

## *Seven Primary Q&A about Universal Gravitation*

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### **ABSTRACT**

In this paper, at first seven primary questions about universal gravitation are put forward as follows:

**Question No.1** Does universal gravitation pass on via gravitational energies? If it does, then what's the formula to describe spreading of gravitational energies?

**Question No.2** How do gravitational energies give rise to gravitation?

**Question No.3** Given universal gravitation passes on through gravitational energies, then what is medium for spreading of gravitational energies?

**Question No.4** Do gravitational energies possess quantized nature? If they have, then what is quanta of gravitational energies?

**Question No.5** Given gravitational energies spread in form of waves, then do wave lengths of gravitational energies distribute themselves within an certain wave band? or just have an common wave length? If only having an common wave length, then how long is it?

**Question No.6** Why is universal gravitation attractive instead of repulsive?

**Question No.7** Why couldn't all of matters shield off universal gravitation? and then, answers to them are made respectively one by one based on *TCST*.

### **KEY WORDS**

GES principle, Instantaneous power of gravitational energies, Medium of gravitational energies, Substantiated point space, Wave length of gravitational waves, Definition of matter, Punctate matter, Conglomerate matter, Vacuum

## TEXT

It has been 328 years since Isaac Newton put forward law of universal gravitation, and since then there has been two kinds of well-known and commonly recognized theories in physics about universal gravitation, one is Newtonian gravitational formula that is quantitative description to universal gravitation, the other is Einstein's general relativity that explains universal gravitation from perspectives of space time. However both of them fell short of telling people exactly how universal gravitation is generated?

To fully understand universal gravitation, besides rigorous quantitative description, definite and delicate answers to following seven primary questions about universal gravitation also should be made very clear.

**Question No.1** Does universal gravitation pass on via gravitational energies? If it does, then what's the formula to describe spreading of gravitational energies?

**Question No.2** How do gravitational energies give rise to gravitation?

**Question No.3** Given universal gravitation passes on through gravitational energies, then what is medium for spreading of gravitational energies?

**Question No.4** Do gravitational energies possess quantized nature? If they have, then what is quanta of gravitational energies?

**Question No.5** Given gravitational energies spread in form of waves, then do wave lengths of gravitational energies distribute themselves within an certain wave band? or just have an common wave length? If only having an common wave length, then how long is it?

**Question No.6** Why is universal gravitation attractive instead of repulsive?

**Question No.7** Why couldn't all of matters shield off universal gravitation?

In followings I render answers to these seven primary questions based on those results drawn from *TCST* and related theories in physics up to now.

*TCST*, fully named Theory of Completable Space Time, is an new theory in physics established by the author in past decade. See appendix V.

Firstly to appoint a writing regarding physical quantities.

To express an physical quantity by  $A = |A| \dim A$ , where  $|A|$  called as modulus value of the physical quantity,  $\dim A$  as physical unit of the physical quantity.

## SECTION ONE

### No.1 Primary Q&A about Universal Gravitation

#### 1.1 Question No.1

*Does universal gravitation pass on via gravitational energies? If it does, then what's the formula to describe spreading of gravitational energies?*

#### 1.2 Answer to Question No.1

*Yes, it does. Universal gravitation passes on from one object to another through gravitational energies. Principle of gravitational energies spreading, abbr.GES principle, provides the formula. The GES principle says that*

*Any two objects apart mutually radiate equivalent gravitational energies to each other, the amounts of gravitational energies are proportional to mass of these two objects and inversely proportional to distance between them.*

$$E_{\ominus,j} = STV \left( \frac{M_j M_{\ominus}}{R_{\ominus,j}} \right) \times J_G$$

*where, STV said space time value*

*$M_j$  and  $M_{\ominus}$  said mass of any two objects*

*$R_{\ominus,j}$  said distance between the objects*

*$J_G$  said gauged energy and  $J_G = 0.490 \times 10^{10} J$*

**Interpretation to the Principle:** Gravitational energies mutually radiated between any two objects are exactly equivalent, that contribute to intrinsic energies and maintain inertial mass of the objects. Sum of gravitational energies radiated from all objects in the universe to an certain object being in state of relative rest are exactly equal to intrinsic energies of the object, and contribute to maintain its inertial mass.

#### 1.3 Theoretical Background for Answer No.1

To fully understand the GES principle and its formula, some of results drawn from *TCST* have to be introduced.

##### 1.3.1 Gauged Quantities and Completable Constant Theorem

There exist an category of physical quantities which do not change in magnitudes along with evolution of the universe, called such kind of physical quantities as gauged quantities, denoted  $A_G$  and

$$A_G = | A_G | \dim A .$$

Gauged quantities are also called as completable constants since their total value are all the same and constantly equal to 1.

Completable constant theorem is used to calculate magnitude of any gauged quantities, it says that

***For any physical unit  $\dim A$ , there always exists an corresponding physical constant denoted  $A_G$  which remains unchanged in space time value, and its magnitude is equal to***

$$A_G = \frac{1}{STV(\dim A)} \times \dim A = \frac{1}{STV(Bm^a s^{-b})} \times \dim A$$

***where,  $Bm^a s^{-b}$  said space time configuration(STC) of physical units***

$$STV(m) = 2.4720661623652209 \times 10^{34}$$

$$STV(s) = 0.7416198487095662 \times 10^{43}$$

For instance, since  $STC(J) = |G| m^5 s^{-4}$ , then by the theorem, we get

$$J_G = \frac{1}{STV(|G| m^5 s^{-4})} J = \frac{STV(s^4)}{|G| \times STV(m^5)} J = 0.490 \times 10^{10} J$$

Another example for physical unit of  $JK^{-1}mol^{-1}$ , by the theorem, we get

$$(JK^{-1}mol^{-1})_G = \frac{1}{STV(JK^{-1}mol^{-1})} JK^{-1}mol^{-1} = \frac{STV(K)STV(mol)}{STV(J)} JK^{-1}mol^{-1}$$

Substituting by space time value related, we get a result of  $(JK^{-1}mol^{-1})_G$

$$= \frac{(2.8120127152383534 \times 10^{-33})(6.0147595191367907 \times 10^{23})}{2.0370370370370370 \times 10^{-10}} JK^{-1}mol^{-1}$$

$$= 8.3030303030303027 JK^{-1}mol^{-1}$$

This is theoretical result of mol gas constant or ideal gas constant with observed data of  $R = 8.31451 JK^{-1}mol^{-1}$

By the theorem, we can calculate all gauged quantities known and unknown.

Appendix II of the paper list STC and STV for some of physical units commonly used. Appendix III list some gauged quantities commonly used.

### 1.3.2 Default Theorem

Default theorem provides a new calculating method applied to mathematical expressions in describing all physical processes. It says that

**Any physical process taking place is actually forming an corresponding space time structure, while magnitude of physical quantity characterized the physical process is determined only by STV of the space time structure and a gauged quantity concerned. That is, for any physical process expressed as  $A = f(x_i, y_j, z_k)$ , always prevail followings**

$$A = STV[f(y_j, z_k)] \times A_G$$

$$\text{or, } A = STV[f(y_j, z_k)] \times |A_G| \dim A$$

**where,  $x_i$  said completable constants or gauged quantities  
 $y_j$  said default factors,  $z_k$  said value factors.**

For example, to calculate gravitational force between two objects whose mass are one kilogram for each and apart one meter from each other. Since gravitational constant  $G$  is an completable constant, by default theorem and Newtonian gravitational formula, we get  $F = STV(kg^2 / m^2) \times N_G$

$$\text{Given } STV(m) = 2.4720661623652209 \times 10^{34}, \quad STV(kg) = 1.83 \times 10^7$$

$$N_G = \frac{1}{STV(|G| m^4 s^{-4})} N = 1.2135597377065632 \times 10^{44} N$$

Substituted by these values and then we have

$$\begin{aligned} F &= \frac{(1.8333333333333333 \times 10^7)^2}{(2.4720661623652209 \times 10^{34})^2} (1.2135597377065632 \times 10^{44} N) \\ &= 6.6745786383860966 \times 10^{-11} N = |G| N \end{aligned}$$

This calculation result is same as obtained from Newtonian gravitational formula by traditional calculating method applying in physics.

