Dark matters, gravational force, neutron life-time anomaly and hadronization

Jae - Kwang   Hwang
JJJ Physics Laboratory, Brentwood, TN 37027, USA
E-mail: jkhwang.koh@gmail.com

The properties of the dark matter, dark energy, graviton and photon are discussed in terms of the new three-dimensional quantized space model. Three new particles (bastons) with the electric charges (EC) are proposed as the dark matters. It is proposed that the EC, LC and CC charges are aligned along the time axes but not along the space axes. The photon is confined on its corresponding three-dimensional quantized space. However, the graviton can be evaporated into other three-dimensional quantized spaces. The rest mass of the electron neutrino (ν_e) of $3.494 \cdot 10^{-3}$ eV/c^2 is obtained from the experimental vacuum energy density in terms of quantum field theory (QFT). The rest mass and force range of the massive g(0,0,0) graviton with the Planck size are $m_g = 3.1872 \cdot 10^{-31}$ eV/c^2 and $x_r = 3.0955 \cdot 10^{23}$ m = 10.0 Mpc, respectively, based on the experimental rest mass and rms charge radius of the proton. The possible diameter (10 Mpc) of the largest galaxy cluster is remarkably consistent with the gravitational force range (10 Mpc). Then, the diameter of the largest dark matter distribution related to the largest galaxy cluster is $9.2865 \cdot 10^{23}$ m = 30 Mpc equal to the force range of the massive g(0) graviton with the rest mass of $1.0624 \cdot 10^{-31}$ eV/c^2. Because of the huge number (N) of the evaporated gravitons, the very small Coulomb's constant of about 10^{-48}k and large gravitation constant of $10^6 G_N$ are expected for the charged dark matters. Therefore, $F_c(mm) > F_g(dd) > F_g(mm) > F_g(dm) > F_c(dd) > F_c(dm) = 0$ for the proton-like particle. The proposed weak gravitational force between the dark matters and normal matters explains the observed dark matter distributions of the bullet cluster, Abell 1689 cluster and Abell 520 cluster. The transition from the galaxy without the dark matters to the galaxy with the dark matters are explained. Also, the accelerated space expansion is caused by the new space quanta created by the evaporated gravitons into the x1x2x3 space and repulsive electromagnetic force between dark matters corresponding to the dark energy. The decreasing coupling constant of the strong force, neutron lifetime anomaly and the pressure distribution inside the proton are explained by the unobservable proton and hadronization. And the rest mass of 1.4 TeV/c^2 is assigned to the Le particle with the EC charge of −2e. The proposed rest mass (26.12 eV/c^2) of the B1 dark matter is indirectly confirmed from the supernova 1987A data. Also, the gravitation constant has been changing with the time because of the graviton evaporation.

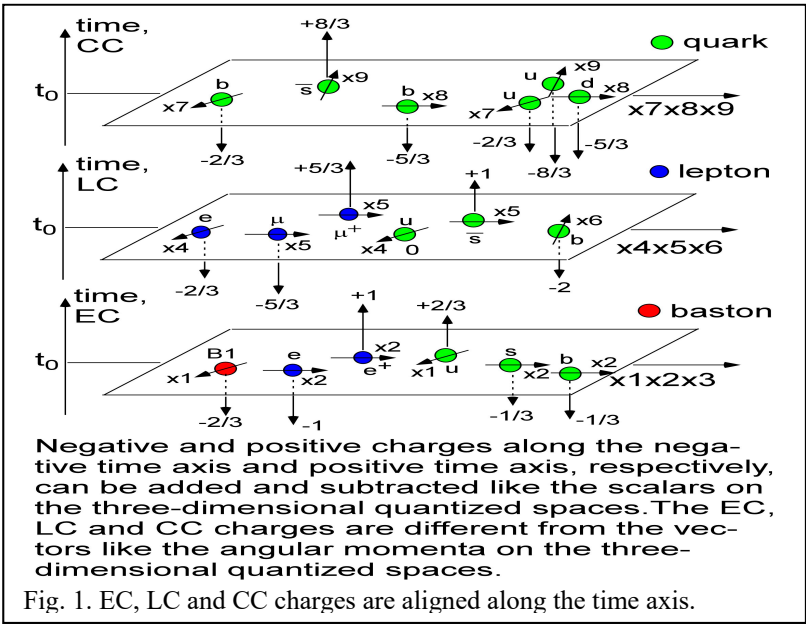
1.   Introduction

There are several unsolved questions in the particle physics and astrophysics. For example, the dark matters and dark energy are among those unsolved questions. Also, whether the graviton has the rest mass or not and why the gravitational force is very weak

Table 1. Elementary fermions in the three-dimensional quantized space model [1]. The bastons (dark matters) interact gravitationally but not electromagnetically with the electrons and protons because the bastons do not have the lepton (LC) and color (CC) charges. See Figs. 1 and 4.

	Bastons (EC)				Leptons(EC,LC)				Quarks(EC,LC,CC)			
	EC				EC				EC			
X1	-2/3	B1			0	ν_e	ν_μ	ν_τ	2/3	u	c	t
X2	-5/3	B2			-1	e	μ	τ	-1/3	d	s	b
X3	-8/3	B3			-2	Le	Lμ	Lτ	-4/3	Q1	Q2	Q3
Total	-5				-3				-1			
	Dark matters				LC				LC			
X4					-2/3	ν_e	e	Le	0	u	d	Q1
X5	Each flavor (charge) corresponds to each dimensional axis.				-5/3	ν_μ	μ	Lμ	-1	c	s	Q2
X6					-8/3	ν_τ	τ	Lτ	-2	t	b	Q3
Total					-5				-3			
									CC			
X7	Baryon: CC = -5 (3 quarks)								-2/3(r)			
X8	Meson: CC = 0 (quark - anti quark) Paryon: LC = -5 (3 leptons)								-5/3(g)			
X9	Koron: LC = 0 (lepton - anti lepton)								-8/3(b)			
Total									-5			

Negative and positive charges along the nega-
tive time axis and positive time axis, respectively,
can be added and subtracted like the scalars on
the three-dimensional quantized spaces. The EC,
LC and CC charges are different from the vec-
tors like the angular momenta on the three-
dimensional quantized spaces.

Fig. 1. EC, LC and CC charges are aligned along the time axis.

compared with other forces are, also, the important questions which need to be solved. There are several extended standard models which include the new particles like the SUSY particles, techniquarks, leptoquarks, Z-prime boson, W-prime boson, heavy quarks

(T, B, X and Y), sterile ν, neutralinos, X- and Y- bosons, WIMPS, axions and preons. However, the experimental evidences for these new particles are still needed for the further researches. Recently, the possible answers for the origins of the dark matters and high energy cosmic rays were proposed in terms of the three-dimensional quantized space model with the new elementary fermions as shown in Table 1 [1,2]. And, in the present work, the properties of the dark matter, dark energy, massive graviton and photon are

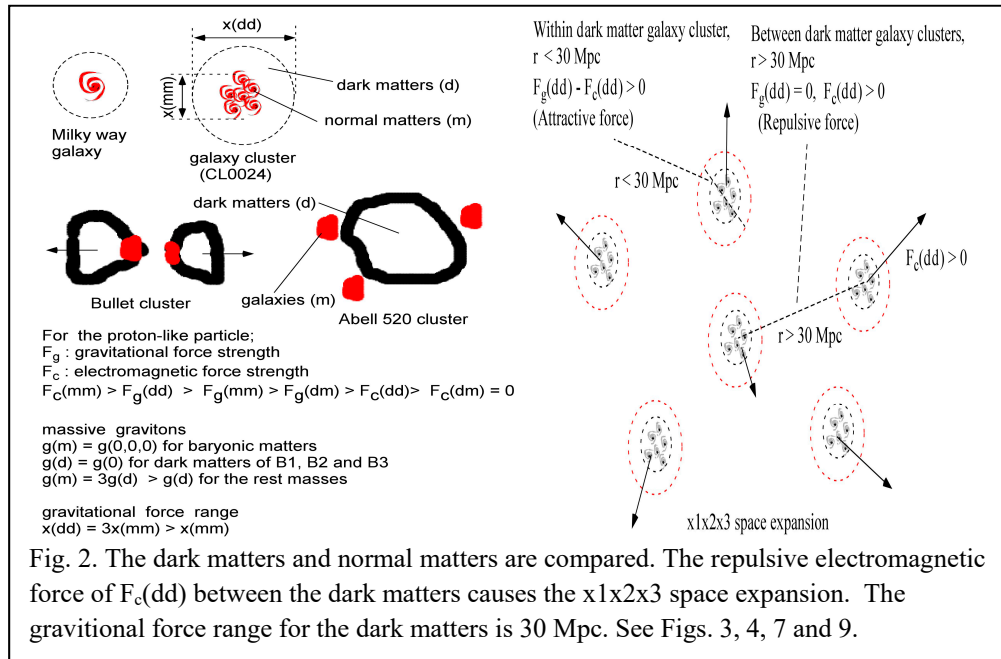
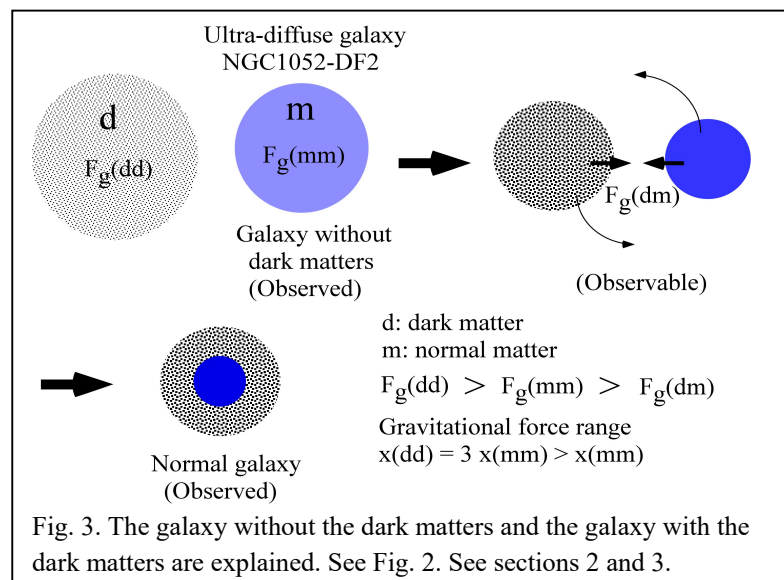
Fig. 2. The dark matters and normal matters are compared. The repulsive electromagnetic force of $F_c(dd)$ between the dark matters causes the x1x2x3 space expansion. The gravitional force range for the dark matters is 30 Mpc. See Figs. 3, 4, 7 and 9.

discussed in terms of the new three-dimensional quantized space model. And the space evolution is described by using the graviton evaporation, too. In the three-dimensional quantized space model, three generations of leptons and quarks correspond to the lepton charges (LC) in Table 1. Then, the leptons have the electric charges (EC) and lepton charges (LC). The quarks have the EC, LC and color charges (CC). Three heavy leptons and three heavy quarks are introduced to make the missing third flavor of EC. Then the three new particles which have the electric charges (EC) are proposed as the bastons (dark matters). The three dark matters (B1, B2, B3), three heavy leptons (Le, Lμ, Lτ) and three heavy quarks (Q1, Q2, Q3) are introduced [1,2]. The EC, LC and CC charges are aligned along the time axes as shown in Fig. 1. Then, each quantized charge is associated with the corresponding space axis as shown in Table1 and Fig. 1. The EC, LC and CC charges can be added and subtracted like the scalars on the three-dimensional quantized spaces. From this definition of the charges, the EC, LC and CC charges should be conserved in the particle decay and reaction processes. It is called the EC, LC and CC charge conservations [1].

