Quanton based model of field interactions

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Key words

Energy density expansion , space and time varying fields , energy degrees of freedom .

Introduction

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

While providing a novel method of tackling the concept of space time in the form of space and time varying energy fields, and given that it is a primer, it is understandable that there is a certain lack in providing adequate references and the main reliance is on the basic concepts in physics

1. The physical basis of this model

This model is based on the following two concepts

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

degree of freedom relationship.

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

the following points will be discussed throughout the model

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

2-Definition of the model

2.a Quantons

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

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

Their frequencies are statistically distributed vs the energy density.

This statistical distribution ensures equi-partition of energy (here it will be called :dimensional energy symmetry) but may vary in their energy content (packet or total energy) with time as they expand and split.

Quanton stability is ensured due to the effect of Internal and external interactions of energy fields.

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

2.b.Anti quantons

anti quantons are similar to quantons but the dominant nature of their energy differs from that of the quanton , the anti quanton fields are mirror symmetric to those of the quanton.

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

Fig.1 provides a representation of quanton –antiquanton fields

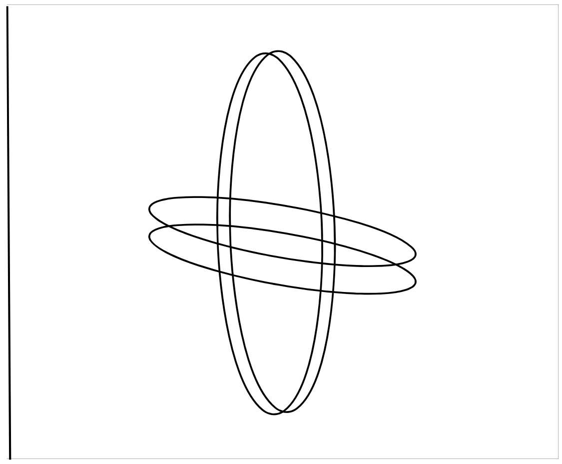


Fig.1 a representation of the quanton –antiquanton (Q+AQ) fields , note here that the radius of the quanton denotes only the decaying manner of the field intensity and does not outline the quanton physical domain

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

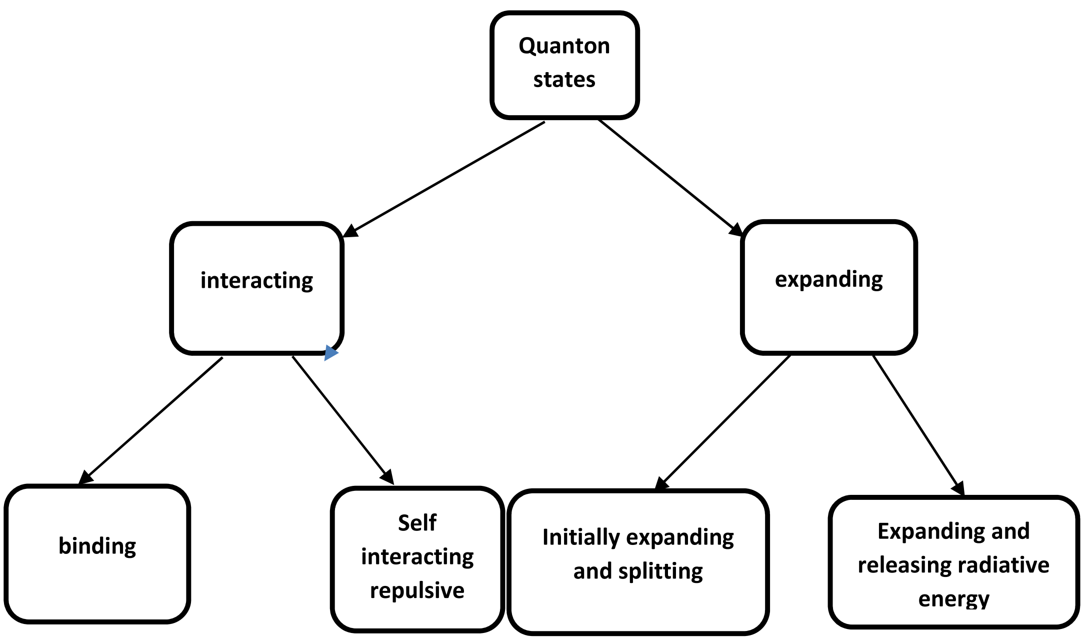


Fig.2. summary of the quanton states

3. Mathematical brief

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

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

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

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

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

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

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

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

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

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

The two types of quanton energy fields are the free energy dominated $E_{qf} = E_{sf} E_{tc}$ (8-3)

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

and can be expressed by the one-dimensional PDE

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

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

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

$E = E_s E_t$ (a singularity – energy not varying in space (12-3) or time with no associated fields) which is generated by energy constraining

4. variation parameters of energy fields

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

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

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

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

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

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

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

5. Energy constraining

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

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

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

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

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

d-Energy fields expansion and their subsequent splitting.

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

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

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

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

Energy fields cannot vary in space and time simultaneously as no energy field is in the form $E_{sf,tf} \; = fn\,(r\,,t)$ **,but rather** $E \; = \; E_{sf}\,(r) \; E_{tf}\,(t)$ **.**

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 space varying field [ ]

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

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}**) similarly , 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} which is a predominantly constrained type due to the field (E_{sc})

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

Based on the previous point, energy fields 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

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

and for anti quanton

$$\varrho_{aq} = (\frac{E_{sf}E_{tc}}{c})(c\ E_{sc}\ E_{tf}) = (\frac{E_{qf}}{c})\ (cE_{qc}) \qquad \textbf{(2-5)}$$

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

The anti quanton's energy density equation is the same as the energy density equation of quanton's , but degrees of freedom of various fields are 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)

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

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

a-for free space varying field , expansion in space

$$\frac{\partial}{\partial s}(E_{sf}) = \frac{\partial E}{\partial s} = E_{sf} \qquad \textbf{(same type of field)} \qquad \textbf{(3-5)}$$

b-Constraining of free energy fields takes the form

$$\int E_{sf}\ ds = \int(\frac{\partial E}{\partial s})\ ds = E_s \qquad \textbf{(4-5)}$$

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

b- for free time varying field

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

and constraining $\int E_{tf}\, dt = \int \frac{\partial E}{\partial t}\, dt = E_t$ (6-5)

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

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

$\int E_{sc}\, ds = E_{sc}$ (same type of field) (7-5)

constraining takes the form

$\frac{\partial}{\partial s}(E_{sc}) = \frac{\partial}{\partial s}(\int E_s\, ds) = E_s$ (8-5)

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

d- For time varying field

expansion in time $\int E_{tc}\, dt = E_{tc}$, and when being constrained (9-5)

$\frac{\partial}{\partial t}(E_{tc}) = \frac{\partial}{\partial t}(\int E_t\, dt) = E_t$ (10-5)

Energy field (free-constrained) expansion is more or less a process of differentiating two variables

Expansion of (free- constrained) energy fields by variation in space or time follows differentiation of two variables rule.

$\frac{\partial}{\partial x}(f(x)\, g(x)) = \frac{\partial f}{\partial x}\, g(x) + \frac{\partial g}{\partial x}\, f(x)$ (11-5)

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

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

$\frac{\partial}{\partial s}(\frac{\partial E}{\partial s}) = \frac{\partial E}{\partial s} + \int E_{sf}\, ds = E_{sf} + E_s$ (12-5)

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

$\frac{\partial}{\partial t}(\frac{\partial E}{\partial t}) = \frac{\partial E}{\partial t} + \int (\frac{\partial E}{\partial t})\, dt = E_{tf} + E_t$ (13-5)

Expansion of constrained space varying field E_{sc}

$\int E_{sc}\, ds = \int E_{sc}\, ds + \frac{\partial}{\partial s}(\int E_s\, ds) = E_{sc} + E_s$ (14-5)

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

$\int E_{tc}\ \ dt = \int E_t\ \ dt + \frac{\partial}{\partial t}(\int E_{tc}\ \ dt) = E_{tc} + E_t$ (15-5)

Now the quanton energy density equation

$\frac{\partial}{\partial s}\frac{\partial}{\partial t}(\varrho_q) = (\frac{\partial E}{\partial s}\ \int E\ dt)(\int E\ ds\ \frac{\partial E}{\partial t}) = (E_{sf}\ \ E_{tc})(E_{sc}\ \ E_{tf}) + E_s\, E_t$ (16-5)

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

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

table 1. mathematical expression of energy expansion /constraining

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

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

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

When dealing with expansion of constrained energy fields integration is the physical equivalent to mathematically maintaining one function as a constant

Quanton energy density equation $\varrho_q = (\frac{\partial E}{\partial s}\ \frac{\partial E}{\partial t})(\int E\ ds \int E\ \ dt)$,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)

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

$Dof_q = Dof_{sf} + Dof_{sc} + Dof_{tf} + Dof_{tc} = 4$ (17-5)

It is understood that the space varying energy fields (free and constrained) have three degrees of freedom or $Dof_{sf} + Dof_{sc} = 3$ (18-5)

While time varying energy fields (free and constrained) have one degree of freedom or $Dof_{tf} + Dof_{tc}$ =one (19-5)

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

$$[\varrho_q] = [\frac{\text{energy}}{\text{volume}}] = \text{M } L^{-1}T^{-2}$$

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

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

$$= (\frac{\partial E}{\partial s}\ \int E\ \ dt\ )(\int E\ \ ds\ \frac{\partial E}{\partial t}\ ) = (E_{sf}\ \ E_{tc})(\ E_{sc}\ \ E_{tf}) + E_s\ E_t \qquad \textbf{(20-5)}$$

= expansion term +constraining term

so on for successive expansion processes

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

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

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

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)

26- Since the quanton is a quantum entity, its 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.

Fields of the following forms do not exist independently

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

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

Though quanton includes both field of both types (free and constrained), but there is a dominant type of energy field, this is based on which type of field

has the majority of *Dof's*

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

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

as $E_p = \frac{h}{2\pi}\omega = \int \varrho_q \, dV$ **(21-5)**

6. Energy Degrees of freedom

As energy is allowed to expand in space or in time, it is said to have an energy degree of freedom where quanton energy density can be defined in terms of the degrees of freedom of its wave parameters (ω, k **, or** r_q **)**

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

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

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

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

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

For space varying and time varying energy fields , where the resultant energy density is in the form $\varrho_q = (E_{sf}\, E_{tc})(E_{sc} E_{tf})$ **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 the constant (c) to become an energy degree of freedom in an exponential form , where energy is divided up symmetrically, between the space and time varying fields, hence the uniform and symmetric expansion of energy across all dimensions.

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

parameters ψ_{tc}, ψ_{sf} of the fields E_{tc}, E_{sf} where

$\psi_{tc} = e^{-j\omega t}$, $\psi_{sf} = e^{+jk(x+y+z)}$ (1-6),(2-6)

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

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

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

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

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

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

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

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

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

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

The same result can be obtained directly from the energy momentum relationship $E^2 = P^2c^2 + m_o{}^2c^4$ (13-6)

differentiating both sides 2 E dE = 2 P dP (14-6)

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

Where for space fabric case (m_o = zero) , E= P c (14-6),(15-6)

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

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

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

Using the Schrödinger equation for time and space derivatives

$-\frac{\partial \psi}{\partial t} = -\frac{jE}{2\pi h}\psi$ (16-6)

$\nabla \psi = \frac{jp}{2\pi h}\psi$ (17-6)

$\frac{\frac{\partial \psi}{\partial t}}{\nabla \psi} = \frac{E}{p} = c$ (18-6)

Based on the above points, the division of energy density between space and time varying fields can be done where strength of space and time varying

energy fields (Dof) is expressed in terms of the constant (c) that defines the relationship between their rate of variation.

It is worth noting that energy field degrees of freedom (field strength) is not related to the total energy of the quanton , as it is only a mechanism for the division of the quanton energy density between the various space and time varying energy fields, and what differs the total energy content of any quanton from another is only the rate of variation of fields with time and space according to Planck Einstein relationship $E_p = \frac{h}{2\pi}\omega$ **(19-6)**

The energy degrees of freedom can be classified as follows

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

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

3- Scalarized degrees of freedom : when a degree of freedom of an energy field becomes part of its intensity parameter instead of its strength parameter [ ]

7.The superposition principle for energy fields

The linear superposition of energy fields still applies with a resultant field which equals to the addition of the individual field intensities on condition that

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

b- Have the same degree of freedom

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

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

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

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

$$= (K_{sfi} + K_{sfj})(K_{tci} + K_{tcj})(D_{sf} D_{tc}) \quad \textbf{(4-7)}$$

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

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

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

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

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

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

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

And for the quanton as a whole

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

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

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

The main reason behind this is that free and constrained fields cannot be considered as an independent energy entity individually, since neither of them does possess four degrees of freedom

and hence their individual Dof's must be added exponentially to obtain either a complex field equivalent to the total energy density of the quanton if the addition is for all four energy fields .

