ E_{tc}}{\sqrt{c}}\right)\right) - \frac{v}{c^2}\left(\left(\frac{E_{sf}\ E_{tc}}{\sqrt{c}}\right) + c\left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}}\right)\right) \quad \textbf{(5-29)}$$

$$B_z{}' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}\left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}}\right)\left(1-\frac{v}{c}\right) + \frac{1}{c}\left(\frac{E_{sf}\ E_{tc}}{\sqrt{c}}\right)\left(1-\frac{v}{c}\right)) = \sqrt{\frac{\left(1-\frac{v}{c}\right)}{\left(1+\frac{v}{c}\right)}}\ B_z \quad \textbf{(6-29)}$$

where $\gamma\left(1-\frac{v}{c}\right) = \frac{\sqrt{\left(1-\frac{v}{c}\right)}\sqrt{\left(1-\frac{v}{c}\right)}}{\sqrt{\left(1+\frac{v}{c}\right)}\sqrt{\left(1-\frac{v}{c}\right)}} = \sqrt{\frac{\left(1-\frac{v}{c}\right)}{\left(1+\frac{v}{c}\right)}}$ **(7-29)**

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

(8-29)

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

(9-29)

where $k' = \sqrt{\frac{1-\beta}{1+\beta}}\ k$, $r' = \sqrt{\frac{1-\beta}{1+\beta}}\ r$

$\omega' = \sqrt{\frac{1-\beta}{1+\beta}}\ \omega$, $t' = \sqrt{\frac{1-\beta}{1+\beta}}\ t$

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

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

30. some concepts behind space fabric

1-equipartition of energy or dimensional energy symmetry (with respect to time and space variation of energy) which is manifested in the form of uniform energy density throughout space

2- all fields are interacting , no silent energy field , energy fields of different types (free / constrained) interact with other energy fields of different or similar nature to create a binding or repulsive interaction

3-Preservation of space fabric integrity (in the form of space fabric Binding and retaining interactions)

4-energy field interactions are expressed at all the scales (energy fields are infinite in range)

31.Interactions of energy fields

1-as energy varies in space or time it creates associated dynamic fields that exist inside as well as outside the quantons

2-the nature of the field interactions depends on the type of the energy field free or constrained energy dominated)

3- energy field interaction is according to following manner

a-Interaction of energy fields of similar type (free or constrained) is repulsive in nature

b-interaction energy fields of different type creates a binding interaction

4-an energy field can interact with another energy field only if they have the same field strength (they both have the same Dof's) (necessity condition)

5- same energy field can self-interact to generate a repulsive reaction

6-though energy fields are infinite in their range of action but this range can still be divided into 3 main zones

a-inside quantons b- outside quantons :short range

c-outside quantons : long range

32.Bound and unbound fields

1-inside the quanton , interaction between energy fields of different nature (free- constrained) generates a binding interaction and those energy fields which are involved in such an interaction are said to be bound fields, while energy fields that do not generate such interactions are said to be unbound fields

2-for quantons free energy fields are split into two parts :bound and unbound part $E_{sf} = K_{sf}$ (D_{sfb} D_{sfu}), E_{tf} = K_{tf} (D_{tfb} D_{tfu})

3-fields generated by free energy (E_{sfb} E_{tfb}) fully interact with fields generated by constrained energy (E_{sc} E_{tc}) in a binging interaction , while for anti quanton E_{sc} = K_{sc} (D_{scb} D_{scu}),

E_{tc} = K_{tc} (D_{tcb} D_{tcu}) , and the binding interaction is between fields

(E_{scb} E_{tcb}) **and (** E_{sf} E_{tf}**)**

4- unbound energy fields are repulsive in nature due to their self-interaction

5-for the space fabric case , binding interaction expresses a state of equilibrium due to the symmetry interacting energy fields (equal in strength and intensity)

6- for an energy system to be under equilibrium , all its energy fields must be tied in a binding relationships (with other energy fields) at all the scales (absence of unbound fields)

7-bound energy fields create binding interactions necessary for the integrity of the space fabric (later they will be called quanton binding (E_b) **and retaining** (E_t) **interactions)**

9-all remaining unbound energy fields and through the self

interaction give rise to quanton inflation , splitting and on larger scale inflationary momentum

33. types of field interactions

33.a.single interactions

1-single Interactions of the type $E_{binding\ ij} = \frac{(E_{sfi})(E_{scj})}{(\Delta r_{ij})}$

do no exist in nature since space varying fields cannot exist independently of time varying fields

2-simple interactions between different energy fields inside and around the quanton do not generate four dimensional potential energies, so we use the term interaction ($E_{binding\ ij}$) to describe the simple binding between energy fields of the type

($E_{sfbi}E_{tfbi}$), $(E_{scj}E_{tcj})$.

3-the dimensions of any interaction depend on its degrees of freedom

the interactions between energy fields ($E_{sfbi}E_{tfbi}$) and $(E_{scj}E_{tcj})$ can

be assessed as follows :

the binding interaction($E_{binding-ij}$) between fields (E_{sfbi},E_{tfbi})

and (E_{scj} E_{tcj})(for visualization here , this can be represented by

shared flux lines) is proportional to the generated

flux(φ_{ij}) between the two energy fields, the flux itself is

proportional to the product of the Dof's and intensities of those two

fields , and follows the same guidelines outlined in the section :

superposition principle inside the qunton , namely

1-the generated interaction Dof's equal to the summation of

energy degrees of freedom of both fields (proportional to the

product of field strength of both fields)-for example

$$D_{binding-ij} = (D_{sfbi}\ D_{tfbi})(D_{scj} D_{tcj}) = c^{Dof_{sfb}+Dof_{tfb}+Dof_{sc}+Dof_{tc}} \quad \textbf{(1-33)}$$

2- the interaction intensity must be proportional to the product of

intensity of both fields as defined by the parameter K_q

(for example $(K_{sfbi}K_{tfbi})(K_{scj}\ K_{tcj})= \quad K_q{}^4$)

3- the interaction must be related to true energy , so dimensions of the energy fields intensities must always represent the real binding energy , in other words interactions must be always in terms of $K_q{}^4$ ($K_{ij\ binding} = (K_{sf}\ K_{tf})\ (K_{sc}\ K_{tc}) = K_q{}^4$)

as the term $K_q{}^4$ represents an energy density divided by c^4

$4 -$ the binding relationship for the case of two fields

$$E_{binding\ ij} = \frac{\varphi_{ij}}{(\Delta r_{ij})} = \frac{(E_{sfbi}E_{tfbi})(E_{scj}E_{tcj})}{(\Delta r_{ij})} \qquad (2\text{-}33)$$

$$= \frac{(K_{sfbi}\ K_{scj})\ (D_{sfbi}D_{scj})(K_{tfbi}\ K_{tcj})\ (D_{tfbi}D_{tcj})}{(\Delta r_{ij})}$$

$$= \frac{(K_{sfbi}\ K_{tfbi})\ (K_{scj}K_{tcj})(D_{sfbi}\ D_{tfbi})\ (D_{scj}D_{tcj})}{(\Delta r_{ij})}$$

$$= \frac{(K_q{}^4)(D_{sbf}\ D_{tfb})\ (D_{sf}D_{sc})}{(\Delta r_{ij})} \qquad (3\text{-}33)$$

$$= \sqrt{\alpha_b}\,\frac{h}{2r_q\ v_q}\quad c^{Dof_{sfb}+Dof_{tfb}+Dof_{sc}+Dof_{tc}} \qquad (4\text{-}33)$$

α_b : parameter of interaction , Δr_{ij} : effective distance between

two fields , while $\mathbf{E_{sfbi}}$ is defined as being equal to $\mathbf{K_{sfbi}}\ \mathbf{D_{tbi}}$

(which expresses the energy field as the product of its strength

(Dof) and intensity ,

the dimensions of such an interaction would be $\frac{\mathbf{Energy}}{\mathbf{c^{4-(Dof_{total})}\ (\ 3D\ volume\ )}}$

where $\mathbf{Dof_{total}}$ = $\mathbf{Dof_{free}}$ + $\mathbf{Dof_{constrained}}$

so only interactions which have four degrees of freedom are

able of generating a binding that has the true dimensions of energy

density

<u>33.b multiple fields interactions</u>

1-Energy fields tend to form higher order interactions whenever

possible (multiple field interactions) (this is true up to Dof = 4)

1- hyper interactions (summation of Dof of constituent fields

greater than 4) are inhibited inside and outside quanton .

for real interactions, Dofs must be equal or less than (4) whether

it is a single or multiple interaction

(in real spaces only real interactions can be generated)

2- simpler interactions can combine to form a multiple interaction with higher degrees of freedom (up to 4)

so ,multiple complex field interactions are generated as a result of two simple binding interactions of the type ($E_{sfbi}\ E_{tfbi}$)($E_{scj}\ E_{tcj}$) that can combine with another simple interaction

($E_{sfbj}\ E_{tfbj}$)($E_{sci}\ E_{tci}$) to form a complex one of the type

$$E_{binding\ ij} = \frac{(E_{sfbi}\ E_{tfbi})(E_{sci}\ E_{tci})(E_{sfbj}\ E_{tfbj})(E_{scj}\ E_{tfj})}{(\Delta r_{ij})} \qquad (5\text{-}33)$$

which is the case of gravitation

<u>33.d. nonbinding (repulsive) interactions</u>

while inside the quanton , the unbound field $E_{sfu}\ E_{tfu}$ (or $E_{scu}\ E_{tcu}$ for the case of anti quanton) generates self-interaction that gives rise only to simple repulsive interactions inside the quanton , while outside the quanton (anti quanton) the generated self-interacting field can be involved in a repulsive interaction

as well with another energy field of the same nature (free or

constrained) and the generated interaction would always be a

repulsive one ,

as this energy field cannot create a binding interaction with

another field with opposing type due to this repulsive self

interacting nature even if they share the same Dof's

$$E_{rij} = (E_{sfui} E_{tfui})(E_{sfuj} E_{tfuj}) \frac{1}{(\Delta r_{ij})}$$

$$= (K_{qi}^{2} D_{sfui} D_{tfui})(K_{qj}^{2} D_{sfuj} D_{tfuj}) \frac{1}{(\Delta r_{ij})} \quad (6\text{-}33)$$

$$= K_{q}^{4} (D_{sfu} D_{tfu})^{2} \frac{1}{(\Delta r_{ij})}$$

$$= \sqrt{\alpha_r} \frac{h}{2 r_q v_q} c^{Dof_{sfu} + Dof_{tfu}} \quad (7\text{-}33)$$

and once outside the quanton , the fields behave as complex ones

so , they must interact with another field (simple or complex) of

the same energy nature to generate a nonbinding (repulsive)

interaction in both cases

34. <u>quanton field interactions</u>

<u>34.a-inside quantons</u>

<u>34.a.1The quanton retaining interaction</u> (E_t)

the free and constrained energy fields interact with the energy of

an opposite nature inside the quanton to create the quanton

retaining interaction (E_t)

This is interaction is between (the bound part) of the free

energy field $(E_{sfb}E_{tfb})$ and constrained energy field $(E_{sc}E_{tc})$ for the

case of quanton and the bound part of the constrained energy field

$(E_{scb}E_{tcb})$ and free energy field $(E_{sf}E_{tf})$ for the bound part of

the free energy field that participates in this interaction has to have

the same degrees of freedom as constrained field (due to the

symmetry of Dof's of the interaction)

and is expressed as

$$\mathbf{E_{sf}E_{tf} = (K_{sf}K_{tf}) (D_{sfb}D_{tfb}) \quad (D_{sfu}D_{tfu})}$$

$$\mathbf{(D_{sf}D_{tf})_{\ binding} = (D_{sfb}D_{tfb}) = D_{sc}D_{tc}}$$ **or** **(1-34)**

$$\mathbf{(D_{sfb}\ D_{tfb}\ ) = c^{1.0}}$$ **(2-34)**

$$\mathbf{(D_{sfu}D_{tfu}) = \frac{E_{sf}E_{tf}}{E_{sc}E_{tc}} = \frac{K_q{}^2\ D_{sf}D_{tf}}{K_q{}^2 D_{sc}D_{tc}} = \frac{D_{sf}D_{tf}}{D_{sc}D_{tc}} = \frac{c^{3.0}}{c^{1.0}} = c^{2.0}}$$ **(3-34)**

the generated retaining interaction $(\mathbf{E_t})$ that maintains the quanton's integrity and prevents it from disintegration, the retaining interaction $(\mathbf{E_t})$ is binding energy type since it is developed between two fields of different nature

this interaction takes the following form for a single quanton

$$\mathbf{(E_t\ )_q = \quad (E_{sf}E_{tf})_{\ binding}\ (E_{sc}E_{tc}\ )}$$ **(4-34)**

$$\mathbf{= \quad [K_q{}^2(D_{sfb}\ D_{tfb}\ ]\ \ [K_q{}^2(D_{sc}D_{tc}\ )]}$$

$$\mathbf{(E_t\ )_q = \quad K_q{}^4\ \ c^{\ 2} \quad = \frac{\sqrt{\alpha_t}h\ k^4}{16\pi^4} = \frac{\sqrt{\alpha_t}h}{16\ c\ \ r_q{}^4}}$$ **(5-34)**

where the term $(\mathbf{E_{sf}E_{tf}})_{\ \mathbf{binding}}$ represents the binding part of the

free energy fields $(E_{sf}E_{tf})$ that interacts with constrained fields

$(E_{sc}E_{tc})$, (r_q) is the quanton radius , α_t : retaining interaction

parameter

while for anti quanton case the retaining interaction would be

$$(E_t)_{aq} = (E_{sc}\,E_{tc})_{bound}\,(E_{sf}E_{tf}) \tag{6-34}$$

$$= [K_q^{\,2}\,(D_{scb}\,D_{tcb})]\;[K_q^{\,2}(D_{sf}\,D_{tf})]$$

$$(E_t)_{aq} = K_q^{\,4}\;c^{\,2} = \frac{\sqrt{\alpha_t}h}{16\,c\,r_q^{\,4}} \tag{7-34}$$

as for the dimensions of such interaction , which has two Dof's ,

while its dimension is $[\frac{\text{energy}}{\text{volume}*c^2}]$= M L^{-3} T^{-00}

<u>34.a.2.quanton inflationary interaction (E_i)</u>
<u>Type : simple nonbinding(repulsive)</u>

Inflationary interaction can be thought of as the result of the

self-interaction of the unbound part of free energy field which is

not involved in the retaining interaction (E_t)

the consequence of this self-interaction is the appearance of a repulsive interaction $(\mathrm{E_i})$ that causes quanton to expand ,

the generated quanton inflationary interaction would be in the form

$$(\mathrm{E_i})_q = \left(\sqrt{(\mathrm{E_{sf}\,E_{tf}})_{\ unbound}}\right)^2 \qquad \textbf{(8-34)}$$

$$= \left(\mathrm{K_q}\ \sqrt{(\mathrm{D_{sfu}\,D_{tfu}})}\right) \quad \left(\mathrm{K_q}\ \sqrt{(\mathrm{D_{sfu}\,D_{tfu}})}\right)$$

$$(\mathrm{E_i})_q = \mathrm{K_q}^2\ \mathrm{c}^2 = \sqrt[2]{\frac{\alpha_i\,\mathrm{h\,c}}{16\quad \mathrm{r_q}^4}} \qquad \textbf{(9-34)}$$

