

# Mass-Energy Equivalence in Spiral Structure for Elementary Particles and Balance of Potentials

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**Abstract** - In this paper, it has been tried to explain the relation between the length of spirals in the structure of elementary particles with the Energy and Mass of the corresponding observable particle. It also explains the expansive behavior of gluon in nucleon for the length of constituent spiral structure of quark. Referring into the information system of Universe at different scales of information processing varying in collective analysis of information cells, it tries to explain the conservation of information been carried out by the SU (1) gauge symmetry group of Universe across different generations of Universe being reflected through the study of Cosmic Microwave Background Radiation. It also tries to derive the expression for creation & annihilation operator for the Universe.

**Keywords** - Spiral Structure for Elementary Particle, Quantum Spiral Theory, Quantum Information, Universe Symmetry.

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## 1 INTRODUCTION:

The Universe as a whole has a stationary heat potent wave associated to it which has the potential to form the largest particle in the Universe which is the Universe itself. But since, it does not create particle at its scale but instead at its sub-scales. The universal heat potent wave's potential curves the space time to accumulate formed mass and the empty curvature around it provide interaction space for gravity. These curvatures in space time due to heat potent wave constitute the dark energy. On the other hand, dark matter is ghost particle extension of normal spiral structure for elementary particles due to acceleration through super symmetry [1-4].

## 2 RELATION BETWEEN MASS-ENERGY EQUIVALENCE WITH LENGTH OF SPIRAL:

We know that  $E = h\vartheta$  and from [4], in Universal reference frame, we have length of spiral  $L(s)$  being given by frequency  $\vartheta$  times the length of spiral  $l(p)$  i.e.  $L(s) = l(p).\vartheta$  as in Quantum Spiral Theory [3, 4] we have fixed wavelength of Planck's length which resembles the information cells of the Universe. The collection of these information cells constitutes the observable waves. Having the constant speed of light  $c$ , (i.e. 299792458 meter/second) the dynamics of spiral structures for particle can span across larger time fractions.

Thus, we have two expressions described above,

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$$E = h\vartheta \quad \dots (1)$$

$$L(s) = l(p).\vartheta \quad \dots (2)$$

Substituting the value of frequency from (2) into (1), we get:

$$E = \frac{h}{l(p)} L(s) \quad \dots (3)$$

$$E = A L(s) \quad \dots (4)$$

$$E \propto L(s) \quad \dots (5)$$

Where  $A = \frac{h}{l(p)}$  is the spiral potential constant. Hence, we can conclude the direct proportionality of energy with the length of spiral structure for respective elementary particle. Deducing the same in terms of mass through Mass-Energy equivalence we have,

$$m = \frac{h}{l(p)c^2} L(s) \quad \dots (6)$$

$$m = B L(s) \quad \dots (7)$$

$$m \propto L(s) \quad \dots (8)$$

Where  $B = \frac{h}{l(p)c^2}$  is the spiral autocatalysis constant. The term  $c^2$  provides the rate of exchange between energy and mass during autocatalysis also known as rate of autocatalysis [2].

**(Autocatalysis is the process for formation of spiral structure for elementary particle from the heat potent wave as ingredient through the work done against potential defined by  $\text{Grad}(\text{Div}(u)) - \text{Curl}(\text{Curl}(u))$ , where  $u$  is the potential energy contained in the heat potent wave. The symmetry group of Universe which contains the invariant information conserved along different generation of Universe, required to controls the flow of**

**defined process is SU (1) which acts as an terminal object spanning across different instances of Universe [ 1-4]).**

**Autocatalysis** is also responsible for the formation of other fundamental structures in Universe like galaxies and clusters with same potential and symmetry group.

### 3 ANALYSIS OF GLUON CAVITY AND ITS EXPANSIVE BEHAVIOUR TO LENGTH OF SPIRAL:

Calculating the expected combined length of spiral structure of up and down quarks configuration for protons and neutrons to analyse their combined effect as a composite particle and comparing it with the observed length of spiral structure for the same, we can analyse the expansive behaviour of gluon cavity [Figure 3] as follows:

$$L(s) = \frac{l(p)}{h} E \quad \dots (9)$$

With substituting the values of  $h = 4.135e - 15 \text{ eV.s}$  and  $l(p) = 1.616e - 35 \text{ m}$  we get,