### 1.3.3 Mass Theorem

**Mass of an object being in state of relative rest is equal to sum of gravitational energies radiated from all objects of the universe and divided by square of gauged speed. that is ,**

$$m_{\ominus} = \frac{\sum E_{\ominus,j}}{v_G^2}$$

**where,  $m_{\ominus}$  said inertial mass of an object,**

**$v_G$  said gauged speed and  $v_G = 2.9 \times 10^8 \text{ ms}^{-1}$ ,**

**$E_{\ominus,j}$  said gravitational energy radiated from any object to the object.**

Mass theorem can be strictly demonstrated based on GES Principle and general quantities equation of the universe. Refer to Appendix IV.

### 1.4 Calculation Example of GES Principle

Taking two objects as example, whose mass are one kilogram for each and one meter apart from each other, by GES Principle we have

$$E_{1,2} = STV\left(\frac{kg^2}{m}\right) \times J_G$$

$$\text{Given } STV(m) = 2.4720661623652209 \times 10^{34}$$

$$STV(kg) = 1.83 \times 10^7, \quad J_G = 0.490 \times 10^{10} J$$

Substituted by these values and then we have

$$\begin{aligned} E_{1,2} &= \frac{(1.8333333333333333 \times 10^7)^2}{2.4720661623652209 \times 10^{34}} (0.490 \times 10^{10} J) \\ &= 0.3640679225730150 \times 10^{-10} J \end{aligned}$$

This amounts of gravitational energies radiated from one of the object contributes to maintain inertial mass of the opposite object, and its contribution is equal to

$$0.3640679225730150 \times 10^{-10} J / c^2 = 0.4045199174779452 \times 10^{-27} kg$$

only accounts for extremely small portion of inertial mass of one kilogram.

## SECTION TWO

### No.2 Primary Q&A about Universal Gravitation

#### 2.1 Question No.2

*How do gravitational energies give rise to gravitation?*

#### 2.2 Answer to Question No.2

*It is instantaneous power of gravitational energies that generate universal gravitation. Time rate of gravitational energies produce the instantaneous power that is composed of a kind of force and a speed, the force is just universal gravitation, and the speed is squarely gauged speed. That is ,*

$$\frac{dE_{\theta,j}}{dt} = \left(-G \frac{M_j M_{\theta}}{R_{\theta,j}^2}\right) \times v_G$$

*where, G said gravitational constant.*

*v<sub>G</sub> said gauged speed and v<sub>G</sub> = 2.9 × 10<sup>8</sup> m s<sup>-1</sup>*

Universal gravitation is a kind of physical effect induced by instantaneous power of gravitational energies, while the power has something to do directly with expansion of one dimensional space at constant ratio of v<sub>G</sub>.

### 2.3 Theoretical Background for the Answer No.2

There are three kinds of absolute mechanical motions in the universe, described by *TCST* as Cosmic Background Movements, abbr.*CBMs*. It is unnecessary to present all of these three *CBMs* herein, only the 1<sup>st</sup> *CBM* here, since it does matter to understand the answer to question No.2.

#### 2.3.1 Theorem of Expansion in One Dimensional Space

The 1<sup>st</sup> *CBM* is also called as theorem of expansion in one dimensional space, it says that

*Total amounts of one dimensional space of the universe are always kept increasing at constant rate, radius of the universe is equal to*

$$R_U(i) = i \times L_G \quad \text{and} \quad \frac{dR_U(i)}{dt} \equiv v_G$$

*where,  $L_G$  said gauged length and  $L_G = 0.4045199174779452 \times 10^{-34} m$*

*$R_U(i)$  said radius of the universe,  $v_G$  said gauged speed*

*$i$  said quantum number of the universe and  $i = 0, 1, 2, 3, \dots, n, \dots, 1.0083 \times 10^{93}$*

*$n$  said quantum number of the universe today and  $n = 7.7266 \times 10^{60}$*

*For any point in space, there always exists at least another ones, these two spatial points are mutually either as center of the universe or at edge of the universe for each other, distance in between is radius of the universe and its time rate is always equal to gauged speed.*

*All points in space are coequal either at edge of the universe or in the centre of the universe.*

This theorem is one of inferences drawn from 2<sup>nd</sup> Cosmological Law that is also called as Cosmological Expression of Copernicus Principle.

Quantum number of the universe is a series of natural numbers with upper limit, it physically mean total numbers of *CSTs* the universe has possessed.

*CST* is abbreviation for Completable Space Time, an concept in *TCST* to reflect the most fundamental existences of which the universe is consists. *CST* also has an numeric nature that its value is always equal to 1.

*CST* process is the most fundamental natural process by which the universe evolves, a natural process constantly producing *CST* one by one, all of *CSTs* produced have commonly formed the substantiated universe. This natural process is described by 1<sup>st</sup> cosmological law being formularized by equation of the great ultimate.

Quantum number of the universe today  $n = 7.7266 \times 10^{60}$  is a result from both temperature of *CBR* and one of basic equation derived from equation of

the great ultimate, it has same accuracy as that of 2.7250K

Regarding 1<sup>st</sup> cosmological law and 2<sup>nd</sup> cosmological law, to present them in another paper , given its importance in cosmology as well as in *TCST*.

### 2.3.2 Demonstration to Instantaneous Power of Gravitational Energies

Supposedly there are two objects with mass of  $M_{\ominus}$  and  $M_j$  respectively, apart from each other at distance of  $R_{\ominus,j}$ , and object  $M_{\ominus}$  is in state of relative rest. By GES principle , amounts of gravitational energies radiated from object  $M_j$  to object  $M_{\ominus}$  can be expressed as

$$E_{\ominus,j} = STV \left( \frac{M_j M_{\ominus}}{R_{\ominus,j}} \right) \times J_G$$

To investigate changes in the gravitational energies due to expansion in one dimensional space. In this case, factors of  $M_{\ominus}$  and  $M_j$  is invariable with respect to time, either factor of  $J_G$  since it is an gauged quantity, while variable with respect to time in this equation is only factor of  $R_{\ominus,j}$ . To take time derivative at both sides of the equation, we get

$$\begin{aligned} \frac{dE_{\ominus,j}}{dt} &= STV(M_j M_{\ominus}) \times STV \left[ \frac{d(1/R_{\ominus,j})}{dt} \right] \times J_G \\ &= STV(M_j M_{\ominus}) \times STV \left( -\frac{1}{R_{\ominus,j}^2} \times \frac{dR_{\ominus,j}}{dt} \right) \times J_G \end{aligned}$$

By theorem of expansion in one dimensional space, and considering the first *CBM* at place where the object  $M_j$  locates, it would be  $\frac{dR_{\ominus,j}}{dt} = v_G$ , then we get further

$$\frac{dE_{\ominus,j}}{dt} = STV \left( -\frac{M_j M_{\ominus}}{R_{\ominus,j}^2} \times v_G \right) \times J_G$$

Since both gravitational constant  $G$  and gauged energy  $J_G$  are all belonging to gauged quantities, these two gauged quantities are equivalent and equal to 1 in terms of space time value. Considering balance of the equation above in terms of dimensions, that would bring a final result of

$$\frac{dE_{\ominus,j}}{dt} = \left( -G \frac{M_j M_{\ominus}}{R_{\ominus,j}^2} \right) \times v_G$$

It would be same result for gravitational energies radiated from object  $M_{\ominus}$  to object  $M_j$ , if considering object  $M_j$  is in state of relative rest. It is simply a case of vice versa

$$\frac{dE_{j,\ominus}}{dt} = \left(-G \frac{M_{\ominus}M_j}{R_{j,\ominus}^2}\right) \times v_G$$

So, it concludes that universal gravitation results from time rate of gravitational energies, in other word, instantaneous power of gravitational energies give rise to universal gravitation.