Fig. 3. The galaxy without the dark matters and the galaxy with the dark matters are explained. See Fig. 2. See sections 2 and 3.

And the gravitational force between the dark matters should be stronger than the electromagnetic force between the dark matters as shown in Figs. 2, 3, and 4. The gravitational lensing measurements of the bullet cluster, Abell 1689 cluster and Abell 520 cluster are the direct evidence of the weak gravitational force between the dark matters and normal matters in Fig. 2. And, the bastons are described as (EC). These new particles have the properties of the dark matters. These new particles interact gravitationally but not electromagnetically with the electrons, protons and quarks because the bastons do not have the lepton (LC) and color (CC) charges in Fig. 4, and Table 1. And the bastons should have the long half-lives because of the lack of the decay channels as shown in Table 1. Then, the bastons are considered as the dark matters in Fig. 4. The dark matters and normal matters are compared in Fig. 4. The x1x2x3 space is the space where we live. Therefore, the bastons are dark matters and the quarks are the unobservable particles with the g(0,0) photon. This explains the reason why each quark is not observed experimentally to us on the x1x2x3 space. Also, the leptons interact gravitationally but not electromagnetically with the quarks because the leptons do not have the color (CC) charges.

The leptons can interact electromagnetically with the hadrons like protons because the hadrons of the mesons and baryons have the color charges of 0 and -5, respectively [1,2]. It is because the mesons have the zero CC charge state and the baryons have the complete three-dimensional CC charge state of CC = -5 separated from the one-dimensional EC and LC charge states in Fig. 4. Therefore the charge configurations of the baryons and mesons can be assigned as (EC,LC) the same as the charge configurations of the leptons in Fig. 4. It is called as the hadronization (leptonization) with the quark confinement in terms of the charge configuration [1]. Then the hadrons of the baryons and mesons can be observed experimentally to us on the x1x2x3 space by the electromagnetic interactions with the leptons through the $\gamma(0,0)$ photons in Fig. 4. And the decreasing coupling constant of the strong force, neutron lifetime anomaly and the pressure distribution inside the proton are explained by the unobservable proton and hadronization in section 5. The rest mass of 1.4 TeV/c^2 is assigned to the Le particle with the EC charge of -2e in section 6. The proposed rest mass (26.12 eV/c^2) of the B1 dark matter is indirectly confirmed from the supernova 1987A data in section 7. The rest mass of the electron neutrino (ν_e) of 3.494 10^{-3} eV/c^2 is obtained from the QFT vacuum energy density equal to the experimental vacuum energy density.

The photons and gravitons are defined to have the zero charges of EC, LC and CC in three-dimensional quantized space model. The difference between the graviton and photon is that the graviton and the photon build the three-dimensional quantized space wave without the charge dependence and the electromagnetic wave with the charge dependence, respectively. This means that the g(0), g(0,0) and g(0,0,0) gravitons in Fig. 4 are changed to each other, and can be spread out and evaporated to other three-dimensional quantized spaces. It is defined as the graviton evaporation in the present work in Fig. 4. And because the photon forms the electromagnetic wave with the charge dependence, the $\gamma(0)$, $\gamma(0,0)$ and $\gamma(0,0,0)$ photons in Fig. 4 are confined within their corresponding three-dimensional quantized spaces of the x1x2x3, x4x5x6 and x7x8x9 spaces, respectively. It is defined as the photon confinement in Fig. 4. The dark matter force through the Z/W/Y(EC) bosons, the weak force through the Z/W/Y(EC,LC) bosons and the strong force through the Z/W/Y(EC,LC,CC) bosons are confined into the x1x2x3, x4x5x6 and x7x8x9 spaces, respectively, because of the charge dependence [1]. This explains that the dark matters of bastons interact with the matters by the gravitational force but not by the electromagnetic force in Fig. 4.

The rest mass of the graviton has been proposed to be < 6 10^{-34} eV and ~10^{-32} eV [3] based on the possible size (x = 3 10^{26} m) of the observable universe and the gravitational Compton wavelength (x = h/(m_gc)). However, there is no direct experimental evidence of the massive graviton. In the present work, the rest mass and force range of the massive graviton with the Planck size are taken as m_g=3.1872 10^{-31} eV/c^2 and x_r = 3.0955 10^{23} m = 10.0 Mpc, respectively, based on the experimental rest mass and rms charge radius of the proton [4,5]. The possible diameter (10 Mpc) of the largest galaxy cluster supports the massive graviton with the Planck size and the gravitational force range (10 Mpc). The proposed graviton force range of 10 Mpc is remarkably consistent with the proposed size (diameter = 10 Mpc) of the largest galaxy cluster which is the largest gravitational structure. Because of the massive graviton,

Table 2. Energies of the previously known particles are shown as the function of the possible sizes (radius, x (m)) of the particles from the equations of E = 8.1365 10^{38} x^2 for the leptons (ν_e,ν_μ,ν_τ, e, μ, τ) and E = 12.2047 10^{38} x^2 for the quarks, baryons and mesons based on the measured size and energy of the proton [5].

x(m)	E(eV)	particles
8.768(69)10^{-16}	938.27 10^6	p
1.229 10^{-22}	(10^{-4})	ν_e,ν_μ,ν_τ
2.506 10^{-17}	0.511 10^6	e
3.604 10^{-16}	105.7 10^6	μ
1.478 10^{-15}	1.777 10^9	τ
4.434 10^{-17}	2.4 10^6	u
6.271 10^{-17}	4.8 10^6	d
2.919 10^{-16}	104 10^6	s
1.020 10^{-15}	1.27 10^9	c
1.855 10^{-15}	4.2 10^9	b
1.184 10^{-14}	171.2 10^9	t
1.616 10^{-35} (Planck length)	3.1872 10^{-31}	graviton, g(0,0,0)

the gravitational potential needs to be changed to $U = -\frac{Gm_1m_2}{r}e^{-m_gr}$ following the Yukawa force effect. Here, m_g is E_g/c^2. This graviton has the zero charge. Also, it is discussed that the accelerated space expansion is caused by the new space addition created by the evaporated gravitons into the x1x2x3 space and repulsive electromagnetic force between dark matters corresponding to the dark energy.

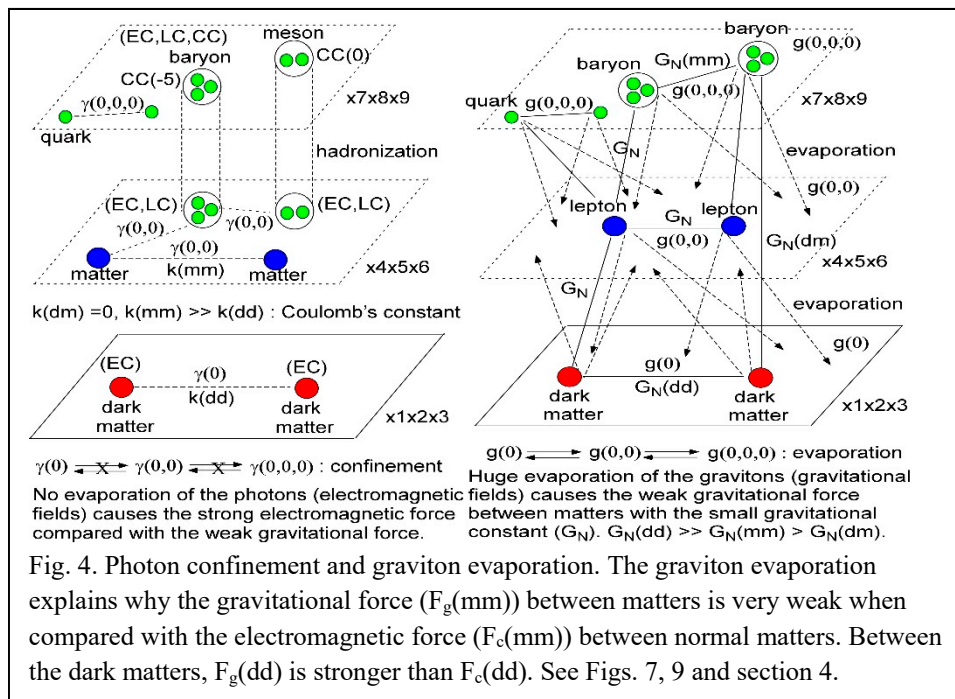
2.   Massive graviton and photon

In Table 2, the rest mass energies of the previously known particles are shown as the function of the possible sizes (radius, x (m)) of the particles from the equations of E(eV) = 8.1365 10^{38} x^2 for the leptons (ν_e,ν_μ,ν_τ, e, μ, τ) with the charge configuration of (EC,LC) and E(eV) = 12.2047 10^{38} x^2 for the quarks and hadrons (quarks, p, baryons, mesons) with the charge configuration of (EC,LC,CC). The equation of E(eV) = 12.2047 10^{38} x^2 is obtained from the measured proton size (charge radius: 8.768(69) 10^{-16} m) and proton energy (E=938.27 10^6 eV) [5]. The particle size prediction from these equations is within the reasonable range for the known particles in Table 2. The energy of the Planck size particle with the charge configuration of (EC,LC,CC) is 3.1872 10^{-31} eV

in Table 2 and Fig. 5. This Planck size particle is considered as the g(0,0,0) graviton for the quarks, baryons and mesons as discussed as follows.

The rest mass energies of the force carrying bosons [1,6,7] can be calculated by using the equations of $E_B = 9.866 \cdot 10^{-8}/x_r$ (eV) (x_r: m) and $m = E_B/c^2$. This E_B equation is obtained from the uncertainty principle of $\Delta E \Delta t \geq \hbar/2$. The Planck range of the force carrying boson is $x_r = 2x_p = 2 \cdot 1.616 \cdot 10^{-35}$ m $= 3.232 \cdot 10^{-35}$ m. From the equation of $E = 9.866 \cdot 10^{-8} / x_r$ (eV) obtained from the uncertainty principle of $\Delta E \Delta t = \hbar/2$, the Planck range boson has the energy of $3.0526 \cdot 10^{27}$ eV. The energy ($E = 3.0526 \cdot 10^{27}$ eV) of the present Planck range boson obtained from the uncertainty principle is consistent with the reduced Planck energy ($2.435 \cdot 10^{27}$ eV) and the Planck energy ($1.2209 \cdot 10^{28}$ eV) of the Planck mass. The Planck energy ($1.2209 \cdot 10^{28}$ eV) of the Planck mass has been calculated from $E = c^2 \sqrt{\frac{\hbar c}{G}}$. Another reduced Planck energy ($2.435 \cdot 10^{27}$ eV) of the Planck mass has been calculated from $E = c^2 \sqrt{\frac{\hbar c}{8\pi G}}$. Therefore, the Planck range boson is considered as the Planck mass in the present work.