**Up Quark:**

$$L(s) = \frac{1.616e-35 \text{ m}}{4.135e-15 \text{ eV.s}} (2.3e6 \text{ eV}) = 0.89886e - 14 \frac{\text{m}}{\text{s}} \\ \equiv 0.89886e - 14 \text{ m}$$

**Down Quark:**

$$L(s) = \frac{1.616e-35 \text{ m}}{4.135e-15 \text{ eV.s}} (4.8e6 \text{ eV}) = 1.87584e - 14 \frac{\text{m}}{\text{s}} \\ \equiv 1.87584e - 14 \text{ m}$$

(The length of spiral in above calculation is in unit of m/s. Since, the length of the spiral is less than 299792458 m/s we can consider the calculated length of spiral to be in m as the concerned spiral is not spanning across more than one second.)

Expected length of spiral for Proton: Since it is made up of two up and one down quark (uud). Thus, the length of concerned spiral is given by:

$$\Rightarrow L(s)_{\text{proton}} = (2 * 0.89886e - 14 \text{ m/s}) + 1.87584e - 14 \text{ m/s} \\ \Rightarrow L(s)_{\text{proton}} = 3.67356e - 14 \frac{\text{m}}{\text{s}} \equiv 3.67356e - 14 \text{ m}$$

Observed length of spiral for Proton: Since the mass of proton is observed to be 938 MeV we have,

$$\Rightarrow L(s)_{\text{proton}} = \frac{1.616e-35 \text{ m}}{4.135e-15 \text{ eV.s}} (938e6 \text{ eV})$$

$$= 366e - 14 \frac{\text{m}}{\text{s}} \equiv 366e - 14 \text{ m}$$

The Expansion Factor for length of Spiral Structure for Proton:

$$\Rightarrow \delta_{\text{proton}} = \frac{\text{Observed length of spiral for Proton}}{\text{Expected length of spiral for Proton}} \\ = \frac{366e - 14 \text{ m}}{3.67356e - 14 \text{ m}} = 99.727 \equiv 100$$

Thus in case of proton the expansion of length of spiral for composite structure of proton provided by the gluon cavity as shown in [Figure 3] is 100 times. Now for neutrons we have,

Expected length of spiral for Neutron: Since it is made up of two down and up down quark (ddu). Thus, the length of concerned spiral is given by:

$$\Rightarrow L(s)_{\text{neutron}} = 0.89886e - 14 \text{ m/s} + (2 * 1.87584e - 14 \frac{\text{m}}{\text{s}}) \\ \Rightarrow L(s)_{\text{neutron}} = 4.6505e - 14 \frac{\text{m}}{\text{s}} \equiv 4.6505e - 14 \text{ m}$$

Observed length of spiral for Neutron: Since the mass of neutron is observed to be 939.57 MeV we have,

$$\Rightarrow L(s)_{\text{neutron}} = \frac{1.616e-35 \text{ m}}{4.135e-15 \text{ eV.s}} (939.57e6 \text{ eV}) \\ = 367e - 14 \frac{\text{m}}{\text{s}} \equiv 367e - 14 \text{ m}$$

The Expansion Factor for length of Spiral Structure for Neutron:

$$\Rightarrow \delta_{\text{neutron}} = \frac{\text{Observed length of spiral for Neutron}}{\text{Expected length of spiral for Neutron}} \\ = \frac{367e - 14 \text{ m}}{4.6505e - 14 \text{ m}} = 78.916 \equiv 79$$

Thus in case of neutron the expansion of length of spiral for composite structure of neutron provided by the gluon cavity as shown in [Figure 3] is 79 times.

### 4 THE PHYSICS BEHIND THE EXPANSIVE BEHAVIOR OF GLUON CAVITY:

We know that the Gluon has 0 charges, with < 0.002 MeV experimental mass along with spin of 1 having 8 linearly independent color charge configuration. The explanation

for the structure is presented in [Figure 3] [2] where we find that the color is readily switched between quark at gluon cavity. The color of the quarks is defined by the phase division of complete composite structure of nucleons [1, 3]. The gluon has no charge; it can revolve around the spiral fraction of the respective quarks within its cavity indefinitely and with unit spin we always need to have two tips of configuring quarks to lie within gluon as a constraint [1]. We have an additional constraint which requires that the spiral fraction of respective quarks inside the gluon cavity to be of similar potentials as the mass for the gluon is around 20 KeV only. (Mass of elementary particles in terms of their Spiral Structure is inversely proportional to decay of potential around the rotational angle i.e. if the decay of potential round the rotational is small, the elementary particle will have more mass). The combination of these constraints allows gluon cavity to expand the length of spiral for nucleon by revolving around the spiral fraction of respective quarks within its cavity by a definite expansion factor as calculated above for proton and neutron.