8.Definition of directional field directional components

For free space / time constrained field

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

and space constrained / time free field

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

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

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

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

9.Dimesional energy symmetry (DES)

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

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

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

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

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

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

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

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

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

$$= \frac{\partial}{\partial s}\frac{\partial}{\partial t}(\varrho_q) \qquad (2\text{-}9)$$

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

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

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

To satisfy dimensional energy symmetry for quanton , the degrees of freedom must be symmetric with respect space and time varying energy fields define the Dof_q , D_q (in terms of c) where the degree of freedom parameter

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

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

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

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

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

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

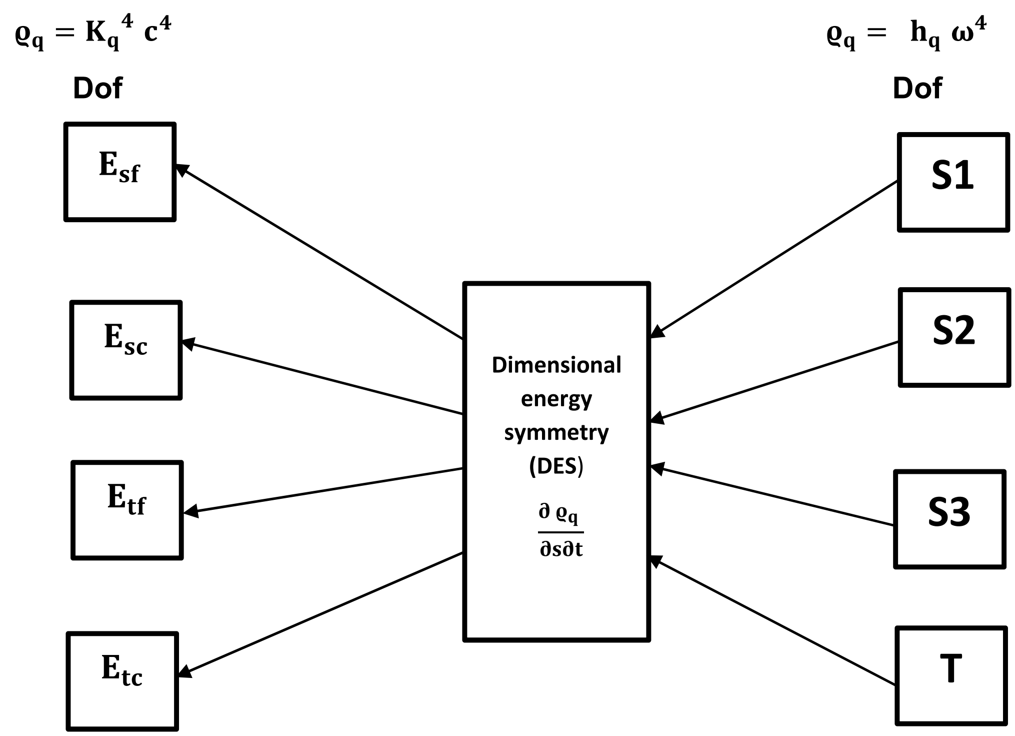


Fig. 3. role of dimensional energy symmetry in ensuring the uniformity of energy density distribution

10. Energy density / Degree of freedom relationship

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) (1-10)

$E_{qc}(x) = E_{qc}\ e^{-j(\frac{x}{2r_q})}$ (constrained energy dominated field) (2-10)

quanton energy density is in the form

$\varrho_q = (E_{sf}E_{tc})(E_{sc}E_{tf}) = E_{qf}\ E_{qc} = E_q\ e^{-j(\frac{x}{r_q})}$ (3-10)

ϱ_q : represents the average energy density over time .

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

$\varrho_q = \frac{h\omega}{2\pi} = \iiint_{-\infty}^{\infty} E_q\ e^{-j(\frac{x+y+z}{r_q})}$ dx dy dz = (4-10)

= $(2)^3 \iiint_{0}^{\infty} E_q\ e^{-j(\frac{x+y+z}{r_q})}$ dx dy dz (symmetric integration) (5-10)

x, y, z=∞

$=8\ (r_q)^3\ E_q\ e^{-j(\frac{x+y+z}{r_q})}\Big|$ $= 8\ (r_q)^3\ \varrho_q$ (6-10)

x, y, z=0

$\varrho_q = \frac{h\omega}{16\pi r_q{}^3} = \frac{h\ \omega^4}{16\ \pi^4\ c^3}$, (7-10)

Where $\frac{h}{16\pi^4\ c^3} = h_q$ (energy density constant) (8-10)

the quanton is represented by an equivalent volume = 8 $r_q{}^3$ (12-10)

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

$\varrho_q = (\frac{h}{16\ \pi^4\ c^3})\ k^4\ c^4 = \frac{h\ c}{16\ r_q{}^4}$ (13-10)

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

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

$\varrho_q = h_q\ \omega^4 = h_q\ k^4 c^4 = h_q\ \frac{\pi^4 c^4}{r_q{}^4}$ (14-10)

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

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

$\varrho_v = \varrho_q$ (15-10)

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

$\varrho_q = \frac{1}{2}(E_{qf} + cE_{qc}) * \frac{1}{2}(\frac{E_{qf}}{c} + E_{qc})$ (16-10)

and since $E_{qfo} = cE_{qco}$ (17-10)

$\varrho_q = E_{qfo} \cos(\frac{\pi r}{2r_q} - \omega t)\ E_{qco} \cos(\frac{\pi r}{2r_q} - \omega t) = E_{qo} \cos^2(\frac{\pi r}{2r_q} - \omega t)$ (18-10)

The average value of a periodic function is defined as

$\varrho_q = \frac{1}{T}\int_0^T E_{qo}\ dt$ (19-10)

$\varrho_q = \frac{E_{qo}}{T}\int_0^T \cos^2(\frac{\pi r}{2r_q} - \omega t)\ dt$ (20-10)

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

$\varrho_{qo} = 2\varrho_q = \frac{h\,\omega^4}{8\pi^4 c^3}$, (21-10)

11 -Energy constraining and the release of radiative energy

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

Energy constraining during quanton inflation as follows

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

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

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

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

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

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

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

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

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

The results of field expansion can be defined as

a- expansion term:

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

Corresponds to the expanding space and time varying fields.

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

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

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

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

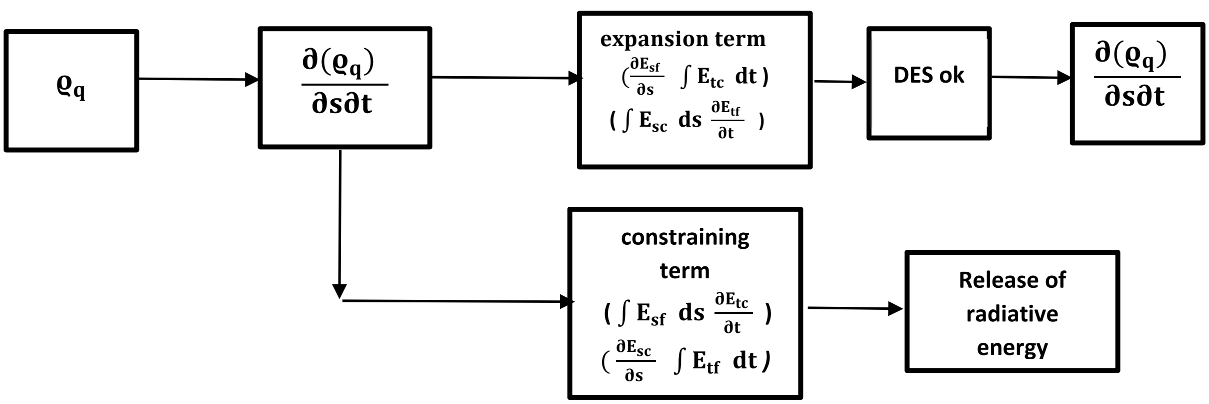


Fig. 4. Quanton energy density expansion process

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

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

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

This free expansion process of the universe, which according to the second law of thermodynamics, is an irreversible process, this irreversibility is due to losses in the form of space fabric giving off heat during expansion.

The origin of this release of thermal energy : is energy constraining.

Based on the previous results,we can conclude that the CMB origin is due to release of thermal energy during free expansion of the space fabric itself .

The extraordinarily high degree of CMB homogeneity with variation of the order of (10^{-5}) , reflects the high degree of homogeneity of space fabric itself as it releases radiation during the free expansion process and, in fact energy constraining is behind that release of this radiation energy.

13. why do quantons split ?

The question how the quantons split is discussed in the following section , but why this happens resides in the fast that the quanton energy density is four dimensional , as the quanton expands from an equivalent volume (V_{q1}) to (V_{q2}) , the quanton radius r_q and its volume V_q should change in the following manner $\frac{V_{q2}}{V_{q1}} = (\frac{r_{q2}}{r_{q1}})^3$ which is expected in case of an expansion in three dimensional energy density.

Quanton energy fields change periodically with time, this variation at the rate of ω rad /sec , and vary in space at the rate of k (= $\frac{\pi}{r_q}$) , the total energy of the quanton (as a quantum entity) is governed by Planck Einstein relationship (function only in its wave parameters) , namely E_p = hf = $\frac{hkc}{2\pi}$ = $\frac{hc}{2r_q}$

the relationship between quantons of different energy content can be put as

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

which means that the quanton radius and the wave length of its characteristic wave behaviour are inversely proportional to its total energy content.

Recalling here the Dof relationship between quanton energy density and its wave parameters, energy density can be assessed as

$\mathrm{E_p} = \varrho_q \; \mathrm{V_q}$ or $\varrho_q = \frac{\mathrm{E_p}}{\mathrm{V_q}}$

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

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 $\frac{\varrho_{q2}}{\varrho_{q1}} = \left(\frac{r_{q1}}{r_{q2}}\right)^4$ (1-13)

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

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

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

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

14.Mechanism of quanton splitting and expansion.

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

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

a-Splitting action of the quantons due dimensional energy asymmetry

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

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

1-The two types of quanton fields (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 types are not the same, the field of the dominant type of energy self-interact creating a repulsive interaction that causes the quantons to expand, the self-interacting (unbound) field is (E_{sfu} E_{tfu}) for quantons and (E_{scu} E_{tcu}) for anti quantons [ ]

2-The unbound field is at the origin of the quanton inflationary energy 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- Release radiative energy to maintain the relationship $E_p = \frac{h\omega}{2\pi}$ or

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

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

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

14.c. stage(3) quanton expands further

Following quanton splitting its total energy becomes

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

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

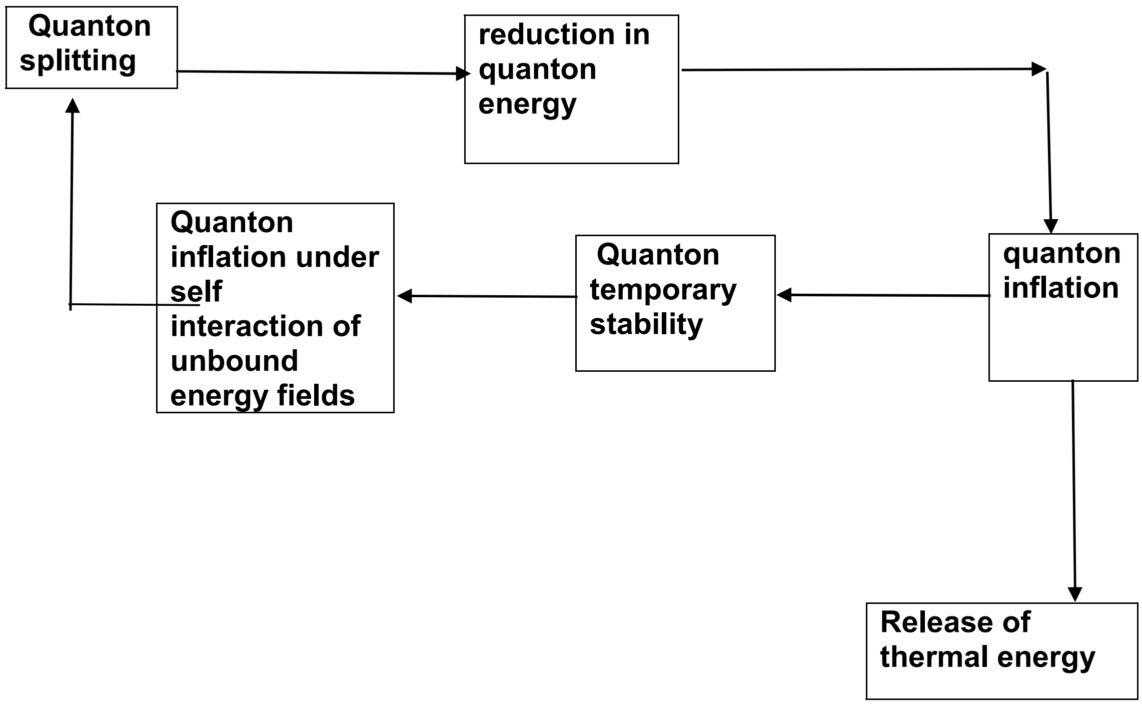


Fig. 5. cycle of quanton splitting and subsequent inflation

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

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

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

Given the high efficiency of the splitting process as a mechanism to manage the expansion of the quanton through both inflation and multiplication while

on the other hand minimizing the thermal energy release, it is clear that quanton splitting and subsequent expansion is the actual mechanism of space fabric expansion.

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

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

15.mathematics behind constraining

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

a−For evolution of constrained space varying field

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

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

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

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

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

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

b-For the evolution of the constrained time varying field

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

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

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

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

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

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

c-Expansion term

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

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

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

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

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

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

b- constraining term

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

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

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

$$= K_s\, D_s\, K_t\, D_t = E_s E_t \quad (20\text{-}15)$$

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

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

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

16. Wave- like properties of space fabric

Energy which varies in time and varies in space has wave like properties as it changes at periodic rate that equals ω rad /sec (= $2\pi f$) 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}= (ψ_{sf} ψ_{tc}) **differentiating both sides w.r.t time**

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

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

While differentiating w.r.t (x)

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

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

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

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

which is the PDE forth free energy dominated field.