The gravitational force between two matters is explained by the force carrying graviton (g). The largest gravitational system is the

Fig. 4. Photon confinement and graviton evaporation. The graviton evaporation explains why the gravitational force ($F_g(mm)$) between matters is very weak when compared with the electromagnetic force ($F_c(mm)$) between normal matters. Between the dark matters, $F_g(dd)$ is stronger than $F_c(dd)$. See Figs. 7, 9 and section 4.

galaxy cluster which has been known to have the largest diameter around 10 Mpc $= 3.08568 \cdot 10^{23}$ m [8]. Therefore, in the present work, the gravitational force range is taken roughly as $x_r = 3.08568 \cdot 10^{23}$ m for the g(0,0,0) graviton which works on all of the baryons and mesons. Then, from the equations of $E_B = 9.866 \cdot 10^{-8}/x_r$ (eV) (x_r: m) and $m = E_B/c^2$ obtained from the uncertainty principle of $\Delta E \Delta t \geq \hbar/2$, the g(0,0,0) graviton has roughly the rest mass (m_g) around $3.19735 \cdot 10^{-31}$ eV/c². The obtained rest mass ($3.19735 \cdot 10^{-31}$ eV/c²) of the g(0,0,0) graviton is remarkably consistent with the rest mass ($3.1872 \cdot 10^{-31}$ eV/c²) of the Planck size particle calculated by using the equation of $E(eV) = 12.2047 \cdot 10^{38} x^2$ for the quarks, baryons and mesons in Table 2. Therefore, it is concluded that the graviton is the Planck size particle in Table 2. The matters are made mainly of the protons and neutrons. The range of the gravitational force for the matters can be calculated by using the rest mass ($3.1872 \cdot 10^{-31}$ eV/c²) of the Planck size particle in the equations of $E_B = 9.866 \cdot 10^{-8}/x_r$ (eV) (x_r: m) and $m = E_B/c^2$. The obtained range of the gravitational force is $3.0955 \cdot 10^{23}$ m $= 10.0$ Mpc. Of course, this is the diameter of the largest galaxy cluster controlled by the gravitational force in Fig. 5. The rest mass of the g(0,0) graviton is 2/3 of the rest mass of the g(0,0,0) graviton. The rest mass of the g(0,0) graviton is $2.13157 \cdot 10^{-31}$ eV/c². Also, the g(0) graviton has 1/3 of the rest mass of the g(0,0,0) graviton. Therefore, the rest mass of the g(0) graviton is $1.0624 \cdot 10^{-31}$ eV/c². Therefore, the force range of the g(0) graviton for the dark matters of the B1, B2 and B3 bastons is 30.0 Mpc $= 9.2865 \cdot 10^{23}$ m. The g(0) graviton decides the diameter of the dark matter distribution around the galaxy cluster. The galaxy cluster is made mostly of the baryons of protons and neutrons. The diameter of the largest dark matter distribution around the largest galaxy cluster is 30.0 Mpc $= 9.2865 \cdot 10^{23}$ m while the diameter of the largest galaxy cluster is $3.0955 \cdot 10^{23}$ m $= 10.0$ Mpc in Fig. 5. For each galaxy, the diameter of the dark matter distribution is three times bigger than the diameter of the normal matter distribution if all other conditions except the graviton are the same for the normal matters and dark matters. This can explain the outer dark matter and inner matter distributions of the observed galaxies and galaxy clusters. It is because the g(0,0,0) graviton mass for the matters is three times bigger than the g(0) graviton mass for the dark matters. Therefore, in the present work, it is concluded that the graviton can be called as the Planck size particle (boson) with the spin of 2 in Table 2. Therefore, the mass and force range of the massive g(0,0,0) graviton are taken as $m_g = 3.1872 \cdot 10^{-31}$ eV/c² and $x_r = 3.0955 \cdot 10^{23}$ m $= 10.0$ Mpc. The graviton with the Planck size has the spin of 2 and the photon has the spin of 1. Because of the massive graviton, the gravitational potential needs to be changed to $U = -\frac{Gm_1m_2}{r} e^{-m_g r}$ following the Yukawa force effect. Here, m_g is E_g/c^2.

The g(0) graviton and γ(0) photon connected to the dark matters are the baston (dark) graviton and baston (dark) photon, respectively. The g(0,0) graviton and γ(0,0) photon connected to the leptons are the lepton (normal) graviton and lepton (normal) photon, respectively. And the g(0,0,0) graviton and γ(0,0,0) photon connected to the quarks, baryons and mesons are the quark (unobservable)

graviton and quark (unobservable) photon, respectively. Also, the γ(0,0) photon is connected to the hadrons of baryons and mesons

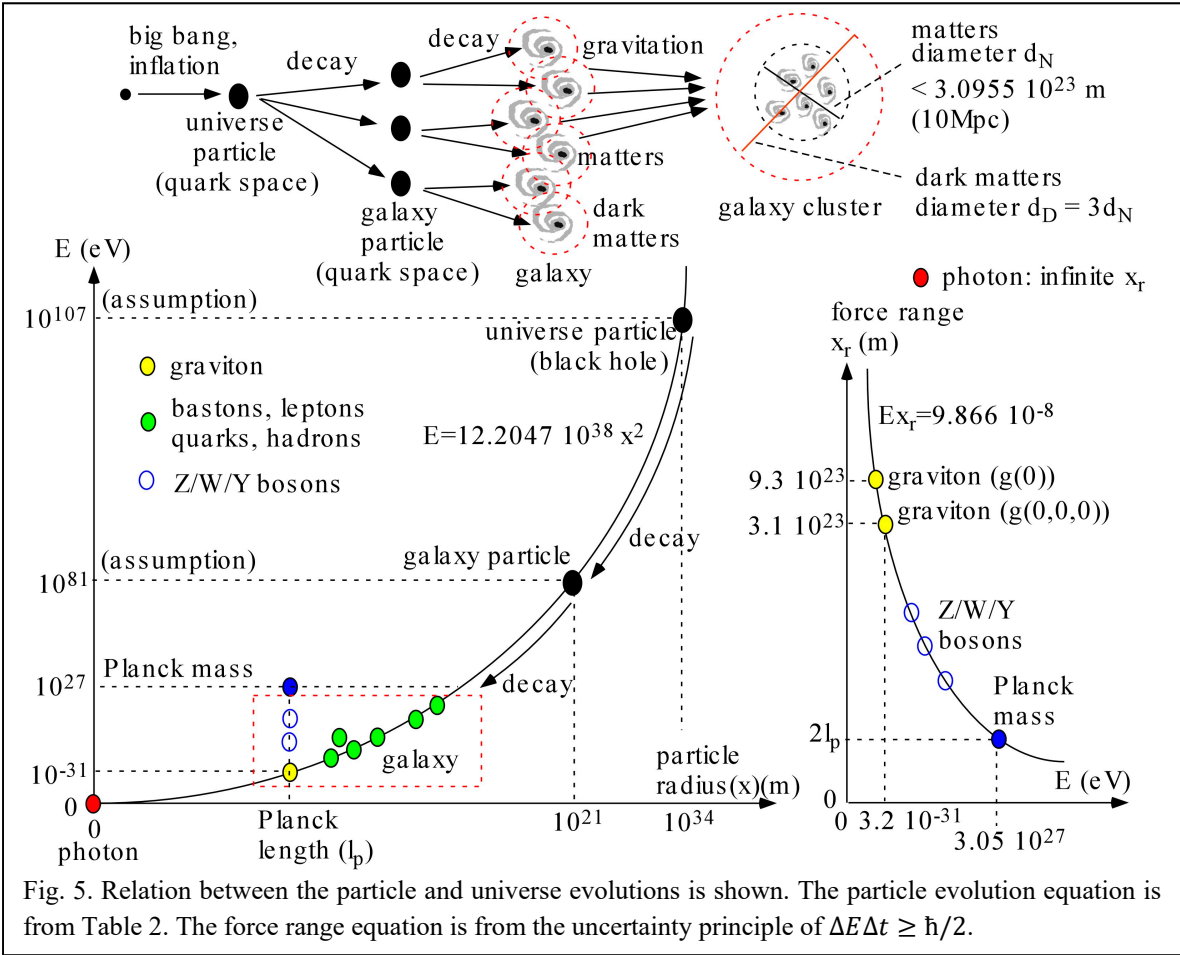
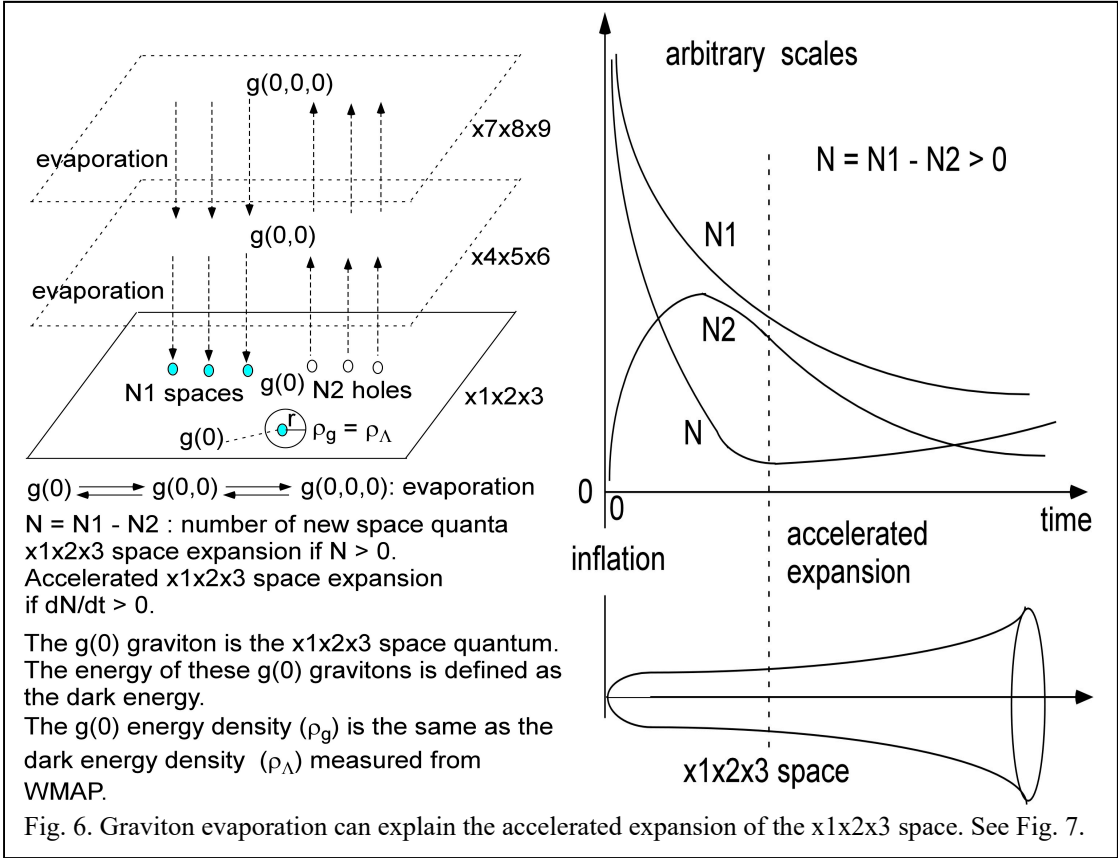
Fig. 5. Relation between the particle and universe evolutions is shown. The particle evolution equation is from Table 2. The force range equation is from the uncertainty principle of $\Delta E \Delta t \geq \hbar/2$.