Minimum Phase Difference (in °)	Maximum Phase Difference (in °)	Colour Charge
0	120	Red
120	240	Green
240	360	Blue

Table 1: Illustration of possible zones of phase differences for color charge.

## 5 COSMIC MICROWAVE BACKGROUND RADIATION: THE POTENTIAL ACCOUNTS OF UNIVERSE CONTAINED IN THE INFORMATION CELLS:

We know that at higher frequencies i.e. processing the information of universe with joint or combined analysis of larger number of information cells together [4] [Figure 5], we find the Universe to be more smooth and regular. The color depiction represents the intensity of heat potent waves which results in spiral structure formation of fundamental structure of universe ranging from micro to macro scale.

Looking at the CMB Maps obtained from various probers, we can describe the different phases of Universe life cycle according to the distribution of dark potential [1-4] and the formed structure of Universe at different information

processing levels varying in number of information cells during collective analysis.

**First Phase:** Initial Universe at 0 Kelvin temperatures where the dark potentials resulted in zero potential due to symmetric simultaneous constructive and destructive interferences.

**Second Phase:** The symmetric structure of the Universe faced the spontaneous symmetry breaking due to Higgs mechanism [2] which resulted in creation of Heat Potent Waves for the formation of Spiral Structures of fundamental objects constituting the Universe.

**Note:** It must be noted that initially the first spiral structure which was formed due to autocatalysis through the invariant information contained in the SU (1) symmetry conserved from the previous instance or life cycle of Universe, comprised of the whole of the universe which can be visualized from [Figure 1] where the CMB Dipole are illustrated and characterized by warmer and cooler section.

**Third Phase:** The autocatalysis of Heat Potent Waves at various sub-levels which resulted in formation of Spiral Structures responsible for both cosmic structures i.e. macro bodies as well as elementary particles i.e. micro bodies can be accounted from [Figure 2] which provide the distribution of Heat Potent Waves. The Planck's All-Sky Maps at Nine Frequencies [Courtesy: European Space Agency] provide the insight into the distribution at different frequencies i.e. different information processing levels [4]. With increasing levels of information processing by including large number of information cells together in collective analysis, we get larger fraction for concerned distribution of the Heat Potent Wave in the Universe. Focusing on the distribution depicted at 857 GHz in [Figure 2], the white portion in middle of the map shows the utilized Heat Potent Waves which has been autocatalysed into Spiral Structure for different fundamental objects of the Universe. The red portion shows the ingredient Heat Potent Waves which can be autocatalysed to form the different required Spiral Structures. **The overall potential content of these Heat Potent Waves are in balance with the potential content of the autocatalysed Spiral Structure for the whole of the Universe.**

## 6 ORTHOGONALITY AND CONFOUNDING IN THE UNIVERSE:

**Orthogonality** in the design of the Universe refers to the property which assures that the different information cells

comprising the Universe can be separately observed without any entanglement. But, due to autocatalysis at scales higher than that of the information cell, there is a deliberate introduction of non-orthogonality in the design of the Universe by the Heat Potent Waves in order to get larger Spiral Structures for different fundamental objects. This entanglement of information cells together in terms of encompassing Heat Potent Waves is termed as Confounding.

However, since the autocatalysis is also possible at the scale of information cells without **Confounding**, the Schwarzschild radius for the smallest Black Hole can be given by:

$$\Rightarrow R_{\text{smallest}} = \frac{2GM}{c^2} = \frac{l(p)}{2}, \text{ where } l(p) \text{ is the Planck's length.}$$

## 7 DERIVING EXPRESSION FOR CREATION AND ANNIHILATION OPERATOR FOR THE UNIVERSE:

If the Universe is created from an extremely dense particle through Big-Bang. Then in quantum scenario we can visualize that the annihilation of this dense particle resulted in creation of the Universe and creation of that particle will result in end of the Universe. From above, we have the spiral structure of the dense particle balanced with the spiral structure for whole of the Universe as observed in Cosmic Microwave Background Radiation at higher information processing levels for the composite universe i.e. at higher frequencies which has higher aperture for observing the Universe large fraction together.