Similarly for the constrained energy dominated wave

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

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

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

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

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

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

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

This PDE for the constrained energy dominated field.

which shows also how a wave equation of space and time varying fields would look like

17. Quanton evolution and degrees of freedom

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

As free energy field expands by variation in space It must vary in time , so a constrained space varying field appears

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

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

While as the time varying field (E_{tf}) expands , a part of it must vary in space in the form of constrained space varying energy field

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

$$b-\left[\int(E_t)\ dt\right]=\int(E)\ dt=\int E\ dt=E_{tc} \quad (4\text{-}17)$$

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

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

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

For time constrained energy field (E_{tc}),its energy Dof equals one third of the corresponding free energy field (E_{sf})

For free time varying energy field(E_{tf}) , its energy degree of freedom equals one third of the corresponding space constrained energy field (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

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

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

Which gives the following results

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

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

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

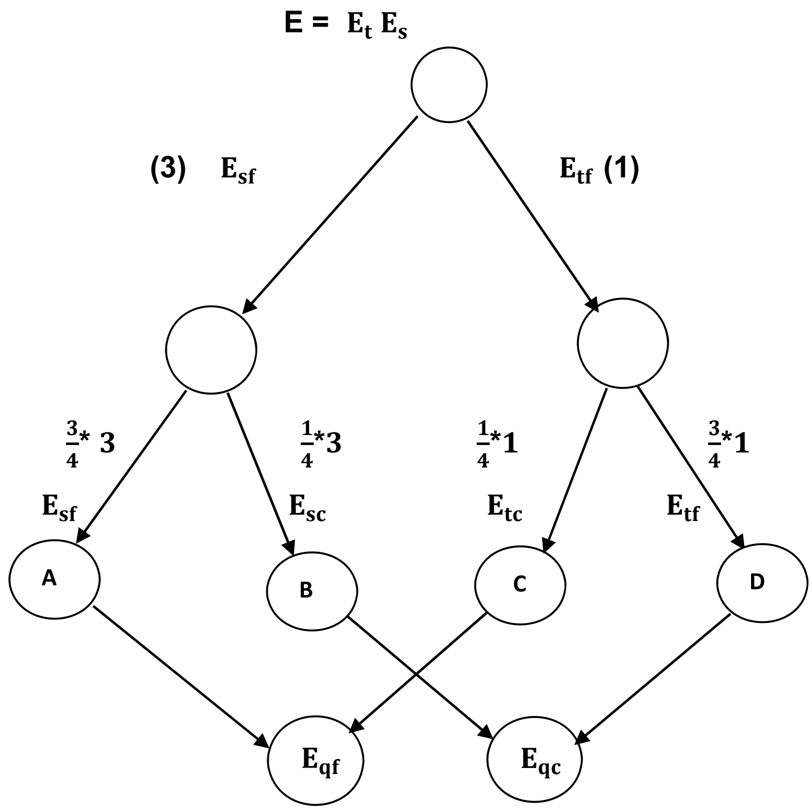


Fig. 6.tree diagram for the evolution of the degrees of freedom of quanton's energy fields

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

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

Unbound free field is manifested in the form of quanton inflation

D_{sfu} D_{tfu} **(unbound field strength)**= $\frac{(D_{sf}\ D_{tf})}{(D_{sc}\ D_{tc})} = \frac{c^{2.25}c^{0.25}}{c^{0.75}c^{0.25}} = c^{2.0}$ **(12-17)**

unbound free Dof =($\sum(\text{free Dof}) - \sum(\text{constrained Dof})$ **(13-17)**

= $[\,(\text{Dof}_{sf}) + (\text{Dof}_{tf})] - [(\text{Dof}_{sc}) + (\text{Dof}_{tc})]$ **= (3.0-1.0)=** $+2$ **(14-17)**

18.Variation of quanton energy fields with time

Not only the unbound energy fields E_{sfu} 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.

18.a-Variation of space varying energy with time

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

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

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

18.b- time varying energy field variation

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

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

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

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

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

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

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

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

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

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

, which means that

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

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

19. Energy field parameters

As energy density expands by variation in space and time, it has four degrees of freedom, this can be used to define quanton space and time varying fields

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

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

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

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

= the field strength parameter of energy fields

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

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

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

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

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

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

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

It must be noted that while $\frac{E_q}{\omega^4} = (\frac{h}{16\,\pi^4\,c^3}) = h_q = \text{constant}$ **, 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 : $K_{sf} = K_{sc} = K_{tf} = K_{tc} = K_q$ (12-19)

Finally, we can write the energy fields themselves as

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

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

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

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

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

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

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

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

20.Dimensions of vector energy fields

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

individual energy content of various fields in the form

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

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

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

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

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

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

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

Dimensions of individual energy fields are expected to be as follows

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

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

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

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

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

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

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

for time varying energy fields

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

The relative ratio between space and time varying energy fields

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

21. quanton field represention

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

Based on the concept of dimensional energy symmetry, the quantons satisfy the equipartition of energy among spatial axis via their statistical distribution

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

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

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

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

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

And the constrained energy dominated field components

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

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

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

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

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

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

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

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

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

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

22. (Q+AQ) pair wave form

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

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

This linear superposition form is due to the fact that either quanton or anti quanton is a separate 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** $(Dof_{qc})_{aq} = (Dof_{qf})_q$ **(1-22)**

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

$(E_{qf})_{aq} = (E_{qc})_q$ **or** $(Dof_{qf})_{aq} = (Dof_{qc})_q$ **(2-22)**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

23. Anti quanton evolution and its degrees of freedom

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

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

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

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

Fig.6 shows the evolution of antiquanton fields' degrees of freedom

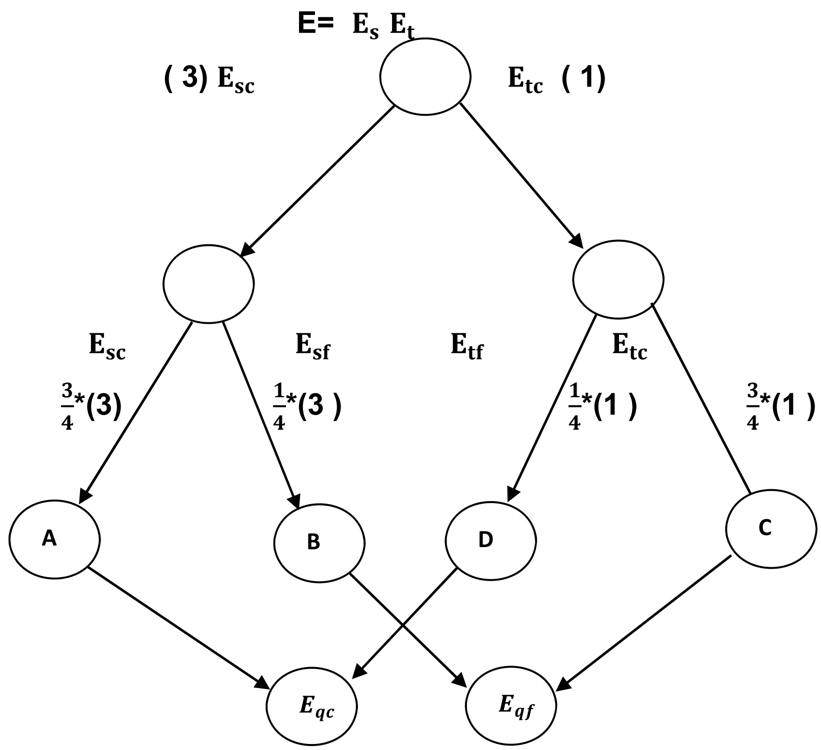


Fig. 6.hypothetical tree diagram for the evolution and the degrees of freedom of anti quanton energy fields, and why the independent evolution of the anti quanton seems to be problematic in an inflationary scenario

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

a-Constraining of the free dominated field

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

Then expands as a constrained dominated field

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

b-For the quanton's constrained dominated field

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

Then expands as a free dominated field

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

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

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

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

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

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

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

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

(unbound)constrained Dof = ($\sum$(constrained Dof)

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

24.Electromagnetic waves as space and time fields

The formulation of electromagnetic waves in terms of energy fields depends on the system of units , under the (Esu) system volumetric electromagnetic energy density U = 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

$E_f(x) = \frac{E_{qf}(x)}{\sqrt{c}} = \frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}}$, $B_c(x) = \frac{E_{qc}(x)}{\sqrt{c}} = \frac{E_{sc}(x)\ E_{tf}}{\sqrt{c}}$ (1-24)

where $\mathrm{E_f(x)}$ is the electric field due to the free dominated field ($\mathrm{E_{qf}}$)

, $\mathrm{B_c(x)}$ is the magnetic field due to the constrained dominated field ($\mathrm{E_{qc}}$)

which propagate along x- axis given that cos(kx-ωt) = $\frac{1}{2}\left(e^{j(kx-\omega t)} + e^{-j(kx-\omega t)}\right)$

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

$$E\,(x) = \frac{1}{2}(\,E_f(x) + c\,B_c(x)\,) = \frac{1}{2}\,(\frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}} + \sqrt{c}\,E_{sc}(x)\ E_{tf}\,) \qquad (2\text{-}24)$$

$$B\,(x) = \frac{1}{2}(B_c(x) + \frac{1}{c}\,E_f(x)) = \frac{1}{2}\,(\frac{E_{sc}(x)\ E_{tf}}{\sqrt{c}} + \frac{1}{c}\ \frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}}\,) \qquad (3\text{-}24)$$

for the (si) system of units

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

$$E_f(x) = \frac{E_{qf}(x)}{\sqrt{c}} = \frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}} \quad , \quad B_c\,(x) = \frac{E_{qc}(x)}{\sqrt{c}} = \frac{E_{sc}(x)\ E_{tf}}{\sqrt{c}} \qquad (4\text{-}24)$$

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

$$E\,(x) = \frac{1}{2}\,\frac{1}{\sqrt{\varepsilon_o}}\,(\,E_f(x) + c\,B_c(x)\,)$$

$$= \frac{1}{2}\,\frac{1}{\sqrt{\varepsilon_o}}\,(\frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}} + \sqrt{c}\,E_{sc}(x)\ E_{tf}\,) \qquad (5\text{-}24)$$

$$B\,(x) = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}(B_c(x) + \frac{1}{c}\,E_f(x)) = \frac{1}{2}\,\frac{1}{\sqrt{\varepsilon_o}}\,(\frac{E_{sc}(x)\ E_{tf}}{\sqrt{c}} + \frac{1}{c}\,\frac{E_{sf}(x)\ E_{tc}}{\sqrt{c}}\,) \qquad (6\text{-}24)$$

$$B\,(x) = \frac{1}{2}\,(\frac{E_{qc}(x)}{\sqrt{\varepsilon_o}\sqrt{c}} + \sqrt{\mu_o}\ \frac{E_{qf}(x)}{\sqrt{c}}) \qquad (7\text{-}24)$$

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

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

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

and as a magnitude, $E_o\,(x) = (\frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{h}{16\,\pi^4\,c^3}}\,)\,(k^2\,c^2)\ (Dof = 2)$ (8-24)

$$B_o\,(x) = (\frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{h}{16\pi^4\,c^3}}\,)\,(k^2\,c\,)\ \ (\,Dof = \text{one}\,) \qquad (9\text{-}24)$$

To note that

1-space and time varying energy fields leave the quanton in the form of electromagnetic (radiation) energy , 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 $\text{Dof}_{\text{electric field}} + \text{Dof}_{\text{magnetic field}} + \text{Dof}_{\text{kinetic}}$ = 3+1 = 4 (10-24)

2 -energy leaves the quanton in the form of an energy packet

$E = E_s\,E_t$, 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

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

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

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

3-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

$E\,(x) = \frac{1}{2}(E_f + c\,B_c)$, $B\,(x) = \frac{1}{2}(B_c + \frac{1}{c}\,E_f)$

5- electromagnetic waves in the form

$E = \frac{1}{2}\left(\frac{E_{qf}}{\sqrt{c}} + c\,\frac{E_{qc}}{\sqrt{c}}\right),\ B = \frac{1}{2}\left(\frac{E_{qf}}{c\sqrt{c}} + \frac{E_{qc}}{\sqrt{c}}\right)$ **can be seen as a relativistic two dimensional quantons , where one energy degree of freedom is replaced by a kinetic energy degree of freedom as the waves are formed ,**

25.<u>dimensional analysis ,</u>

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

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

and the magnetic field [B] $= [\frac{E_{sf}E_{tc}}{c\sqrt{c}}] = M^{+0.5}\, L^{+1.5}\, T^{00.0}$ **(2-25)**

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

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

=[$\frac{E}{V}$] = M $L^{-1}\ T^{-2}$, this is the generic form (non statistical) of Electromagnetic energy density while in terms of the magnetic field [$\frac{E}{V}$] = [$\frac{B^2}{\mu}$] = M $L^{-1}\ T^{-2}$

[U]= $c^2\ (B_c + \frac{1}{c} E_f)^2$ = $c^2 \left(\frac{E_{sc} E_{tf}}{\sqrt{c}} + \frac{1}{c} \frac{E_{sf} E_{tc}}{\sqrt{c}}\right)^2$

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

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

	Dof_x (kinetic)	Dof_{yz}	Dof_t	*Total Dof*
E (x)	0.5	$E_{sfyz}(x)$=1.50	E_{tc}=0.5	*2.00*
B (x)	0.5	$E_{scyz}(x)$=0.50	E_{tf}=0.5	1.00
total	1.00	2.00	1.00	

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

Table .2 provides the most significant differences between quantons of space fabric and those of electromagnetic fields

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

Table. 2 Comparison between space fabric and electromagnetic quantons

26.Maxwell equations of energy fields

As energy density expands in the form of space and time fields, so we can relate the four Maxwell equations for electromagnetism to their original form for space and time energy fields .