through the hadronization of the quark confinement in terms of the charge configuration in Fig. 4. The difference between the graviton and photon is that the graviton and the photon build the three-dimensional quantized space wave without the charge

Fig. 6. Graviton evaporation can explain the accelerated expansion of the x1x2x3 space. See Fig. 7.

dependence and the electromagnetic wave with the charge dependence, respectively. This means that the g(0), g(0,0) and g(0,0,0) gravitons are changed to each other and can be spread out and evaporated to other three-dimensional quantized spaces as shown in Fig. 4. It is defined as the graviton evaporation in the present work. And because the photon forms the electromagnetic wave with

the charge dependence, the γ(0), γ(0,0) and γ(0,0,0) photons are confined within their corresponding three-dimensional quantized spaces of the x1x2x3, x4x5x6 and x7x8x9 spaces, respectively as shown in Fig. 4. It is defined as the photon confinement. The dark matter force through the Z/W/Y(EC) bosons, the weak force through the Z/W/Y(EC,LC) bosons and the strong force through the Z/W/Y(EC,LC,CC) bosons are confined into the x1x2x3, x4x5x6 and x7x8x9 spaces, respectively, because of the charge dependence [1,6,7].

Because the gravitons do not have the charge dependence, the gravitons can be exchanged between two particles with the different dimensions as shown in Fig. 4. Because of this property of the graviton, all particles have the gravitational effects on other particles. Unlike the graviton, photons have the charge dependence as the character of the electromagnetic wave. This means that all photons are confined to the corresponding space as shown in Fig. 4. It indicates that the photons cannot be exchanged between two particles which exist on the different three-dimensional quantized spaces in Fig. 4. Because of this property of the photon, all matters do not have the EC, LC and CC charge interaction effects on other dimensional matters without the hadronization. The EC, LC and CC charge interactions can be carried out by exchanging the photons between two matters confined on the same three-dimensional quantized space. This can explain the reason why the dark matters interact with the matters by the gravitational force but not by the electromagnetic force.

The gravitational force strength between matters is very weak when compared with the electromagnetic force, weak force and strong force. There is no clear explanation about this. One possible explanation has been tried by introducing the fourth space dimension connecting two three dimensional spaces [9,10]. One is our space with the weak gravitational interaction and another one is the separated space with the strong gravitational interaction. Then it is assumed that the gravitons are leaking from our space into another space through the fourth space dimension. Now I am going to solve this question in terms of the three-dimensional quantized space model in Figs. 4, 6 and 7. In the three-dimensional quantized space model, the gravitons can be evaporated and spread out into other three-dimensional quantized spaces as shown in Figs. 4, 6 and 7. The number of the evaporated gravitons should be huge because the measured Newton gravitational constant (G_N) between baryons in Fig. 4 is very small. And the huge evaporation condition of the gravitons into other spaces can explain the reason why the dark matters interact with the matters by the gravitational force but not by the electromagnetic force. Also, the evaporated gravitons are spread out on the wide three-dimensional space. Therefore, the density of the evaporated gravitons can be very small and constant as the density of the dark energy does. Note that, in Figs. 4 and 7, the gravitational constants (G_N) including the non-baryonic particles like the leptons and dark matters could be different from the measured gravitational constants (G_N) between the baryons. It is discussed in Fig. 7 and sections 3 and 4 that the gravitational force between the dark matters through the g(0) gravitons are stronger than the electromagnetic force through the γ(0) photons between the dark matters. Therefore, the distributions of the dark matters around the galaxies and galaxy clusters are controlled by the gravitational force rather than the electromagnetic force between the dark matters in Fig. 3.

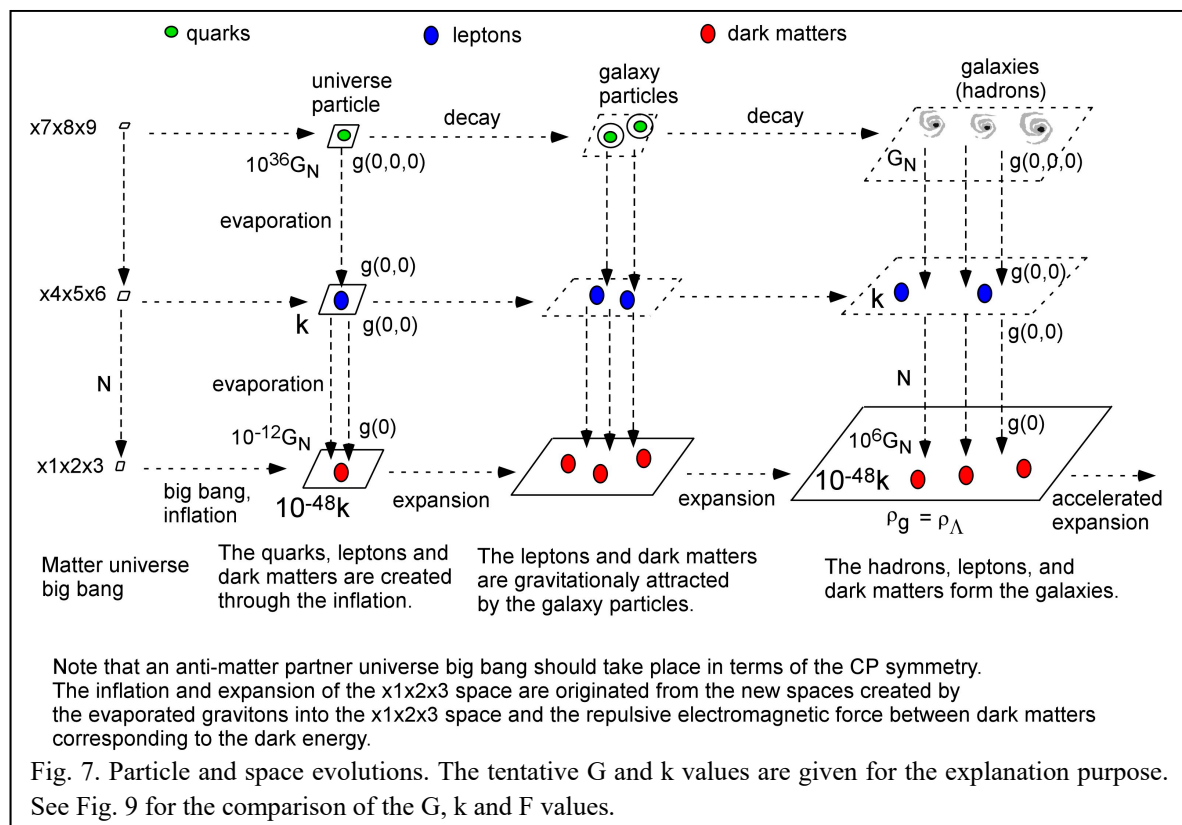
3. Dark matters, dark energy and evaporated gravitons

The graviton is the three-dimensional space particle (quantum) in Fig. 6. In other words, the gravitational wave is the three-dimensional space wave. This means that the evaporated gravitons can create and add the new spaces on the three-dimensional space. In the present work, most of the evaporated gravitons are transferred to the new three-dimensional spaces. And a few of them are absorbed to the particles for the gravitational interactions between the matter and dark matter in Figs. 4 and 6. For example, in Fig. 6, the number of the added gravitons (g(0)) into the x1x2x3 space is N = N1 - N2. Here, the N1 gravitons make the N1 new spaces and N2 gravitons create the N2 new holes in Fig. 6. The new created spaces cause the space expansion but the new created holes cause the space shrinking. The x1x2x3 space has the new spaces created by these added gravitons. Then, the x1x2x3 space should be expanded if N is positive. If the dN/dt rate is positive, the expansion of the x1x2x3 space should be accelerated. The x1x2x3 space is our space where we live. It has been observed that the space expansion is accelerated in WMAP [11] and supernova data [12,13]. Because of the accelerated space expansion, the dN/dt rate should be positive. The accelerated x1x2x3 space expansion came, for the first time, from the inflation at the big bang stage in Figs. 5 and 7. The x1x2x3 space inflation after the big bang can be explained by the huge number (N) of the evaporated gravitons in Figs. 6 and 7. These evaporated gravitons cause the inflation of the x1x2x3 space. The x1x2x3 space has experienced, for the second time, the accelerated expansion of the x1x2x3 space near the present time. This second expansion of the x1x2x3 space might be the possible evidence of the small inflation coming from the small bangs which take place within the x1x2x3 space. These small bangs like the super-nova explosions increase the number (N1 and N) of the evaporated g(0) gravitons into the x1x2x3 space in Fig. 6. The increasing number (N1 and N) of the evaporated gravitons in Fig. 6 explains the accelerated expansion of the x1x2x3 space at the present time. Also, the accelerated expansion of the x1x2x3 space can be explained by the positive dN/dt value if the decreasing rate (dN2/dt) of the N2 gravitons is faster than the decreasing rate (dN1/dt) of the N1 gravitons in Fig. 6. Then, it is concluded that the second accelerated expansion of the x1x2x3 space could be originated from the small bangs and the faster decreasing rate (dN2/dt). Therefore, the x1x2x3 spaces created by the evaporated gravitons can explain the inflation and expansion of the x1x2x3 space, and the energy of the evaporated gravitons can be considered as the dark energy in Fig. 7.