According to Quantum Spiral Theory [1-4], for the decay of the particle it requires to have positive charge. The decayed spiral structure for the dense particle provides the Heat Potent Waves which are ingredient for the formation of positive and negative particle. The positive particles annihilated back, leaving the Universe to be formed by negative spirals. Thus the joint composite behaviour of these particles formed in the Universe in current state resulted in the negatively charged Universe as can be seen from the angle of the spiral structure of whole of the Universe as observed from the Cosmic Microwave Background Radiation. The overall negative charge of the Universe curls back to the formation of dense state resulting in end of the Universe. With curling of the Universe back to dense state, the residual annihilated positive energy within the cavity of Universe is absorbed in the spiral arms of the dense particle which consecutively increases its charge by increasing the angle through a

fraction  $\emptyset$  i.e. if **A** is the angle of negatively charged spiral for dense particle without absorption of residuals as stated earlier and **B** is the final angle for positively charged spiral with absorption of the residuals. Then,

$$A + \emptyset = B > 90^\circ$$

Hence, it annihilates back for the formation of the Universe.

The operators can be expressed as:

**Annihilation of dense particle:**  $a |1\rangle = 1 |0\rangle$

**Creation of dense particle:**  $a^+ |0\rangle = |1\rangle$

In the expression provided for annihilation of dense particle, on right hand side 1 represents the provided Heat Potent Waves. And the  $|0\rangle$  represents the potential canvas for the creation of the Universe.

In the expression provided for creation of dense particle,  $a^+ |0\rangle$  represents the creation of the dense particle through the annihilation of the potential canvas through curling back the overall negative charge of the Universe.

## 8 CONCLUSION:

In this paper we look at the Mass - Energy Equivalence in terms of Spiral Structure for Elementary Particles. We also described the process of autocatalysis carried out by the invariant information conserved in the SU (1) symmetry of the Universe which is the terminal information as it is the residual of dying Universe and seed for the birth of new Universe. The combination of these above descriptions provides us the account of potentials contained in Heat Potent Waves and its balance with the Spiral Structure for whole of the Universe. These accounts can be analysed with varying number of information cells jointly under consideration i.e. frequencies. The Balance of Potentials can be well visualised from the CMB Maps of the Universe. Further deriving the expression for creation and annihilation operator for the Universe provides us with quantum treatment to the Universe as a whole.

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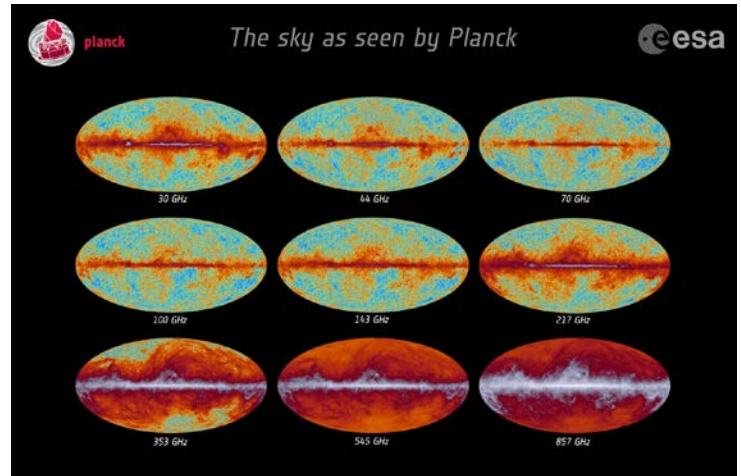
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[Courtesy: Jet Propulsion Laboratory, California Institute of Technology]

Figure 1: CMB Dipole illustrated with warmer and cooler region.



[Courtesy: European Space Agency]

Figure 2: 2015 All-sky maps at nine frequencies [April 2015].