Remark: by *STC* Analysis (see Appendix V and Appendix II), it is easy to get gravitational constant  $G$  from gauged energy  $J_G$ ,

$$\begin{aligned} \text{Since } STV(J_G) &= STV\left[\frac{1}{STV(|G|m^5s^{-4})} \times J\right] = STV\left(\frac{1}{|G|m^5s^{-4}} kgm^2s^{-2}\right) \\ &= STV\left(\frac{1}{|G|m^3kg^{-1}s^{-2}}\right) = STV\left(\frac{1}{G}\right) = STV(G), \text{ so } J_G = G . \end{aligned}$$

## SECTION THREE

### No.3 Primary Q&A about Universal Gravitation

#### 3.1 Question No.3

*Given universal gravitation passes on through gravitational energies, then what is medium for spreading of gravitational energies?*

#### 3.2 Answer to Question No.3

*Medium of gravitational energies is a sort of the smallest matter so called substantiated point space, abbr.SPS, that is composed of various of original quantities. Total numbers of SPS in the universe are always equal to  $i^2$  (square of quantum number of the universe), and all of SPSs are identical in terms of their properties physically represented by original quantities whose magnitudes denoted  $A_{Origin}(i)$  can be calculated by a formula of*

$$A_{Origin}(i) = \frac{A_G}{i}$$

*where,  $A_G$  said gauged quantities*

$$i = 1, 2, 3, \dots, n, \dots, 1.0083 \times 10^{93}, \quad n = 7.7266 \times 10^{60}$$

*For the universe today, original quantities can be calculated by formula as*

$$A_{Origin}(n) = \frac{A_G}{n}$$

**Total numbers of SPS are**  $n^2 = (7.7266 \times 10^{60})^2 = 5.970 \times 10^{121}$  *in the universe.*

**Original quantities include but not limited as**

**Original Length**  $L_{Origin}(n) = \frac{L_G}{n} = 0.5235 \times 10^{-95} m$

**Original Time**  $t_{Origin}(n) = \frac{t_G}{n} = 0.1745 \times 10^{-103} s$

**Original Mass**  $M_{Origin}(n) = \frac{M_G}{n} = 0.7059 \times 10^{-68} kg$

**Original Temperature**  $T_{Origin}(n) = \frac{T_G}{n} = 0.4602 \times 10^{-28} K$

**Original Frequency**  $f_{Origin}(n) = \frac{f_G}{n} = 0.95986 \times 10^{-18} Hz$

**Original Momentum**  $p_{Origin}(n) = \frac{p_G}{n} = 2.1178 \times 10^{-60} kgms^{-1}$

**Original Energy**  $E_{Origin}(n) = \frac{J_G}{n} = 0.6353 \times 10^{-51} J$

**Original Acceleration**  $a_{Origin}(n) = \frac{a_G}{n} = 0.2879 \times 10^{-9} ms^{-2}$

**Original Speed**  $v_{Origin}(n) = \frac{v_G}{n} = 0.3882 \times 10^{-52} ms^{-1}$

**Original Electric Current**  $I_{Origin}(n) = \frac{I_G}{n} = 0.4277 \times 10^{-30} A$

**Original Quantity of Charge**  $Q_{Origin}(n) = \pm \frac{C_G}{n} = \pm 0.5767 \times 10^{-73} C$

**Original Magnetic Flux**  $\phi_{Origin}(n) = \frac{W_{bG}}{n} = 0.1922 \times 10^{-81} W_b$

Remark: These two formula the above for original quantities are results drawn from 2<sup>nd</sup> cosmological law and applicable to linear physical quantities of the universe. Original quantities are those physical quantities inversely proportional to the first power of quantum number of the universe.

In addition, original quantities had not been produced at the first *CST* that corresponds to  $i=0$ , accordingly in expression for original quantities, quantum number of the universe should takes  $i=1,2,3,\dots,n,\dots,1.008\dot{3}\times 10^{93}$

### 3.3 Theoretical Background for the answer No.3

Universal gravitation is the most fundamental interaction among matters of all kinds and throughout the universe. It is reasonable that this interaction closely has correlation with the smallest matter in the universe, that is *SPS*.

*SPS* is too small in size and kept becoming even smaller along with increasing of quantum number of the universe ( in the same direction as that of evolution of the universe). *SPS* is too tiny to be detected by any experiments and observations directly, but do we can prove its existence by other means indirectly. One of the means to vindicate authenticity and substantiality of *SPS* is to verify original quantities of which *SPS* is composed.

Therefore to verify existence of *SPS* turn to a task to prove authenticity and substantiality of original quantities. It is a work done by investigating total amounts of physical quantities and micro physical quantities of the universe today with help of experimental results and observed datum for them available at present, simply because related calculating results based on original quantities are fully in line with these experimental and observed datum[1].

Total amounts of linear physical quantities of the universe are equal to

$$A_U(n) = n^2 \times A_{Origin}(n)$$

and some of micro physical quantities are either equal to or directly related to

$$A_{UP}(n) = \frac{n^2 \times A_{origin}(n)}{1.008\dot{3}\times 10^{93}} = \frac{A_U(n)}{1.008\dot{3}\times 10^{93}}$$

Following examples serve as some of such proof to original quantities:

- Original length → Radius of the universe

$$\begin{aligned} R_U(n) &= n^2 \times L_{Origin}(n) = (7.7266 \times 10^{60})^2 (0.5235 \times 10^{-95} m) \\ &= 3.1253 \times 10^{26} m \end{aligned}$$

That is , radius of the universe is sum of  $n^2$  numbers of original lengths

**Related evidence:** observed data of the radius is about  $10^{26} m$

- Original mass → Total mass of the universe

$$M_U(n) = n^2 \times M_{Origin}(n) = (7.7266 \times 10^{60})^2 (0.7059 \times 10^{-68} \text{ kg})$$

$$= 4.2142 \times 10^{53} \text{ kg}$$

That is , total mass of the universe is sum of  $n^2$  numbers of original mass.

**Related evidence :** By observation, total mass of observable matter in the universe is about  $10^{22} \times M_{sum} = 1.986 \times 10^{52} \text{ kg}$  ,and observable matter only accounts for about 5% of total matter of the universe.

By these two observed datum, total mass of the universe would be  $1.986 \times 10^{52} \text{ kg} / 5\% = 3.972 \times 10^{53} \text{ kg}$  around.

- Original energies → Total energies of the universe

$$E_U(n) = n^2 \times E_{Origin}(n) = (7.7266 \times 10^{60})^2 (0.6353 \times 10^{-51} \text{ J})$$

$$= 3.7927 \times 10^{70} \text{ J}$$

That is , total energies of the universe is sum of  $n^2$  numbers of original energy.

**Related evidence :** By mass-energy equation  $E = Mc^2$ , we have

$$(3.972 \times 10^{53} \text{ kg})(3 \times 10^8)^2 = 3.5748 \times 10^{70} \text{ J}$$

- Original energies → Averaged energies of photons in CBR

$$E_{UP}(n) = \frac{n^2 \times E_{Origin}(n)}{1.0083 \times 10^{93}} = \frac{3.7927 \times 10^{70} \text{ J}}{1.0083 \times 10^{93}} = 3.7613 \times 10^{-23} \text{ J}$$

That is , averaged energy of photons in CBR has something to do directly with original energy and is equal to a share of total energies of the universe divided by  $1.0083 \times 10^{93}$

**Related evidence :** By theory as well as experiments in physics up to now, averaged energy of photons in photon gas is equal to  $k_B T$ , so averaged energy of photons in CBR would be

$$k_B T_{CBR} = (1.380658 \times 10^{-23} \text{ JK}^{-1})(2.7250 \text{ K}) = 3.7622 \times 10^{-23} \text{ J}$$

- Original frequency → Oscillation frequency of total mass of the universe

$$f_U(n) = n^2 \times f_{Origin}(n) = (7.7266 \times 10^{60})^2 (0.9598 \times 10^{-18} \text{ Hz})$$

$$= 5.7300 \times 10^{103} \text{ Hz}$$

That is , Oscillation frequency of total mass of the universe is sum of  $n^2$  numbers of original frequency.