In Figs. 4 and 7, if the gravitons are confined within the corresponding space like the photons, the gravitation constant of G_N(mm) could be larger than the gravitation constant of G_N(dd) like k(mm) is larger than k(dd). In Figs. 2, 4 and 7, it is proposed that k(dd) is much smaller than k(mm) in order to explain the dark matter distribution of the galaxy cluster. And if the gravitons are evaporated to the other spaces, the gravitation constant of G_N(mm) can be smaller than the gravitation constant of G_N(dd). Experimentally, F_g(mm) = $8*10^{-37}$ F_c(mm) for the proton. Therefore, the G_N(mm) value is so small at the present time when compared with the k(mm) value. This indicates that the gravitons are evaporated as shown in Figs. 4 and 7. Because of the huge number (N) of the evaporated gravitons into the x1x2x3 space in Figs. 4, 6 and 7, the gravitational force between the dark matters on the x1x2x3 space should be stronger than the gravitational force between the matters of the baryons, leptons and mesons and the electromagnetic force between

dark matters. Because of the strong gravitational force between the dark matters, the charged dark matters of the B1, B2 and B3 bastons are distributed following the gravitational forces rather than the electromagnetic force between the dark matters. The observed dark matter distributions around the galaxies and galaxy clusters support the strong gravitational force between the dark matters. As shown in Figs. 2, 4 and 7, for the dark matters, $F_g(dd) > F_c(dd)$, for the matters $F_g(mm) << F_c(mm)$ and between the matter and dark matter $F_g(dm) > F_c(dm) = 0$. Here F_g and F_c are the gravitational force strength and electromagnetic force strength, respectively. Also, it is assumed that $G_N (dd) > G_N(mm) > G_N (dm)$ for the gravitation constant and $k(dm) = 0$, $k(mm) >> k(dd)$ for the Coulomb's constant in Figs. 4 and 7. Here d and m mean the dark matter and (normal) matter, respectively. Then, $F_c(dm) = 0$, $F_c(mm) >> F_c(dd)$ for the proton-like particle and $F_g(dm) < F_g(mm) < F_g(dd)$ for the proton-like particle. Also, $F_c(mm) > F_g(dd)$ in Figs. 2, 4 and 7. It has been observed from the gravitational lensing measurements for the bullet cluster [14], Abell 1689 cluster [15] and Abell 520 cluster [16] that the dark matters have been easily separated from the normal matters. The weak gravitational force with the small $G_N(dm)$ value between the dark matters and normal matters can explain why the dark matters are distributed as observed in the gravitational lensing measurements [14,15,16]. In other words, these gravitational lensing measurements [14,15,16] are the direct evidence of the weak gravitational force with the small $G_N(dm)$ value between the dark matters and normal matters. Therefore, the dark matters and normal matters around the galaxies are connected by the weak gravitational force which can affect the rotational motions of the normal matters. For the bullet cluster [14], the dark matters and normal matters are taking the head and tail parts, respectively, when the corresponding galaxy cluster is moving. The strong gravitational force with the longer force range of the g(0) graviton between the dark matters can make the location and shape of the dark matter distributions different from those of the normal matter distributions as observed in the Abell 1689 cluster [15] and Abell 520 cluster [16]. The weak gravitational force with the shorter force range of the g(0,0,0) graviton between the baryonic normal matters can make the location and the shape of the normal matter distributions as observed in the Abell 1689 cluster [15] and Abell 520 cluster [16], which have mostly the normal matters (galaxies) in the outside area and dark matters in the inside center area. Recently, the ultra-diffuse galaxy called as NGC1052-DF2 without the dark matters was found [17]. The formation of the galaxy without the dark matters can be explained under the assumptions of $F_g(dm) < F_g(mm) << F_g(dd)$ and $x(dd) = 3x(mm)$ in Fig. 3. The transition from the galaxy without the dark matters to the galaxy with the dark matters are shown in Fig. 3, too. Then the dark matter galaxy and matter galaxy can rotate as the pair by the $F_g(dm)$ force. Therefore, looking for the rotating pair of the dark matter and matter galaxies will be interesting.

Because the evaporated gravitons are spread out on the wide three-dimensional space, the density of the evaporated gravitons can be very small and constant as the density of the dark energy does. Then, the energy of the evaporated gravitons added on the x1x2x3 space is considered as the dark energy in Figs. 5, 6 and 7. The dark energy density is the energy density of the evaporated gravitons. The dark energy density of $7 \ 10^{-27}$ kg/m^3 was observed from the WMAP data [11]. The x1x2x3 space volume including one g(0) graviton can be calculated. The obtained radius and volume of the x1x2x3 space sphere containing one g(0) graviton in Fig. 5 are $1.8624 \ 10^{-14}$ m and $27.061 \ 10^{-42}$ m^3, respectively. Here, the g(0) graviton rest mass of $1.063 \ 10^{-31}$ eV/c^2 is used in the calculation. Also, if N = N1-N2 is negative, the x1x2x3 space lose the spaces. This means that the x1x2x3 space shrinks because of the evaporated

Fig. 7. Particle and space evolutions. The tentative G and k values are given for the explanation purpose.
See Fig. 9 for the comparison of the G, k and F values.

gravitons from the x1x2x3 space. If N = N1-N2 is zero, the evaporated gravitons do not make any effects on the space expansion.

Because the massive g(0) graviton has the force range of 30 Mpc, the galaxy clusters should get farther and farther because of the repulsive electromagnetic force of $F_c(dd)$ as shown in Fig. 2. It is because the photon has the infinite force range. Therefore, the x1x2x3 space expansion is caused by both of the $F_c(dd)$ repulsive force between the dark matter galaxy clusters and the evaporated

gravitons into the x1x2x3 space. In order to understand the dark energy, the $F_c(dd)$ repulsive force and the evaporated gravitons need to be considered for the further research.

The dark energy can be described as the ground state oscillation of the vacuum energy, also. Then the vacuum energy density (ρ) was derived in terms of the QFT (quantum field theory) [18].

$$\rho(QFT) = \frac{\hbar}{2\pi^2 c^3} \int_0^{\omega_{max}} \omega^3 d\omega = \frac{\hbar}{8\pi^2 c^3} \omega_{max}^4 = \frac{1}{8\pi^2 (\hbar c)^3} (\hbar \omega_{max})^4$$

As shown in Fig. 8, the maximum vacuum oscillation energy is $E_{max} = \hbar\omega_{max}$. When the Planck energy of $E_p = 1.2 \ 10^{19}$ GeV is taken as the maximum vacuum oscillation energy, the obtained vacuum energy density is $\rho(QFT) = 5.85 \ 10^{114}$ erg/cm^3 which is too big to explain the observed vacuum energy density of $\rho_{exp} = 6.29 \ 10^{-9}$ erg/cm^3 [11]. The huge vacuum energy density of $\rho(QFT) = 5.85 \ 10^{114}$ erg/cm^3 is one of the unsolved questions in physics that is called as the cosmological constant puzzle.

M_p: Planck mass
$G_N(mm) = G_N$: Newton's gravitation constant
ρ_{exp}: vacuum energy density
$\rho(QFT) = 2.64 \ (E_{max})^4$ erg/cm^3
$\rho_{exp} = 6.29 \ 10^{-9}$ erg/cm^3

E_{max}: maximum vacuum oscillation energy
E_{min}: minimum rest mass energy of a particle
$E(\nu_e)$: rest mass energy of an electron neutrino
$E_{max} = 2E_{min} = 2E(\nu_e)$,   energy unit: eV
From $\rho(QFT) = \rho_{exp}$,
$E(\nu_e) = 3.494 \ 10^{-3}$ eV

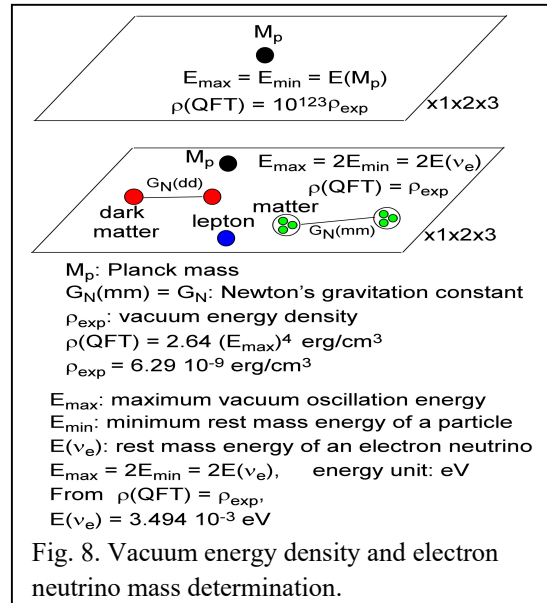



Fig. 8. Vacuum energy density and electron neutrino mass determination.

This problem is solved in the present work as follows. In Fig. 8, the x1x2x3 space is the background space where the particles are moving. The vacuum energy is calculated based on the x1x2x3 space. The space oscillation energy can be converted to the rest masses of the elementary particles like the quarks, leptons and dark matters by the pair production of the particle and anti-particle in Fig. 8 when this space oscillation energy is greater than the rest mass energies of the created particles. Therefore, in the present work, the vacuum oscillation energy is defined as the space energy which cannot be larger than the rest mass energy of the created particle pair. From this new definition, the minimum rest mass energy of the particles can be taken as the half of the maximum vacuum oscillation energy of $E_{max} = \hbar\omega_{max}$. In the x1x2x3 space without the elementary particles, the Planck energy of $E_p = 1.2 \ 10^{19}$ GeV can be taken as the maximum vacuum oscillation energy in Fig. 8. The vacuum energy density of $\rho(QFT) = 5.85 \ 10^{114}$ erg/cm^3 obtained on the x1x2x3 space without the elementary particles cannot explain the experimental vacuum energy density of $\rho_{exp} = 6.29 \ 10^{-9}$ erg/cm^3 observed on the x1x2x3 space with the elementary particles. And in the x1x2x3 space with the elementary particles of the dark matters (bastons), leptons and quarks, the rest mass energy of the electron neutrino (ν_e) can be used as the half of the maximum vacuum oscillation energy of $E_{max} = \hbar\omega_{max}$ as shown in Fig. 8. Therefore, from the relation of $\rho(QFT) = \rho_{exp} = 6.29 \ 10^{-9}$ erg/cm^3, the obtained rest mass energy of the electron neutrino (ν_e) is 3.494 10^{-3} eV. This one can be compared to the calculated one of 2.876 10^{-7} eV [1]. In other words, the rest mass of the electron neutrino (ν_e) is determined to be 3.494 10^{-3} eV/c^2 experimentally from the observed vacuum energy density of $\rho_{exp} = 6.29 \ 10^{-9}$ erg/cm^3 [11] in terms of the quantum field theory (QFT).

4.   Particle and space evolutions

In Figs. 5 and 7, the simple picture of the space evolution is shown from the big bang stage with the inflation. For the explanation purpose, the universe particle and galaxy particle are assumed as the quark (x7x8x9) space because it is in the huge kinetic energy state. The universe particle and galaxy particle, which are the quark spaces, follow the mass energy and radius relation of $E = 12.2047 \ 10^{38} \ x^2$ for the quarks, baryons and mesons based on the measured size and energy of the proton [5] in Table 2. The mass energy of the universe particle is assumed as $E \approx 10^{107} eV \approx 10^{71} \ kg \cdot c^2$ in the present work. Then the corresponding radius is $x \approx 10^{34} \ m$. Then the universe particle is the black hole. And the mass energy of the galaxy particle is assigned as $E \approx 10^{81} eV \approx 10^{45} \ kg \cdot c^2$ which decays up to several thousand galaxies because the mass energy of each galaxy is assigned as $E \approx 10^{78} eV \approx 10^{42} \ kg \cdot c^2$ [8]. Then the corresponding radius of the galaxy particle is $x \approx 10^{21} \ m$. It has been observed that the galaxy clusters with the maximum radius of $x \approx 10 \ Mpc \approx 10^{23} \ m$ consist of several hundred galaxies or several thousand galaxies [8]. Therefore, the mass of the proposed galaxy particle in Fig. 5 is reasonable.