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

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

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

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

1-Gauss law of electric field

$$\nabla.E = \frac{\varrho_c}{\varepsilon_o} \qquad (1\text{-}26)$$

ϱ_c **: charge density**

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

$$(E_{tc}\nabla.\ E_{sf})_q + (E_{tf}\ \nabla.\ E_{sc})_{aq} = 0$$

(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 $$(E_{tc}\nabla.\ E_{sf})_q = -\ (E_{tf}\ \nabla.\ E_{sc})_{aq} \qquad (3\text{-}26)$$

2-Gauss law of magnetic field

$$\nabla.B = 0$$

$$\left(\frac{E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\ \nabla.\ E_{sc}\right)_q + \left(\frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\ \nabla.\ E_{sf}\right)_{aq} = 0 \qquad (4\text{-}26)$$

$$(E_{tc}\ \nabla.\ E_{sf})_{aq} = -(E_{tf}\ \nabla.\ E_{sc})_q \qquad (5\text{-}26)$$

3-farday's law for electric field

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

$$\nabla \times E = \left(\nabla \times E_{sf}\ \frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \left(\nabla \times E_{sc}\ \frac{E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}}\right)_{aq} \qquad (6\text{-}26)$$

$$= \left(\nabla \times E_{sf}\ \frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q + \left(\frac{E_{tf}}{\sqrt{c}\sqrt{\varepsilon_o}}\nabla \times E_{sc}\right)_{aq} \qquad (7\text{-}26)$$

$$-\frac{\partial B}{\partial t} = -\frac{\partial}{\partial t}\left(E_{sc}\ \frac{E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_q - \left(E_{sf}\ \frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\right)_{aq} \qquad (8\text{-}26)$$

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

By comparing eq 6 , 7 We get

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

$$(E_{tc}\ \nabla \times E_{sf})_q = -\left(E_{sc}\frac{\partial E_{tf}}{\partial t}\right)_q$$ **and** $$(9\text{-}26)$$

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

$(E_{tf}\nabla x\, E_{sc})_{aq}$ = -$(E_{sf}\frac{\partial E_{tc}}{\partial t})_{aq}$ **(10-26)**

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

∇**xB =**μ_o **(j+** $\varepsilon_o\frac{\partial E}{\partial t}$ **)**

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

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

= $(\frac{E_{tf}}{\sqrt{\varepsilon_o}\sqrt{c}}\nabla x\, E_{sc})_q$**+** $(\frac{E_{tc}}{\sqrt{\varepsilon_o}\sqrt{c}}\nabla x\, E_{sf})_{aq}$ **(11-26)**

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

=$\frac{1}{c^2}$**[**$(\frac{E_{sf}}{\sqrt{\varepsilon_o}\sqrt{c}}\frac{\partial E_{tc}}{\partial t})_q$**+** $(\frac{E_{sc}}{\sqrt{c}\sqrt{\varepsilon_o}}\frac{\partial E_{tf}}{\partial t})_{aq}$ **]** **(12-26)**

By comparing eq 10 , 11 we get

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

$(E_{tc}\nabla x\, E_{sf})_{aq}$ **=** $\frac{1}{c^2}(E_{sc}\frac{\partial E_{tf}}{\partial t})_{aq}$ **(13-26)**

It is worth noting that the equations (2 , 3) can be put in the following form

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

For anti quantons : $\frac{\nabla x\, E_{sc}}{\frac{\partial E_{tc}}{\partial t}} = -\frac{E_{sf}}{E_{tf}}$ **(15-26)**

2- Maxwell equations remain invariant under relativistic effects as this effect is split equally between two fields

27.Role of Maxwell equations in the evolution of the quanton

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

1-the 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 cur 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 constrained 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* $\nabla x\, E_{sc} = \frac{1}{c^2}\frac{E_{sf}}{E_{tf}}\frac{\partial E_{tc}}{\partial t}$ such that fields E_{sc} , E_{tf} *are* also contained in the quanton as it formed

28.Lorentez transformation of energy fields

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

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

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

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

$E_x' = E_x$, $E_y' = \gamma (E_y + \beta c B_z)$

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

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

In this case the electric field is represented by the field $E_y(x)$, *a*nd 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

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

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

after substitution , we get for E and B

$$E_y{}' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}((\frac{E_{sf}\ E_{tc}}{\sqrt{c}}) + c\left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}}\right) + v\left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}}\right) + \frac{v}{c}(\frac{E_{sf}\ E_{tc}}{\sqrt{c}})) \quad (1\text{-}28)$$

$$= \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}((\frac{E_{sf}\ E_{tc}}{\sqrt{c}})\left(1 + \frac{v}{c}\right) + c\left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}}\right)(1 + \frac{v}{c})) \quad (2\text{-}89)$$

$$E_y{}' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}((\frac{E_{sf}\ E_{tc}}{\sqrt{c}}) + c\left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}}\right))\left(1 + \frac{v}{c}\right) = \sqrt{\frac{\left(1+\frac{v}{c}\right)}{\left(1-\frac{v}{c}\right)}}\ E_y \quad (3\text{-}28)$$

Where $\gamma\left(1 + \frac{v}{c}\right) = \frac{\sqrt{\left(1+\frac{v}{c}\right)}\sqrt{\left(1+\frac{v}{c}\right)}}{\sqrt{\left(1+\frac{v}{c}\right)}\sqrt{\left(1-\frac{v}{c}\right)}} = \sqrt{\frac{\left(1+\frac{v}{c}\right)}{\left(1-\frac{v}{c}\right)}}$ (4-28)

$$B_z{}' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}((\frac{E_{sc}\ E_{tf}}{\sqrt{c}}) + \frac{1}{c}\left(\frac{E_{sf}\ E_{tc}}{\sqrt{c}}\right)) - \frac{v}{c^2}\ (\left(\frac{E_{sf}\ E_{tc}}{\sqrt{c}}\right) + c\left(\frac{E_{sc}\ E_{tf}}{\sqrt{c}}\right)) \quad (5\text{-}28)$$

$$B_z{}' = \frac{\gamma}{2}\frac{1}{\sqrt{\varepsilon_o}}\ (\frac{E_{sc}\ E_{tf}}{\sqrt{c}})(1-\frac{v}{c}) + \frac{1}{c}\left(\frac{E_{sf}\ E_{tc}}{\sqrt{c}}\right)(1-\frac{v}{c})) = \sqrt{\frac{\left(1-\frac{v}{c}\right)}{\left(1+\frac{v}{c}\right)}}\ B_z \quad (6\text{-}28)$$

Where $\gamma\left(1 - \frac{v}{c}\right) = \frac{\sqrt{\left(1-\frac{v}{c}\right)}\sqrt{\left(1-\frac{v}{c}\right)}}{\sqrt{\left(1+\frac{v}{c}\right)}\sqrt{\left(1-\frac{v}{c}\right)}} = \sqrt{\frac{\left(1-\frac{v}{c}\right)}{\left(1+\frac{v}{c}\right)}}$ (7-28)

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

$$E' = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}(\frac{E_{sf}{}'\ E_{tc}{}'}{\sqrt{c}} + c\ \frac{E_{sc}{}'\ E_{tf}{}'}{\sqrt{c}}) = \frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{1+\beta}{1-\beta}}\ K_q{}^2\ c^2\ cos(k'r' - \omega' t') \quad (8\text{-}28)$$

$$B' = \frac{1}{2}\frac{1}{\sqrt{\varepsilon_o}}(\frac{E_{sc}{}'\ E_{tf}{}'}{\sqrt{c}} + \frac{1}{c}\ \frac{E_{sf}{}'\ E_{tc}{}'}{\sqrt{c}}) = \frac{1}{\sqrt{\varepsilon_o}}\sqrt{\frac{1-\beta}{1+\beta}}\ K_q{}^2\ c\ \ cos(k'r' - \omega' t') \quad (9\text{-}28)$$

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 $E_y{}'\ B_z{}' = \sqrt{\frac{\left(1+\frac{v}{c}\right)}{\left(1-\frac{v}{c}\right)}}\ E_y\ \sqrt{\frac{\left(1+\frac{v}{c}\right)}{\left(1+\frac{v}{c}\right)}}\ B_z$

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

29 RESERVED

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-same quanton interactions b- inter quanton :short range

c- inter quanton : 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

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

2- the interaction intensity must be proportional to the product of intensity of both fields as defined by the parameter K_q

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

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

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

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

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

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

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

α_b : parameter of interaction , Δr_{ij} : effective distance between two fields , while E_{sfbi} is defined as being equal to $K_{sfbi}\ D_{tbi}$ (which expresses the energy field as the product of its strength (Dof) and intensity , the dimensions of such an interaction would be $\frac{Energy}{c^{4-(Dof_{total})}\ (\text{3D volume})}$

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

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 at all the scales

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 ($\mathrm{E_{sfbi}\ E_{tfbi}}$)($\mathrm{E_{scj}\ \ E_{tcj}}$)

that can combine with another simple interaction

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

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

which is the case of gravitation

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

while inside the quanton , the unbound field $\mathrm{E_{sfu}\ \ E_{tfu}}$ (or $\mathrm{E_{scu}\ \ E_{tcu}}$ for the case of anti quanton) generates self-interaction that gives rise only to simple repulsive interactions ,while when involving other quantons (anti quanton) the generated repulsive interaction 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

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

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

$$= \mathrm{K_q}^4(\mathrm{D_{sfu}D_{tfu}})^2\ \frac{1}{(\Delta \mathrm{r_{ij}})} = \sqrt{\alpha_r}\,\frac{\mathrm{h}}{2\mathrm{r_q}\,\mathrm{v_q}}\ \mathrm{c}^{\mathrm{Dof_{sfu}}+\mathrm{Dof_{tfu}}} \qquad (7\text{-}33)$$

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. quanton field interactions

34.a-inside quantons

34.a.1The quanton retaining interaction (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

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

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

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

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

the generated retaining interaction (E_t) that maintains the quanton's integrity and prevents it from disintegration, the retaining interaction (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

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

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

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

where the term $(E_{sf}E_{tf})_{\text{binding}}$ 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

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

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

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

as for the dimensions of such interaction , which has two Dof's , while its dimension is $[\frac{energy}{volume * c^2}] = M\, L^{-3}\, T^{-00}$

34.a.2.quanton inflationary interaction (E_i)

Type : simple nonbinding(repulsive)

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 (E_i) that causes quanton to expand ,

the generated quanton inflationary interaction would be in the form

$(E_i)_q = (\sqrt{(E_{sf} E_{tf})}_{\ unbound})^2$ **(8-34)**

$= (K_q \sqrt{(D_{sfu} D_{tfu})}) \quad (K_q \sqrt{(D_{sfu} D_{tfu})})$

$(E_i)_q = K_q^2 \; c^2 = \sqrt[2]{\frac{\alpha_i\, h\, c}{16 \quad r_q^4}}$ **(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 $\sqrt{D_{sfu} D_{tfu}}$ **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 $[\sqrt{\frac{energy}{volume}}] = M^{0.5}\, L^{-0.5}\, T^{-1.0}$

While for the case of anti quanton , the inflationary energy

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

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

34.b-outside quanton

34.b.1-Space fabric binding interaction (E_b)

Type : multiple binding

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

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

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

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

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

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

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

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

The binding interaction due to the constrained field E_{sc} E_{tc} will be in the form

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

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

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

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

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

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

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

<u>as for the factor</u> $\frac{\sqrt{r_{qi}\,r_{qj}}}{(r_i-r_j)}$, 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

$$E_{tp} = \int_{V_q} E_t\ dV\ = \int_{V_q}(E_{sfb}\ E_{tfb})\ (E_{sc}\ E_{tc})\ dV\ = \frac{h}{16(\pi)^4}\,k^4\,V_q$$

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

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

34.b.2-Quanton repulsive interaction (E_r)

Type : repulsive

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

for quanton (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})

For anti quanton (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 $E_r((E_{scui}E_{tcui})_{aq})$=

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

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

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

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

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

35.Generation of space fabric binding interaction (E_b)

1- Energy fields out of the quanton , which generate the quanton binding

2- 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 (E_t) or $(E_{sfb}E_{tfb})_q$ $=K_q{}^2(D_{sfb}D_{tfb})_q$ and has (1.0 Dof's) , and the second part which generates the quanton inflationary interaction (E_i) namely the unbound part ($(E_{sfu}\ E_{tfu})_q = K_q{}^2(D_{sfu}D_{tfu})_q$ which has two degrees of freedom, so we can summarize the energy fields as they leave the quanton as follows

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

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

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

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

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

$c - (E_{scu}E_{tcu})$ (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 $(E_{sf}E_{tf})_{bound}$ of the quanton or ($E_{sf}E_{tf}$) of the anti quantons create in an interaction with the constrained energy field ($E_{sc}E_{tc}$) of the other quantons or $(E_{sc}E_{tc})_{bound}$ 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 (E_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

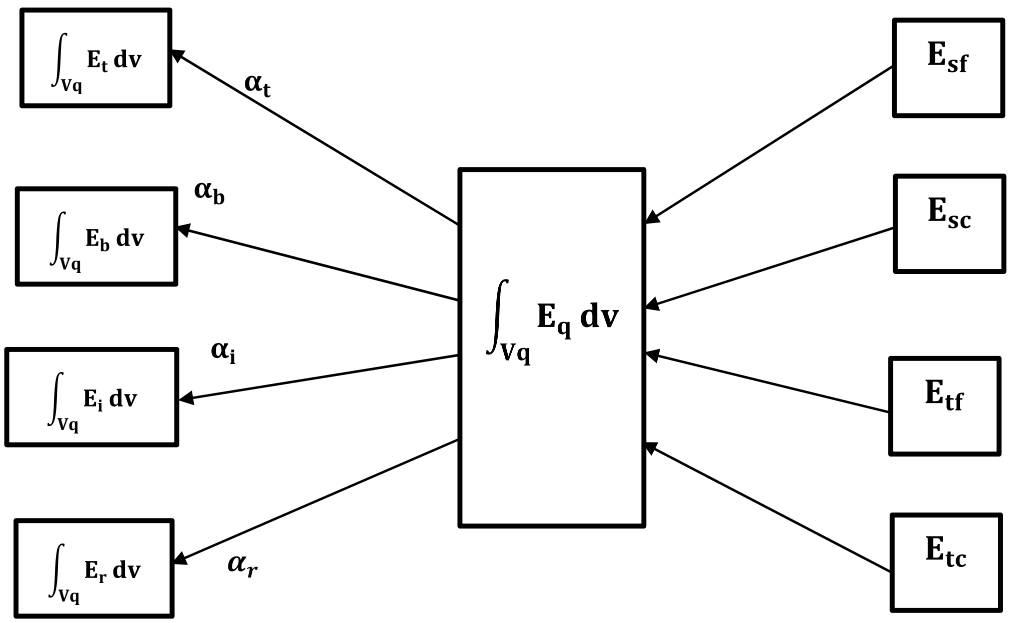


Fig. 7.the relationship between quanton packet energy and the Energy of various interactions

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 $[E_i] = \left(\frac{energy}{volume}\right)\left(\frac{1}{c^{4-x}}\right) =$