**Related evidence :** By De Broglie theory about matter wave, oscillation frequency of total mass of the universe would be

$$\nu = \frac{Mc^2}{h} = \frac{3.7927 \times 10^{70} J}{6.6260755 \times 10^{-34} Js} = 5.7239 \times 10^{103} Hz$$

- Original frequency  $\rightarrow$  Peak frequency of *CBR*'s spectrum

$$f_{UP}(n) = \frac{n^2 \times f_{Origin}(n)}{1.0083 \times 10^{93}} = \frac{5.7300 \times 10^{103} Hz}{1.0083 \times 10^{93}} = 5.6826 \times 10^{10} Hz$$

Peak frequency in spectrum of *CBR* is equal to

$$2.82 \times f_{UP}(n) = (2.82)(5.6826 \times 10^{10} Hz) = 1.6025 \times 10^{11} Hz,$$

where value of 2.82 is an coefficient in peak frequency formula of Planck's black body radiation law.

That is , Peak frequency in spectrum of *CBR* has something to do directly with original frequency.

**Related evidence :** Conclusion drawn from Planck's black body radiation law is fully in line with observed data about *CBR* at high accuracy, by the law peak frequency of *CBR*'s spectrum is equal to

$$\nu_{peak} = 2.82 \frac{k_B T_{CBR}}{h} = \frac{(2.82)(3.7622 \times 10^{-23} J)}{6.6260755 \times 10^{-34} Js} = 1.6011 \times 10^{11} Hz$$

- Original temperature  $\rightarrow$  Temperature of *CBR*

$$\begin{aligned} T_{UP}(n) &= \frac{n^2 \times T_{Origin}(n)}{1.0083 \times 10^{93}} = \frac{(7.7266 \times 10^{60})^2 (0.4602 \times 10^{-28} K)}{1.0083 \times 10^{93}} \\ &= \frac{2.7474 \times 10^{93} K}{1.0083 \times 10^{93}} = 2.7247 K \end{aligned}$$

That is, *CBR*'s temperature has something to do directly with original temperature.

Remark: This conclusion is of inevitable, since quantum number of the universe today is settled in *TCST* just based on observed data of temperature of *CBR*, it is taken 2.7250K as standard observed sample to the universe today.

- Original time  $\rightarrow$  Age of the universe today

$$\begin{aligned} t_U(n) &= n^2 \times t_{Origin}(n) = (7.7266 \times 10^{60})^2 (0.1745 \times 10^{-103} s) \\ &= 10.4176 \times 10^{17} s = 3.3034 \times 10^{10} years \\ &\quad (\text{around thirty three billion years}) \end{aligned}$$

That is , age of the universe is sum of  $n^2$  numbers of original time.

**Related evidence:** Regarding age of the universe, there is no direct observed data, it can only be settled by cosmological theory based on other observation

At present Big Bang theory gave a result of 13.7 billion years, others gave an estimation of 10 billion to 20 billion years in between. Difference between 33 billion years and 13.7 billion years is caused by application of Hubble constant, since the Hubble constant does not purely reflect cosmological red shift, it includes contribution from those red shifts caused by others reasons. If directly using Hubble constant to calculate age of the universe , it must bring an result with certain amounts of deviation from age of the universe today.

●Original velocity → hyperspatial speed

$$\begin{aligned} v_U(n) &= n^2 \times v_{Origin}(n) = (7.7266 \times 10^{60})^2 (0.3882 \times 10^{-52} \text{ ms}^{-1}) \\ &= 2.3175 \times 10^{69} \text{ ms}^{-1} = 3.1246 \times 10^{26} \text{ m} / t_G = R_U(n) / t_G \end{aligned}$$

That is , hyperspatial speed is sum of  $n^2$  numbers of original speed.

The hyperspatial speed is speed of a special particle that can moves across the universe from somewhere to anywhere within a gauged time.

**Related evidence:** Quantum entanglement phenomena have been observed by lots of experiments, these kinds of phenomena occur at a rate faster-than-light, it seem to take place instantaneously regardless of how far away entangled particles are from each other.

●Original electric current → Electric current of vacuum

$$I_{UP}(n) = \frac{n^2 \times I_{Origin}(n)}{1.008\dot{3} \times 10^{93}} = \frac{(7.7266 \times 10^{60})^2 (0.4277 \times 10^{-30} \text{ A})}{1.008\dot{3} \times 10^{93}} = 25.3241 \times 10^{-3} \text{ A}$$

That is , Electric current of vacuum has something to do directly with original electric current.

**Related evidence:** This is a prediction that there exist a sort of electric current that can be detected at ambient of vacuum and under condition of superconductive status. I remembered that reportedly in so many years ago, an Chinese engineer had detected a sort of electric current constantly flowing from vacuum, but no data available from that report, I do not remember name of the engineer either.

●Original magnetic flux → fluxon

There is an physical quantity of

$$\phi_{UP}(n) = \frac{n^2 \times \phi_{Origin}(n)}{1.008\dot{3} \times 10^{93}} = \frac{(7.7266 \times 10^{60})^2 (0.1922 \times 10^{-81} \text{ W}_b)}{1.008\dot{3} \times 10^{93}} = 1.1382 \times 10^{-53} \text{ W}_b$$

This magnetic flux turn to fluxon under condition of a pair of elementary charges and temperature of  $2.725 \text{ K}$  , that is,

$$\frac{(2.7250 \text{ K})(2e)}{STV(2.725 \text{ K}) \times STV(2e)} \times 1.1382 \times 10^{-53} \text{ W}_b$$

$$= \left[ \frac{(2.7250K)(2e)}{(2.7250)(2.8120127152383534 \times 10^{-33})(2)(1.60217733 \times 10^{-19})} \right] \left[ \frac{(1.1382 \times 10^{-53} W_b)}{(0.2243682799086353 \times 10^{13})} \right]$$

$$= (2.725 K)(2e)(2.0660 \times 10^{-15} W_b) = (2.725 K)(2e)(\phi_0)$$

That is , fluxon has something to do directly with original magnetic flux under condition of a pair of elementary charges and ambient temperature of 2.725 K .

**Related evidence :** Observed data of fluxon  $\phi_0 = 2.06783461 \times 10^{-15} W_b$

●Original acceleration → Retro acceleration of object in space

Any object in space has a sort of acceleration that is resultant of acceleration based on both original acceleration and ten dimensional space times [2]. The acceleration is called as retro acceleration denoted  $a_{retro}(i)$  that is equal to

$$a_{retro}(i) = \sqrt{10 \times a_{Origin}(i)^2} = \sqrt{10} \times a_{Origin}(i)$$

For the universe today,  $a_{Origin}(n) = 0.2879 \times 10^{-9} ms^{-2}$ , the retro acceleration is

$$a_{retro}(n) = \sqrt{10} \times a_{Origin}(n) = (3.1623)(0.2879 \times 10^{-9} ms^{-2})$$

$$= 9.1043 \times 10^{-10} ms^{-2}$$

**Related evidence:** Retro acceleration is very small in magnitude, it is not easy to detect but detected was it by NASA based on analysis to flight data of space ships [3] , the observed acceleration is about  $(8.74 \pm 1.33) \times 10^{-10} ms^{-2}$

## SECTION FOUR

### No.4 Primary Q&A about Universal Gravitation

#### 4.1 Question No.4

*Do gravitational energies possess quantized nature? If they have, then what is quanta of gravitational energies?*

#### 4.2 Answer to Question No.4

*Yes, they have. Gravitational energies are quantized with their quanta as original energies. That is ,*

$$E_{\Theta,j} = i \times STV \left( \frac{M_j M_{\Theta}}{R_{\Theta,j}} \right) \times E_{Origin}(i)$$

$E_{Origin}(i)$  said original energy,  $i = 1, 2, 3, \dots, n, \dots, 1.0083 \times 10^{93}$ ,  $n = 7.7266 \times 10^{60}$

### 4.3 Theoretical Background for the Answer No.4

By definition of original energy  $E_{Origin}(i) = \frac{J_G}{i}$  and replacing gauged energy accordingly in the formula of GES Principle, we have,

$$E_{\Theta,j} = STV \left( \frac{M_j M_{\Theta}}{R_{\Theta,j}} \right) \times [i \times E_{Origin}(i)],$$

then we get

$$E_{\Theta,j} = i \times STV \left( \frac{M_j M_{\Theta}}{R_{\Theta,j}} \right) \times E_{Origin}(i)$$

That is, gravitational energies radiated from any object to other ones are quantized, its basic share is original energy.