Therefore, under this condition, the universe particle decays to the galaxy particles, which decay to galaxies. Then when the galaxy particle decays to the galaxies, the gravitational force works to build the galaxy clusters. The galaxy cluster is the largest gravitational structure. So, the diameter of the largest galaxy cluster corresponds to the gravitational force range of the massive graviton. Because the universe particle and galaxy particle are the quark spaces, the equation of $E(eV) = 12.2047 \ 10^{38} \ x^2$ for the quarks, baryons and

mesons are used in Fig. 5. The quark (x7x8x9) spaces have the quarks and Z/W/Y(EC,LC,CC) bosons [1,6,7]. The elementary particles are created from the decay of the galaxy particle to the galaxies. Then the force carrying Z/W/Y bosons are created along with the corresponding elementary particles. And the rest masses of the force carrying Z/W/Y bosons can be calculated by using the equations of $E_B = 9.866 \ 10^{-8}/x_r$ (eV) (x_r: m) and $m = E_B/c^2$. This E_B equation is obtained from the uncertainty principle of $\Delta E \Delta t \geq \hbar/2$. This curve is shown in Fig. 5. The rest mass of the graviton with the Planck size can be calculated from both equations of the $E(eV) = 12.2047 \ 10^{38} \ x^2$ and $E_B = 9.866 \ 10^{-8}/x_r$ (eV) in Fig. 5. Therefore, it is shown in Fig. 5 that the particle evolution can be explained in the relation with the universe evolution. In Fig. 7, the inflation and expansion of the x1x2x3 space are caused by the new spaces created by the evaporated gravitons corresponding to the dark energy. Also, note that the universe particle are the quark (x7x8x9) space black hole having the very high energy. The black hole can be evaporated by emitting the gravitons, which cause the expansion of the x1x2x3 space by increasing the number (N) of the evaporated gravitons in Fig. 6. In Figs. 5 and 7, our x1x2x3 universe are made of the matters and dark matters. The universe particle and galaxy particles are matters which decay to the matters. Therefore, in terms of the CP symmetry, the partner big bang and inflation should take place to make the anti-matters of the universe anti-particle and galaxy anti-particles which decay to the ant-matters. This indicates that the anti-matter universe should exist as the partner of our matter universe. Therefore, the anti-matter partner universe we cannot see is proposed in the present work [6,7]. And

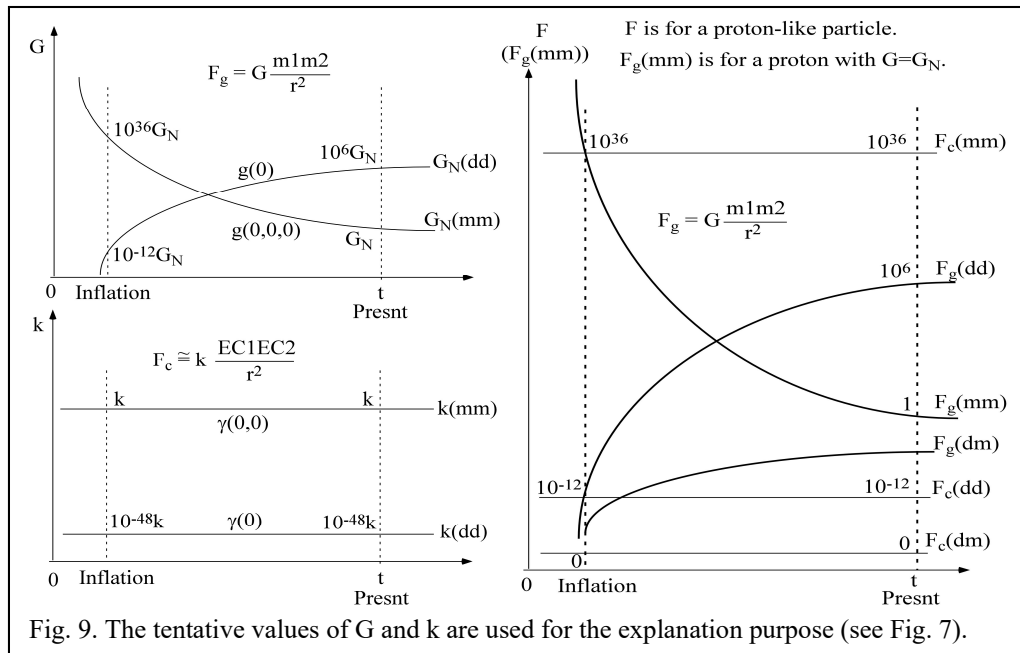



Fig. 9. The tentative values of G and k are used for the explanation purpose (see Fig. 7).

the elementary bosons, elementary fermions, the baryons and mesons are not the black holes because these particles can decay.

Also, in Fig 4, the photons are confined within the corresponding space. This indicates that the Coulomb's constant (k) does not change since the inflation. Therefore, always k(mm) >> k(dd) and k(mm) = k. However, the gravitation constant of G_N is different because the gravitons can evaporate into other spaces in Figs. 4 - 7. This indicates that the gravitation constant of G_N has been changing since the inflation. In other words, near the inflation period, $F_g(dd) << F_g(mm)$, $F_c(mm) > F_c(dd)$ with the condition of $G_N(mm) >> G_N(dd)$ and k(mm) >> k(dd) in Figs. 2, 7 and 9. Then, because of the graviton evaporation, $G_N(mm)$ has been decreasing and $G_N(dd)$ has been increasing since the inflation. At the present time, $F_g(dd) > F_g(mm)$, $F_g(dd) > F_c(dd)$ and $F_g(mm) \ll F_c(mm)$ with the condition of $G_N(mm) < G_N(dd)$ and k(mm) >> k(dd). At the present time, $F_c(mm) > F_g(dd) > F_c(dd)$ in the force strength and $F_g(dd) > F_g(mm)$. In other words, it is assumed that $G_N(dd) > G_N(mm) = G_N = G_N(qq) \approx G_N(ll)$.

The tentative numerical values of k and G in Figs. 7 and 9 are added just in order to show that the graviton evaporation and photon confinement can explain the relative force strengths of the electromagnetic interactions and gravitational interactions well. For example, it can be assumed that near the inflation $G_N(mm) \approx 10^{36}G_N$, and $G_N(dd) = 10^{-12}G_N$ in Figs. 7 and 9. This condition indicates that the matters forms the black holes with the very large Schwarzschild radius because of the large gravitation constant of $G_N(mm) \approx 10^{36}G_N$. Here Schwarzschild radius (R_s) is $R_s = 2MG/c^2$. It can be assumed that at the present time, $G_N(mm) = G_N$, and $G_N(dd) \approx 10^6 G_N$ because of the graviton evaporation in Figs. 7 and 9. This condition indicates that the matters forms the black holes with the small Schwarzschild radius because of the small gravitation constant of $G_N(mm) \approx G_N$. And, it can be assumed that always k(mm) $= k \approx 10^{48}k(dd)$.

At the present time, $F_g(mm) = 8 \ 10^{-37}F_c(mm) \approx 10^{-36}F_c(mm)$ for the proton. $F_c = F_c(EC) + F_c(LC) + F_c(CC) \approx F_c(EC) = k \frac{EC1EC2}{r^2}$ because k(EC) > k(LC) > k(CC) [6,7]. The lepton charge force of $F_c(LC)$ plays an important role for the neutrinos with the zero EC charges and non-zero LC charges [6,7]. Here it is assumed that the k and G values are similar for the leptons and quarks. Then $F_c(mm) \approx 10^{36}F_g(mm)$, $F_g(dd) = 10^6 F_g(mm)$ and $F_c(dd) = 10^{-12}F_g(mm)$ for a proton-like particle in Figs. 2, 3, 7 and 9. This assumption can explain the relation of, at present time, $F_c(mm) > F_g(dd) > F_g(mm) > F_g(dm) > F_c(dd) > F_c(dm) = 0$ for the proton-like particle in Figs. 2, 3, 7 and 9. For the B1 dark matter with the rest mass of 26.12 eV/c^2 [1], $F_g(dd) \approx 10^{-10}F_g(mm)$ and $F_c(dd) = \frac{4}{9} 10^{-12}F_g(mm)$ where $F_g(mm)$ is for the proton. Therefore, $F_g(dd) > F_c(dd)$ for the B1, B2 and B3 dark matters as shown in Fig. 3. This assumption can explain the reason why the gravitational force strength ($F_g(mm)$) between the matters is so weak compared with the electromagnetic force strength ($F_c(mm)$) between the matters. Therefore, it is concluded that the Coulomb's constant is constant because of the photon confinement but the gravitation constant has been changing since the inflation because of the graviton

evaporation along with the space evolution in Figs. 5-7 and 9. It is expected that the changing process of the gravitation constant between the matters from $G_N(mm) \approx 10^{36}G_N$ to $G_N(mm) = G_N$ happened mostly near the inflation period in Figs. 7 and 9. Therefore, during the most of the universe evolution the gravitation constant could be taken as $G_N(mm) = G_N$. This explanation with the

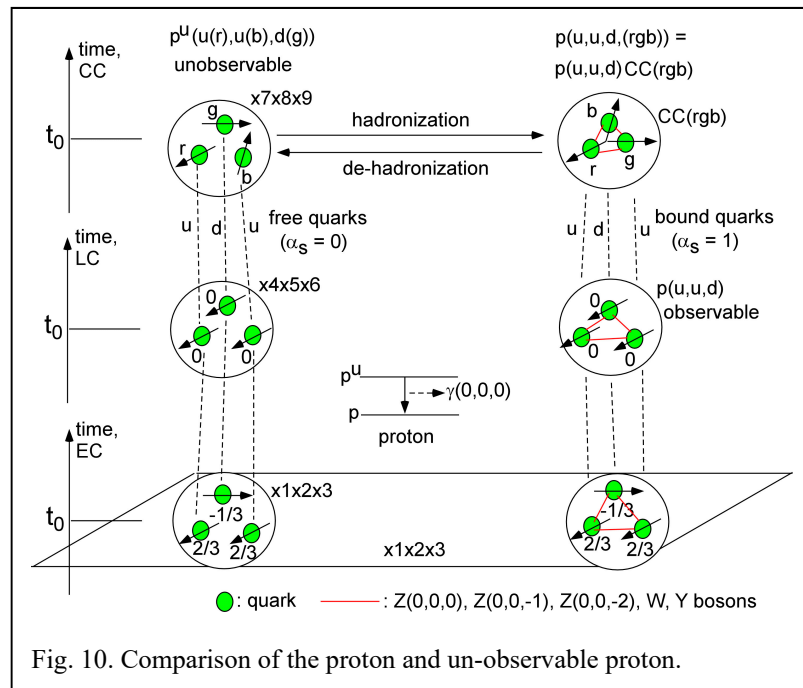



Fig. 10. Comparison of the proton and un-observable proton.

possible numerical values of k and G in Figs. 7 and 9 is only the example which needs to be further investigated in the future.