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

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

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

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

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

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

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

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

for the inflationary interaction

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

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

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

for the repulsive interaction

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

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

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

37b.multiple form of quanton interactions

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

$$E_{sfu}\, E_{tfu} + E_{sfb}\, E_{tfb} E_{sc}\, E_{tc} \qquad (4\text{-}37)$$

and for anti quanton

$$E_{scu}\, E_{tcu} + E_{sf}\, E_{tf} E_{scb}\, E_{tcb} \qquad (5\text{-}37)$$

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

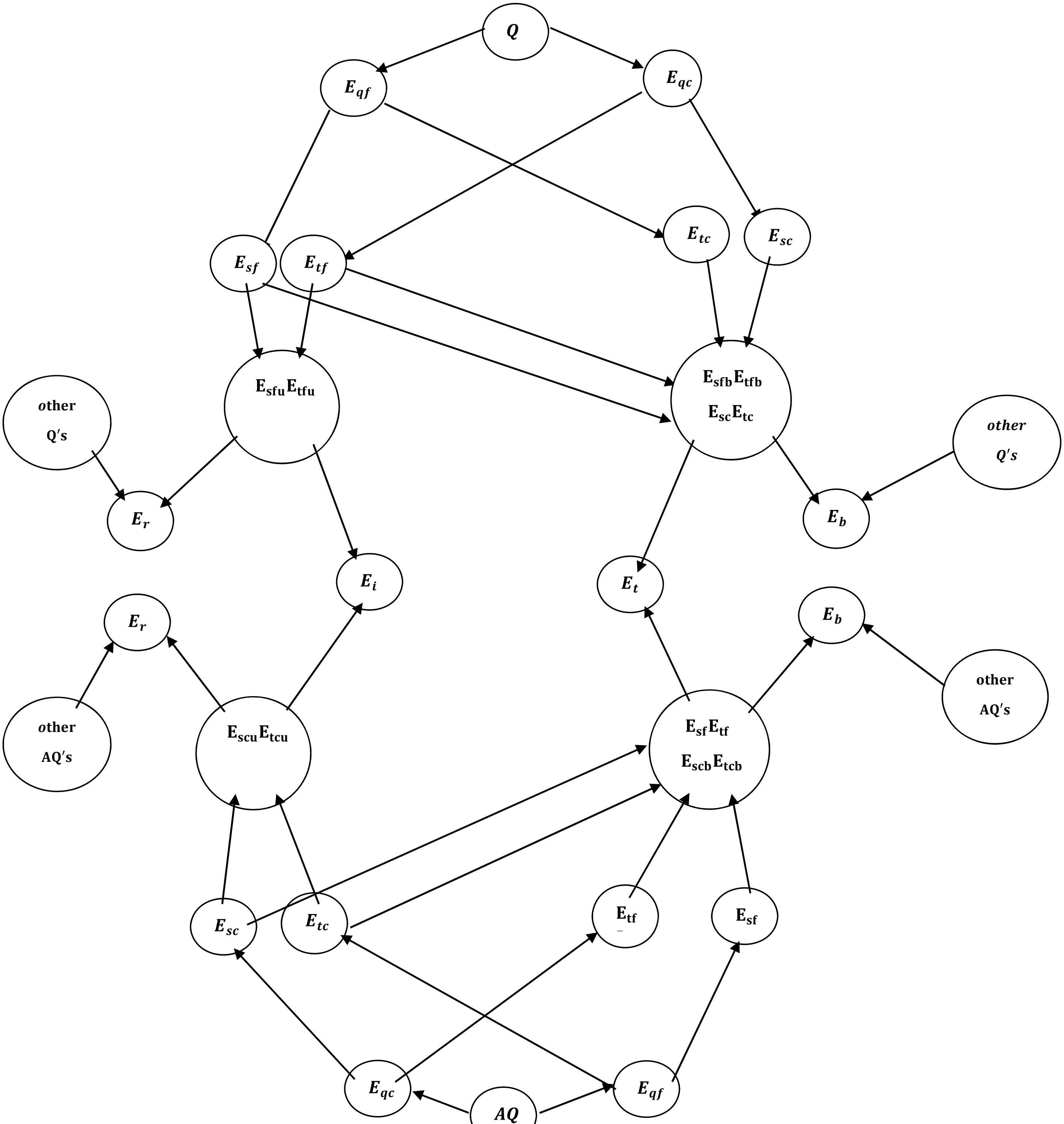


Fig. 8. Evolution of Q.AQ field interactions

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))

$$E_{btij} = \frac{c^4 {E_{bp}}^2}{E_{ref}} = \frac{c^4}{E_{ref}}$$

$$[(\int_{V_{qi}} (E_{sfbi}E_{tfbi})_q (E_{sci}E_{tci})_q dV \sum_j^n \int_{V_{qj}} (E_{sfbj}E_{tfbj})_q (E_{scj}E_{tcj})_q\, dV) \ \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}$$

$$+ \int_{V_{qi}}((E_{sfbi}E_{tfbi}E_{sci}E_{tci})_q\, dV \sum_j^n \int_{V_{qj}}(E_{sfj}E_{tfj}E_{scbj}E_{tcbj})_{aq} \quad dV \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}\ ] \qquad \textbf{(6-37)}$$

$$= \frac{2\, r_{ref}\, c^4}{hc} [\ ({K_{qi}}^4 (D_{sfbi}D_{tfbi}D_{sci}D_{tci})_q\, V_{qi}\ \sum_j^n {K_{qj}}^4 (D_{sfbj}D_{tfbj}\, D_{scj}D_{tcj})_q\, V_{qj}\ \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}$$

$$+ {K_{qi}}^4 (D_{sfbi}D_{tfbi}D_{sci}D_{tci})_q\, V_{qi}\ \sum_j^n {K_{qj}}^4 (D_{sfj}D_{tfj}D_{scbj}D_{tcbj})_{aq})\ \ V_{qj}\ \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)})] \qquad \textbf{(7-37)}$$

$$E_{btij} = \frac{2\alpha_b\ c^3}{h}\ \frac{h}{2V_{qi}\, c^3\, r_{qi}}\, c^2\, V_{qi}\ \{[\ \sum_j^n \frac{h}{2V_{qj}\, c^3\, r_{qj}}\ \ c^2\, V_{qj}\ \frac{r_{qi}\, r_{qj}}{{(r_i - r_j)}_{q-q}}] +$$

$$[\sum_j^n \frac{h}{2V_{qj}\, c^3\, r_{qj}}\ c^2\, V_{qj} \frac{r_{qi}\, r_{qj}}{{(r_i - r_j)}_{q-aq}})]\} \qquad \textbf{(8-37)}$$

$$= \frac{\alpha_b\, hc}{2} \quad (\sum_j^n\ (\frac{1}{{(r_i - r_j)}_{q-q}}\ ) + (\sum_j^n\ \ \frac{1}{{(r_i - r_j)}_{q-aq}})\ ) \qquad \textbf{(9-37)}$$

$$E_{ref} = \frac{hc}{2\, r_{ref}}\ \ ,\ \ r_{ref} = \sqrt{r_{qi}\, r_{qj}} \qquad \textbf{(10-37)}$$

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 = $(E_{sfb}E_{tfb})(E_{sc}E_{tc})$

$$\frac{c^4 {E_{tp}}^2}{E_{ref}} = \frac{c^4}{E_{ref}} \int_{V_q} (E_{sfb}E_{tfb})_q\ \ (E_{sb}E_{tc})_q\, dV \int_{V_{aq}} (E_{sf}E_{tf})_{aq}\, (E_{sfb}E_{tcb})_{aq}\, dV \qquad \textbf{(11-37)}$$

$$= \frac{2\, r_{ref} c^4}{hc} ({K_q}^4 (D_{sfb}D_{tfb}D_{sc}D_{tc})_q\, V_q (D_{sf}D_{tf}D_{scb}\, D_{tcb})_{aq}\, V_{aq} \qquad \textbf{(12-37)}$$

$$= \frac{2\alpha_t\, r_{ref} c^4}{hc} (\frac{h}{16\, c^3 {r_q}^4}\ \ c^2 V_q\ )\ (\frac{h}{16\, c^3 {r_q}^4}\ \ c^2 V_{aq})$$

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 ≠ j

37b.3. inflationary and repulsive interactions in multiple form

for the combined inflationary interaction due to unbound fields of both the Q.Q pair

$$E_{ip} = \int_{V_q} (E_{sfu}\, E_{tfu}\,)_q \quad (E_{scu}\, E_{tcu}\,)_{aq}\, dV \quad (15\text{-}37)$$

$$= [K_q{}^2\, (D_{sfu}\, D_{tfu})_q \quad (K_q{}^2\, (D_{scu}\, D_{tcu})_{aq} \;]\; V_q \quad (16\text{-}37)$$

$$= \alpha_i \;(\sqrt[2]{\frac{h}{16\, c^3}} \;\frac{c^2}{r_q{}^2})\, (\sqrt[2]{\frac{h}{16\, c^3}} \;\frac{c^2}{r_q{}^2} V_q)$$

$$E_{ip} = \alpha_i \; \frac{hc}{2 V_q r_q} V_q = \alpha_i \; \frac{hc}{2\, r_q} \quad (17\text{-}37)$$

the combined repulsive interaction of the Q.AQ pair

$$E_{rpij} = \frac{1}{E_{ref}} \; [\int_{V_{qi}} (E_{sfui} E_{tfui})_q \;(E_{scui} E_{tcui})_{aq}\, dV \,] \;\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}]$$

$$\sum_j^n \int_{V_{qi}} \; (E_{sfuj} E_{tfuj})_q (E_{scuj} E_{tcuj})_{aq}\, dv] \;\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}\,] \quad (18\text{-}37)$$

$$= \frac{\sqrt{r_{qi}\, r_{qj}}}{hc} [\; (K_{qi}{}^4 (D_{sfui} D_{tfui}\,)_q \;(D_{scui} D_{tcui}\,)_q \quad \frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)}$$

$$\sum_j^n K_{qj}{}^4 (D_{sfuj} D_{tfuj}\;)_q \;(D_{scuj} D_{tcuj}\;)_q V_q] \;\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)} \quad (19\text{-}37)$$

$$E_{rpij} = \alpha_r \;\frac{\sqrt{r_{qi}\, r_{qj}}}{hc} [\,\frac{h}{16\, c^3} \;\frac{c^4}{r_{qi}{}^4} V_{qi} [\sum_j^n \frac{h}{16\, c^3} \;\frac{c^4}{r_{qj}{}^4} V_q \;(\frac{\sqrt{r_{qi}\, r_{qj}}}{(r_i - r_j)_{\,q-q}})]$$

$$= \frac{\alpha_r\, hc}{2} \quad (\sum_j^n \;(\frac{1}{(r_i - r_j)_{\,q-q}} \quad) \quad (20\text{-}37)$$

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

$E_u * f_{DE}$ = [$N_q E_{ip} + \frac{1}{2} \sum_i^m \sum_j^n E_{rpij}$] **(21-37)**

$$= [N_q \frac{\alpha_i h}{2r_q} + \frac{\alpha_r h}{2} \sum_i^m \sum_j^n \frac{1}{(r_i - r_j)}]$$

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.<u>Role of individual energy fields in the formation of space fabric interactions</u>

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 <u>space fabric</u>

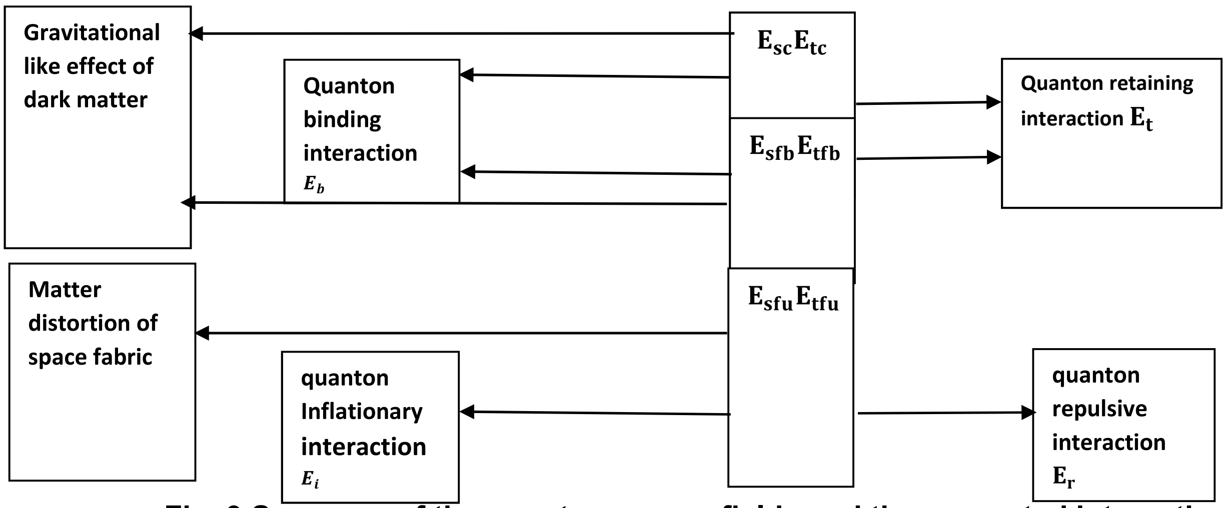


Fig. 9.Summary of the quanton energy fields and the generated interactions

	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 ($\mathbf{E_{sfb}}$, $\mathbf{E_{tfb}}$ $\mathbf{E_{scb}}$ $\mathbf{E_{tcb}}$) (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 ($\mathbf{E_{sfu}}$, $\mathbf{E_{tfu}}$), or ($\mathbf{E_{sfu}}$, $\mathbf{E_{tfu}}$) 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

$\mathrm{Dof_{sfb}} = \mathrm{Dof_{scb}} = 0.75 \quad , \quad \mathrm{Dof_{tfb}} = \mathrm{Dof_{tcb}} = 0.25$ **(1-42)**

$(\mathrm{Dof_{sfb}} + \mathrm{Dof_{scb}}) = 1.5 \quad , \sum \mathrm{Dof_p} = 2$ **(2-42)**

Energy of the bound mass take the non-relativistic form

$\mathrm{E_m} = \sum_{i}^{m} \int_{V_p} \mathrm{E_{sfb} E_{tfb}\ E_{scb} E_{tcb}\ dV} \quad ,$ **(3-42)**