α_i : inflationary interaction parameter

the inflationary interaction is at the origin of the quanton's inflation

and subsequent division, which is a synonym with space fabric

expansion , this self-interaction can be thought of as energy field

of a strength $\sqrt{\mathrm{D_{sfu}\,D_{tfu}}}$ that is interacting with another energy

field of similar magnitude creating this repulsive interaction

the dimensions of such a energy-like interaction , which has

two Dof's , it should be [$\sqrt{\frac{\mathrm{energy}}{\mathrm{volume}}}$] = $\mathrm{M^{0.5}\ L^{-0.5}\ T^{-1.0}}$

While for the case of anti quanton , the inflationary energy

$$(E_i)_{aq} = (K_q \sqrt{(D_{scu} D_{tcu})})^2 \quad K_q \sqrt{(D_{scu} D_{tcu})})$$

$$(E_i)_{aq} = K_q^{\,2} c^2 = \sqrt[2]{\frac{\alpha_i h c}{16 \quad r_q^{\,4}}} \tag{10-34}$$

34.<u>b-outside quanton</u>

<u>34.b.1-Space fabric binding interaction</u> (E_b)

<u>Type : multiple binding</u>

as energy fields are not limited in range to inside the quanton ,

the fields of the free energy outside the quanton interact with the

fields of the constrained fields of other quantons to generate

the binding interaction (E_b) and vice versa

the generated binding interaction (E_b) is responsible for

maintaining the space fabric integrity , it is represented by two

contributions due to quantons and anti quantons ,

where (E_{bi})$_q$ is the binding interaction developed between the

quanton (q_i) and other quantons (q_j) or anti quatons ($aq_{\,j}$) ,

a-For the case o quantons

$$E_{bfi} = E_b(E_{sfbi}E_{tfbi})_q = \{[(E_{sfbi}E_{tfbi})_q \sum_j^n (E_{scj}E_{tcj})_q] (\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)})$$

$$+[\left((E_{sfbi}E_{tfbi})_q \sum_j^n (E_{scbj}E_{tcbj})_{aq}\right)]\} (\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}) \qquad \textbf{(11-34)}$$

$$= \{[K_{qi}{}^2 (D_{sfbi}D_{tfbi})_q \sum_j^n K_{qj}{}^2 (D_{scj}D_{tcj})_q] ((\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)})) +$$

$$[K_{qi}{}^2 (D_{sfbi}D_{tfbi})_q \sum_j^n K_{qj}{}^2 (D_{scbj}D_{tcbj})_{aq}]\} (\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)})$$

$$E_{bfi} = K_q{}^4 c^2 (\sum_j^n (\frac{r_q}{(r_i - r_j)_{\,q-q}}) + (\sum_j^n \frac{r_q}{(r_i - r_j)_{\,q-aq}}))$$

$$= \frac{\sqrt{\alpha_b}h}{2} \frac{1}{8\, c\, r_q{}^3} (\sum_j^n (\frac{1}{(r_i - r_j)_{\,q-q}}) + (\sum_j^n \frac{1}{(r_i - r_j)_{\,q-aq}})) \qquad \textbf{(12-34)}$$

where the term $(E_{sfb}E_{tfb})_q$) represents the bound part of the free energy fields $(E_{sf}E_{tf})$ that interacts with constrained energy fields $(E_{sc}E_{tc})$,

$(r_i - r_j)$: the distance between quantons (q_i) and (q_j) or anti quantons (aq_j) , (i≠j) , $\sqrt{\alpha_b}$: binding interaction parameter

while the binding interaction due to the constrained field E_{sc} E_{tc}

will be in the form

$$E_{bci} = E_{bi}\,(E_{sci}E_{tci})_q = \{[(E_{sci}E_{tci})_q \ \sum_j^n \ (E_{sfbj}E_{tfbj})_q \ ] \ (\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)})$$

$$+ \{[E_{sci}E_{tci})_q \ (E_{sfj}E_{tfj})_{aq} \ ] \ (\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}) \} \qquad \textbf{(13-34)}$$

$$= \{ K_q{}^4 [(D_{sci}D_{tci})_q \ \sum_j^n \ (D_{sfbj}D_{tfbj})_q \ ] \ (\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}) \ +$$

$$[K_q{}^4 \ (D_{sci}D_{tci})_q \ \sum_j^n \ (D_{sfj}D_{tfj})_{aq}] \ (\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}) \ )\}$$

$$= \ K_q{}^4 c^2 \ (\sum_j^n \ (\frac{r_q}{(r_i - r_j)_{\ q-q}} \ ) + (\sum_j^n \ \frac{r_q}{(r_i - r_j)_{\ q-aq}} \ )$$

$$E_{bci} = \ \frac{\sqrt{\alpha_b}h}{2} \ \ \frac{1}{8\, c\, r_q{}^3} \ \ [\sum_j^n \ (\frac{1}{(r_i - r_j)_{\ q-q}} \ ) + (\sum_j^n \ \frac{1}{(r_i - r_j)_{\ q-aq}}) \ ] \qquad \textbf{(14-34)}$$

which is the same expression as before or E_{bf} ($E_{sfi}E_{tfi}$) =

E_{bc} ($E_{sci}E_{tci})_q$ and this is due to the symmetry of interactions

later a single expression for both interactions will be developed

which will be of a multiple binding type ,

of course there would be no counting of any quantons , as the

summation can be handled by assessing energy density over an

integration volume

as for the factor $\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}$, while for a single quanton of a radius r_q

it has a total binding energy between bound free energy fields

$(E_{sfb}\ E_{tfb})$ and constrained energy fields $(E_{sc}\ E_{tc})$ that is

equivalent To $E_{tp} = \int_{V_q} E_t\ dV = \int_{V_q} (E_{sfb}\ E_{tfb})\ (E_{sc}\ E_{tc})\ dV$

$$= \frac{h}{16(\pi)^4} k^{4}\, V_q$$

$$= \frac{\sqrt{\alpha_t}\, h}{2} \frac{1}{8\, r_q{}^3 c} \frac{1}{r_q} V_q = \sqrt{\alpha_t}\, \frac{h}{2\, r_q c} \frac{1}{V_q} V_q = \sqrt{\alpha_t}\, \frac{h}{2 r_q c}$$

which says that the binding energy is directly proportional to $(\frac{1}{r_q})$,

now for the case of a virtual quanton whose radius now becomes

$(r_i - r_j)$ instead of r_q, the binding energy between the two energy

fields inside two separate quantons q_i , q_j becomes

$$E_{bp} = (\int_{V_{qi}} (E_{sfbi}\ E_{tfbi}) dV \int_{V_{qj}} (E_{scj}\ E_{tcj})\ dV) \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}$$

$$= K_{qi}{}^{2}\ (D_{sfbi}\ D_{tfbi})\ \ K_{qj}{}^{2}\ (D_{scj}\ D_{tcj})V_{q}\ \frac{\sqrt{r_{qi}\,r_{qj}}}{(r_i - r_j)}$$

$$= \sqrt{\alpha_b}\ c^2\ \sqrt[2]{\frac{h}{2\,c^3\,V_{qi}\,r_{qi}}}\ \sqrt[2]{\frac{h}{2\,c^3\,V_{qj}\,r_{qj}}}\ \ V_q\ \frac{\sqrt{r_{qi}\,r_{qj}}}{(r_i - r_j)}$$

$$= \frac{\sqrt{\alpha_b}\ h}{2(r_i - r_j)\ c}$$

this factor ($\frac{\sqrt{r_{qi}\,r_{qj}}}{(r_i - r_j)}$) acts as a conversion factor for the calculation of the binding between any energy fields regardless whether they belong to the same quanton or not

<u>34.b.2-Quanton repulsive interaction (E_r)</u>
<u>Type : repulsive</u>

out side the quanton , the unbound free energy field $(E_{sfui}E_{tfui})_q$ generates a repulsive interaction with other quantons ' unbound free energy $(E_{sfuj}E_{tfuj})_q$

<u>for quanton</u> (q_i)

$$E_r((E_{sfui}\ E_{tfui})_q\ ) = \ [(E_{sfui}E_{tfui})_q\ \ \sum_j^n (E_{sfuj}E_{tfuj})_q \left(\frac{\sqrt{r_{qi}\,r_{qj}}}{(r_i - r_j)}\right)] \qquad \textbf{(16-34)}$$

$$= [K_{qi}{}^{2}\ D_{sfui}D_{tfui}\ )_q\ \sum_j^n (K_{qj}{}^{2}\ D_{sfuj}D_{tfuj}\ )_q\ )\ \left(\left(\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}\right)\right]$$

$$= \sqrt[2]{\alpha_r}\ c^4\ \sqrt[2]{\frac{h}{16\ \ c^3 r_{qi}{}^4}}\ \ \sum_j^n\ \sqrt[2]{\frac{h}{16\ \ c^3 r_{qj}{}^4}}\ \left(\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)_{\ q-q}}\right)$$

$$E_r = \frac{\sqrt[2]{\alpha_r} h\ c}{16\ \ r_q{}^3}\ \sum_j^n\ \left(\frac{1}{(r_i - r_j)_{\ q-q}}\right) \qquad \textbf{(17-34)}$$

α_r : repulsive interaction parameter

The dimensions of such a energy density interaction , which has four Dof's , it should be $[\frac{energy}{volume}]$ (= M $L^{-1}\ T^{-2}$)

<u>For anti quanton</u> (aq_i)

generated interaction due to unbound field $(E_{scui}E_{tcui})_{aq}$) outside the anti quanton is also a repulsive in nature in nature since this field interacts with the surrounding anti quantons' unbound constrained energy field $(E_{scuj}E_{tcuj})_{\ aq}$ to generate a repulsive interaction $E_r((E_{scui}E_{tcui})_{aq}$)=

$$[(E_{scui}E_{tcui})_{aq}\ \ \sum_j^n\ (E_{scui}E_{tcui})_{aq}\ \ ]\ \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)} \qquad \textbf{(18-34)}$$

$$= [K_{qi}{}^2 D_{scui} D_{tfui}\ )_{aq}\ \sum_j^n\ (K_{qj}{}^2 D_{scuj} D_{tfuj}\ )_{aq}\ ]\ (\left(\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}\right))$$

$$= K_q{}^4\ c^4 \sum_j^n \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)_{aq-aq}})$$

$$= \sqrt[2]{\alpha_r}\ c^4\ \sqrt[2]{\frac{h}{16\ \ c^3 r_{qi}{}^4}}\ \sum_j^n\ \sqrt[2]{\frac{h}{16\ \ c^3 r_{qj}{}^4}}\ \left(\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)_{aq-aq}}\right)$$

$$E_{ri} = \frac{\sqrt[2]{\alpha_r}\, h\, c}{16\ \ r_q{}^3}\ \sum_j^n\ \left(\frac{1}{(r_i - r_j)_{aq-aq}}\right) \qquad \textbf{(19-34)}$$

35.generation of space fabric binding interaction (E_b)

1- energy fields out of the quanton , which generate the quanton binding interaction are also at the origin of dark matter gravitation like effect as well as at the origin of gravitation for the case of normal matter , if inter-quanton binding were not present , there would have been no gravitational like effect of dark matter , nor gravitation for normal matter

2-The generated free energy fields out of the quanton are not in the form E_{sf} E_{tf} , instead the free energy field

out of the quanton is divided into two parts :

first part which is the binding part which forms the retaining

interaction ($\mathbf{E_t}$) or $(\mathbf{E_{sfb}E_{tfb}})_{\mathbf{q}}$ =$\mathbf{K_q}^2(\mathbf{D_{sfb}D_{tfb}})_{\mathbf{q}}$ and has

(1.0 Dof's) , and the second part which generates the quanton

inflationary interaction ($\mathbf{E_i}$) namely the unbound part

($(\mathbf{E_{sfu}\ E_{tfu}})_{\mathbf{q}} = \mathbf{K_q}^2(\mathbf{D_{sfu}D_{tfu}})_{\mathbf{q}}$ which has two degrees of freedom,

so we can summarize the energy fields as they leave the quanton

as follows

$\mathbf{a - E_{sc}E_{tc}}$ (1.0 Dof's) (bound constrained fields)

b- $(\mathbf{E_{sfb}E_{tfb}})$ (1.0 Dof's) (bound free fields)

$c - (\mathbf{E_{sfu}E_{tfu}})$ (1.0 +1.0 Dof's) (unbound self-interacting free field) , and for anti quanton case

$a - \mathbf{E_{sf}E_{tf}}$ (1.0 Dof's) (bound free field)

b- $(\mathbf{E_{scb}E_{tcb}})$ (1.0 Dof's) (bound constrained field)

$\mathbf{c} - (\mathbf{E}_{\mathbf{scu}}\mathbf{E}_{\mathbf{tcu}})$ (1.0+1.0 Dof's) (unbound constrained field)

3-each energy field can only interact with an energy field which has the similar degrees of freedom

4-the free energy fields $(\mathbf{E}_{\mathbf{sf}}\mathbf{E}_{\mathbf{tf}})_{\mathbf{bound}}$ of the quanton or $(\mathbf{E}_{\mathbf{sf}}\mathbf{E}_{\mathbf{tf}})$ of the anti quantons create in an interaction with the constrained energy field $(\mathbf{E}_{\mathbf{sc}}\mathbf{E}_{\mathbf{tc}})$ of the other quantons or $(\mathbf{E}_{\mathbf{sc}}\mathbf{E}_{\mathbf{tc}})_{\mathbf{bound}}$ of the anti quantons which generates a more stable binding energy rather than the less stable repulsive interaction with an energy field of the same nature

5-binding energy fields out of the quanton are symmetric to those out of the anti quanton (1.0 Dof's of each type of field), and they all the generate a binding interaction $(\mathbf{E}_{\mathbf{b}})$

Fig. 7. Illustrates how the quanton packet (total) energy is transformed through field interactions into different inflationary

and binding potentials which form the basis of dark energy and dark matter

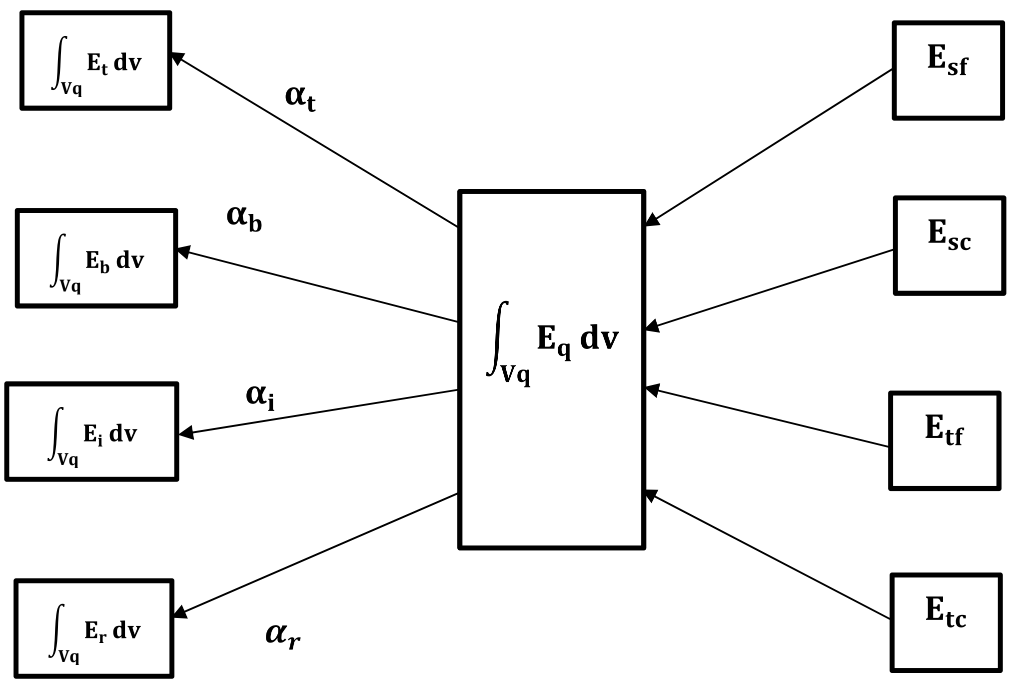


Fig. 7.the relationship between quanton packet energy and the Energy of various interactions