## SECTION FIVE

### No.5 Primary Q&A about Universal Gravitation

#### 5.1 Question No.5

*Given gravitational energies spread in form of waves, then do wave lengths of gravitational energies distribute themselves within an certain wave band? or just have an common wave length? If only having an common wave length, then how long is it?*

#### 5.2 Answer to Question No.5

*Gravitational waves only have common wave length, the wave length is always equal to radius of the universe. That is,*

$$\lambda_g(i) = \frac{v_G}{f_{Origin}(i)} = R_U(i)$$

*where,  $v_G$  said gauged speed,  $f_{Origin}(i)$  said original frequency*

*$R_U(i)$  said radius of the universe,  $\lambda_g(i)$  said gravitational wave length*

$$i = 1, 2, 3, \dots, n, \dots, 1.008\dot{3} \times 10^{93}, \quad n = 7.7266 \times 10^{60}$$

*For the universe today, gravitatio0nal wave length is equal to*

$$\lambda_g(n) = \frac{v_G}{f_{Origin}(n)} = \frac{2.9 \times 10^8 \text{ ms}^{-1}}{0.9598 \times 10^{-18} \text{ Hz}} = 3.1256 \times 10^{26} \text{ m} = R_U(n)$$

*where,  $R_U(n)$  said radius of the universe today.*

#### 5.3 Theoretical Background for the Answer No.5

The answer justifies by reasons from following aspects

1), Carrier of gravitational energies is *SPS* whose speed is gauged speed.

Gravitational energies are composed of original energies, while carrier of original energy is *SPS*, therefore carrier of gravitational energies must be *SPS* alike. Additionally original momentum

$$p_{Origin}(i) = \frac{P_G}{i} = \frac{M_G \times v_G}{i} = M_{Origin}(i) \times v_G$$

So speed of carrier of gravitational energies would be gauged speed.

2), Oscillation frequency of *SPS* is equal to original frequency, its wave length would be

$$\lambda_g(i) = \frac{v_G}{f_{Origin}(i)} = \frac{i \times v_G}{f_G} = i \times L_G$$

3), By Theorem of Expansion in One Dimensional Space, radius of the universe is equal to product of quantum number of the universe and gauged length  $R_U(i) = i \times L_G$ . For the universe today, radius of the universe would be

$$R_U(n) = n \times L_G = (7.7266 \times 10^{60})(0.4045199174779452 \times 10^{-34} m) = 3.1255 \times 10^{26} m$$

4), As concluded in section four, gravitational energies are quantized and their quanta is original energy and expressed as  $E_{\Theta,j} = i \times STV \left( \frac{M_j M_{\Theta}}{R_{\Theta,j}} \right) \times E_{Origin}(i)$

5), All of *SPS* carrying gravitational energies are separated and freely move inside all kinds of matters.

To explain this reason, definition of density of *SPS* and critical density of *SPS*, definition and classification of matter have to be introduced.

**Definition of density of *SPS*:** to define numbers of *SPS* contained per unit of space volume as density of *SPS*, denoted  $\rho_{Origin}(i)$ , and

$$\rho_{Origin}(i) = \frac{\rho}{M_{Origin}(i)}$$

where,  $\rho$  said mass density of matter,  $M_{Original}(i)$  said original mass

$$i = 1, 2, 3, \dots, n, \dots, 1.0083 \times 10^{93}, \quad n = 7.7266 \times 10^{60}$$

**Definition of critical density of *SPS*:** to define numbers of *SPS* contained in averaged mass density of the universe as critical density of *SPS*, denoted  $\rho_{Critical}(i)$ , and

$$\rho_{Origin}^{Critical}(i) = \frac{\rho_U(i)}{M_{Origin}(i)}$$

where,  $\rho_U(i)$  said averaged mass density of the universe

$M_{Original}(i)$  said original mass

$$i = 1, 2, 3, \dots, n, \dots, 1.008\dot{3} \times 10^{93}, \quad n = 7.7266 \times 10^{60}$$

For the universe today, critical density of *SPS* is equal to

$$\rho_{Origin}^{Critical}(n) = \frac{\rho_U(n)}{M_{Origin}(n)} = \frac{3.2591 \times 10^{-27} \text{ kgm}^{-3}}{0.7059 \times 10^{-68} \text{ kg}} = 4.6169 \times 10^{41} / \text{m}^3$$

Remark: averaged mass density of the universe can be calculated by a formula derived from general quantity equation of the universe which is one of equation of 2<sup>nd</sup> cosmological law. The formula is expressed as

$$\rho_U(i) = \frac{3}{4\pi} \times i^{-2} \times \rho_G$$

where,  $\rho_G$  said gauged mass density,  $\rho_G = 8.2402205412174036 \times 10^{95} \text{ kgm}^{-3}$

$$i = 0, 1, 2, 3, \dots, n, \dots, 1.008\dot{3} \times 10^{93}, \quad n = 7.7266 \times 10^{60}$$

For the universe today, averaged mass density of the universe is equal to

$$\begin{aligned} \rho_U(n) &= \frac{3}{4\pi} \times n^{-2} \times \rho_G \\ &= \frac{3}{4\pi} \times (7.7266 \times 10^{60})^{-2} (8.2402205412174036 \times 10^{95} \text{ kgm}^{-3}) = 3.2951 \times 10^{-27} \text{ kgm}^{-3} \end{aligned}$$

By definition of *SPS* and critical density of *SPS*, we can get definition of matter as:

***To define substantiated point space (SPS) and physical realities whose density of SPS are larger or equal to critical density of SPS as matter.***

By this definition of matter, we can clarify matter into three categories as:

**Punctate matter:** this kind of matter are individually Substantiated Point Space(*SPS*). Substantiated point space, denoted  $O_{Origin}(i)$ , are composed of all kinds of original quantities and expressed as

$$O_{Origin}(i) \supseteq A_{Origin}(i) \quad \text{and} \quad A_{Origin}(i) = \frac{A_G}{i}$$

where,  $A_G$  said gauged quantities,  $A_{Original}(i)$  said original quantities;

$$i = 1, 2, 3, \dots, n, \dots, 1.008\dot{3} \times 10^{93}, \quad n = 7.7266 \times 10^{60}.$$

Punctate matter are varying all the time along with evolving process of the universe and kept decreasing in terms of its magnitudes of dimension, mass, energy, and so on. For the universe today,

$$O_{Origin}(n) \supseteq A_{Origin}(n) \text{ and } A_{Origin}(n) = \frac{A_G}{n}$$

where,  $n$  said quantum number of the universe today and  $n = 7.7266 \times 10^{60}$

**Conglomerate matter:** this kind of matter are those ones whose density of *SPS* are larger than critical density of *SPS*. That is

$$\rho_{Congl.}(i) > \rho_{Origin}^{Critical}(i)$$

Conglomerate matters are all composed of *SPS* and three dimensional spaces. Numbers of *SPS* contained in any conglomerate matter are equal to numbers of original mass the matter possessed, for instance,

Any matter with mass of  $1kg$  contains  $\frac{1kg}{0.7059 \times 10^{-68} kg} = 1.4165 \times 10^{68}$

numbers of *SPS*;

Total amounts of matters of the universe today contain  $n^2$  numbers of *SPS*,

$$\text{that is, } \frac{4.2142 \times 10^{53} kg}{0.7059 \times 10^{-68} kg} = 5.9700 \times 10^{121} = n^2$$

The earth contains  $\frac{5.9722 \times 10^{24} kg}{0.7059 \times 10^{-68} kg} = 8.4578 \times 10^{92}$  numbers of *SPS*;

An human with  $65kg$  contains  $\frac{65kg}{0.7059 \times 10^{-68} kg} = 9.2075 \times 10^{69}$  umbers of *SPS*,

The particle with energy of  $125GeV$  whose equivalent mass is about  $2.2252 \times 10^{-25} kg$  contains  $\frac{2.2252 \times 10^{-25} kg}{0.7059 \times 10^{-68} kg} = 3.1522 \times 10^{43}$  numbers of *SPS*;