5.   Decreasing coupling constant of the strong force, neutron lifetime anomaly and pressure distribution inside the proton

In Figs. 1 and 4, the baryons are formed by the complete 3-dimenstional CC state of (rgb) with CC=-5. Then three quarks inside the proton space are strongly bound as shown for the proton in Fig. 10. Then strong force bosons of Z(0,0,0) Z(0,0,-1), Z(0,0,-2), W and Y bosons [1] are applied. These bosons play the roles similar to those the gluons play in the standard model. The EC, LC and CC charges of each quark inside the baryon are changed. For example, the proton has the u, u, and d quarks which are changed by exchanging the strong force bosons of Z(0,0,0) Z(0,0,-1), Z(0,0,-2), W and Y bosons [1] under the charge conservation of EC, LC and CC. The charge configuration of the proton is p(uud, (rgb)) = p(uud)CC(rgb). A p(uud) part of the proton can interact

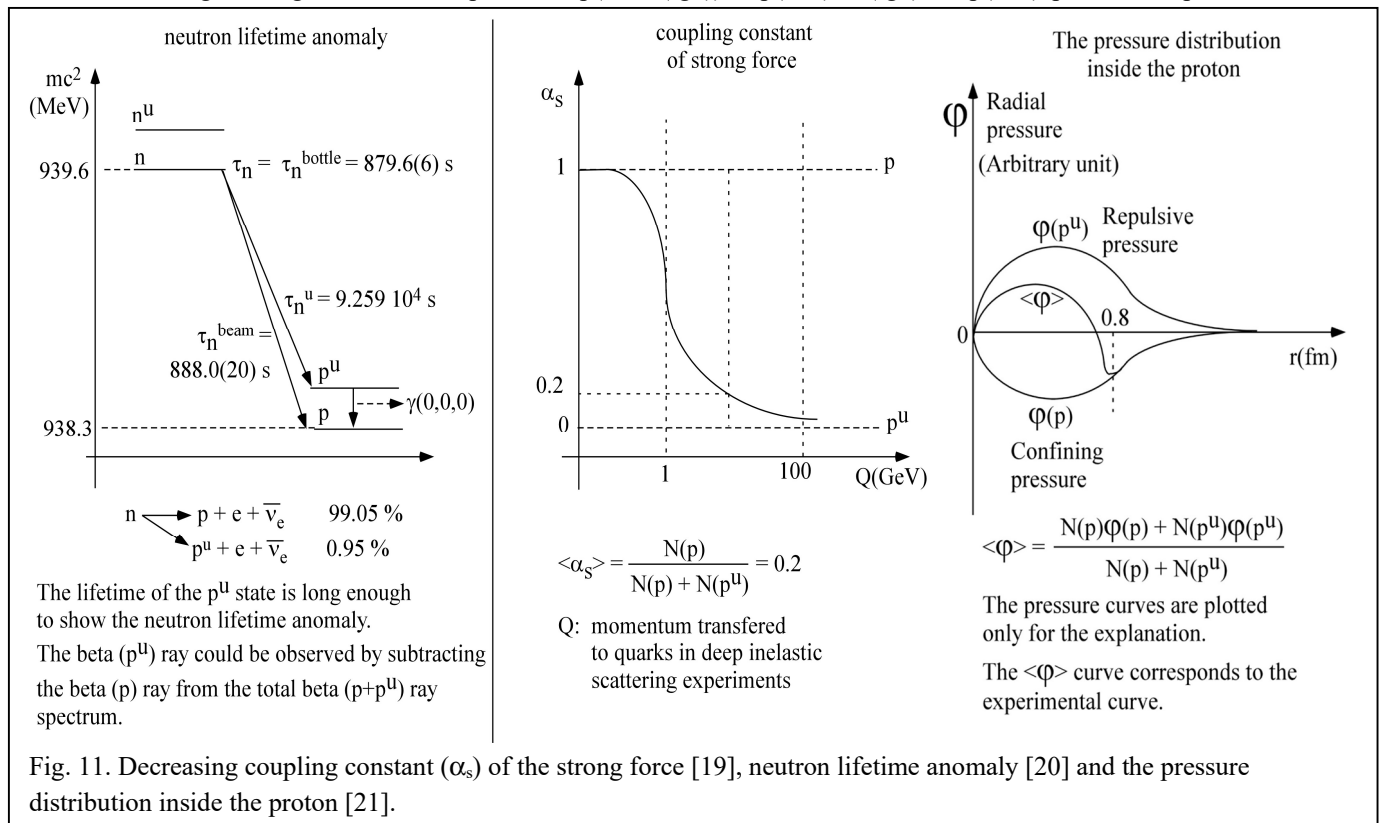



Fig. 11. Decreasing coupling constant (α_s) of the strong force [19], neutron lifetime anomaly [20] and the pressure distribution inside the proton [21].

electromagnetically with the leptons with the charge configuration of (EC,LC) because a 3-dimensional color charge state of CC(rgb) can be separated from the proton of p(uud,(rgb)). Therefore, a proton of p(uud,(rgb)) is observable with the $\gamma(0,0)$ photons and the leptons.

A proton can be de-hadronized by breaking the 3-dimensional CC(rgb) state of the three quarks. The de-hadronization makes three quarks move freely inside the proton space. The de-hadronized proton is defined as the un-observable proton of p^u in the present work. No strong force bosons are applied to three quarks inside the unobservable proton of p^u. If the coupling constant (α_s) of the strong force is 1 for the proton, then the coupling constant (α_s) of the strong force is 0 for the unobservable proton of p^u. And the charges of (EC,LC,CC) are conserved and fixed to each quark. For example, the charge configuration of the un-observable proton (p^u) is p(u(r),u(b),d(g)) in Fig. 10. Then an unobservable proton (p^u) cannot interact electromagnetically with the leptons with the charge configuration of (EC,LC) because the CC charges cannot be separated from the EC and LC charges. Therefore, an unobservable proton (p^u) is unobservable with the $\gamma(0,0)$ photons and the leptons.

The decreasing coupling constant (α_s) of the strong force [19] and neutron lifetime anomaly [20] are explained as shown in Fig. 11. The coupling constant (α_s) of the strong force is observed to be much smaller than 1 at the deep inelastic scattering experiment. This indicates that the quarks are free inside the hadron. Then the asymptotic freedom was introduced in the standard model. But in the present work, the decreasing coupling constant (α_s) of the strong force [19] is explained by introducing the unobservable proton in Fig. 11. The observed coupling constant (α_s) of the strong force [19] is the average value. For example, the average value of $< \alpha_s > = 0.2$ means that the 80 percent of protons are excited to the unobservable proton of p^u by the momentum transferred to the three quarks in the deep inelastic scattering experiment [19]. Another example is the neutron lifetime anomaly [20] in Fig. 10. The neutron lifetime is 879.6(16) s from the bottle experiments and 888.0(20) s from the beam experiments which give the lifetime difference of 8.4 s. This anomaly is explained by using the unobservable proton (p^u) in Fig. 10. The unobservable process is $n \rightarrow p^u + e + \overline{v}_e$ and the observable process is $n \rightarrow p + e + \overline{v}_e$. The branching ratio of the unobservable process is 0.95 %.

Recently, the pressure distribution which the quarks experience was observed inside the proton by using the deeply virtual Compton scattering of the electrons [21]. There is a confining pressure near the surface of the proton. However, at the deep inside of the proton there is a strong repulsive pressure. This opposite pressure is explained by using the unobservable proton in Fig. 11. The proton has the strongly bound state of three quarks which has the confining strong pressure. Then the quarks become free by absorbing the energy from the electrons. The proton with the bound quarks is changed to the unobservable proton with the free quarks. The unobservable proton has the free quarks which have the strong repulsive pressure. The electrons with the relatively low energy interact electromagnetically with the bound quarks by exchanging the photon of $\gamma(0,0)$ near the surface of the proton . And the electrons with the relatively high energy interact with the free quarks by exchanging the neutral bosons of Z(,0,0) and Z(0,0,0) at the deep inside of the proton. The neutral bosons of Z(0,0) and Z(0,0,0) can be changed into each other. The electrons do not interact electromagnetically with the free quarks because the electrons do not have the color charges. As shown in Fig. 11, it is

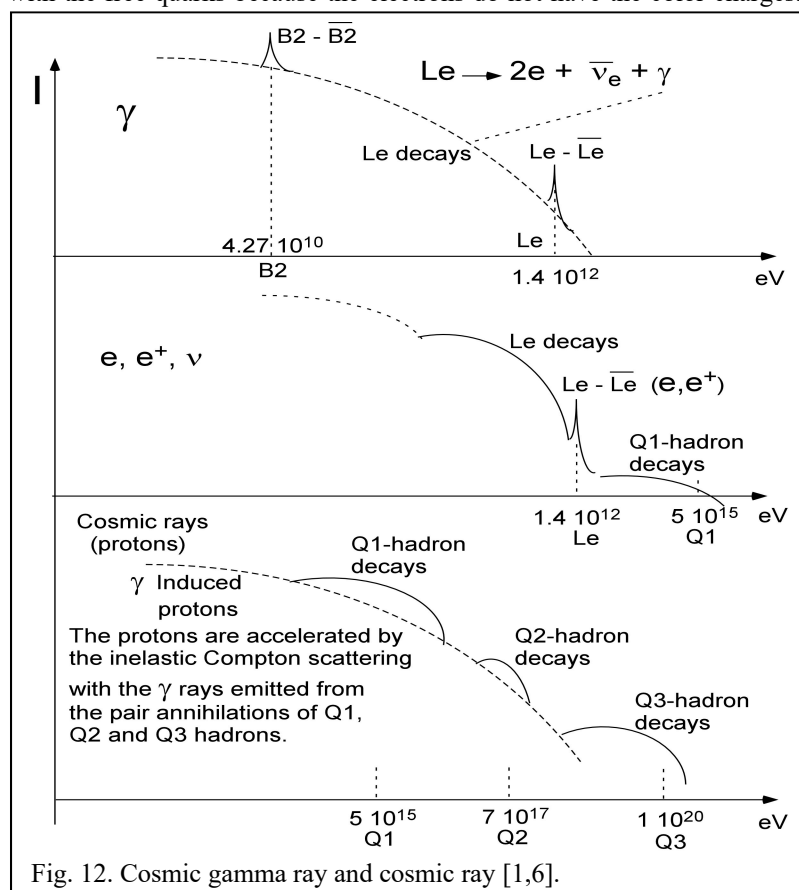



Fig. 12. Cosmic gamma ray and cosmic ray [1,6].

thought that the bound quarks within the proton has the strong confining pressure near the center of the proton. And the free quarks within the unobservable proton has the strong repulsive pressure near the center of the unobservable proton. The deeply virtual Compton scattering of the electrons [21] shows that the electrons interact electromagnetically with the bound quarks near the surface

of the proton by exchanging the photons of γ(0,0) and interact with the free quarks at the deep inside of the proton by exchanging the neutral bosons of Z(0,0) and Z(0,0,0) [1] as shown in Fig. 11. For example, the repulsive pressure for the quarks near the center of the proton means that some of protons are excited to the unobservable proton of p^u by the momentum transferred to the three quarks in deeply virtual Compton scattering of the electrons [21].