36.Dimensions of energy field interactions

While interactions that generate real energy density have 4 Dof's ,

interactions that involve space fabric, have different dimensions

generally, the number of energy Dof's involved in an interaction is what determines its dimensions

From the previous discussion , we can deduce some rules

regarding the dimensionality of an interaction (E_i) that involves

$(Dof_i = x)$ degrees of freedom

dimensions of interaction $[E_i]$ = $(\frac{energy}{volume})(\frac{1}{c^{4-x}})$ =

$= M\, L^{2-3-4+x}\, T^{-2+4-x} = M\, L^{x-5}\, T^{2-x} = [\frac{M\, L^{x-2}\, T^{2-x}}{volume}]$

$= \frac{energy}{volume}(\frac{T^x}{L^x})$

For the special case of x= 4 , $[E_{D_4}] = M\, L^{-1}\, T^{-2} = (\frac{energy}{volume})$

37-dark energy and dark matter in terms of quanton interaction potentials

Previously the quanton interactions were discussed in terms of

energy density , alternatively , those interactions can be assessed

in terms of the quanton packet energy via volumetric integration

$$E_{tp} = (\int_{V_q} (E_{sf} E_{tf})_{bound} (E_{sc} E_{tc}))\, dV$$

$$= [(K_q^2 (D_{sfb}\, D_{tfb})\ (K_q^2 (D_{sc} D_{tc})]\ V_q \qquad (1\text{-}37)$$

$$= \; K_q{}^4 \; c^2 \, V_q \; = \alpha_t \, \frac{h\,k^4}{16\,\pi^4\,c} \; = \frac{\sqrt{\alpha_t}h}{2}\frac{1}{(8\,r_q{}^3)\,r_q c}\,V_q$$

$$E_{tp} = \sqrt{\alpha_t}\;\frac{h}{2 r_q c} \qquad \textbf{(2-37)}$$

for the inflationary interaction

$$E_{ip} = \int_{V_q} K_q\,(\sqrt{D_{sfu}\,D_{tfu}}\,)(\,K_q\,\sqrt{D_{sfu}\,D_{tfu}}\,)dV$$

$$=[\,(K_q{}^2\;\;(D_{sfu}D_{tfu}\,)]\;\sqrt{V_q}$$

$$= \sqrt[2]{\frac{\alpha_i\;\;h\,c}{2V_q r_q}}\;\;\sqrt{V_q}\; = \sqrt[2]{\frac{\alpha_i\;\;h\,c}{2r_q}} \qquad \textbf{(3-37)}$$

for the repulsive interaction

$$E_{rp} = \int_{V_q} K_{qi}{}^2\,(D_{sfui}\,D_{tfui}\,)\,(\,K_{qj}{}^2\,D_{sfuj}\,D_{tfuj}\,)dV$$

$$=[\,(K_q{}^4(D_{sfu}D_{tfu})^2]\;\;V_q$$

$$= \frac{\sqrt[2]{\alpha_r}\;\;h}{2V_q r_q c}\;\;V_q = \frac{\sqrt[2]{\alpha_r}\;\;h}{2V_q r_q c} \qquad \textbf{(4-37)}$$

<u>37b.multiple form of quanton interactions</u>

When possessing a wave behaviour the quanton anti quanton pair

Behave in the form Q+AQ to obtain an energy density as a result of this superposition , however as quanton/ anti quanton develop field interaction , the manner quanton anti quanton behaviour does not follow a linear superposition rule , instead it follows a Dof superposition of the form Q.AQ to obtain the total energy of the quanton as a result of this superposition, this means the when interacting , the quanton or the anti quanton possesses only two Dof's in comparison to four Dof's when having a wave behaviour

it must be stressed here that both images of the quanton anti quanton pair (Q+AQ and Q.AQ) are simultaneous and not interchangeable, the interactions of the Q+AQ pair combine to form higher order interactions (Dof = four)

this particular point addresses the question why the quanton evolved to become a pair of the form Q.AQ

now for the quanton , the interaction terms become

$E_{sfu}\ E_{tfu}\ +E_{sfb}\ E_{tfb} E_{sc}\ E_{tc}$ **(4-37)**

and for anti quanton

$E_{scu}\ E_{tcu}\ +E_{sf}\ E_{tf} E_{scb}\ E_{tcb}$ **(5-37)**

We notice here the plus sign (+) between the binding and inflationary fields which replaces the multiplication for the case of wave behaviour ,later it will be shown how both fields of the quanton anti quanton pair would interact as Q.AQ pair interaction would lead to development of real four dimensional potential in the form E_p (total energy of the quanton)=

E_{tp} (total retaining energy) $+E_{ip}$ (total inflationary energy)

$+E_{bp}$ (total binding energy) $+E_{rp}$ (total repulsive energy)

fig. 8 . shows how the Q.AQ multiple interactions are evolved

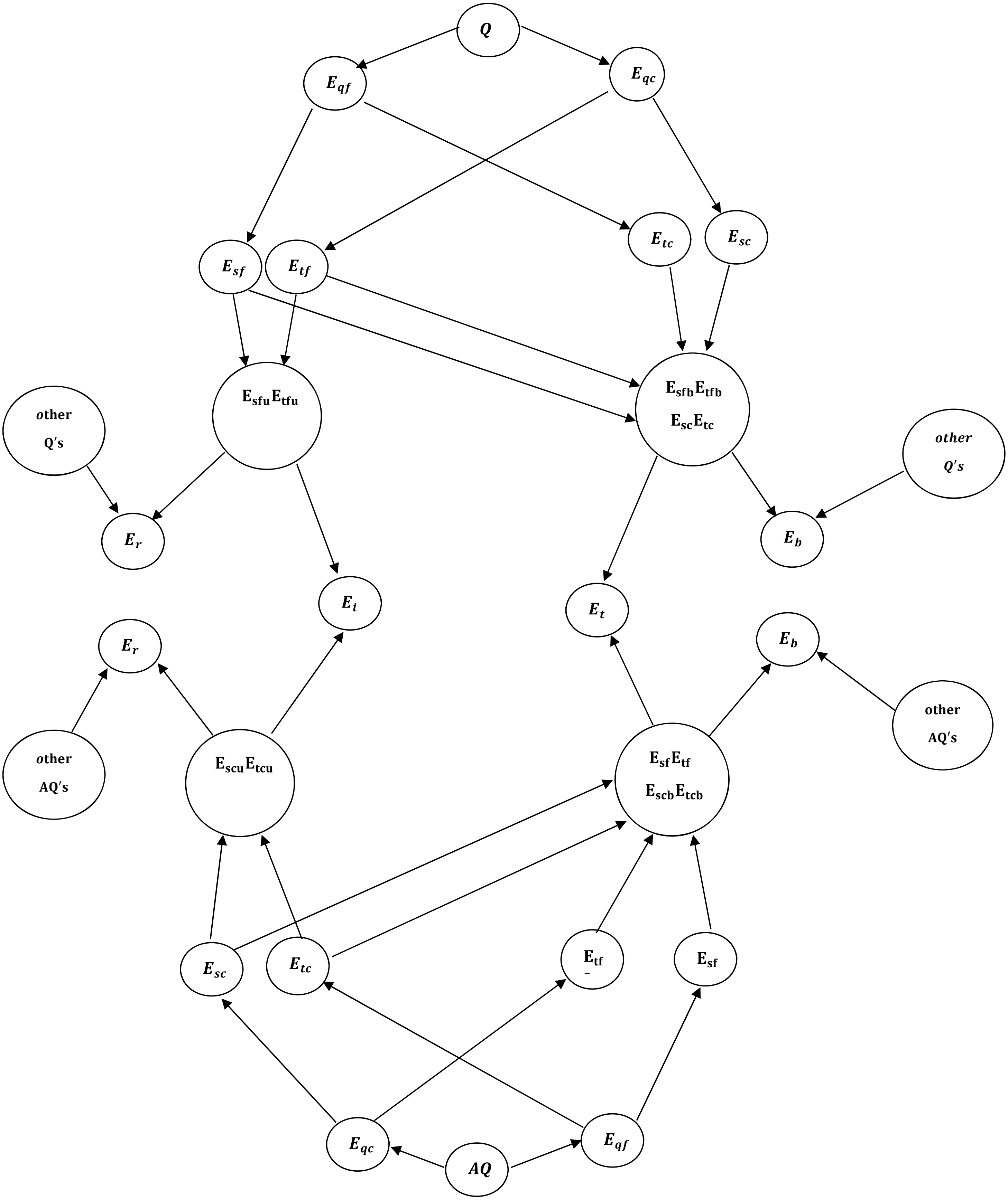

Q
E_{qf}
E_{qc}
E_{sf}
E_{tf}
E_{tc}
E_{sc}
$E_{sfu}E_{tfu}$
$E_{sfb}E_{tfb}$
$E_{sc}E_{tc}$
other
Q's
E_r
E_i
other
Q's
E_b
E_t
E_r
E_b
other
AQ's
$E_{scu}E_{tcu}$
other
AQ's
$E_{sf}E_{tf}$
$E_{scb}E_{tcb}$
E_{sc}
E_{tc}
E_{tf}
E_{sf}
E_{qc}
AQ
E_{qf}

Fig. 8. Evolution of Q.AQ field interactions

37b.1.binding interaction

for a multiple interaction which combines both binding of

1- field $(E_{sfbi}E_{tfbi})_q$ of the quanton (i) with the constrained fields

$(E_{scj}E_{tcj})_q$ of the quanton (j) (or $(E_{scbj}E_{tcbj})_q$anti quanton (j))

2-the constrained fields $(E_{sci}E_{tci})_q$ quanton (i) with free fields

$(E_{sfbj}E_{tfbj})_q$ of the quanton (j) ($(E_{sfj}E_{tfj})_q$or anti quanton(j))

$$E_{btij} = \frac{c^4 {E_{bp}}^2}{E_{ref}} = \frac{c^4}{E_{ref}}$$

$$[(\int_{V_{qi}} (E_{sfbi}E_{tfbi})_q (E_{sci}E_{tci})_q dV \sum_j^n \int_{V_{qj}} (E_{sfbj}E_{tfbj})_q (E_{scj}E_{tcj})_q \, dV) \quad \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}$$

$$+ \int_{V_{qi}} ((E_{sfbi}E_{tfbi}E_{sci}E_{tci})_q \, dV \sum_j^n \int_{V_{qj}} (E_{sfj}E_{tfj}E_{scbj}E_{tcbj})_{aq} \quad dV \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)} \;] \quad (6\text{-}37)$$

$$= \frac{2\, r_{ref}\; c^4}{hc} [\,({K_{qi}}^4 (D_{sfbi}D_{tfbi}D_{sci}D_{tci})_q \, V_{qi} \sum_j^n {K_{qj}}^4 (D_{sfbj}D_{tfbj}\, D_{scj}D_{tcj})_q \; V_{qj} \; \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)})$$

$$+{K_{qi}}^4 (D_{sfbi}D_{tfbi}D_{sci}D_{tci})_q \; V_{qi} \; \sum_j^n {K_{qj}}^4 (D_{sfj}D_{tfj}D_{scbj}D_{tcbj})_{aq}) \quad V_{qj} \; \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)})]$$

(7-37)

$$E_{btij}=\frac{2\alpha_b\ c^3}{h}\ \frac{h}{2V_{qi}\,c^3\,r_{qi}}c^2\,V_{qi}\ \{[\ \sum_j^n\frac{h}{2V_{qj}\,c^3\,r_{qj}}\ c^2\,V_{qj}\ \frac{r_{qi}\,r_{qj}}{(r_i-r_j)_{\ q-q}}]+$$

$$[\sum_j^n\frac{h}{2V_{qj}\,c^3\,r_{qj}}\ c^2\,V_{qj}\,\frac{r_{qi}\,r_{qj}}{(r_i-r_j)_{\ q-aq}})]\} \tag{8-37}$$

$$=\frac{\alpha_b\,hc}{2}\quad(\sum_j^n\ (\frac{1}{(r_i-r_j)_{\ q-q}}\ )+(\sum_j^n\ \frac{1}{(r_i-r_j)_{\ q-aq}})\ ) \tag{9-37}$$

$$E_{ref}=\ \frac{hc}{2\,r_{\,ref}}\quad,\quad r_{\,ref}=\sqrt{r_{qi}\,r_{qj}} \tag{10-37}$$

E_{bt}= total binding potential of quanton / anti quanton pair $(=\frac{c^4 E_{bp}{}^2}{E_{ref}})$

37.b.2.retaining interaction

for the retaining interaction that combines both bindings of Q .AQ

pair , given that $E_t=\ (E_{sfb}E_{tfb})(E_{sc}E_{tc})$

$$\frac{c^4 E_{tp}{}^2}{E_{ref}}=\frac{c^4}{E_{ref}}\ \int_{V_q}(E_{sfb}E_{tfb})_q\ (E_{sb}E_{tc})_q\,dV\ \int_{V_{aq}}(E_{sf}E_{tf})_{aq}\ (E_{sfb}E_{tcb})_{aq}\,dV \tag{11-37}$$

$$=\frac{2\ r_{ref}\,c^4}{hc}(K_q{}^4(D_{sfb}D_{tfb}D_{sc}D_{tc})_{\ q}\,V_q(D_{sf}D_{tf}D_{scb}\ D_{tcb})_{aq}\,V_{aq} \tag{12-37}$$

$$=\frac{2\alpha_t\,r_{ref}c^4}{hc}\ (\frac{h}{16\ c^3 r_q{}^4}\ \ c^2 V_q\ )\ (\frac{h}{16\ c^3 r_q{}^4}\ \ c^2 V_{aq})$$

total retaining interaction potential $\frac{c^2 E_{tp}{}^4}{E_{ref}}\ =\ \frac{\alpha_t hc}{2r_q}$ (13-37) the summation of both the binding and retaining interactions

For the total number of quantons N_q represents the dark matter

with its largely gravitational effects

$$E_u * f_{DM} = [N_q \frac{r_q c^4 E_{tp}{}^2}{h} + \frac{1}{2} \sum_i^m \sum_j^n \frac{r_q c^4 E_{tbij}{}^2}{h}] \quad (14\text{-}37)$$

$$= [N_q \frac{\alpha_t h}{2 r_q} + \frac{\alpha_b h}{2} \sum_i^m \sum_j^n \frac{1}{(r_i - r_j)}]$$