A neutron contains  $\frac{1.6749286 \times 10^{-27} kg}{0.7059 \times 10^{-68} kg} = 2.3726 \times 10^{41}$  numbers of *SPS*;

A proton contains  $\frac{1.6726231 \times 10^{-27} kg}{0.7059 \times 10^{-68} kg} = 2.3693 \times 10^{41}$  numbers of *SPS*;

An electron contains  $\frac{9.1093897 \times 10^{-31} kg}{0.7059 \times 10^{-68} kg} = 1.2904 \times 10^{38}$  numbers of *SPS*;

An photon with peak frequency of *CBR* 's spectrum whose equivalent mass is about  $1.1798 \times 10^{-39} \text{ kg}$  contains  $\frac{1.1798 \times 10^{-39} \text{ kg}}{0.7059 \times 10^{-68} \text{ kg}} = 1.6713 \times 10^{29}$  numbers of *SPSs*;

An photon with frequency of  $1 \text{ Hz}$  whose equivalent mass is about  $0.7362 \times 10^{-50} \text{ kg}$  contains  $\frac{0.7362 \times 10^{-50} \text{ kg}}{0.7059 \times 10^{-68} \text{ kg}} = 1.0429 \times 10^{18}$  numbers of *SPSs*;

**Vacuum:** this kind of matter are those matter whose density of *SPS* are exactly equal to critical density of *SPS*, that is,

$$\rho_{\text{Congl.}}^{\text{Vacuum}}(i) = \rho_{\text{Origin}}^{\text{Critical}}(i)$$

Vacuum is a sort of matter whose density of *SPS* is the smallest one among all kinds of matters, a spatial form of matter.

Mass density of vacuum is equal to averaged mass density of the universe.

Space volume of vacuum is approximately equal to its amounts of three dimensional spaces at high accuracy. Since space volume occupied by all *SPSs* in vacuum are extremely small. Space volume occupied by one single *SPS* is about  $(10^{-95} \text{ m})^3 = 10^{-285} \text{ m}^3$ , total space volume occupied by all *SPSs* in one cubic meter of vacuum are about  $(10^{-285} \text{ m}^3 (4.6169 \times 10^{41})) = 10^{-244} \text{ m}^3$ , it is so small amounts of space volume compared with that of one cubic meter, too little to take into account in calculations of space volume of vacuum.

Generally matters showcase themselves in a way as below:

***The more mass of an object is, the more the object inclines to appear itself strikingly in mass form of matter and the more properties of particle it exhibits; The less mass of an object is, the more the object inclines to appear itself strikingly in energy form of matter and the more properties of wave it exhibits; As mass density of an object is exactly averaged mass density of the universe, the object show up in space form of matter that is vacuum.***

Now we investigate distance between any two adjacent *SPSs* among conglomerate matter and vacuum. Supposedly all *SPSs* are evenly distributed among conglomerate matters and vacuum.

For conglomerate matter , taking a matter with maximum mass density  $10^{35} \text{ kgm}^{-3}$  as example. In this case, numbers of *SPS* contained in the matter are

$$\rho_{\text{Origin}}(n) = \frac{10^{35} \text{ kgm}^{-3}}{0.7059 \times 10^{-68} \text{ kg}} \approx 10^{103} / \text{m}^3, \text{ so distance between any two adjacent}$$

*SPSs* would be about  $10^{-34}m$ , while length of *SPS* is about  $10^{-95}m$ , so the distance allows  $10^{61}$  numbers of *SPS* freely passing through side by side inside the matter.

For other conglomerate matter, since their mass density are all smaller than  $10^{35}kgm^{-3}$ , so numbers of *SPSs* passing through between any two adjacent *SPSs* inside these conglomerate matters would be even more than  $10^{61}$  pieces.

For vacuum (today), distance between any two adjacent *SPSs* is about  $\frac{1}{\sqrt[3]{4.6169 \times 10^{41} / m^3}} \approx 10^{-14}m$ , thus, the distance allows  $\frac{10^{-14}m}{10^{-95}m} = 10^{81}$  numbers of *SPS* freely passing through side by side in vacuum.

Summarized all of those analysis results the above, we can get an conclusion that *SPSs* carrying gravitational energies are all separated and freely passing through inside both conglomerate matter and vacuum with extremely little chance to collide with each other, either with those *SPSs* of which these two kinds of matters are composed.

## SECTION SIX

### No.6 Primary Q&A about Universal Gravitation

#### 6.1 Question No.6

*Why is universal gravitation attractive instead of repulsive?*

#### 6.2 Answer to Question No.6

*Universal gravitation is caused by instantaneous power of gravitational energies, while the instantaneous power being consists of universal gravitation and gauged speed is always of negative due to constantly expansion of one dimensional space at any point of space, it would result in that direction of the force is always opposite to that of expansion of one dimensional space, therefore would bring an effect of attractive force.*

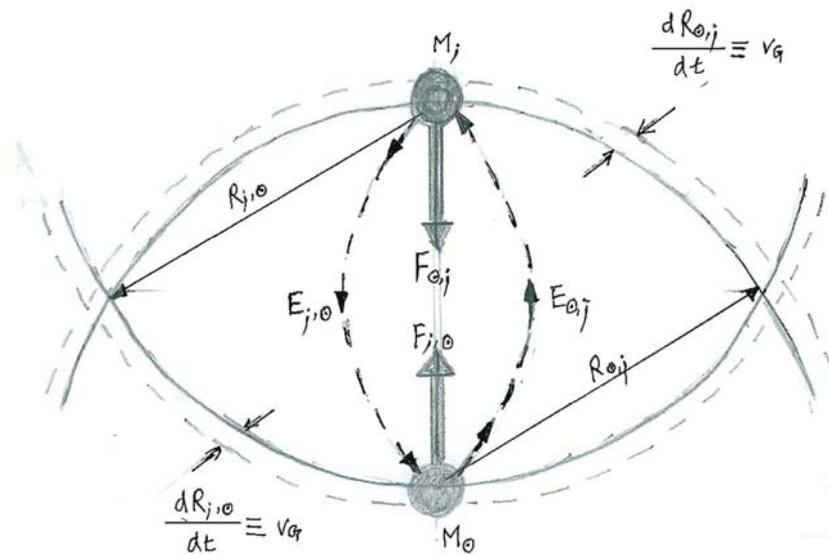
$$P_{\Theta,j} = \frac{dE_{\Theta,j}}{dt} = \left(-G \frac{M_j M_{\Theta}}{R_{\Theta,j}^2}\right) \times v_G \quad \text{and} \quad P_{j,\Theta} < 0$$

*where,  $P_{\Theta,j}$  said instantaneous power of gravitatio0nal energies .*

#### 6.3 Theoretical Background for the Answer No.6

Gravitational energies are inversely proportional to distance between any two objects, while besides relative motion, any object has absolute mechanical

movement along with expansion of one dimensional space that has an constant rate of gauged speed, gravitational energies radiated from any object to an certain object would decrease accordingly, so instantaneous power of gravitational energies would be always of negative, therefore would bring an effect of attractive force instead of repulsive ones. Refer to a draft as below.



$$E_{0,j} = E_{j,0} \quad F_{0,j} = F_{j,0}$$

$$E_{0,j} = STV \left( \frac{M_j M_0}{R_{0,j}} \right) J_g \quad \frac{dE_{0,j}}{dt} = \left( -G \frac{M_j M_0}{R_{0,j}^2} \right) v_g$$

## SECTION SEVEN

### No.7 Primary Q&A about Universal Gravitation

#### 7.1 Question No.7

*Why couldn't all of matters shield off universal gravitation?*

#### 7.2 Answer to Question No.7

*Both conglomerate matters and vacuum could not shield off universal gravitation, simply because SPSs of gravitational energies can freely pass through inside of conglomerate matter and vacuum with almost no chance to collide with those SPSs of which both conglomerate matters and vacuum are composed, since inside conglomerate matters and vacuum, there are extremely enough three dimensional spaces to allow SPSs of gravitational energies going through separately, while universal gravitation is caused by instantaneous power of gravitational energies whose carrier are the SPSs.*

#### Appendix I Axiom of Physics

For any physical reality designated by physical unit  $\dim A$ , there always exist an corresponding physical reality  $A_G$  whose space time value is constantly equal to 1. That is,

$$A_G = | A_G | \dim A \text{ and } STV(A_G) \equiv 1.$$

Axiom of physics is an abstracted result from principle of the great ultimate which is core of Taoism of Chinese religion. It is presumedly considered by the author as logic origin of whole theoretical system of physics.