The volumetric integration represents bound fields that are involved in formation of bound mass

b-charged atomic fields

a-space unbound fields ($\mathrm{E_{sfu}}$, $\mathrm{E_{scu}}$) have the same Dof

$(\mathrm{Dof_{sfu}} = \mathrm{Dof_{scu}} = 1.5$ **Dof's)** **(4-42)**

b-time unbound fields ($\mathrm{E_{tfu}}$, $\mathrm{E_{tcu}}$) also have the same Dof

$(\mathrm{Dof_{tfu}} = \mathrm{Dof_{tcu}} = 0.5)$ **(5-42)**

3-for positively charged particles : the atomic field is represented by the unbound fields ($\mathrm{E_{sfu}}\ \mathrm{E_{tfu}}$) , while for the negatively charged particles , the associated atomic Field is represented by the unbound fields ($\mathrm{E_{scu}}\ \mathrm{E_{tcu}}$)

4-for normal matter , the active degrees of freedom are four : two for the normal matter quanton , and two for the associated fields

2- 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	Follow Planck-Einstein relationship	Do not
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	No wave behaviour , only binding energy fields
Degrees of freedom	Four	Dof_p: two Associated unbound fields : two
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
Scalarized degrees of freedom	Not present	present

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 two pair of orthogonal fields (free /constrained) namely

$$\mathbf{E}_{qf} = \mathbf{E}_{sfb}\,\mathbf{E}_{tcb}\ ,\quad \mathbf{E}_{qc} = \mathbf{E}_{scb}\,\mathbf{E}_{tfb} \qquad \textbf{(1-43)}$$

$$\mathbf{E}_m = \sum_j^n \int_{V_p} \mathbf{E}_{qfbj}\,\mathbf{E}_{qcbj}\ dV = \sum_j^n \mathbf{E}_{qfj}\,\mathbf{E}_{qcj}\,\mathbf{V}_{pj} \qquad \textbf{(2-43)}$$

unlike the case of quanton fields or electromagnetic waves (where the free dominated field $\mathbf{E}_{qf}$ and the constrained dominated $\mathbf{E}_{qc}$ 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

$$\nabla.\mathbf{E}_{qf} = -\ \nabla.\mathbf{E}_{qc} \qquad \text{(completely mirror symmetric fields)} \qquad \textbf{(4-43)}$$

43.b For the relativistic effects of the bound matter

as the inertial body moves along a certain direction (x) , the two dimensional fields $\mathbf{E}_{qf}$, $\mathbf{E}_{qc}$ 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 $\mathbf{E}_{mo}' = (\mathbf{E}_{qf}'\,\mathbf{E}_{qc}'\,\mathbf{V}_p)$ **(5-43)**

$$\mathbf{E}_{mo}' = \frac{(\mathbf{E}_{qf}\ \mathbf{E}_{qc}\,\mathbf{V}_p)}{\sqrt{1-(\frac{v}{c})^{2}}} = \frac{\mathbf{E}_{mo}}{\sqrt{1-\beta^2}} \qquad \textbf{(6-43)}$$

and the same results can be obtained via the energy momentum relationship where $\mathbf{Pc} = \frac{\mathbf{E}}{\mathbf{c}}\,\mathbf{v} = \frac{(\mathbf{E}_{qf}\mathbf{E}_{qc}\mathbf{V}_p)}{\mathbf{c}}\ \mathbf{v}$ **(7-43)**

$$\mathbf{E}_m{}^2 = \mathbf{m}^2\mathbf{c}^4 = \mathbf{P}^2\mathbf{c}^2 + \mathbf{m}_o{}^2\mathbf{c}^4$$

$$(\mathbf{E}_{qf}'\,\mathbf{E}_{qc}'\mathbf{V}_p)^2 = (\mathbf{E}_{qf}'\,\mathbf{E}_{qc}'\mathbf{V}_p)^2\,\frac{\mathbf{v}^2}{\mathbf{c}^2} + (\mathbf{E}_{qf}\ \mathbf{E}_{qc}\,\mathbf{V}_p)^2 \qquad \textbf{(8-43)}$$

$$\left(\mathbf{E}_{qf}'\,\mathbf{E}_{qc}'\,\mathbf{V}_p\right)^2\left(1 - \frac{\mathbf{v}^2}{\mathbf{c}^2}\right) = (\mathbf{E}_{qf}\ \mathbf{E}_{qc}\,\mathbf{V}_p)^2 \qquad \textbf{(9-43)}$$

$$(\mathbf{E}_{qf}'\,\mathbf{E}_{qc}'\,\mathbf{V}_p) = \mathbf{E}_m = \frac{\mathbf{E}_{qf}\ \mathbf{E}_{qc}\mathbf{V}_p}{\sqrt{1-\beta^2}} = \frac{\mathbf{E}_{mo}}{\sqrt{1-\beta^2}} \qquad \textbf{(10-43)}$$

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 $E_m \neq fn\ (\frac{1}{r_p})$, 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

$$E_m = \sum_j^n \int_{V_p} E_{sfbj}\, E_{scbj}\ E_{tfbj}\, E_{tcbj}\ dV$$

$$= \sum_j^n (E_{sfbj}\, E_{scbj}\ \ E_{tfbj}\, E_{tcbj})\, V_{pj} \qquad (3\text{-}44)$$

given that V_p = constant , $\sum_j^n V_{pj} = n\, V_p$

$$E_m = V_p\, (\sum_j^n E_{sfbj}\, E_{tfbj}\ )\ (E_{scbj}\, E_{tcbj})$$

$$E_m = nE_{sfb}\, E_{scb}\, E_{tfb}\, E_{tcb}\, V_p = n\ \frac{\alpha_m\, hc}{2\, r_p} \qquad (4\text{-}44)$$

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

$$[\frac{hc}{c^2 r_p{}^4}] = M^1 L^{-3} T^{00} = \frac{\text{energy}}{\text{volume}* c^2} = \frac{\text{mass}}{\text{volume}}$$

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)

$$E_{sfb} = \sqrt[4]{\frac{\alpha_m h\, c^2}{16 \quad c^3}}\ \frac{c^{0.75}}{r_p} = \sqrt[4]{\frac{\alpha_m h}{16 \quad c}}\ \frac{c^{0.75}}{r_p} = K_p\ c^{0.75} = K_{sfb}\, D_{sfb} \qquad (6\text{-}44)$$

$$K_{sfb} = K_p = \sqrt[4]{\frac{\alpha_m h\, c^2}{16 \quad c^3}}\ \frac{1}{r_p} \quad , \; D_{sfb} = c^{0.75} \qquad (7\text{-}44)$$

$$E_{tfb} = \sqrt[4]{\frac{\alpha_m h\, c^2}{16 \quad c^3}}\ \frac{c^{0.25}}{r_p} = K_p\ c^{0.25} = K_{tfb}\, D_{tfb} \qquad (8\text{-}44)$$

$$E_{scb} = K_{scb}\, D_{scb} = \sqrt[4]{\frac{\alpha_m h\, c^2}{16 \quad c^3}}\ \frac{c}{r_p{}^2} = K_p c^{0.75} = K_{scb}\, D_{scb} \qquad (9\text{-}44)$$

$$E_{tcb} = \sqrt[4]{\frac{\alpha_m h\, c^2}{16 \quad c^3}}\ \frac{c^{0.25}}{r_p} = K_p\ c^{0.25} = K_{tcb}\, D_{sfb} \qquad (10\text{-}44)$$

where $K_{sfb} = K_{tfb} = K_{scb} = K_{tcb} = K_p$

44.b- unbound energy fields

44.b.1-positively charged particles

$$E_{sfu} = \sqrt[4]{\frac{\alpha_e\, h}{16 \quad c^3}}\ \frac{c^{1.5}}{r_p} = K_{sfu}\, D_{sfu} = K_p\ c^{1.5} \qquad (11\text{-}44)$$

$$E_{tfu} = \sqrt[4]{\frac{\alpha_e\, h}{16 \quad c^3}}\ \frac{c^{0.5}}{r_p} = K_{tfu}\, D_{tfu} = K_p c^{0.5} \qquad (12\text{-}44)$$

$$K_{sfu}\, K_{tfu} = K_p{}^2 \quad , \; \alpha_e = \frac{1}{137} \qquad (13\text{-}44)$$

44.b.2-negatively charged particles

$$E_{scu} = \sqrt[4]{\frac{\alpha_e h}{16 \quad c^3}}\ \frac{c^{1.5}}{r_p} = K_{scu}\, D_{scu} = K_p\ c^{1.5} \qquad (14\text{-}44)$$

$$E_{tcu} = K_{tcu}\, D_{tcu} = K_p\ c^{0.5},\ K_{scu}\, K_{tcu} = K_p{}^2 \qquad (15\text{-}44)$$

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

$$K_{sfb}\,K_{tfb}\,K_{scb}\,K_{tcb} = K_p{}^4 = \left(\sqrt[4]{\frac{\alpha_m h}{16\ \ c}}\right)^4 \left(\frac{1}{r_p{}^4}\right)$$

$$= \frac{\alpha_m h}{16\ \ c\, r_p{}^4} = \frac{\text{mass}}{\text{volume}}$$

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)

$$(E_t) = (E_{sfb}\,E_{tfb})\,(E_{scb}E_{tcb}) \qquad \textbf{(1-46)}$$

$$= (K_p{}^2 D_{sfb}D_{tfb})\ (K_p{}^2 D_{scb}D_{tcb})$$

$$= \int_{V_p} (K_p{}^2\ \frac{c}{r_p{}^2})(\ K_p{}^2\ \frac{c}{r_p{}^2})\ \ dV$$

$$E_t = \alpha_t\,(\frac{h\ c^2}{16\ \ c^3})\,\frac{c^2}{r_p{}^4}\ (8\,r_p{}^3) = \alpha_t\,\frac{h\,c}{2\,r_p} \qquad \textbf{(2-46)}$$

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)

$$E_{gbi} = \frac{c^4}{E_{ref}} [(\int_{V_{pi}} \frac{E_{sfbi}\ E_{tfbi} E_{scbi}\ E_{tcbi}}{c^2} dV) \sum_j^n \int_{V_{pj}} \frac{E_{sfbj}\ E_{tfbj} E_{scbj}\ E_{tcbj}}{c^2} dV] \left(\frac{\sqrt{r_{pi} r_{pj}}}{(r_i - r_j)}\right) \quad \textbf{(5-46)}$$

$$= \frac{c^4}{E_{ref}} [(K_{pi}{}^4 \frac{D_{sfbi}\ D_{tfbi} D_{scbi}\ D_{tcbi}}{c^2} V_{qi}) (\sum_j^n K_{pj}{}^4 \frac{D_{sfbj}\ D_{tfbj} D_{scbj}\ D_{tcbj}}{c^2} V_{qj}) \left(\frac{\sqrt{r_{pi} r_{pj}}}{(r_i - r_j)}\right)]$$

$$(E_{gbi}) = \frac{c^4 r_p{}^2}{E_{ref}} [(K_{pi}{}^4\ V_{pi})(\sum_j^n K_{pj}{}^4\ V_{pj}) (\frac{1}{(r_i - r_j)})]$$

which is a summation for particles (j)

given that $r_{pi} = r_{pj} = r_p$, for normal matter $K_{pi} = K_{pj} = K_p = \sqrt[4]{\frac{h}{16\ c} \frac{1}{r_p}}$

$$\int_{V_p} E_{sfb}\ E_{tfb}\ E_{scb}\ E_{tcb} dV = E_{sfb}\ E_{tfb}\ E_{scb}\ E_{tcb}\ V_p$$

$$V_{pi} = V_{pj} = V_p = 8\ r_p{}^3$$

$$K_p{}^4 = \frac{h}{16\ c} (\frac{1}{r_p})^4 = \frac{h}{2\ c\ r_p} \frac{1}{V_p}$$

$$E_{gbi} = \frac{2\alpha_g c^4 r_p{}^2}{hc} [(\frac{h}{2\ c\ V_{pi}} \frac{1}{r_p} V_{pi}) \sum_j^n (\frac{h}{2\ c\ V_{pj}} \frac{1}{r_p} V_{qj})(\frac{1}{(r_i - r_j)})]$$

$$= (\frac{\alpha_g c^4}{hc}) (\frac{h}{c}) \sum_j^n (\frac{h}{2c}) (\frac{1}{(r_i - r_j)}) \quad \textbf{(6-46)}$$

$$= (\alpha_g c^2) \sum_j^n (\frac{h}{2\ c}) (\frac{1}{(r_i - r_j)})$$

$$= \frac{\alpha_g h\ c}{2} \sum_j^n (\frac{1}{(r_i - r_j)}) \quad \textbf{(7-46)}$$