Where f_{DM} represents the dark matter fraction of the total energy

of the universe , E_u : total energy in the universe

and the summation for n $=N_q$, m= N_q-1 , $i \neq j$

<u>37b.3. inflationary and repulsive interactions in multiple form</u>

for the combined inflationary interaction due to unbound fields

of both the Q.Q pair

$$E_{ip} = \int_{V_q} (E_{sfu}\, E_{tfu}\,)_q \quad (E_{scu}\, E_{tcu}\,)_{aq}\, dV \quad (15\text{-}37)$$

$$= \quad [K_q{}^2\, (D_{sfu}\, D_{tfu})_q \quad (K_q{}^2\, (D_{scu}\, D_{tcu})_{aq} \quad]\; V_q \quad (16\text{-}37)$$

$$= \alpha_i \;(\sqrt[2]{\frac{h}{16\, c^3}}\; \frac{c^2}{r_q{}^2})\, (\sqrt[2]{\frac{h}{16\, c^3}}\; \frac{c^2}{r_q{}^2} V_q)$$

$$E_{ip} = \alpha_i \frac{hc}{2V_q r_q} V_q = \alpha_i \frac{hc}{2\, r_q} \quad (17\text{-}37)$$

the combined repulsive interaction of the Q.AQ pair

$$E_{rpij} = \frac{1}{E_{ref}} \left[\int_{V_{qi}} (E_{sfui}E_{tfui})_q \ (E_{scui}E_{tcui})_{aq} \, dV \right] \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}\Big]$$

$$\sum_j^n \int_{V_{qi}} \ (E_{sfuj}E_{tfuj})_q (E_{scuj}E_{tcuj})_{aq} \, dv\Big] \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)} \Big] \quad (18\text{-}37)$$

$$= \frac{\sqrt{r_{qi}\, r_{qj}}}{hc} \Big[\ (K_{qi}{}^4 (D_{sfui}D_{tfui} \ )_q \ (D_{scui}D_{tcui} \ )_q \quad \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}$$

$$\sum_j^n K_{qj}{}^4 (D_{sfuj}D_{tfuj} \ )_q \ (D_{scuj}D_{tcuj} \ )_q V_q\Big] \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)} \quad (19\text{-}37)$$

$$E_{rpij} = \alpha_r \frac{\sqrt{r_{qi}\, r_{qj}}}{hc} \Big[\frac{h}{16\, c^3} \frac{c^4}{r_{qi}{}^4} V_{qi} \Big[\sum_j^n \frac{h}{16\, c^3} \ \frac{c^4}{r_{qj}{}^4} V_q \ \Big(\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}_{\,q-q}\Big)\Big]$$

$$= \frac{\alpha_r\, hc}{2} \quad \Big(\sum_j^n \ \Big(\frac{1}{(r_i - r_j)}_{\,q-q} \ \Big) \quad (20\text{-}37)$$

the summation of both the inflationary and the repulsive

Interactions for the total number of quantons N_q in the universe

represents the dark energy with its largely inflationary effects

$$E_u * f_{DE} = [N_q E_{ip} + \frac{1}{2} \sum_i^m \sum_j^n E_{rpij}] \quad (21\text{-}37)$$

$$= [N_q \frac{\alpha_i h}{2r_q} + \frac{\alpha_r h}{2} \sum_i^m \sum_j^n \frac{1}{(r_i - r_j)}]$$

Where f_{DE} represents the dark energy fraction of the total energy of the universe

38.Why quanton does not achieve equilibrium

energy fields inside the quanton try to achieve stability in the form of binding Interaction which has the maximum of binding potential the rearrangement, the quanton Dof's to satisfy the condition would be as follows : $Dof_{tf} = Dof_{tc} = 0.5$

$Dof_{sf} = Dof_{sc} = 1.5$, $Dof_{sf} Dof_{tf} = Dof_{sc} Dof_{tc} = 2$

his binding interaction here has all four Dof's

under such conditions the quanton is in equilibrium ,no unbound fields exist to cause quanton inflation or splitting ,

But this will not happen as such a condition would entail that there would be no inflation of the universe beyond the single quanton ,

which would remain in this state indefinitely

this scenario is not possible as energy has to expand , by variation

in space and variation in time since the repulsive self interaction

(represented by the dark energy) is always present in addition to

the biding potential (represented by the dark matter)

39.The inverse relationship between wave length / energy – a possible explanation

The quanton retaining (binding) interaction took the form

$E_t = (E_{sfb} E_{tfb})(E_{sc} E_{tc})$, unlike any other potentials like

$U_g = G\frac{M\,m}{r}$ or $U_e = K\frac{Q_i\,Q_j}{r}$, term $(\frac{1}{\Delta r})$ does not appear in this

binding potential

In fact , the quanton , like any other quantum system has its energy

which is defined as $E_p = \frac{hkc}{2\pi}$, and can be put alternatively as

E_p(packet energy) $= \frac{hkc}{2\pi} = \frac{hc}{2\,r_q}$ (where $k = \frac{\pi}{r_q}$)

While $E_{tp} = \int_{V_q} E_t \, dv = E_t \, V_q = \frac{\sqrt{\alpha_t} h}{2 \, r_q}$

(E_{tp} : total retaining energy inside quanton)

this shows that the quanton radius is inversely proportional to retaining energy (a binding type interaction) , which already satisfies the inverse proportionality law

as the quanton energy E_p decreases , its retaining energy decreases and consequently quanon radius and its wave length increases , this shows that the term $(\frac{1}{r_q})$ is inherently present in the retaining interaction as well as all forms of quanton interactions and for the particular case of electromagnetic waves , the inverse relationship between the wavelength and the energy of the wave is an expression of an increased binding energy which leads to a corresponding change in the relativistic quanton dimensions or its wave length

both table 8. and fig. 9. summarize the quanton interactions at all the scales (inside , outside short and long range) , while table 9. Lists all the developed quanton / anti quanton interactions outside the quanton

40.Role of individual energy fields in the formation of space fabric interactions

Energy field	role inside quanton	role outside quanton (short range)	interaction at cosmological scale
E_{sfb} E_{tfb} (bound)	Quanton retaining interaction E_t	Quanton binding interaction E_b	Dark matter gravitational like effect
E_{sc} E_{tc} (bound)	quanton retaining interaction E_t	Quanton binding interaction E_b	Dark matter gravitational like effect
E_{sfu} E_{tfu} (unbound)	Quanton inflationary interaction E_i	Quanton repulsive interaction E_r	Matter distortion of space fabric

Table 8 . summary of the role of individual energy fields and their interactions at Planck and cosmological scale for the quantons of space fabric

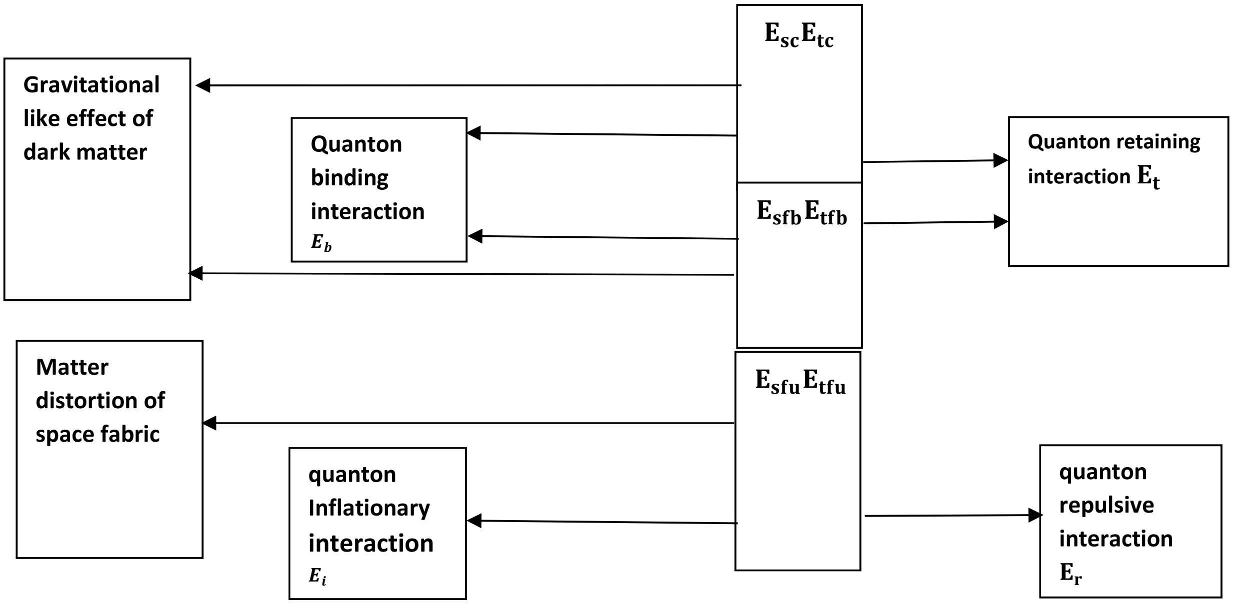


Fig. 9.Summary of the quanton energy fields and the generated interactions

	structure	quanton			Anti quanton		
structure	Energy field	$(E_{sfbj}E_{tfbj})$ (bound)	$E_{scj}E_{tcj}$ (bound)	$E_{sfuj}E_{tfuj}$ unbound	$E_{scbj}E_{tcbj}$ (bound)	$E_{sfj}E_{tfj}$ (bound)	$E_{scuJ}E_{tcuj}$ (unbound)
quanton	$(E_{sfbi}E_{tfbi})$ (bound)	N/A	E_b	N/A	E_b	N/A	N/A
	$E_{sci}E_{tci}$ (bound)	E_b	N/A	N/A	N/A	E_b	N/A
	$(E_{sfui}E_{tfui})$ unbound)	N/A	N/A	E_r	N/A	N/A	N/A
Anti quanton	$(E_{scbi}E_{tcbi})$ (bound)	E_b	N/A	N/A	N/A	E_b	N/A
	$E_{sfi}E_{tfi}$ (bound)	N/A	E_b	N/A	E_b	N/A	N/A
	$(E_{scui}E_{tcui})$ (unbound)	N/A	N/A	N/A	N/A	N/A	E_r

Table 9. Summary of the generated interactions outside quanton / anti quanton due to different energy fields outside of the quanton

41. energy fields' role in the generation of the fundamental forces

1-ordinary matter evolved from quanton / anti quanton pair as they split in a process that led to the rearrangement of their degrees of freedom which became different compared space fabric case

2-normal matter quantons are quantized , but not a quantum entity and can be regarded as at the origin of bound mass

in addition to bound mass ,normal matter is composed of

associated fields

3-normal matter quantons are comprise only two degrees of freedom as the remaining two become scalarized (transformed from being part of the field strength to being part of its intensity)

4-for the case of space fabric , the qunaton is not under equilibrium of interactions (equilibrium: absence of the repulsive self interacting fields) ,as it expands and splits ,while for the case of normal matter quntons , they are under an actual equilibrium of interactions due to the complete symmetry between free and constrained fields, where no inflation or splitting

5-under such conditions, normal matter quantons and anti quantons became identical

6-for space fabric , unbound fields inside the quanton , give rise to quanton inflation , for the normal matter , the unbound energy fields (associated fields) gave rise to fundamental forces

through their interactions with other fields (except gravitation where it is originated from bound energy fields inside the quanton) a model for this rearrangement in the structure of the normal matter quanton is as follows

1- bound fields : normal matter quantons are formed from space and time fields (E_{sfb} , E_{tfb} E_{scb} E_{tcb}) (now quantons and for anti quantons are identical due to fact that bound free and constrained fields both have the same Dof's)

2-unbound fields (E_{sfu} , E_{tfu}), or (E_{sfu} , E_{tfu}) have the following roles ,

a-for the gluons : they gave rise to part of the strong nuclear force

b-for the electrically charged particles : they are at the origin of the atomic electric field

42.Degrees of freedom of quantons of normal matter

a-gravitational mass

we recall that the normal matter quantons have only two Dof's and for normal matter both quantons and anti quantons are identical

1-since normal matter quantons are under equilibrium of interactions the bound fields now can reflect the space time symmetry such that

$$\mathbf{Dof_{sfb}} = \mathbf{Dof_{scb}} = 0.75 \quad , \quad \mathbf{Dof_{tfb}} = \mathbf{Dof_{tcb}} = 0.25 \qquad (1\text{-}42)$$

$$(\mathbf{Dof_{sfb}} + \mathbf{Dof_{scb}}) = 1.5 \quad , \sum \mathbf{Dof_p} = 2 \qquad (2\text{-}42)$$

Energy of the bound mass take the non-relativistic form

$$\mathbf{E_m} = \sum_i^m \int_{V_p} \mathbf{E_{sfb} E_{tfb}\ E_{scb} E_{tcb}\ dV} \quad , \qquad (3\text{-}42)$$

The volumetric integration represents bound fields that are involved in formation of bound mass

b-charged atomic fields

a-space unbound fields ($\mathbf{E_{sfu}}$, $\mathbf{E_{scu}}$) have the same Dof

($\mathbf{Dof_{sfu}} = \mathbf{Dof_{scu}}$ = 1.5 Dof's) **(4-42)**

b-time unbound fields ($\mathbf{E_{tfu}}$, $\mathbf{E_{tcu}}$) also have the same Dof

($\mathbf{Dof_{tfu}} = \mathbf{Dof_{tcu}}$ = 0.5) **(5-42)**

3-for positively charged particles : the atomic field is represented

by the unbound fields ($\mathbf{E_{sfu}}$ $\mathbf{E_{tfu}}$)

while for the negatively charged particles , the associated atomic

Field is represented by the unbound fields ($\mathbf{E_{scu}}$ $\mathbf{E_{tcu}}$)

4-for normal matter , the active degrees of freedom are four

: two for the normal matter quanton , and two for the associated

fields

3- Due to absence of the curl (point source) , the atomic electric

Field becomes invariant (but its denotation is maintained)

table 10. illustrates main differences between quantons of space

fabric and those of normal matter

parameter	Space fabric quantons	Normal matter quantons
Nature of the quanton	Quantum entity of the form Q+AQ	Not a quantum entity Q and AQ are identical
Bound fields	Q: $(E_{sfb}\ E_{tfb})\ (E_{sc}\ E_{tc})$ AQ: $(E_{sf}\ E_{tf})(E_{scb}\ E_{tcb})$	Q or AQ: $E_{sfb}\ E_{tfb}\ E_{scb}\ E_{tcb}$
unbound fields	unbound fields : Q: $(E_{sfu}\ E_{tfu})$ AQ: $(E_{scu}\ E_{tcu})$	unbound fields Gluons Q: $E_{sfu}E_{tfu}$ AQ: $E_{scu}E_{tcu}$ Positive particles $E_{sfu}\ E_{tfu}$ negative particles $E_{scu}\ E_{tcu}$
Wave behaviour	Q+AQ pair has wave properties	Inside quantons : No wave behaviour , only binding energy fields
Degrees of freedom	Four	Dof_p: two Associated unbound fields : two
Nature of fields E_{qf} , E_{qc}	orthogonal	parallel
Quanton Expansion , splitting	Quantons Expand , and split	No expansion or splitting (quantons are under actual equilibrium)
r_q , ω Variation (under static conditions)	Varying	invariant

Table 10. Summary of the differences between space fabric and normal matter quantons