#### Appendix II Rule of *STC*&*STV*

*STC* is an abbreviation of space time configuration, *STV* of space time value.

All of physical realities designated by physical units possess an common nature of space time structure that can be exclusively expressed by *STC* and *STV*. Description of *STC* and *STV* strictly follow rule of *STC* and rule of *STV*. Under axiom of physics, with help of SI units, referred to Planck units, these two rules can be obtained.

#### Rule of *STC*

For any physical reality designated by physical unit  $\dim A$ , expression of its space time structure identically abides by an expression as

$$STC(\dim A) = Bm^a s^{-b}$$

where, *STC*( $\dim A$ ) said space time configuration of physical units;  
 $m$  denotes an unit of one dimensional space or length unit;  
 $s$  denotes an unit of one dimensional time or time unit;

$$a, b = -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5;$$

$$B \text{ said coefficient and } B \geq |G| = 6.6745786383860966 \times 10^{-11}.$$

Called this regulation the above as rule of space time configuration for physical units, abbreviated Rule of *STC*.

Interpretation to the Rule : All of physical realities possess space time structure which are composed of specific amounts of dimensional spaces or dimensional times or dimensional spaces and dimensional times combined.

Applicability of the Rule : applicable to all branches of physics.

### Examples of *STC*

- *STC* of time unit  $STC(s) = m^0 s^1$
- *STC* of length unit  $STC(m) = m^1 s^0$
- *STC* of mass unit  $STC(kg) = |G| m^3 s^{-2}$
- *STC* of mol unit  $STC(mol) = a m^2 s^{-1}$
- *STC* of electric current strength unit  $STC(A) = \sqrt{|G|} m^3 s^{-3}$
- *STC* of thermodynamic temperature unit

$$STC(K) = \frac{a^{-1}}{|N_A| \times 10^{-23}} m^4 s^{-4} \approx 22.7773 m^4 s^{-4}$$

$$\begin{aligned} STC(kgm^{-3}) &= |G| m^0 s^{-2} & STC(ms^{-2}) &= m^1 s^{-2} \\ STC(J) &= |G| m^5 s^{-4} & STC(Nm^{-1}) &= |G| m^3 s^{-4} \\ STC(W) &= |G| m^5 s^{-5} & STC(Wm^{-2} Hz^{-1}) &= |G| m^3 s^{-4} \\ STC(C) &= \sqrt{|G|} m^3 s^{-2} & STC(V) &= \sqrt{|G|} m^2 s^{-2} \\ STC(Am^{-2}) &= \sqrt{|G|} m^1 s^{-3} & STC(kgm^2 s^{-1}) &= |G| m^5 s^{-3} \\ STC(Wm^{-2}) &= |G| m^3 s^{-5} & STC(kgms^{-1}) &= |G| m^4 s^{-3} \\ STC(S) &= m^1 s^{-1} & STC(\Omega) &= m^{-1} s^1 \\ STC(Cm^{-3}) &= \sqrt{|G|} m^0 s^{-2} & STC(H) &= m^{-1} s^2 \\ STC(Vm^{-1}) &= \sqrt{|G|} m^1 s^{-2} & STC(JT^{-1}) &= \sqrt{|G|} m^5 s^{-3} \\ STC(Am^{-1}) &= \sqrt{|G|} m^2 s^{-3} & STC(W_b) &= \sqrt{|G|} m^2 s^{-1} \\ STC(T) &= \sqrt{|G|} m^0 s^{-1} & STC(N) &= |G| m^4 s^{-4} \end{aligned}$$

$$\text{where, } a = 1/137 ; |N_A| = 6.0147595191367907 \times 10^{23};$$

$$|G| = 6.6745786383860966 \times 10^{-11}; \quad \sqrt{|G|} = 0.8169809445994500 \times 10^{-5}$$

### Rule of STV

For any physical reality designated by physical units  $\dim A$ , its space time structure has numeric characteristics that can be exclusively expressed by its space time value. The space time value identically stick to an expression as

$$STV(\dim A) = STV(Bm^a s^{-b}) = B \times STV(m^a) \times STV(s^{-b})$$

where,  $STV(\dim A)$  said space time value of physical units;

$$STV(m) = 2.4720661623652209 \times 10^{34};$$

$$STV(s) = 0.7416198487095662 \times 10^{43}.$$

Called this regulation the above as rule of space time value for physical units, abbreviated Rule of STV.

Interpretation to the Rule : Space time value of physical units reflect numeric nature of physical realities, also are quantitative stipulation to physical quantities  $A_G$  and exclusive. Space time value means value in math, it has no zero value, no infinite value ether.

Applicability of the Rule : applicable to all branches of physics.

### Examples of STV

- $STV(m) = 2.4720661623652209 \times 10^{34}$  and exclusive.
- $STV(s) = 0.7416198487095662 \times 10^{43}$  and exclusive.
- $STV(kg) = 1.83 \times 10^7$  and exclusive.
- $STV(K) = 2.8120127152383534 \times 10^{-33}$  and exclusive.
- $STV(A) = 0.3025855350368333 \times 10^{-30}$  and exclusive.
- $STV(mol) = 6.0147595191367907 \times 10^{23}$  and exclusive.
- $STV(J) = 2.037 \times 10^{-10}$  and exclusive.
- $STV(N) = 0.8240220541217403 \times 10^{-44}$  and exclusive.
- $STV(kgms^{-1}) = 0.061 \times 10^0$  and exclusive.
- $STV(kgm^2s^{-1}) = 0.1510707099223190 \times 10^{34}$  and exclusive.
- $STV(kgm^{-3}) = 0.1213559752433835 \times 10^{-95}$  and exclusive.
- $STV(C) = 0.2243682799086353 \times 10^{13}$  and exclusive.
- $STV(JT^{-1}) = 0.1849133825225098 \times 10^{39}$  and exclusive.
- $STV(W_b) = 0.6732103161471585 \times 10^{21}$  and exclusive.
- $STV(Am^{-1}) = 0.1224018756631197 \times 10^{-64}$  and exclusive.

### Appendix III Gauged Quantities Commonly Used

- Gauged Length  $L_G = 0.4045199174779452 \times 10^{-34} m$  and  $STV(L_G) \equiv 1$   
 Gauged Time  $t_G = 1.3483997249264841 \times 10^{-43} s$  and  $STV(t_G) \equiv 1$   
 Gauged Mass  $M_G = 0.54 \times 10^{-7} kg$  and  $STV(M_G) \equiv 1$   
 Gauged Temperature  $T_G = 0.3556171686496934 \times 10^{33} K$  and  $STV(T_G) \equiv 1$   
 Gauged Frequency  $f_G = 0.7416198487095662 \times 10^{43} Hz$  and  $STV(f_G) \equiv 1$   
 Gauged Momentum  $p_G = 16.36 \times 10^0 kgms^{-1}$  and  $STV(p_G) \equiv 1$   
 Gauged Angular Moment  $j_G = 6.6194168314572859 \times 10^{-34} kgm^2s^{-1}$  and  $STV(j_G) \equiv 1$   
 Gauged Force  $N_G = 1.2135597377065632 \times 10^{44} N$  and  $STV(N_G) \equiv 1$   
 Gauged Energy  $J_G = 0.490 \times 10^{10} J$  and  $STV(J_G) \equiv 1$   
 Gauged Power  $W_G = 3.6406792573015072 \times 10^{52} W$  and  $STV(W_G) \equiv 1$   
 Gauged Mass Density  $\rho_G = 8.2402205412174036 \times 10^{95} kgm^{-3}$  and  $STV(\rho_G) \equiv 1$   
 Gauged Acceleration  $a_G = 2.2248595461285986 \times 10^{51} ms^{-2}$  and  $STV(a_G) \equiv 1$   
 Gauged Electric Current  $I_G = 3.3048506429042329 \times 10^{30} A$  and  $STV(I_G) \equiv 1$   
 Gauged mol  $mol_G = 0.166267686833435 \times 10^{-23} mol$  and  $STV(mol_G) \equiv 1$   
 Gauged Quantity of Charge  $C_G = 4.4562596978151820 \times 10^{-13} C$  and  $STV(C_G) \equiv 1$   
 Gauged Magnetic Flux  $Wb_G = 1.4854198992717273 \times 10^{-21} Wb$  and  $STV(Wb_G) \equiv 1$   
 Gauged Magnetic Flux Density  $B_G = 9.0775660511050011 \times 10^{47} T$  and  $STV(B_G) \equiv 1$   
 Gauged Magnetic Moment  $m_G = 5.4079374156614689 \times 10^{-39} JT^{-1}$  and  $STV(m_G) \equiv 1$   
 Gauged Speed  $v_G = 2.9 \times 10^8 ms^{-1}$  and  $STV(v_G) = 1$   
 Gravitational Constant  $G = 6.6745786383860966 \times 10^{-11} m^3 kg^{-1} s^{-2}$  and  $STV(G) \equiv 1$   
 Boltzmann Constant  $k_B = 1.3804426056624644 \times 10^{-23} JK^{-1}$  and  $STV(k_B) \equiv 1$