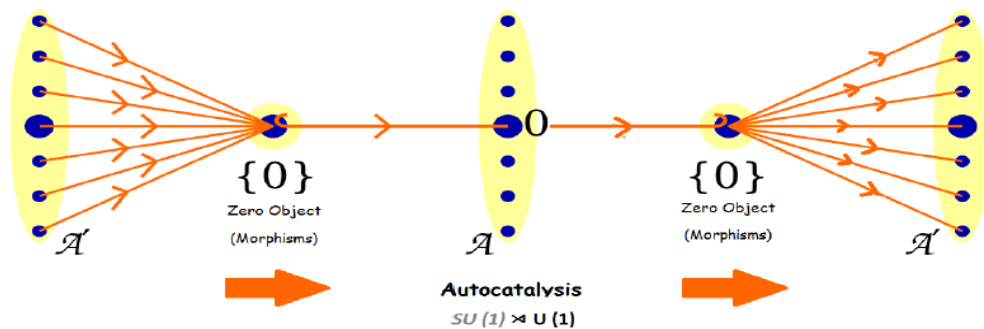
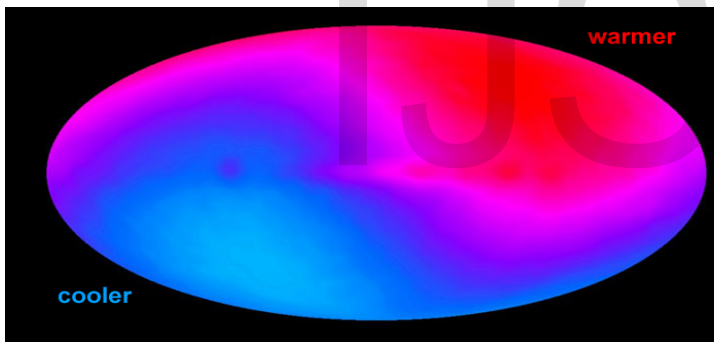
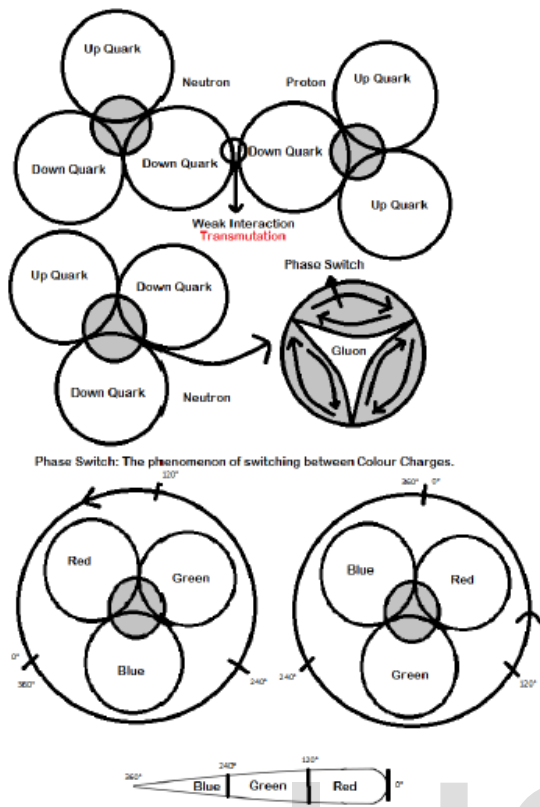
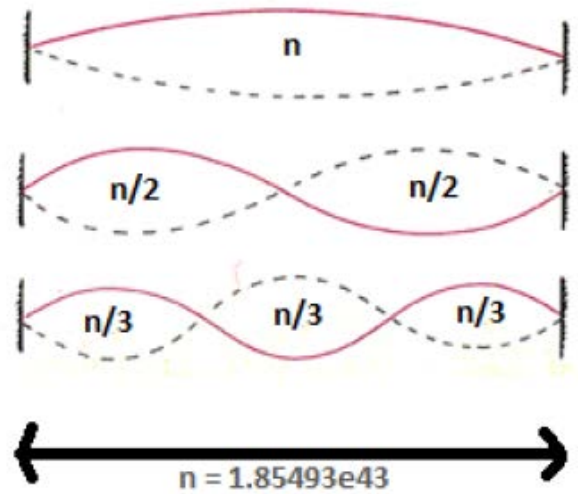


Figure 4: Illustration of autocatalysis through invariant information contained in SU (1) symmetry group on the U (1) symmetry group of Standard Model (in the units of  $c^2$ ). [Courtesy: Reference [3]]



[Courtesy: Reference [2]]

Figure 3: The assembly of quarks inside nucleons glued together with gluons and the derivation of colour charges associated to the quarks.



[Courtesy: Reference [4]]

Figure 5: Illustration of consumption of Scale of Universe (i.e. Information Cells) by wave cycles of different frequencies.