43. bound mass and its relativistic effect

The reduced quanton of the normal matter is composed of a pair of coplanar fields (free /constrained) namely

$$\mathrm{E}_{qf} = \mathrm{E}_{sfb}\,\mathrm{E}_{tcb}\ ,\quad \mathrm{E}_{qc} = \mathrm{E}_{scb}\,\mathrm{E}_{tfb} \tag{1-43}$$

$$\mathrm{E}_{m} = \sum_{j}^{n} \int_{V_p} \mathrm{E}_{qfbj}\,\mathrm{E}_{qcbj}\ dV = \sum_{j}^{n} \mathrm{E}_{qfj}\,\mathrm{E}_{qcj}\,\mathrm{V}_{pj} \tag{2-43}$$

unlike the case of quanton fields or electromagnetic waves (where the free dominated field E_{qf} and the constrained dominated E_{qc} are orthogonal to each other) ,for the normal matter the free and the constrained energy dominated fields are coplanar (exist in one plane) , the magnitude of the energy density is represented by dot product of both fields , this would lead to the development of field equations of gravitational mass

$$\mathrm{E}_{qf} \times \mathrm{E}_{qc} = 0 \quad \text{(fields are coplanar , their cross product equals zero)} \tag{3-43}$$

$\nabla . E_{qf} = - \nabla . E_{qc}$ **(completely mirror symmetric fields)** **(4-43)**

43.b For the relativistic effects of the bound matter

as the inertial body moves along a certain direction (x) , the two dimensional fields E_{qf} , E_{qc} undergo a gradual limitation of variation , from 3 dimensional , to becoming two dimensional (y, z) which is orthogonal to the movement direction

the main driving force behind this change is to maintain the integrity of the matter , under such conditions , we would expect there would be no energy fields along the direction of motion

the relativistic mass under Lorentz transform of transverse energy fields now becomes $E_{mo}{}' = (E_{qf}{}' E_{qc}{}' V_p)$ **(5-43)**

$$E_{mo}{}' = \frac{(E_{qf} \ E_{qc} V_p)}{\sqrt{1-(\frac{v}{c})^{2}}} = \frac{E_{mo}}{\sqrt{1-\beta^{2}}} \qquad (6\text{-}43)$$

and the same results can be obtained via the energy momentum relationship where $Pc = \frac{E}{c} v = \frac{(E_{qf} E_{qc} V_p)}{c} v$ **(7-43)**

$$E_m{}^2 = m^2c^4 = P^2c^2 + m_o{}^2c^4$$

$$(E_{qf}{}' E_{qc}{}' V_p)^2 = (E_{qf}{}' E_{qc}{}' V_p)^2 \frac{v^2}{c^2} + (E_{qf} E_{qc} V_p)^2 \qquad (8\text{-}43)$$

$$\left(E_{qf}{}' E_{qc}{}' V_p\right)^2 \left(1 - \frac{v^2}{c^2}\right) = (E_{qf} E_{qc} V_p)^2 \qquad (9\text{-}43)$$

$$(E_{qf}{}' E_{qc}{}' V_p) = E_m = \frac{E_{qf} E_{qc} V_p}{\sqrt{1-\beta^2}} = \frac{E_{mo}}{\sqrt{1-\beta^2}} \qquad (10\text{-}43)$$

44. Energy field parameters for normal matter

normal matter quanton which is composed of bound energy fields

$(E_{sfb} E_{tfb})$ $(E_{scb} E_{scb})$ is not a quantum entity (as it possesses only

two degrees of freedom) ,no splitting or expansion , yet it can be

quantized form using the relationship $E_p = \frac{\alpha_m h c}{2 r_p}$

where r_p (particle radius) = fixed

$$E_m = M c^2 = \sum_j^n \frac{m_j}{c^2} c^4 = \sum_j^n \frac{\alpha_m h}{2 c^3 r_{pj}} c^4$$

$$= n \frac{\alpha_m h}{2c^3 r_p} c^4 \qquad (1\text{-}44)$$

where $\frac{\alpha_m h}{2 c^3 r_p}$ = constant (2-44)

this is quantized energy relationships and not a quantum relationship since the Planck Einstein relationship is not applicable namely $E_m \neq fn\left(\frac{1}{r_p}\right)$, r_p represents the radius of normal matter's quanton , normal matter energy is presented in this quantized form as it will serve two main purposes

1-to define field interactions in terms of the constant (c)

2-to facilitate studying interactions with quantum based fields.

the parameters ω , k , and r_q for the quanton are now replaced by the alternative characteristic length (r_p)

the energy of the bound mass

$$E_m = \sum_j^n \int_{V_p} E_{sfbj}\, E_{scbj}\;\; E_{tfbj}\, E_{tcbj}\;\; dV$$

$$= \sum_j^n (E_{sfbj}\, E_{scbj}\;\; E_{tfbj}\, E_{tcbj})\, V_{pj} \qquad \text{(3-44)}$$

given that V_p = constant , $\sum_j^n V_{pj} = n\, V_p$

$$E_m = V_p \left(\sum_j^n E_{sfbj}\, E_{tfbj}\right) \left(E_{scbj}\, E_{tcbj}\right)$$

$$E_m = nE_{sfb}\, E_{scb}\, E_{tfb}\, E_{tcb}\, V_p = n\, \frac{\alpha_m\, hc}{2\, r_p} \qquad (4\text{-}44)$$

and as an energy density

$$E_{pm} = \frac{n\, \alpha_m\, hc}{2\, r_p\, (V_p\ )} = \frac{n\alpha_m\, hc}{2\, r_q\, (8\, r_p^{\,3})} = n\, \frac{\alpha_m\, hc}{16\ \ r_p^{\,4}} \qquad (5\text{-}44)$$

where the dimensions of the bound fields $E_{sfb}E_{tfb}E_{scb}E_{tcb}$ are

$$[\frac{hc}{c^2 r_p^{\,4}}] = M^1L^{-3}T^{00} = \frac{\text{energy}}{\text{volume} * c^2} = \frac{\text{mass}}{\text{volume}}$$

44.a-NM Bound energy fields

these degrees of freedom here become part of the intensity parameter as the NM quanton has two Dof's only

(scalarized degrees of freedom)

$$E_{sfb} = \sqrt[4]{\frac{\alpha_m h\, c^2}{16\quad c^3}}\ \frac{c^{0.75}}{r_p} = \sqrt[4]{\frac{\alpha_m h}{16\quad c}}\ \frac{c^{0.75}}{r_p} = K_p\ \ c^{0.75} = K_{sfb}\, D_{sfb} \qquad (6\text{-}44)$$

$$K_{sfb} = K_p = \sqrt[4]{\frac{\alpha_m h\, c^2}{16\quad c^3}\ \frac{1}{r_p}}\ , \quad D_{sfb} = c^{0.75} \qquad (7\text{-}44)$$

$$E_{tfb} = \sqrt[4]{\frac{\alpha_m h\, c^2}{16\quad c^3}}\ \frac{c^{0.25}}{r_p} = K_p\ \ c^{0.25} = K_{tfb}\, D_{tfb} \qquad (8\text{-}44)$$

$$E_{scb} = K_{scb}\, D_{scb} = \sqrt[4]{\frac{\alpha_m h\, c^2}{16\quad c^3}}\ \frac{c}{r_p^{\,2}} = K_p c^{0.75} = K_{scb}\, D_{scb} \qquad (9\text{-}44)$$

$$E_{tcb} = \sqrt[4]{\frac{\alpha_m h\, c^2}{16 \quad c^3}}\ \frac{c^{0.25}}{r_p} = K_p\ c^{0.25} = K_{tcb}\, D_{sfb} \tag{10-44}$$

where $K_{sfb} = K_{tfb} = K_{scb} = K_{tcb} = K_p$

44.b- unbound energy fields

44.b.1-positively charged particles

$$E_{sfu} = \sqrt[4]{\frac{\alpha_e\, h}{16 \quad c^3}}\ \frac{c^{1.5}}{r_p} = K_{sfu}\, D_{sfu} = K_p\ c^{1.5} \tag{11-44}$$

$$E_{tfu} = \sqrt[4]{\frac{\alpha_e\, h}{16 \quad c^3}}\ \frac{c^{0.5}}{r_p} = K_{tfu}\, D_{tfu} = K_p c^{0.5} \tag{12-44}$$

$$K_{sfu}\, K_{tfu} = K_p^{\ 2} \quad , \alpha_e = \frac{1}{137} \tag{13-44}$$

44.b.2-negatively charged particles

$$E_{scu} = \sqrt[4]{\frac{\alpha_e h}{16 \quad c^3}}\ \frac{c^{1.5}}{r_p} = K_{scu}\, D_{scu} = K_p\ c^{1.5} \tag{14-44}$$

$$E_{tcu} = K_{tcu}\, D_{tcu} = K_p\ c^{0.5},\ K_{scu}\, K_{tcu} = K_p^{\ 2} \tag{15-44}$$

45. scalarized degrees of freedom, a possible origin of bound mass,

bound mass density is represented by the product of the

normal matter field intensities which are

$$K_{sfb}\ K_{tfb}\ K_{scb}\ K_{tcb}\ = K_p{}^4 \ = (\sqrt[4]{\frac{\alpha_m h}{16\ \ c}})^4\ (\frac{1}{r_p{}^4})$$

$$= \frac{\alpha_m h}{16\ \ c\ r_p{}^4} = \frac{\text{mass}}{\text{volume}}$$

the normal matter the intensity parameter became

$$K_{sfb} = K_{tfb} = K_{scb} = K_{tcb} = \sqrt[4]{\frac{h\,c^2}{16\ \ c^3}}\ \frac{1}{r_p} = \sqrt[4]{\frac{h}{16\ \ c}}\ \frac{1}{r_p}$$ **instead of**

$$\sqrt[4]{\frac{h}{16\ \ c^3}}\ \frac{1}{r_p}$$ **for the space fabric quantons**

while energy density equation of normal matter quanton is in the form $E_q = E_{sfb}\ E_{scb} E_{tfb}\ E_{tcb}$, with a reduction of overall degrees of freedom from four to two due to the fact that two degrees of freedom now transformed from belonging to the field strength parameter to become a part of the field intensity

as a result of this reduction of degrees of freedom the normal matter, Dof's of quantons representing the bound mass become of the form (1.5+0.5) instead of (3+1)

gauge theory prevents the gauge particles from acquiring mass , however , under low dimensions conditions , photons , gluons can acquire a dynamic mass under Schwinger model of reduced dimensions , here , a generalization which proposes that reduction in the energy degree of freedom is possibly at the origin of mass generation (rest/ dynamic) is suggested

46. field interactions of normal matter

46.a-Quanton retaining interaction (Type : single binding)

$$(E_t) = (E_{sfb}\, E_{tfb})\,(E_{scb} E_{tcb}) \qquad (1\text{-}46)$$

$$= (K_p{}^2 D_{sfb} D_{tfb})\,(K_p{}^2 D_{scb} D_{tcb})$$

$$= \int_{V_p} (K_p{}^2\ \frac{c}{r_p{}^2})(\ K_p{}^2\ \frac{c}{r_p{}^2})\quad dV$$

$$E_t = \alpha_t\,(\frac{h\ c^2}{16\ \ c^3})\,\frac{c^2}{r_p{}^4}\,(8\ r_p{}^3) = \alpha_t\,\frac{h\,c}{2\,r_p} \qquad (2\text{-}46)$$

where $K_p = \sqrt[4]{\frac{h}{16\ \ c}}$, this interaction has two degrees of freedom , and the dimensions of energy= $M^1L^2T^{-2}$

46.b-quanton's gravitational binding of the bound mass type : multiple binding

the normal matter particles develop a gravitational type of binding as energy fields tend to form higher order interactions up to four degrees of freedom

bound energy fields of each quanton form a gravitational binding interaction with bound energy fields of other quantons of the form $(E_{sfbi}\, E_{tfbi})\,(E_{scbj}\, E_{tcbj})$ **and** $(E_{scbi}\, E_{tcbi})\ (E_{sfbj}\, E_{tfbj})$ **to generate the gravitational binding energy** E_{gb} **between particle** p_i **and other particles** p_j

formulation of the gravitational binding energy of the normal matter differs from all other normal matter interactions due to the following reason

1-for normal matter space and time fields $(E_{sfb}\, E_{tfb})(E_{scb}\, E_{tcb})$

The intensity parameter is of nature $({K_p}^4)$

2-the gravitational binding interaction is based on two binding interactions for fields for particles p_i , p_j , which are

a-between (E_{sfbi} E_{tfbi}) and (E_{scbj} E_{tcbj})

b-between (E_{sfbj} E_{tfbj}) and (E_{scbi} E_{tcbi})

those two simple interactions combine to form gravitational binding since each one of those interactions has only two degrees of freedom (complex interactions allowed up to 4 Dof's)

3-the resulting interaction has would be in the form

$$E_g = K_g \ (K_{pi}{}^4 c^2)(K_{pj}{}^4 c^2) \frac{r_{pi} r_{pj}}{(r_i - r_j)} \qquad \textbf{(3-46)}$$

intensity term is becomes $(K_p{}^4)^2$ instead of $(K_p{}^4)$ which is required for true energy generated by the interaction

and since E_g has the dimensions of energy $M^1L^{+2}T^{-2}$, the constant K_g appears as a dimensional correction since each of the parameters $[K_{pi}{}^4 \ V_{pi}][K_{pj}{}^4 \ V_{pj}] = (\frac{h}{2\,c\,r_p})^2 = [\frac{energy}{c^2}]*[\frac{energy}{c^2}]$

to obtain a truly binding interaction E_g (in terms of energy

with dimensions $M^1L^{+2}T^{-2}$)

the constant K_g should be equivalent to $\frac{c^4}{E_{ref}}$ where for normal

matter $E_{ref} = \frac{hc}{2r_p}$ **(4-46)**

(quanton gravitational binding is between fields which have the dimension of energy , while gravitation in its classical form is between two masses so each of the interaction terms is divided by (c^2) and then multiplying ($\frac{1}{E_{ref}}$) by (c^4)

$$E_{gbi} = \frac{c^4}{E_{ref}} [(\int_{V_{pi}} \frac{E_{sfbi}\ E_{tfbi} E_{scbi}\ E_{tcbi}}{c^2} dV) \sum_j^n \int_{V_{pj}} \frac{E_{sfbj}\ E_{tfbj} E_{scbj}\ E_{tcbj}}{c^2} dV] \left(\frac{\sqrt{r_{pi} r_{pj}}}{(r_i - r_j)}\right)$$

(5-46)

$$= \frac{c^4}{E_{ref}} [(K_{pi}{}^4 \frac{D_{sfbi}\ D_{tfbi} D_{scbi}\ D_{tcbi}}{c^2} V_{qi}) (\sum_j^n K_{pj}{}^4 \frac{D_{sfbj}\ D_{tfbj} D_{scbj}\ D_{tcbj}}{c^2} V_{qj}) \left(\frac{\sqrt{r_{pi} r_{pj}}}{(r_i - r_j)}\right)]$$

$$(E_{gbi}) = \frac{c^4 r_p{}^2}{E_{ref}} [(K_{pi}{}^4\ V_{pi})(\sum_j^n K_{pj}{}^4\ V_{pj}) (\frac{1}{(r_i - r_j)})]$$

which is a summation for particles (j)

given that $r_{pi} = r_{pj} = r_p$, for normal matter $K_{pi} = K_{pj} = K_p = \sqrt[4]{\frac{h}{16\ c}\frac{1}{r_p}}$

$$\int_{V_p} E_{sfb}\, E_{tfb}\, E_{scb}\, E_{tcb}\, dV = E_{sfb}\, E_{tfb}\, E_{scb}\, E_{tcb}\, V_p$$

$$V_{pi} = V_{pj} = V_p = 8\ r_p{}^3$$

$$K_p{}^4 = \frac{h}{16\ c}\ (\frac{1}{r_p})^4 = \frac{h}{2\ c\ r_p}\ \frac{1}{V_p}$$

$$E_{gbi} = \frac{2\alpha_g c^4 r_p{}^2}{hc}[(\frac{h}{2\ c\ V_{pi}}\ \frac{1}{r_p}\ V_{pi})\ \sum_j^n\ (\frac{h}{2\ c\ V_{pj}}\ \frac{1}{r_p} V_{qj})(\frac{1}{(r_i - r_j)})]$$

$$= (\frac{\alpha_g c^4}{hc})\ (\frac{h}{c})\ \sum_j^n (\frac{h}{2c})\ (\frac{1}{(r_i - r_j)}) \qquad (6\text{-}46)$$

$$= (\alpha_g c^2)\ \sum_j^n (\frac{h}{2\ c})(\frac{1}{(r_i - r_j)})$$

$$= \frac{\alpha_g h\ c}{2}\ \sum_j^n\ (\frac{1}{(r_i - r_j)}) \qquad (7\text{-}46)$$