### Appendix IV Demonstration to Mass Theorem

Supposedly there is an object with mass of  $M_\odot$ , being in state of relative rest,  $E_\odot$  said sum of gravitational energies radiated from all objects in the universe to the object, and under following preconditions

- 1, Mass density at large scale are same everywhere in the universe.
- 2, Relative to any location in the universe, geometric shape of total amounts of three dimensional spaces of the universe are constantly of spherical.

By GES principle, we have

$$E_{\ominus} = \sum E_{\ominus,j} = \sum [STV \left( \frac{M_j M_{\ominus}}{R_{\ominus,j}} \right) \times J_G] = M_{\ominus} \times J_G \times \sum STV \left( \frac{M_j}{R_{\ominus,j}} \right)$$

Where,  $M_j$  said mass of any object in the universe

$R_{\ominus,j}$  said distance between object  $M_j$  and object  $M_{\ominus}$

As per preconditions the above, total amounts of gravitational energies radiated from all objects of the universe to the object  $M_{\ominus}$  are equal to that of total mass of the universe at the distance of radius of the universe, that is,

$$E_{\ominus} = \sum E_{\ominus,j} = M_{\ominus} \times J_G \times \frac{\sum STV(M_j)}{STV[R_U(i)]} = M_{\ominus} \times J_G \times STV \left[ \frac{M_U(i)}{R_U(i)} \right]$$

where,  $M_U(i)$  said total mass of the universe

$R_U(i)$  said radius of the universe.

According to general quantities equation of the universe, total mass of the universe and radius of the universe are respectively equal to

$$M_U(i) = i \times M_G, \quad R_U(i) = i \times L_G$$

where,  $M_G$  said gauged mass,  $L_G$  said gauged length

$$i = 0, 1, 2, 3, \dots, n, \dots, 1.0083 \times 10^{93}$$

By rule of *STC* and rule of *STV*, we get,

$$M_U(i) = i \times M_G = i \times |M_G| |G| m^3 s^{-2}, \quad R_U(i) = i \times L_G = i \times |L_G| m^1 s^0$$

$$\text{So, we have } E_{\ominus} = \sum E_{\ominus,j} = M_{\ominus} \times STV \left[ \frac{M_U(i)}{R_U(i)} \right] \times J_G$$

$$= \left[ \frac{|M_{\ominus}| |G| m^3 s^{-2} \times STV(i |M_G| |G| m^3 s^{-2})}{STV(i |L_G| m)} \right] \left[ \frac{1}{STV(|G| m^5 s^{-4})} \times J \right]$$

By exchangeability of *STC* and *STV*, we further get

$$E_{\ominus} = \sum E_{\ominus,j} = M_{\ominus} \times STV \left[ \frac{M_U(i)}{R_U(i)} \right] \times J_G = |M_{\ominus}| \times STV \left( \frac{|G| |M_G|}{|L_G|} \right) \times J$$

$$\text{While } STV \left( \frac{|G| |M_G|}{|L_G|} \right) = STV \left[ \frac{|G| (|G| m^3 s^{-2})^{-1}}{m^{-1}} \right] = STV(m^{-2} s^2) = |v_G|^2$$

$$\text{Thus, } E_{\ominus} = \sum E_{\ominus,j} = |M_{\ominus}| |v_G|^2 J = |M_{\ominus}| |v_G|^2 (|G| m^5 s^{-4})$$

$$= (|M_{\ominus} | |G| m^3 s^{-2}) (|v_G|^2 m^2 s^{-2})$$

Replacing  $|G| m^3 s^{-2}$  by sign of  $kg$ , and  $v_G = |v_G| m s^{-1}$ ,  
thus  $E_{\ominus} = (|M_{\ominus} | kg) (|v_G| m s^{-1})^2 = M_{\ominus} v_G^2$

$$\text{That is, } E_{\ominus} = \sum E_{\ominus,j} = M_{\ominus} v_G^2$$

$$\text{or, } M_{\ominus} = \frac{\sum E_{\ominus,j}}{v_G^2} = \frac{E_{\ominus}}{v_G^2}$$

By mass-energy equation, total amounts of intrinsic energies of the object  $M_G$  should be  $E = M_{\ominus} c^2$ , where  $c = 3 \times 10^8 m s^{-1}$

To compare these two results the above, it would be

$$E_{\ominus} = E$$

Mass-eneqy equation stands firmly supported by so many experiments, therefore mass theorem prevails as well accordingly.

#### Appendix V Brief in TCST

The author spent lots of time spanned decades in research on physics and the universe, finally established a new theory in physics during years of 2005 to 2007, which has been developed until now, namely Theory of Completable Space Time, abbreviated *TCST*.

*TCST* is consists of two parts, the first part presents an new analysis method in physics so called Space Time Configuration Analysis, abbreviated *STC* Analysis, the second one is contributed to an new cosmological model of the universe, namely Completable Space Time Model for the Universe, abbreviated *CSTMU*.

*STC* Analysis extends and deepens theoretical basis of physics and provides an effective method of theoretical analysis applicable to all branches of physics, which contains those results including but not limited as axiom of physics, rule of space time configuration, rule of space time value, completable constants theorem, default theorem, periodic table of physical elements, m-s system of units.

*CSTMU* is an cosmological theory which lay its foundation upon concepts of two objective existences, an initial information and one unit of cosmic vacuum, that was origin of the universe. Cosmic vacuum is a sort of non-substantiated existence totally different from vacuum.

With help of *STC* Analysis , *CSTMU* develops so well in self-consistency and have produced so many results regarding the universe, that are well compatible to each other and in line with those experimental results and astronomical observation datum available at present. *CSTMU* presents three cosmological laws regarding operation of the universe, the universe as a whole and formation of matter.

*CST* is abbreviation for Completable Space Time, an concept in *TCST* to reflect the most fundamental existences of which the universe is consists. *CST* also has an numeric nature that its value is always equal to 1.

*CST* process is the most fundamental natural process by which the universe evolves, a natural process constantly producing *CST* one by one, all of *CST*s produced have commonly formed the substantiated universe. This natural process is described by 1<sup>st</sup> cosmological law being formularized by equation of the great ultimate.

2<sup>nd</sup> cosmological law is an vehicle to get unified solution in physics to physical quantities of the universe, which is also called as cosmological expression of Copernicus principle.

3<sup>rd</sup> cosmological law reveals operational mechanism of *CST*, that is principle of information being materialized, it briefly said that information interacts with cosmic vacuum creates holographic image of the universe which is composed of all events happening in an universal moment(gauged time), instantaneously the holographic image condenses parallel into all kinds of physical realities (physical elements) with specific amounts.

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