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

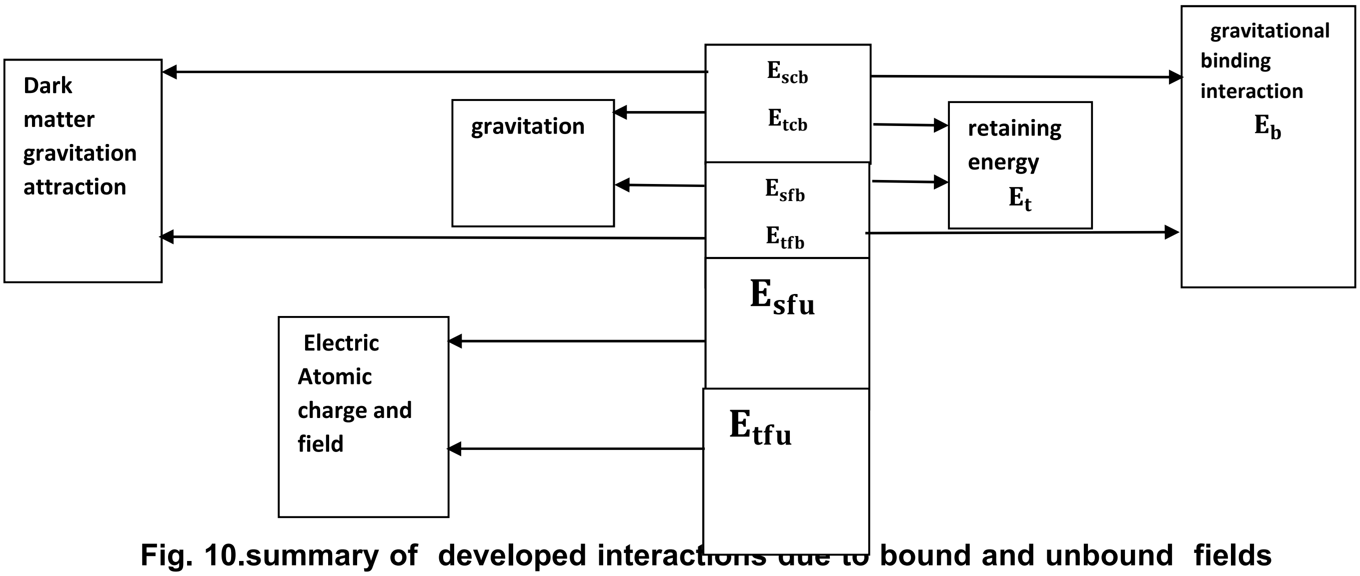


Fig. 10.summary of developed interactions due to bound and unbound fields for positively charged particles

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 positively charged particles

47.Gravitational interaction of bound mass

Type : multiple binding

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) , E_g : gravitational binding energy

while the gravitational interaction takes place between bound fields (E_{sfb} E_{tfb} E_{scb} E_{tcb} 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 $(c^2 x\, c^2)$ and then multiply the compensation term K_g by c^4 to obtain a gravitational interaction which represents the two masses ($m = \frac{E_m}{c^2}$)

$$E_g = G\ (\frac{E_{mi}}{c^2})(\frac{E_{mj}}{c^2})\frac{1}{(r_i - r_j)} = G\ \frac{m_i m_j}{(r_i - r_j)} \quad (G = \frac{2\alpha r_p{}^2{}_g}{E_{ref}} = \frac{2\alpha_g c^4 r_p{}^2}{hc})$$

$$= \frac{2\ c^4}{hc}[\sum_i^m \int_{V_{pi}} \frac{E_{sfbi}E_{tfbi}E_{scbi}E_{tcbi}}{c^2} dV][\sum_j^n \int_{V_{pj}} \frac{E_{sfbj}E_{tfbj}E_{scbj}E_{tcbj}}{c^2} dV]\frac{r_{pi}\, r_{pj}}{(r_i - r_j)} \qquad \text{(1-47)}$$

$$= \frac{2\ c^4 r_p{}^2}{hc}(\sum_i^m K_{pi}{}^4 \frac{D_{sfbi}D_{tfbi}D_{scbi}D_{tcbi}}{c^2} V_{pi})(\sum_j^n K_{pj}{}^4 \frac{D_{sfbj}D_{tfbj}D_{scbj}D_{tcbj}}{c^2} V_{pj}\ ) \frac{1}{(r_i - r_j)}$$

$$= \frac{2\alpha_g\, c^3\, r_p{}^2}{h}(\ \sum_i^m \frac{h}{16\quad c\quad r_{pi}{}^3} \frac{1}{r_{pi}} V_{pi} \sum_j^n \frac{h}{16\quad c\quad r_{pj}{}^3} \frac{1}{r_{pj}} V_{qj} \frac{1}{(r_i - r_j)}$$

$$= \frac{2\alpha_g\, c\, r_p{}^2}{hc}(\ \sum_i^m \frac{h}{2\,(8\, r_{pi}{}^3)} \frac{V_{pi}}{r_{pi}} \sum_j^n \frac{h}{2\quad(8\, r_{pj}{}^3)} \frac{V_{pj}}{r_{pj}} \frac{1}{(r_i - r_j)}$$

$$= \alpha_g c\ r_p{}^2\ (\ \sum_i^m (\frac{h}{2\, r_{pi}})\sum_j^n \frac{1}{r_{pj}} \frac{1}{(r_i - r_j)})$$

$$= \frac{\alpha_g hc}{2}(\ \sum_i^m \sum_j^n \frac{1}{(r_i - r_j)}) \qquad \text{(2-47)}$$

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 , and this is one of the reasons behind the weakness of gravitation in comparison to other forces

48.atomic electric charge and field

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

$E_e = \int_{V_p} (E_{sfu}E_{tfu})^2\, dV = \sum_i^m (E_{sfu}E_{tfu})^2\; V_{pi}$ **(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

$Q(+) = 4\,\pi\;\varepsilon_o {r_p}^2 (\,E_{sfu}\;\, E_{tfu})$

$\quad = 4\,\pi\;\varepsilon_o {r_p}^2\, {K_p}^2\, D_{sfu}\, D_{tfu}$ **(3-48)**

which has the dimensions of [Q] = $M^{0.5}\;\; L^{+1.5}\;\; T^{-1}$

the accompanying electric field at any point (r_0) becomes

$E\,(+) = \frac{Q}{4\,\pi\;\varepsilon_o(\Delta\, r_0)^2} = \frac{{r_p}^2\, E_{sfu}\;\; E_{tfu}}{(\Delta\, r_0)^2} = \sqrt{\frac{\alpha_e h\;c}{2\;V_p r_p}}\;\frac{{r_p}^2}{(\Delta\, r_0)^2}$ **(4-48)**

which has the dimensions of [E]= $M^{0.5}\;\; L^{-0.5}\;\; T^{-1}$

for negatively charged particles (constrained fields dominated)

$Q(-) = 4\,\pi\;\varepsilon_o {r_p}^2\;\; E_{scu}\;\; E_{tcu}$ **(5-48)**

where $E_{scu}\;\; E_{tcu}$ are the unbound invariant constrained fields

48.b.Electric binding energy

$E_e = K_e \frac{Q_i\; Q_j}{(\Delta\, r_{ij})}$

$= K_e(\,4\,\pi\,\varepsilon_o {r_p}^2)\,(\,E_{sfui}\;\;E_{tfui}\;\,)(4\,\pi\;\,\varepsilon_o {r_p}^2)\,(E_{scuj}\;\;E_{tcuj})\,\frac{\sqrt{r_{\,pi} r_{\,pj}}}{(r_{\,i} - r_{\,j})})$ **(6-48)**

$E_e \;=\; \frac{4\,\pi\,\varepsilon_o\,\alpha_e hc}{(r_{\,i} - r_{\,j})}$ **(7-48)**

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

$$E_{sfu}\, E_{tfu} = {K_p}^2\ (D_{sfu}\, D_{tfu}) \quad (1\text{-}49)$$

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

$$E_{scu}\, E_{tcu} = {K_p}^2\ (D_{scu}\, D_{tcu}) \quad (2\text{-}49)$$

where $D_{scu} = c^{1.5}$, $D_{tcu} = c^{0.5}$

4-energy stored in the flux tubes

$$E_s = \int_{V_f} (E_{sfu}\, E_{tfu})^2\, dV \quad \text{and} \quad (3\text{-}49)$$

$$E_s = \int_{V_f} (E_{scu}\, E_{tcu})^2\, dV \quad (4\text{-}49)$$

, V_f : flux tube volume

a-Repulsive part (self interaction) type : simple nonbinding

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

$$E_{sr} = \left(\int_{V_f} {K_p}^4 [D_{sfu}D_{tfu}]^2 dV + \int_{V_f} {K_p}^4 [D_{scu}D_{tcu}]^2\, dV\right)\left(\frac{r_p}{\Delta r_p}\right) \quad (5\text{-}49)$$

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

$$E_{sr} = {K_p}^4 \left(\sum_i^m [D_{sfui}D_{tfui}]^2\ V_{fi} + \sum_i^m [D_{scui}D_{tcui}]^2\ V_{fi}\right)\left(\frac{r_p}{\Delta r_p}\right) \quad (6\text{-}49)$$

$$= \alpha_s \left(\sqrt[2]{\left(\frac{h}{2\, c^3 V_p r_p}\right)}\right)^2 (c^2)^2 \sum_j^n V_{fi} \left(\frac{r_p}{\Delta r_p}\right)$$

$$E_{sr} = \alpha_s \frac{hc}{2\, \Delta r_p} \sum_j^n \left(\frac{V_{fi}}{V_p}\right) \quad \textbf{(7-49)}$$

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

$$E_{sb} = \left(\int_{V_f} (E_{sfu} E_{tfu})(E_{scu} E_{tcu} dV\right) \left(\frac{r_p}{\Delta r_f}\right)$$

$$E_{sb} = K_p{}^4 \left(\int_{V_f} (D_{sfu} D_{tfu})(D_{scu} E_{tcu} dV\right) \left(\frac{r_p}{\Delta r_f}\right) \quad \textbf{(8-49)}$$

$$= K_p{}^4 \sum_i^m (D_{sfui} D_{tfui}) (D_{scui} D_{tcui}) V_{fj} \left(\frac{r_p}{\Delta r_f}\right)$$

$$= \alpha_s \left(\sqrt[2]{\left(\frac{h}{2\, c^3 V_p r_p}\right)}\right)^2 (c^2)^2 \sum_i^m V_{fi} \left(\frac{r_p}{\Delta r_f}\right)$$

$$= \alpha_s \frac{h\, c}{2 V_p\, r_p} V_f \left(\frac{r_p}{\Delta r_f}\right) = \alpha_s \frac{h\, c}{2\, \Delta r_f} \sum_j^n \frac{V_{fj}}{V_p} \quad \textbf{(9-49)}$$

Δr_f = average distance between the flux tubes

it is noted that the distance (Δr_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 (Δr_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

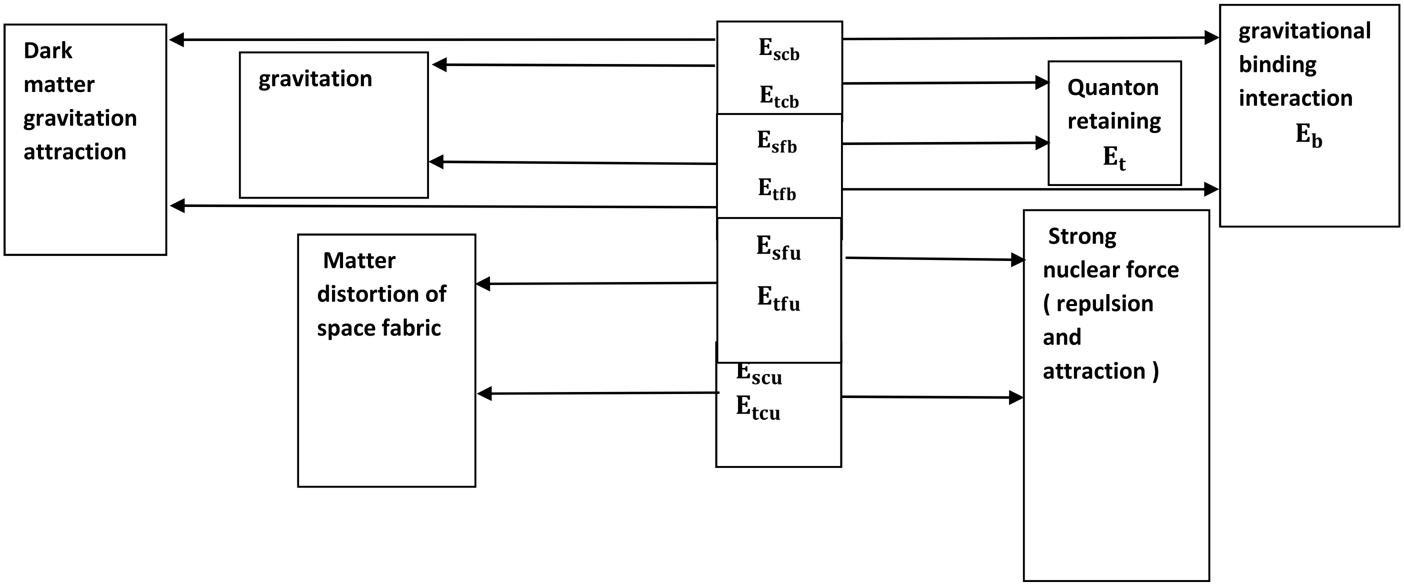


Fig. 11. Summary of the interactions of bound and unbound fields for gluons

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 $(E_{sfb}\, E_{tfb}\, E_{sc}\, E_{tc})_s$ of space fabric's quantons or $(E_{sf}\, E_{tf}\, E_{scb}\, E_{tcb})_s$ for ani-quantons and the bound fields $(E_{sfb}\, E_{tfb}\, E_{scb}\, E_{tcb})_m$ 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 E_{gs} =

$$\left(\frac{E_{sfbi}E_{tfbi}E_{scbi}E_{tcbi}}{c^2}\right)_m \sum_j^n (E_{sfbj}E_{tfbj}E_{scj}E_{tcj})_s \left(\frac{\sqrt{r_{pi}r_{qj}}}{(r_i-r_j)}\right) \quad \textbf{(1-50)}$$

while in its complex form

$$E_{gs} = \frac{c^4}{E_{ref}} \int_{V_p} \left(\frac{E_{sfbi}E_{tfbi}E_{scbi}E_{tcbi}}{c^2}\right)_m dV \ \{[\sum_j^n \int_{V_{qs}} \left(E_{sfbj}E_{tfbj}E_{scj}E_{tcj}\right)_{qs} dV]$$

$$+[\sum_j^n \int_{V_{aqs}} \left(E_{sfj}E_{tfj}E_{scbj}E_{tcbj}\right)_{aqs} dV] \ \} \quad \left(\frac{\sqrt{r_{pi}r_{qj}}}{(r_i-r_j)}\right) \quad \textbf{(2-50)}$$

$$= \frac{c^4}{E_{ref}} \sum_i^m K_{pi}{}^4 \left(\frac{D_{sfbi}D_{tfbi}D_{scbi}D_{tcbi}}{c^2}\right)_m V_{pi} \left\{\left[\sum_j^n K_{qj}{}^4 \left(D_{sfbj}D_{tfbj}D_{scj}D_{tcj}\right)_{qs} V_{qj}\right)\right]$$

$$+ [\sum_j^n K_{aqj}{}^4 \left(D_{sfj}D_{tfj}D_{scbj}D_{tcbj}\right)_{aqs} V_{aqj}]\} \frac{\sqrt{r_{pi}r_{qj}}}{(r_i-r_j)} \quad \textbf{(3-50)}$$

$$= \frac{2\sqrt{\alpha_g\alpha_b}\, r_{ref}\, c^4}{hc} \left[\left(\frac{h}{2\,c\,V_{pi}r_{pi}}\right) V_{pi} \sum_j^n c^2 \left(\frac{h}{2\,c^3 V_{qj}\, r_{qj}}\right) V_{qj} \left(\frac{\sqrt{r_{pi}r_{qj}}}{(r_i-r_j)}\right)_{m-s}\right]$$

$$E_{gs} = \frac{\sqrt{\alpha_g\alpha_b}\, h\, c}{2} \sum_j^n \left(\frac{1}{(r_i-r_j)}\right)_{m-qs} \quad \textbf{(4-50)}$$