G can be defined in terms of $(\frac{2\alpha_g c^3 r_p{}^2}{h})$ (8-46)

And $r_p = \sqrt{\frac{Gh}{2\alpha_g c^3}}$, (9-46)

$r = \sqrt{\frac{Gh}{2\pi\ c^3}}$ is nothing other than the Planck length

it is worth noting that while the gravitational constant G remains invariant with time as the normal matter particle radius r_p =

constant , the binding parameter for space fabric

$K_g = \frac{2\alpha_g c^2 r_q^{\ 2}}{h}$ is a variable with time as the quanton radius r_q

varies with time

fig. 10. and table 12. Show the roles of the bound and unbound

fields for the positively charged particles of the normal matter

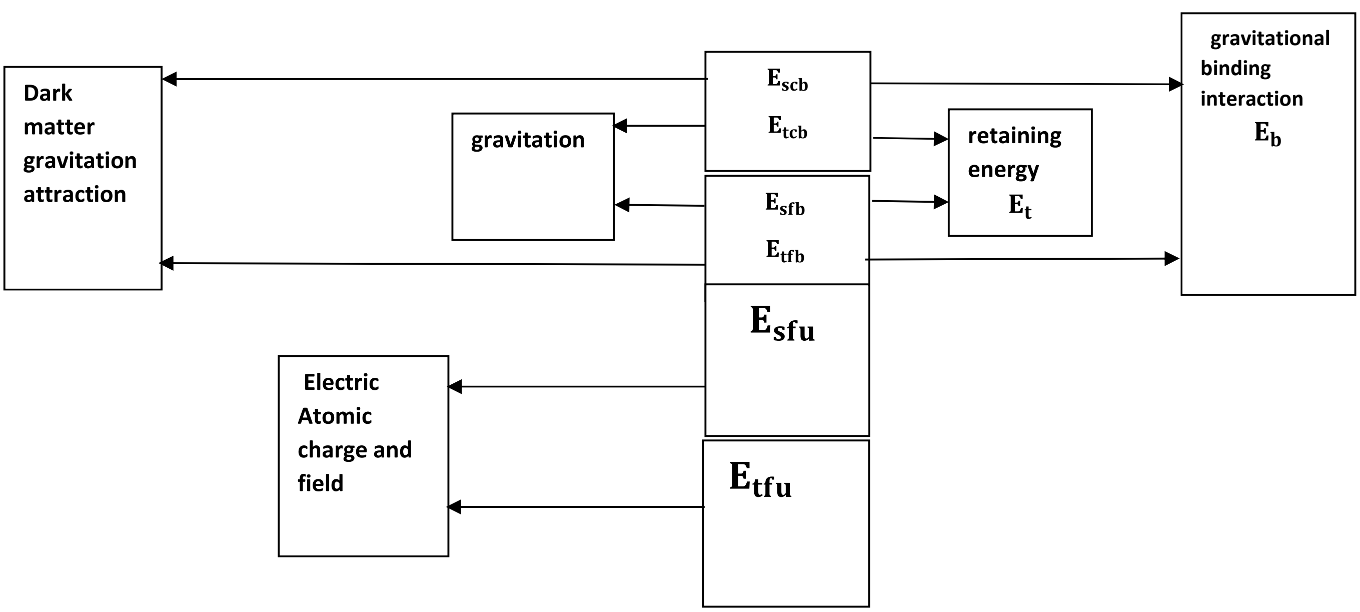


Fig. 10.summary of developed interactions due to bound and unbound fields for positively charged particles

Energy field	Role at short range(inside quanton)	interactions outside quanton	Long range interactions
$E_{sfb}E_{tfb}$ (bound)	quanton retaining interaction E_t	quanton binding interaction E_b (gravitational binding)	1-gravitation 2-dark matter gravitational attraction
$E_{scb}E_{tcb}$ (bound)	quanton retaining interaction E_t	quanton binding interaction E_b (gravitational binding)	1-gravitation 2-dark matter gravitational attraction
E_{sfu} E_{tfu} (unbound)	Atomic electric field	Atomic Electric field	Atomic Electric field
$E_{scu}E_{tcu}$ (unbound)	N/A	N/A	N/A

Table 12. Summary of the interactions developed by each energy fields at different scales for <u>positively charged particles</u>

47.<u>Gravitational interaction of bound mass</u>

<u>Type : multiple binding</u>

outside quantons , bound energy field interactions are involved in maintaining normal matter integrity via the gravitational binding interaction, but as pointed out earlier that energy fields are infinite in range, so there is a residual amount that is left untied in any

binding interaction , which gives rise to gravitation , defined as the summation of interactions due to this residual bound free and constrained fields outside of the quanton between two bodies (i ,j)

$\mathbf{E_g}$ **: gravitational binding energy**

while the gravitational interaction takes place between bound fields ($\mathbf{E_{sfb}}$ $\mathbf{E_{tfb}}$ $\mathbf{E_{scb}}$ $\mathbf{E_{tcb}}$ $\mathbf{V_q}$) of bodies (I,j) the gravitation in its universal form E = G$\frac{m_1 m_2}{R}$ is defined in terms of mass interaction so we have to divide the gravitational field interaction by ($\mathbf{c^2 x\, c^2}$) and then multiply the compensation term $\mathbf{K_g}$ by $\mathbf{c^4}$ to obtain a gravitational interaction which represents the two masses (m= $\frac{\mathbf{E_m}}{\mathbf{c^2}}$)

$$\mathbf{E_g = G\ (\frac{E_{mi}}{c^2})(\frac{E_{mj}}{c^2})\frac{1}{(r_i - r_j)} = G\ \frac{m_i m_j}{(r_i - r_j)}\ \ (G = \frac{2\alpha r_p{}^2{}_g}{E_{ref}} = \frac{2\alpha_g c^4 r_p{}^2}{hc})}$$

$$\mathbf{= \frac{2\ c^4}{hc}[\sum_i^m \int_{V_{pi}} \frac{E_{sfbi}E_{tfbi}E_{scbi}E_{tcbi}}{c^2}\ dV][\sum_j^n \int_{V_{pj}} \frac{E_{sfbj}E_{tfbj}E_{scbj}E_{tcbj}}{c^2}\ dV]\frac{r_{pi}\, r_{pj}}{(r_i - r_j)}} \quad \textbf{(1-47)}$$

$$\mathbf{= \frac{2\ c^4 r_p{}^2}{hc}(\sum_i^m K_{pi}{}^4\ \frac{D_{sfbi}D_{tfbi}D_{scbi}D_{tcbi}}{c^2}\ V_{pi})(\sum_j^n K_{pj}{}^4\ \frac{D_{sfbj}D_{tfbj}D_{scbj}D_{tcbj}}{c^2} V_{pj})\ \frac{1}{(r_i - r_j)}}$$

$$=\frac{2\alpha_g c^3 r_p{}^2}{h} \left(\sum_i^m \frac{h}{16 \quad c \quad r_{pi}{}^3} \frac{1}{r_{pi}} V_{pi} \sum_j^n \frac{h}{16 \quad c \quad r_{pj}{}^3} \frac{1}{r_{pj}} V_{qj} \frac{1}{(r_i - r_j)} \right.$$

$$= \frac{2\alpha_g c\, r_p{}^2}{hc} \left(\sum_i^m \frac{h}{2\,(8\, r_{pi}{}^3)} \frac{V_{pi}}{r_{pi}} \sum_j^n \frac{h}{2 \quad (8\, r_{pj}{}^3)} \frac{V_{pj}}{r_{pj}} \frac{1}{(r_i - r_j)} \right.$$

$$= \alpha_g c\, r_p{}^2 \left(\sum_i^m \left(\frac{h}{2\, r_{pi}}\right) \sum_j^n \frac{1}{r_{pj}} \frac{1}{(r_i - r_j)} \right)$$

$$= \frac{\alpha_g hc}{2} \left(\sum_i^m \sum_j^n \frac{1}{(r_i - r_j)} \right) \qquad \textbf{(2-47)}$$

to note that the gravitation is the only force due to residual of fields between two bound energy fields $(E_{sfb}\ , E_{tfb})\ (E_{scb}\ , E_{tcb})$ those energy fields form the retaining interaction (E_t) first, then the gravitational like binding interaction(E_{gb}) and gravitation at last and this is one of the reasons behind the weakness of gravitation in comparison to other forces

<u>48.atomic electric charge and field</u>

unbound fields for the case of charged particles are expressed in the form of atomic electric field and ensuing electric charge ,

those unbound energy fields must now be defined in terms of dimensions the new particle structure rather than the quanton dimensions

energy stored in the positive atomic electric field is in the form

$$E_e = \int_{V_p} (E_{sfu} E_{tfu})^2 \, dV = \sum_i^m (E_{sfu} E_{tfu})^2 \, V_{pi} \quad \text{(1-48)}$$

Or $\alpha_e \frac{hc}{2\,r_p} = \frac{Q^2}{4\pi\varepsilon_o r_p}$ **(2-48)**

α_e = coupling constant for atomic electric field , V_p : particle Volume , for the case of positively charged particles (free energy dominated), the atomic charge can be assessed using Gauss law , where $\int E_{sfu}\, E_{tfu}\, dA = \frac{\varrho}{\varepsilon_o}$

ϱ = charge density , E_{sfu} E_{tfu} are the unbound now invariant atomic (static) electric field

E(+) = E_{sfu} E_{tfu} = $\frac{Q}{4\pi\ \varepsilon_o {r_p}^2}$, r_p : estimated radius of the particle

$Q(+) = 4\,\pi\ \varepsilon_o {r_p}^2 (\ E_{sfu}\ E_{tfu})$

$$= 4\,\pi\ \varepsilon_o r_p{}^2\ K_p{}^2\ D_{sfu}\ D_{tfu} \quad (3\text{-}48)$$

which has the dimensions of [Q] = $M^{0.5}\ \ L^{+1.5}\ \ T^{-1}$

the accompanying electric field at any point (r_0) becomes

$$E\,(+) = \frac{Q}{4\,\pi\ \varepsilon_o(\Delta\,r_0)^2} = \frac{r_p{}^2\,E_{sfu}\ \ E_{tfu}}{(\Delta\,r_0)^2} = \sqrt{\frac{\alpha_e h\ c}{2\,V_p r_p}\,\frac{r_p{}^2}{(\Delta\,r_0)^2}} \quad (4\text{-}48)$$

which has the dimensions of [E]= $M^{0.5}\ \ L^{-0.5}\ \ T^{-1}$

for negatively charged particles (constrained fields dominated)

$$Q(-) = 4\,\pi\ \varepsilon_o r_p{}^2\ \ E_{scu}\ \ E_{tcu} \quad (5\text{-}48)$$

where E_{scu} E_{tcu} are the unbound invariant constrained fields

48.b.Electric binding energy

$$E_e = K_e\,\frac{Q_i\ Q_j}{(\Delta\,r_{ij})}$$

$$= K_e(\,4\,\pi\,\varepsilon_o r_p{}^2)\,(\,E_{sfui}\ \ E_{tfui}\ \ )(4\,\pi\ \varepsilon_o r_p{}^2)\,(E_{scuj}\ \ E_{tcuj})\,\frac{\sqrt{r_{pi} r_{pj}}}{(r_i - r_j)}) \quad (6\text{-}48)$$

$$E_e = \frac{4\,\pi\,\varepsilon_o\,\alpha_e hc}{(r_i - r_j)} \quad (7\text{-}48)$$

K_e : Coulomb Constant (=$4\,\pi\ \varepsilon_o$) ,

49.Strong nuclear binding / repulsive interaction

1-It is represented by self-interaction of the unbound free and constrained energy fields

2-real energies (which have the dimension of $ML^{+2}T^{-2}$) must be generated by interactions which have four degrees of freedom (terms of c^4) , so we should expect the strong self-interaction also to be to have four degrees of freedom

3-gluons are based equitably on both free and constrained fields so as to provide for the symmetry of the self-interaction

free energy field based flux tube V_{fi} of the form $(E_{sfu}\ E_{tfu})$

this field which has two Dof's is complex in nature

$$E_{sfu}\ E_{tfu} = K_p{}^2\ (D_{sfu}\ D_{tfu}) \qquad \textbf{(1-49)}$$

where $D_{sfu} = c^{1.5}$, $D_{tfu} = c^{0.5}$

constrained energy field based flux tube V_{fj} in the form

$(E_{scu}\ E_{tcu})$, which has also two Dof's

$E_{scu}\ E_{tcu} = K_p{}^2\ (D_{scu}\ D_{tcu})$ **(2-49)**

where $D_{scu} = c^{1.5}$, $D_{tcu} = c^{0.5}$

4-energy stored in the flux tubes

$E_s = \int_{V_f} (E_{sfu}\ E_{tfu}\ )^2\ dV$ **and** **(3-49)**

$E_s = \int_{V_f} (E_{scu}\ \ E_{tcu})^2\ \ dV$ **(4-49)**

, V_f **: flux tube volume**

<u>a-Repulsive part (self interaction) type : simple nonbinding</u>

the repulsive part of strong nuclear force is a self interaction based gluon flux tubes with free energy fields $(E_{sfu}E_{tfu}\ )$ **in addition to self-interaction of the constrained energy field based flux tubes or** $(E_{scu}E_{tcu}\ )$ **and generating the repulsive part of the strong binding energy , the interaction takes the form**

$E_{sr} = (\int_{V_f}\ K_p{}^4[D_{sfu}D_{tfu}\ ]^2 dV + \int_{V_f} K_p{}^4[D_{scu}D_{tcu}]^2\ dV\ )(\frac{r_p}{\Delta r_p})$ **(5-49)**

Δr_p : characteristic length : distance between two quarks ,

the first term describes the contribution of free fields , while the

second term describes the contribution of constrained fields

$$E_{sr} = K_p{}^4 \left(\sum_i^m [D_{sfui} D_{tfui}]^2 \ V_{fi} + \sum_i^m [D_{scui} D_{tcui}]^2 \ V_{fi}\right)\left(\frac{r_p}{\Delta r_p}\right) \qquad (6\text{-}49)$$

$$= \alpha_s \left(\sqrt[2]{\left(\frac{h}{2\, c^3 V_p r_p}\right)}\right)^2 (c^2)^2 \sum_j^n V_{fi} \left(\frac{r_p}{\Delta r_p}\right)$$

$$E_{sr} = \alpha_s \ \frac{hc}{2\, \Delta r_p} \sum_j^n \left(\frac{V_{fi}}{V_p}\right) \qquad (7\text{-}49)$$

α_s : strong coupling constant

49.b- the binding part type : simple binding

the attraction part is generated by the interaction between free

field dominated flux tubes and constrained field dominated gluon

flux tubes

$$E_{sb} = \left(\int_{V_f} (E_{sfu} E_{tfu})(E_{scu} E_{tcu} dV\right) \left(\frac{r_p}{\Delta r_f}\right)$$

$$E_{sb} = K_p{}^4 \left(\int_{V_f} (D_{sfu} D_{tfu})(D_{scu} E_{tcu} dV\right) \left(\frac{r_p}{\Delta r_f}\right) \qquad (8\text{-}49)$$

$$= \quad K_p^{\ 4} \ \sum_i^m (D_{sfui} D_{tfui}) \, (D_{scui} D_{tcui}) \, V_{fj} \ (\frac{r_p}{\Delta r_{\ f}})$$

$$= \ \alpha_s \ (\sqrt[2]{\left(\frac{h}{2\ c^3 V_p r_{\ p}}\right)})^{2} \quad (c^2)^2 \ \sum_i^m V_{fi} \quad (\frac{r_p}{\Delta r_{\ f}})$$

$$= \alpha_s \ \frac{h\ c}{2V_p \ r_p} \ V_f \quad (\frac{r_p}{\Delta r_{\ f}}) \ = \alpha_s \ \frac{h\ c}{2\ \Delta r_{\ f}} \ \sum_j^n \frac{V_{fj}}{V_p} \qquad \textbf{(9-49)}$$

$\Delta r_{\ f}$ = average distance between the flux tubes

it is noted that the distance ($\Delta r_{\ f}$) between flux tubes = constant

as the distance between quarks increases , V_f increases linearly

as more energy is being added to the flux tubes , so the potential

for the attraction energy increases linearly with the distance ,

unlike the case of repulsive interaction where ($\Delta r_{\ p}$) (distance

between quarks) changes and the value of the interaction

changes accordingly , while energy content of the flux tubes

remains the same

fig. 11. and table 13. detail the role of energy fields inside and

outside the quanton for the gluons

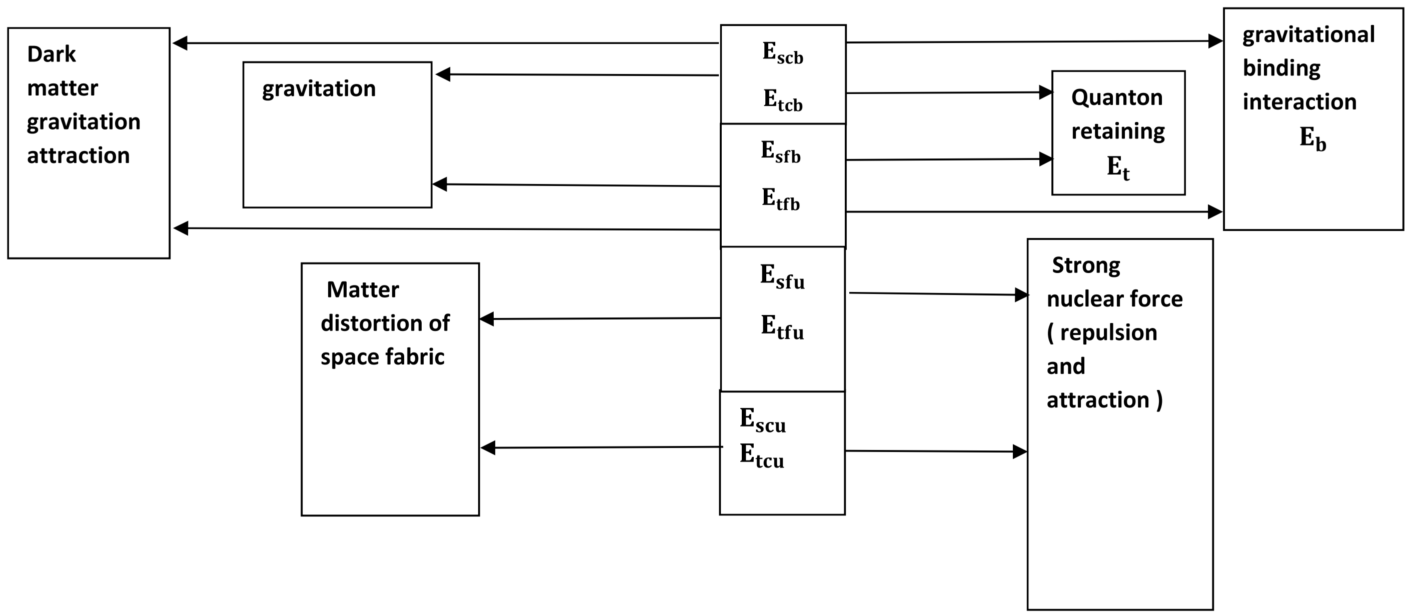


Fig. 11. Summary of the interactions of bound and unbound fields for gluons

Energy field		Role at short range(inside quanton)	Role outside quanton (short range)	interactions at long range
E_{sfb} E_{tfb} (bound)		1-Quanton retaining interaction E_t	Quanton binding E_b (gravitational binding)	1-gravitation 2-Dark matter gravitation of normal matter
E_{scb} E_{tcb} (bound)		1-Quanton retaining interaction E_t	Quanton binding E_b (gravitational binding)	1-gravitation 2-Dark matter gravitation of normal matter
E_{sfu} E_{tfu} (unbound)		Strong nuclear force (attraction and repulsion part)		Matter distortion of space fabric
$E_{scu}E_{tcu}$(unbound)		Strong nuclear force (attraction and repulsion part)		Matter distortion of space fabric

table 13. Summary of the role of the interactions developed by each energy field at Planck and cosmological scales for gluons

50.Gravitational like attraction of dark matter
Type : multiple binding

1-The interaction that generates the gravitational like attraction of the dark matter is between fields of the bound fields

$(\mathbf{E_{sfb}\, E_{tfb}\;\, E_{sc}\, E_{tc}})_s$ **of space fabric's quantons or**

$(\mathbf{E_{sf}\, E_{tf}\;\, E_{scb}\, E_{tcb}})_s$ **for ani-quantons and the bound fields**

$(\mathbf{E_{sfb}\, E_{tfb}\;\, E_{scb}\, E_{tcb}})_m$ **of the normal matter's quantons**

2-space fabric bound fields have 2.0 Dof's each which create a gravitational binding interaction with the galactic normal matter quantons' bound fields (also have two Dof's) , those same energy fields which generate the gravitation binding

50.b.Gravitational like effect on normal matter free energy field

while in its density interaction form $\mathbf{E_{gs}}$ =

$$\left(\frac{E_{sfbi}E_{tfbi}E_{scbi}E_{tcbi}}{c^2}\right)_m \sum_j^n \left(E_{sfbj}E_{tfbj}E_{scj}E_{tcj}\right)_s \left(\frac{\sqrt{r_{pi}r_{qj}}}{(r_i-r_j)}\right) \qquad \textbf{(1-50)}$$

while in its complex form

$$E_{gs} = \frac{c^4}{E_{ref}} \int_{V_p} \left(\frac{E_{sfbi}E_{tfbi}E_{scbi}E_{tcbi}}{c^2}\right)_m \mathbf{dV} \ \{[\sum_j^n \int_{V_{qs}} \left(E_{sfbj}E_{tfbj}E_{scj}E_{tcj}\right)_{qs} dV]$$

$$+[\sum_j^n \int_{V_{aqs}} \left(E_{sfj}E_{tfj}E_{scbj}E_{tcbj}\right)_{aqs} dV] \ \} \quad \left(\frac{\sqrt{r_{pi}r_{qj}}}{(r_i-r_j)}\right) \qquad \textbf{(2-50)}$$

$$= \frac{c^4}{E_{ref}} \sum_i^m K_{pi}{}^4 \left(\frac{D_{sfbi}D_{tfbi}D_{scbi}D_{tcbi}}{c^2}\right)_m V_{pi} \left\{\left[\sum_j^n K_{qj}{}^4 \left(D_{sfbj}D_{tfbj}D_{scj}D_{tcj}\right)_{qs} V_{qj}\right)\right]$$

$$+ [\sum_j^n K_{aqj}{}^4 \left(D_{sfj}D_{tfj}D_{scbj}D_{tcbj}\right)_{aqs} V_{aqj}]\} \frac{\sqrt{r_{pi}r_{qj}}}{(r_i-r_j)} \qquad \textbf{(3-50)}$$

$$= \frac{2\sqrt{\alpha_g\alpha_b}\, r_{ref}\, c^4}{hc} \left[\left(\frac{h}{2\, c\, V_{pi} r_{pi}}\right) V_{pi} \sum_j^n c^2 \left(\frac{h}{2\, c^3 V_{qj}\ r_{qj}}\right) V_{qj} \left(\frac{\sqrt{r_{pi}r_{qj}}}{(r_i-r_j)}\right)_{m-s}\right]$$

$$E_{gs} = \frac{\sqrt{\alpha_g\alpha_b}\, h\, c}{2} \sum_j^n \left(\frac{1}{(r_i-r_j)}\right)_{m-qs} \qquad \textbf{(4-50)}$$

this binding interaction is between bound free and constrained energy fields of normal matter quantons (i) and bound free and constrained energy fields of the space fabric's quantons or anti

quantons (j) , $E_{ref}=\frac{hc}{2\sqrt{r_p r_q}}$, and since the quanton radius of space fabric is varying with time , it is expected that the gravitational parameter of this interaction to be varying also with time as well

50.c.Why normal matter generates space fabric distortion

It had been proposed that bound energy fields $(E_{sfb}\ E_{tfb}\ E_{sc}\ E_{tc})_q$ or $(E_{scb}\ E_{tcb}\ E_{sf}E_{tf})_{aq}$ of space fabric which generate the space fabric binding interaction E_b , would also generate the gravitational attraction between the dark matter and the normal matter E_{gs} , since the binding interaction is more stable than the repulsive alternative, now for normal matter why this is not the case , which, based on the fore-mentioned discussion, there should have been no normal matter distortion of space fabric as unbound fields $(E_{sfu}\ E_{tfu})$, $(E_{scu}\ E_{tcu})$ of both normal matter's gluons and space fabric would have created more stable binding

interaction rather than the less stable repulsive interaction

the main reason behind this is that the unbound fields of space

fabric $(\mathbf{E_{sfu}\ E_{tfu}})_{\mathbf{q}}$ **of quanton and** $(\mathbf{E_{scu} E_{tcu}})_{\mathbf{aq}}$ **of anti quanton**

generate self-interacting fields

those fields , which are at the origin of the quanton expansion ,

splitting and the inflationary momentum in general , are repulsive

in nature, this means that they are complex repulsive fields

(have combined Dof that is equal 1.0 +1.0) , those repulsive fields

do not completely merge to generate a resultant field of Dof

strength = 2.0) as those fields are of the form :

$(\mathbf{K_q}\sqrt{(\mathbf{D_{sfu}\ D_{tfu}})_{\mathbf{q}}})(\mathbf{K_q}\sqrt{(\mathbf{D_{sfu}\ D_{tfu}})_{\mathbf{q}}})$ **or**

$(\mathbf{K_q}\sqrt{(\mathbf{D_{scu} D_{tcu}})_{\mathbf{aq}}})(\mathbf{K_q}\sqrt{(\mathbf{D_{scu} D_{tcu}})_{\mathbf{aq}}})$ **and not of the form**

$\mathbf{K_q}^2(\mathbf{D_{sfu}\ D_{tfu}})_{\mathbf{q}}$ **or** $\mathbf{K_q}^2(\mathbf{D_{scu} D_{tcu}})_{\mathbf{aq}}$ **, which causes them to be**

involved in repulsive interaction with unbound fields of normal

matter's gluons $(\mathbf{E_{sfu}\ E_{tfu}})_{\mathbf{m}}$, $(\mathbf{E_{scu}\ E_{tcu}})_{\mathbf{m}}$ **(which are generating strong nuclear force) , and this repulsive interaction is at the origin of normal matter distortion of space fabric**

51. Evidence of space fabric distortion : case of abnormal galagtic rotational curves

1-the contribution of the dark matter to the rotation curves of galaxies is increasing away from the galactic bulge

this is suggestive of a presence of a repulsive effect of normal galactic mass near the bulge which causes

a-reduced space fabric quanton energy density near the bulge (which leads to near Keplerian pattern of rotational velocities)

b-an increased space fabric quanton energy density away from the galactic bulge and consequently an increased gravitational effect of dark matter and increased rotation curve velocities away from the galactic bulge

2- a localized drop in the rotational curve of spiral galaxies was observed, this localized drop coincides with the spiral arms of the spiral galaxies, an interpretation of such phenomena can be put as follows , an accumulation of galactic mass in the spiral arms causes a distortion in the nearby region of the space fabric , and as a result of this distortion a drop in the gravitational like effect of the dark matter takes place , and thus causing this characteristic localized drop of rotational curves of spiral galaxies

examples : rotational curve of the milky way , localized bottoming coincides with and scutum –Centaurus and Orion - Cygnus arms

for other spiral galaxies : NGC 2590, NGC 1620 , NGC 7674 , NGC 7217, NGC 2998 , NGC 801 ,fig. 12. , 13. , 14. Show the same localized rotation curve bottoming characteristic of spiral galaxies

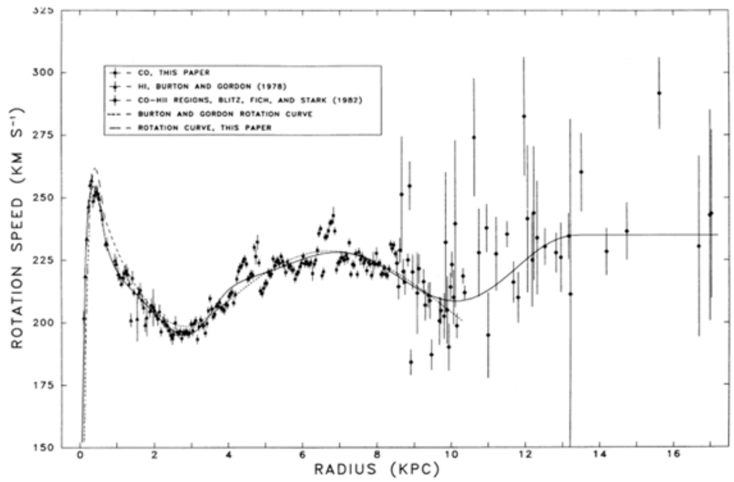


Fig. 12.Rotational velocity of the milky display characteristic localized bottoming which coincides with spiral arms