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 quatons 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 $(E_{sfu}E_{tfu})_q$ of quanton and $(E_{scu}E_{tcu})_{aq}$ of anti quanton generate self-interacting 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 :

$(K_q \sqrt{(D_{sfu}\ D_{tfu})_q})(K_q \sqrt{(D_{sfu}\ D_{tfu})_q})$ or

$(K_q \sqrt{(D_{scu}D_{tcu})_{aq}})(K_q \sqrt{(D_{scu}D_{tcu})_{aq}})$ and not of the form

$K_q^2(D_{sfu}\ D_{tfu})_q$ or $K_q^2(D_{scu}D_{tcu})_{aq}$, which causes them to be involved in repulsive interaction with unbound fields of normal matter's gluons $(E_{sfu}\ E_{tfu})_m$, $(E_{scu}\ E_{tcu})_m$ (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

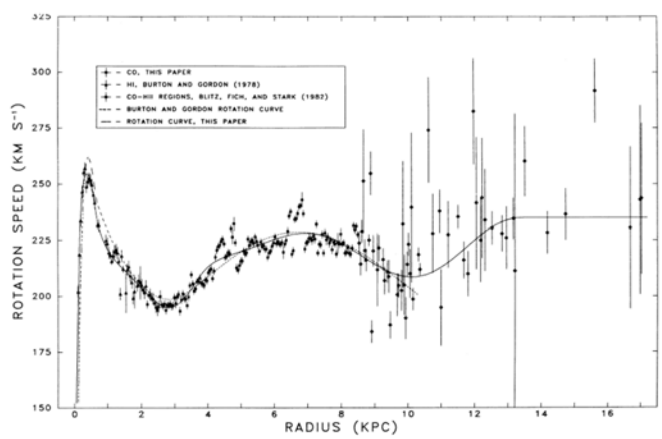


Fig. 12.Rotational velocity of the milky display characteristic localized bottoming which coincides with spiral arms

Source https://web.njit.edu/~gary/202/Lecture25.html

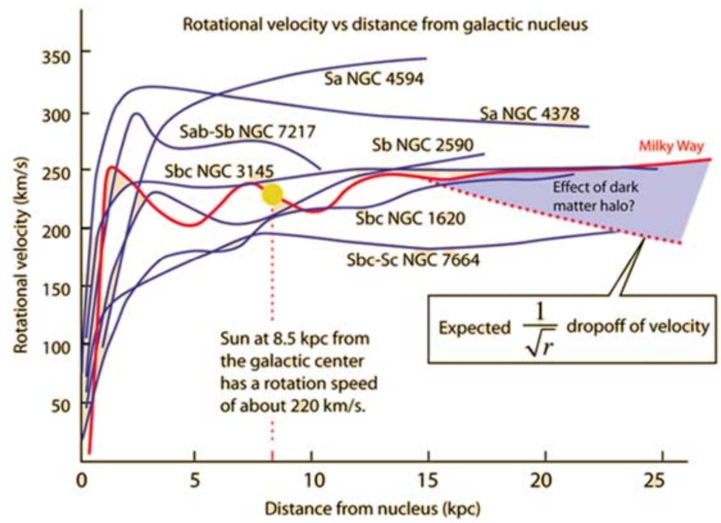
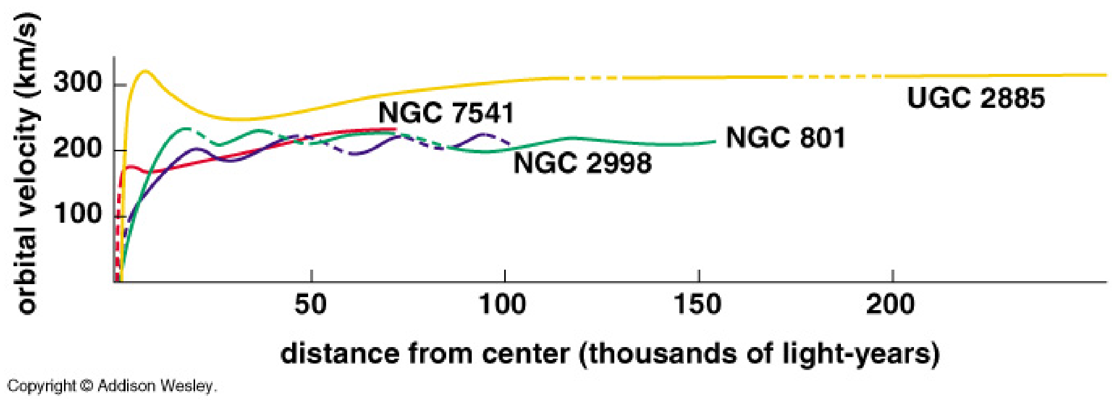


Fig. 13. Source : http://hyperphysics.phy-astr.gsu.edu/hbase/Astro/darmat.html



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

$$E_{di} = \frac{1}{E_{ref}} \{\int_{V_{qs}} [(E_{sfui}\, E_{tfui})_{qs}\, (E_{scui}\, E_{tcui})_{aqs}\, dV]$$

$$[\textstyle\sum_j^n \int_{V_f} (E_{sfuj}\, E_{tfuj}\,)_m\, (E_{scuj}\, E_{tcuj}\,)_m \quad dV)]\,\} \frac{\sqrt{r_{qi} r_{pj}}}{(r_i - r_j)} \qquad \text{(1-51)}$$

$$= \frac{2\, r_{ref}}{hc} \{\, [K_{pi}{}^4\, (D_{sfui} D_{tfui}\,)_{qs} (D_{scui} D_{tcui}\,)_{aqs} V_{qi}\,]$$

$$[\, \textstyle\sum_j^n \; K_{qj}{}^4\, (D_{sfuj}\, D_{tfuj})_m\, (D_{scuj} D_{tcuj}\,)_m V_{pj}\, (\frac{V_{fj}}{V_{pj}})]\} \frac{\sqrt{r_{qi} r_{pj}}}{(r_i - r_j)}$$

$$= \frac{2\alpha_r \sqrt{r_{qi} r_{pj}}}{hc} \quad \frac{h \;\; c^4}{2c^3 V_{qi}\;\, r_{qi}} V_{qi} \; \textstyle\sum_j^n \frac{h \;\; c^4}{2c^3 V_{pj}\;\, r_{pj}} \; V_{pj} \left(\frac{V_{fj}}{V_{pj}}\right) \left(\frac{\sqrt{r_{qi} r_{pj}}}{(r_i - r_j)}\right) \qquad \text{(3-51)}$$

$$E_{di} = \alpha_r \left(\frac{h}{2}\right) \sum_j^n \left(\frac{V_{fj}}{V_{pj}}\right)\left(\frac{1}{(r_i - r_j)}\right) \quad (4\text{-}51)$$

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

$\text{Dof}_{sf}\ \text{Dof}_{tc}$ **= 2.5-0.5 = 2.00 ,** $\text{Dof}_{sc}\ \text{Dof}_{tf}$ **= 1.5-0.5 = 1.0**

$(\text{Dof}_{sf}\ \text{Dof}_{tf})_{bound}$ **=** $(\text{Dof}_{sc}\ \text{Dof}_{tc})_{bound}$ **0.5**

$(\text{Dof}_{sf}\ \text{Dof}_{tf})_{unbound}$ **= 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

$$E_{tp} = \int_{V_q} (E_{sfb} E_{tfb}) \quad (E_{sc} E_{tc})\ c\ dV \quad (1\text{-}52)$$

$$= [K_{qs}{}^2 (D_{sfb}\, D_{tfb})]\ [K_{qs}{}^2 (D_{sc}\, D_{tc})]\ c\, V_q$$

$$E_{tp} = K_{qs}{}^4\ c^2\ V_q = \sqrt{\alpha_t}\ \frac{hk^4}{16\,\pi^4\ c}\ V_q = \sqrt{\alpha_t}\ \frac{h}{16\ c\ r_q{}^4}\, V_q \quad (2\text{-}52)$$

$$E_{tp} = \sqrt{\alpha_t}\ \frac{h}{2\ c\, r_q} \quad (3\text{-}52)$$

and the total retaining energy for the photon Q+AQ pair

$$= \frac{c^4}{E_{ref}}\, E_{tp}{}^2 = \alpha_t\, \frac{h\,c}{2\ r_q}$$

52.b inflationary ,and repulsive interactions

Same as space fabric

52.c-Gravitational binding interaction of electromagnetic waves

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

$$E_{gbi}=\frac{c^4}{E_{ref}}\{[\frac{1}{2}\int_{V_{qe}}(E_{sfbi}E_{tfbi}E_{sci}E_{tci})_q\, c\, dV]+$$

$$[\frac{1}{2}\int_{V_{qe}}(E_{sfi}E_{tfi}E_{scbi}E_{tcbi})_{aq} c\, dV]\}\sum_j^n\int_{V_p}(\frac{E_{sfbj}E_{tfbj}E_{scbj}E_{tcbj}}{c^2})_m dV\left(\frac{\sqrt{r_{qi}r_{pj}}}{(r_i-r_j)}\right) \quad \textbf{(4-52)}$$

$$=\frac{c^4\, r_{qi}r_{pj}}{hc}\{[(\frac{1}{2}K_{qi}{}^4(D_{sfbi}D_{tfbi}D_{sci}D_{tci})_q cV_{qi})]+$$

$$[\frac{1}{2}K_{qi}{}^4(D_{sfi}D_{tfi}D_{scbi}D_{tcbi})_{aq} cV_{aqi})]\}\sum_j^n K_{pj}{}^4\frac{D_{sfbj}D_{tfbj}D_{scbj}D_{tcbj}}{c^2}V_{pj}\frac{1}{(r_i-r_j)}$$

$$=\frac{2c^3\, r_q r_p}{h}(K_{qi}{}^4 c^2 V_{qi})(\sum_j^n K_{pj}{}^4 c^2 V_{pj})(\frac{1}{(r_i-r_j)}) \quad \textbf{(5-52)}$$

$$=\frac{2c^3\, r_q r_p\sqrt{\alpha_b\alpha_g}}{h}\left(\frac{h\ c^2}{2c^3V_{qi}\ r_{qi}}\right)V_{qi}\ \sum_j^n\left(\frac{h}{2\,c\ V_{pj}\, r_{pj}}\right)V_{pj}\ (\frac{1}{(r_i-r_j)}$$

$$E_{gbi}=\frac{h\, c\sqrt{\alpha_b\alpha_g}}{2}\ \sum_j^n(\frac{1}{(r_i-r_j)}) \quad \textbf{(6-52)}$$

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)

52 d.dark matter distortion of electromagnetic waves

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

$$E_{rei} = \frac{1}{E_{ref}}\{[\int_{V_{qe}}(E_{sfui}E_{tfui})_{qe}\ (E_{scui}E_{tcui})_{aqe}\, dV]$$

$$[\sum_j^n\int_{V_{qs}}(E_{sfuj}E_{tfuj})_{qs}(E_{scuj}E_{tcuj})_{aqs}dV]\}(\frac{\sqrt{r_{qi}r_{pj}}}{(r_i-r_j)}) \quad \textbf{(6-52)}$$

$$=\frac{r_{ref}}{hc}\{[K_{qi}{}^4(D_{sfui}D_{tfui})_{qe}\ (D_{scui}D_{tcui})_{aqe}\ V_{qi}]$$

$$[\sum_j^n K_{pj}{}^4(D_{sfuj}D_{tfuj})_{qs}(D_{scuj}D_{tcuj})_{aqs}\ V_{qj}]\ (\frac{\sqrt{r_{qi}r_{pj}}}{(r_i-r_j)}) \quad \textbf{(7-52)}$$

$$=\frac{2\sqrt{r_{qi}r_{pj}}}{hc}(K_{qi}{}^4 c^4 V_{qi})(\sum_j^n K_{pj}{}^4 c^4 V_{qj})(\frac{1}{(r_i-r_j)})$$

$$=\alpha_r(\frac{h}{2c^3V_{qi}\ r_{qi}}V_{qi})c^4\ \sum_j^n\frac{h}{2c^3V_{qj}\ r_{qj}}c^4 V_{qj}\ (\frac{\sqrt{r_{qi}r_{pj}}}{(r_i-r_j)})$$

$$\mathbf{E_{rei}} = \frac{\alpha_r\, h\, c}{2} \quad \sum_j^n \frac{1}{(r_i - r_j)}_{\,e-s} \qquad \textbf{(8-52)}$$

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 $\mathbf{E_{ref}} = \frac{h\, c}{2\sqrt{r_{qi} r_{pj}}}$

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
For normal matter 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 level

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 (E_{tf})	negative configuration for the constrained time field (E_{tc})
parity	Positive position vector configuration for the free space fields (E_{sf})	negative position vector configuration for the constrained space field (E_{sc})
charge	positive atomic fields and charges due to unbound fields ($E_{sfu} E_{tfu}$)	negative atomic fields and charges due to unbound fields ($E_{scu} E_{tcu}$)

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 .