Source https://web.njit.edu/~gary/202/Lecture25.html

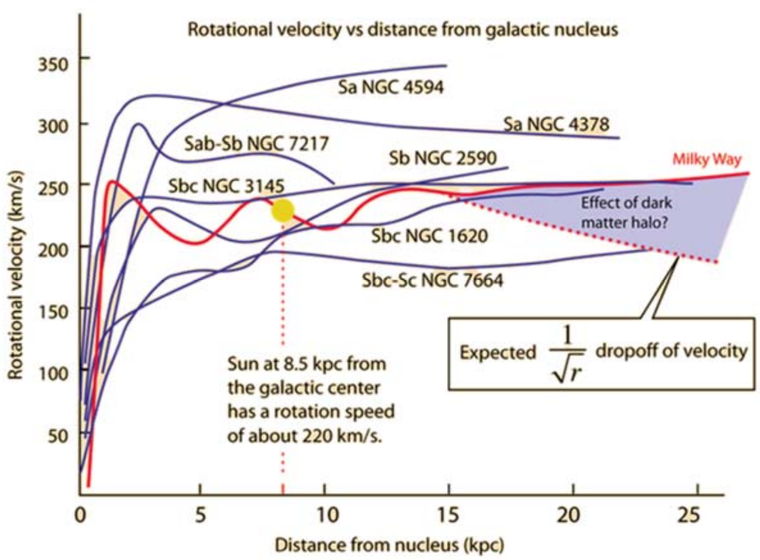
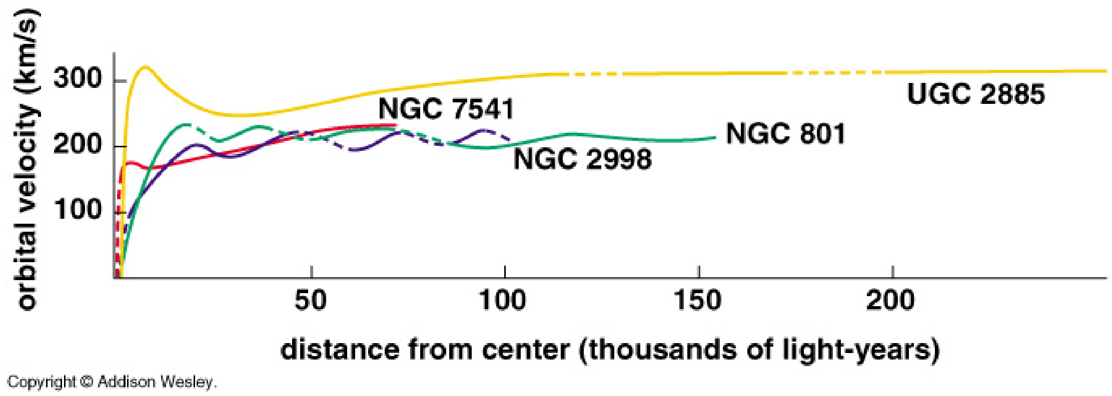


Fig. 13. Source : http://hyperphysics.phy-astr.gsu.edu/hbase/Astro/darmat.html



Source :
http://ircamera.as.arizona.edu/Astr2016/lectures/darkmatter.htm

Fig. 14 . rotational curves of various spiral galaxies display characteristic localized bottoming which coincides with spiral arms : an evidence of mass distortion space fabric and gravitational pattern

51.b. mass distortion of space fabric

$$E_{di} = \frac{1}{E_{ref}} \{ \int_{V_{qs}} [(E_{sfui}\ E_{tfui})_{qs} (E_{scui}\ E_{tcui})_{aqs}\ dV]$$

$$[\sum_j^n \int_{V_f} (E_{sfuj}\ E_{tfuj})_m (E_{scuj}\ E_{tcuj})_m \ dV)] \} \frac{\sqrt{r_{qi} r_{pj}}}{(r_i - r_j)} \qquad \textbf{(1-51)}$$

$$= \frac{2\ r_{ref}}{hc} \{ [K_{pi}{}^4 (D_{sfui} D_{tfui})_{qs} (D_{scui} D_{tcui})_{aqs} V_{qi}]$$

$$[\sum_j^n K_{qj}{}^4 (D_{sfuj}\ D_{tfuj})_m (D_{scuj} D_{tcuj})_m V_{pj} (\frac{V_{fj}}{V_{pj}})]\} \frac{\sqrt{r_{qi} r_{pj}}}{(r_i - r_j)}$$

$$= \frac{2\alpha_r \sqrt{r_{qi} r_{pj}}}{hc} \frac{h\ c^4}{2c^3 V_{qi}\ r_{qi}} V_{qi} \sum_j^n \frac{h\ c^4}{2c^3 V_{pj}\ r_{pj}} V_{pj} \left(\frac{V_{fj}}{V_{pj}}\right) \left(\frac{\sqrt{r_{qi} r_{pj}}}{(r_i - r_j)}\right) \qquad \textbf{(3-51)}$$

$$E_{di} = \alpha_r \left(\frac{h}{2}\right) \sum_j^n \left(\frac{V_{fj}}{V_{pj}}\right)\left(\frac{1}{(r_i - r_j)}\right) \quad \textbf{(4-51)}$$

the summation for quanton and anti quanton pair (i) of space

fabric for 1 to n and for j quantons of the stellar matter unbound gluon fields

52.Electromagnetic field interactions

the relativistic degree of freedom affected the space varying fields and led to the rearrangement of energy degree of freedom as follows

$Dof_{sf}\ Dof_{tc}$ **= 2.5-0.5 = 2.00 ,** $Dof_{sc}\ Dof_{tf}$ **= 1.5-0.5 = 1.0**

$(Dof_{sf}\ Dof_{tf})_{bound}$ **=** $(Dof_{sc}\ Dof_{tc})_{bound}$ **0.5**

$(Dof_{sf}\ Dof_{tf})_{unbound}$ **= 2.0 ,**

52.a-Retaining energy interaction

the photon retaining interaction is has two degrees of freedom as

the relativistic Dof is added to the binding Dof to generate a four dimensional interaction

$$E_{tp} = \int_{V_q} (E_{sfb} E_{tfb}) \quad (E_{sc} E_{tc}) \ c \ dV \qquad \textbf{(1-52)}$$

$$= [K_{qs}{}^2 (D_{sfb} \, D_{tfb})] \ [K_{qs}{}^2 \, (D_{sc} \, D_{tc})] \ c \, V_q$$

$$E_{tp} = K_{qs}{}^4 \ c^2 \ V_q = \sqrt{\alpha_t} \, \frac{hk^4}{16 \, \pi^4 \, c} \, V_q = \sqrt{\alpha_t} \, \frac{h}{16 \ c \ r_q{}^4} \, V_q \qquad \textbf{(2-52)}$$

$$E_{tp} = \sqrt{\alpha_t} \ \frac{h}{2 \ c \, r_q} \qquad \textbf{(3-52)}$$

and the total retaining energy for the photon Q+AQ pair

$$= \frac{c^4}{E_{ref}} E_{tp}{}^2 = \alpha_t \, \frac{h \, c}{2 \ r_q}$$

<u>52.b inflationary ,and repulsive interactions</u>

Same as space fabric

<u>52.c-Gravitational binding interaction of electromagnetic waves</u>

recalling the mass-energy equivalency principle, which for the case of the photon takes the form E= $\frac{m}{c^2}$

the two degrees of freedom here belong to the unbound fields

which is the opposite to bound mass case

the binding interaction for electromagnetic wave has one degree of freedom in addition to the relativistic Dof

the binding interaction takes the form

$$E_{gbi}=\frac{c^4}{E_{ref}}\{[\frac{1}{2}\int_{V_{qe}}(E_{sfbi}E_{tfbi}E_{sci}E_{tci})_q\, c\, dV]+$$

$$[\frac{1}{2}\int_{V_{qe}}(E_{sfi}E_{tfi}E_{scbi}E_{tcbi})_{aq} c\, dV]\}\sum_j^n \int_{V_p}\ (\frac{E_{sfbj}E_{tfbj}E_{scbj}E_{tcbj}}{c^2})_m dV\left(\frac{\sqrt{r_{qi}r_{pj}}}{(r_i-r_j)}\right) \quad \textbf{(4-52)}$$

$$=\frac{c^4\, r_{qi}r_{pj}}{hc}\{[(\frac{1}{2}K_{qi}{}^4\,(D_{sfbi}D_{tfbi}D_{sci}D_{tci})_q cV_{qi})]+$$

$$[\frac{1}{2}K_{qi}{}^4\,(D_{sfi}D_{tfi}D_{scbi}D_{tcbi})_{aq} cV_{aqi})]\}\sum_j^n K_{pj}{}^4\ \frac{D_{sfbj}D_{tfbj}D_{scbj}D_{tcbj}}{c^2}\ V_{pj}\frac{1}{(r_i-r_j)}$$

$$=\frac{2c^3\, r_q r_p}{h}\ (K_{qi}{}^4\, c^2\, V_{qi})\ (\sum_j^n K_{pj}{}^4\, c^2\ \ V_{pj})(\frac{1}{(r_i-r_j)}) \quad \textbf{(5-52)}$$

$$=\frac{2c^3\, r_q r_p\sqrt{\alpha_b\alpha_g}}{h}\ \left(\frac{h\ c^2}{2c^3 V_{qi}\ r_{qi}}\right)V_{qi}\ \ \sum_j^n\left(\frac{h}{2\,c\ V_{pj}\, r_{pj}}\right)V_{pj}\ \ (\frac{1}{(r_i-r_j)}$$

$$E_{gbi}=\frac{h\,c\sqrt{\alpha_b\alpha_g}}{2}\ \ \sum_j^n(\frac{1}{(r_i-r_j)}) \quad \textbf{(6-52)}$$

noting that this gravitational like binding can exist between two different electromagnetic waves

2-the parameter $K_g = \frac{c^4}{E_{ref}} = \frac{2\sqrt{r_{qi} r_{pj}}\, c^3}{h}$ **(previously, it was defined as** $K_g = \frac{2\, r_p\, c^3}{h}$ **for the case of normal mater gravitation)**

<u>52 d.dark matter distortion of electromagnetic waves</u>

both unbound fields of space fabric and electromagnetic waves interact in a mutually repulsive interaction to create the dark matter distortion of electromagnetic waves, keeping in mind that those unbound fields can only create a repulsive interaction

$$E_{rei} = \frac{1}{E_{ref}} \{[\int_{V_{qe}} (E_{sfui} E_{tfui})_{qe} \ (E_{scui} E_{tcui})_{aqe}\, dV]$$

$$[\sum_j^n \int_{V_{qs}} (E_{sfuj} E_{tfuj})_{qs} (E_{scuj} E_{tcuj})_{aqs} dV] \}(\frac{\sqrt{r_{qi} r_{pj}}}{(r_i - r_j)}) \quad \textbf{(6-52)}$$

$$= \frac{r_{ref}}{hc} \{[K_{qi}{}^4 (D_{sfui} D_{tfui})_{qe} \ (D_{scui} D_{tcui})_{aqe} \ V_{qi}]$$

$$[\ \sum_j^n K_{pj}{}^4 \left(D_{sfuj} D_{tfuj}\right)_{qs} \left(D_{scuj} D_{tcuj}\right)_{aqs} \ V_{qj}\ ] \ (\frac{\sqrt{r_{qi} r_{pj}}}{(r_i - r_j)}) \quad \textbf{(7-52)}$$

$$= \frac{2\sqrt{r_{qi} r_{pj}}}{hc} \left(K_{qi}{}^{4} \; c^{4} \; V_{qi} \right) \left(\sum_{j}^{n} K_{pj}{}^{4} \; c^{4} \; V_{qj} \right) \left(\frac{1}{(r_i - r_j)} \right)$$

$$= \alpha_r \left(\frac{h}{2c^3 V_{qi} \; r_{qi}} \; V_{qi} \right) c^4 \; \sum_{j}^{n} \frac{h}{2c^3 V_{qj} \; r_{qj}} \; c^4 \; V_{qj} \; \left(\frac{\sqrt{r_{qi} r_{pj}}}{(r_i - r_j)} \right)$$

$$E_{rei} = \frac{\alpha_r \, h \, c}{2} \; \sum_{j}^{n} \frac{1}{(r_i - r_j)}{}_{e-s} \qquad \textbf{(8-52)}$$

this interaction which has four Dof's and between unbound free and constrained fields of photon (i) and unbound free and constrained fields of quanton and anti quanton pair (j)

where $E_{ref} = \frac{h \, c}{2\sqrt{r_{qi} r_{pj}}}$

table 14. provides a summary of interactions, their source fields and their types

interaction	free energy field	constrained energy field	Interaction type
1-E_t : quanton retaining 2-E_b : quanton binding	$E_{sfb}E_{tfb}$	$E_{scb}E_{tcb}$	multiple binding
<u>For normal matter</u> E_t : quanton retaining	E_{sfb} E_{tfb}	E_{scb} E_{tcb}	Single binding
1-E_i : quanton inflationary 2-E_r : quanton repulsive	$E_{sfu}E_{tfu}$	E_{scu} E_{tcu}	repulsive
1-gravitation binding 2- Gravitation	E_{sfb} E_{tfb}	E_{scb} E_{tcb}	Multiple binding
Electric force	E_{sfu} E_{tfu}	$E_{scu}E_{tcu}$	a-single binding or b-repulsive
Strong nuclear	$E_{sfu}E_{tfu}$	E_{scu} E_{tcu}	a-single binding or b-repulsive
Dark matter gravitation like effect	$(E_{sfb}E_{tfb})_{qs}$ $(E_{sf}$ $E_{tf})_{aqs}$ $(E_{sfb}E_{tfb})_{m}$	$(E_{sc}E_{tc})_{qs}$ $(E_{scb}$ $E_{tcb})_{aqs}$ $(E_{scb}E_{tcb})_{m}$	Multiple binding
Matter distortion of space fabric	$(E_{sfu}$ $E_{tfu})_{m}$, $(E_{sfu}$ $E_{tfu})_{s}$	$(E_{scu}$ $E_{tcu})_{m}$, $(E_{scu}$ $E_{tcu})_{s}$,	repulsive
gravitation like binding of EM waves	$(E_{sfb}$ $E_{tfb})_{qe}$ $(E_{sf}$ $E_{tf})_{aqe}$ $(E_{sfb}$ E_{tfb} $)_{m}$	$(E_{sc}$ $E_{tc})_{qe}$ $(E_{scb}$ $E_{tcb})_{aqe}$ $(E_{scb}$ $E_{tcb})_{m}$	multiple binding
Dark matter distortion of electromagnetic waves	$(E_{sfu}$ $E_{tfu})_{e}$ $(E_{sfu}$ $E_{tfu})_{s}$	$(E_{scu}$ $E_{tcu})_{e}$ $(E_{scu}$ $E_{tcu})_{s}$	repulsive

Table 14. Summary of interactions, their types and their energy field source

53.CPT symmetry at the Quanton scale

CPT symmetry has its origins at the quanton level ,as it reflects symmetries created due to energy constraining, as the degrees of freedom of anti quanton's free and constrained fields are mirror symmetric to those of the quanton's

tables 15. ,16. provide an illustration of this symmetry at the level of the quanton fields and their Dof's

field	quanton	anti quanton	Dof
Nature of dominant energy	free	constrained	
Main-space field	E_{sf}	E_{sc}	2.25
Auxiliary-space field	E_{sc}	E_{sf}	*0.75*
Main time field	E_{tf}	E_{tc}	0.75
Auxiliary time field	E_{tc}	E_{tf}	0.25

Table 15. Mirror symmetry between quanton and anti quanton

CPT	free	constrained
time	Positive configuration for the free time field ($\mathbf{E_{tf}}$)	negative configuration for the constrained time field ($\mathbf{E_{tc}}$)
parity	Positive position vector configuration for the free space fields ($\mathbf{E_{sf}}$)	negative position vector configuration for the constrained space field ($\mathbf{E}_{sc}$)
charge	positive atomic fields and charges due to unbound fields ($\mathbf{E_{sfu}E_{tfu}}$)	negative atomic fields and charges due to unbound fields ($\mathbf{E_{scu}E_{tcu}}$)

Table 16. CPT symmetry and its link to quanton / anti quanton mirror symmetry

54.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 .

55. References

Basic physics .