6.   Possible discovery of the Le lepton decay and annihilation

In Table 1, three heavy leptons with the EC charge of -2 are proposed. The rest mass energy of the Le particle is expected between 3 10^{11} eV and 3 10^{13} eV because the gamma ray excess was reported from the TeV gamma ray spectrum from RX J1713.7-3946 with HESS and Fermi-LAT data [22,23]. In the present work, this gamma ray excess is proposed as the gamma ray peak from the annihilation peak of Le and anti Le particles as shown in Fig. 12. And the cosmic-ray electron and positron excess at the energy range between 10^{11} eV and 2 10^{12} eV was observed from the data of DAMP (Dark Matter Particle Explorer) [24]. Also, the 1.4 TeV electron and positron peak was observed from the same data. And the 1.4 TeV peak observed at the cosmic ray is explained as the annihilation peak of Le and anti Le particles as shown in Fig. 12. Then, the rest mass of 1.4 TeV/c^2 is assigned to the Le particle with the EC charge of -2e. This rest mass of Le is smaller than the tentative previous rest mass (25.3 TeV/c^2) of Le [1]. And the cosmic-ray electron and positron excess at the energy range between 10^{11} eV and 2 10^{12} eV, which was observed from the data of DAMP (Dark Matter Particle Explorer) [24], is explained to be originated from the decay of Le particle as shown in Fig. 12. Here, $L_e \rightarrow 2e + \bar{v}_e$. And the cosmic gamma ray spectrum by CALET 5 year measurements [25] was observed from the Galactic center including galactic diffusing background. The 1.4 TeV gamma ray peak which was originated from annihilation peak of Le and anti Le particles was found [25]. The rest masses of Le, Lμ and Lτ leptons can be tentatively calculated by E = 0.4498 10^{38+2F} and F(EC,LC) = -23.24488 + 7.26341 |EC| - 1.13858 EC^2 + 0.62683 |LC| + 0.22755 LC^2. These data support the existence of heavy leptons like Le, Lμ and Lτ.

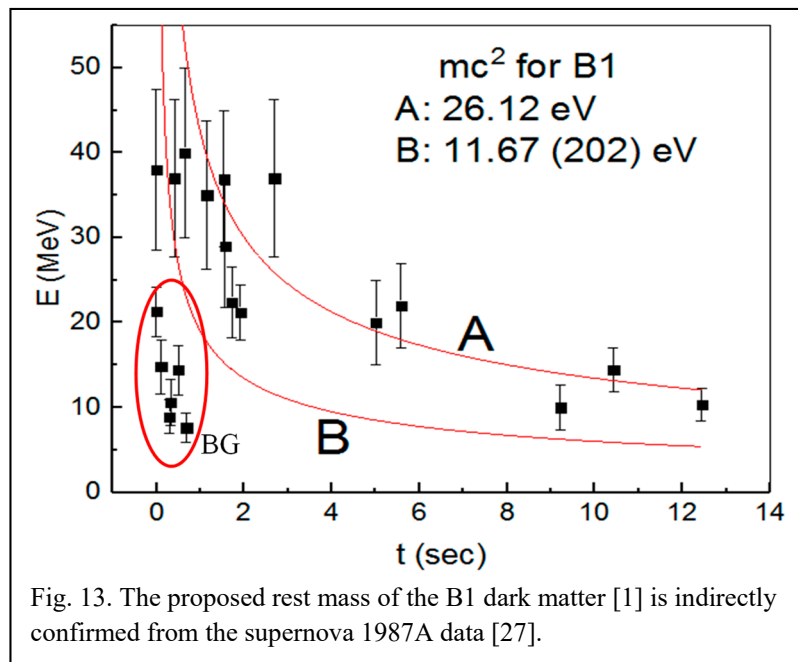



Fig. 13. The proposed rest mass of the B1 dark matter [1] is indirectly confirmed from the supernova 1987A data [27].

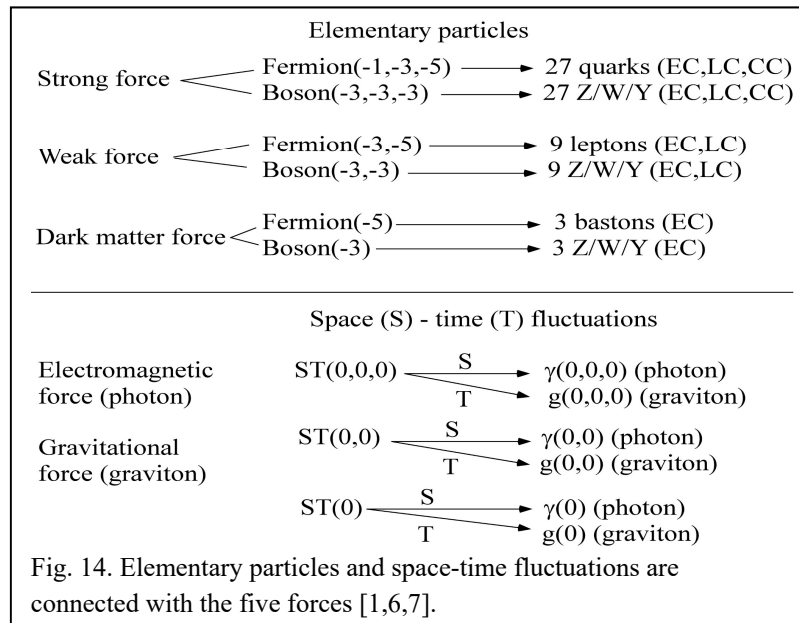
7.   Rest masses of the B1 and B2 dark matters

In Table 1, the B1, B2 and B3 dark matters (bastons) are proposed. Their possible rest masses have been tentatively calculated in ref. [1] under the assumption that the B2 dark matter has the 42.7 GeV/c^2 [24]. The 42.7(7) GeV peak was identified in the gamma-ray spectrum from the Fermi Large Area Telescope (LAT) in the directions of 16 massive nearby Galaxy Clusters [1,26]. The 42.7 GeV peak is proposed as the B2 annihilation peak. Then, the rest mass of the B2 dark matter is 26.12 eV/c^2 [1]. And the anti-neutrino data emitted from SN 1987A [27] were explained by using the annihilation of B1 and anti-B1 dark matters [1]. The Cherenkov radiation of the electrons produced from the elastic scattering of the anti-neutrino and electron was observed by the Kamiokande II detector, Irvine-Michigan-Brookhaven detector (IMB) and Baksan neutrino observatory detector (BNO) [27].

In the present work, the alternative explanation is tried to explain the SN 1987A data [27]. It is assumed that the Cherenkov radiation of the electrons produced from the elastic scattering of the B1 dark matter and electron was observed by the Kamiokande II detector, Irvine-Michigan-Brookhaven detector (IMB) and Baksan neutrino observatory detector (BNO) [27]. In Fig. 13, the curve A fits the observed data well except the 6 BG data. The equation of $2E^2t = m^2c^4t_0$ is taken from the paper by Ehrlich [27]. Here, t_0 is the travel time of the light from SN 1987A to the earth. The background data are expressed as BG in Fig. 13. The 5 data detected by the BNO detector considered as the background data are not shown in Fig. 13 [27]. The curve A uses the proposed dark matter mass of B1. It is proposed that the B1 particles come from SN 1987A to the earth. The energies, E(ν) of the observed neutrinos are re-interpreted

as the energies, E(B1) of the B1 dark matters. This supports indirectly that the rest mass of the B1 dark matter is 26.12 eV/c^2. The curve B fitted with all data in Fig. 12 is shown for the comparison with the curve A.

Also, the 130 GeV peak has been observed at the cosmic ray spectrum from the Fermi Large Area telescope in regions close to the Galactic center [28]. This peak is shaped around 125 GeV [6,28]. This peak is called the 125 GeV peak in the present work [6]. More statistics will make the better peak shape. The rest mass of the B2 dark matter is 42.7 GeV/c2. Therefore, the 125 GeV peak observed at the cosmic gamma ray spectrum is explained by the dark matter particle annihilation peak of the (B2 – anti B2) particle (B(0) particle) that is proposed as B(aram) particle with the rest mass energy of 125 GeV and the zero electric charge like the (u –

Fig. 14. Elementary particles and space-time fluctuations are connected with the five forces [1,6,7].

anti u) particle is the π^0 particle. Then, it can be thought that the 125 GeV peak proposed previously as the Higgs boson at LHC [29,30] is originated from the dark matter B(0) boson decay. The B(0) boson has the decay properties the same as the proposed Higgs boson. Therefore, the 125 GeV boson observed at CMS and ATLAS of LHC can be the dark matter B(0) boson or the Higgs boson.

8. Discoveries beyond standard model

In Fig. 14, the five forces of the dark matter force, weak force, strong force, electromagnetic force and gravitational force are shown along with the corresponding elementary fermions and bosons [1,6,7]. The photons and gravitons are understood as the space (S) and time (T) fluctuations [7], respectively. The more details can be found in Ref. [7]. And the Higgs bosons are discussed in Ref . [7], too. In Fig. 15, the p-p and p-e inelastic scattering is shown. For the p-e inelastic scattering, the unobservable proton with the

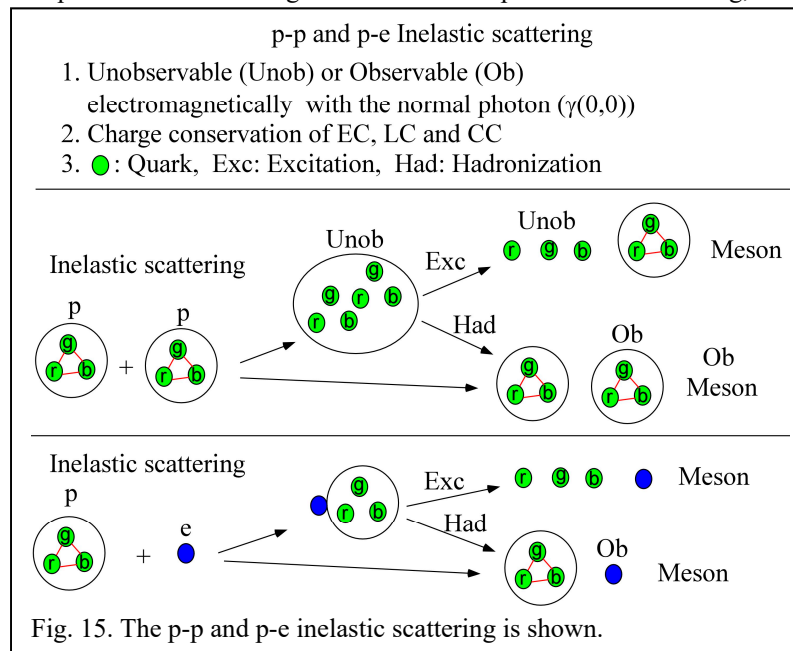



Fig. 15. The p-p and p-e inelastic scattering is shown.

free quarks can be formed by absorbing the energy from the high energy electrons. This unobservable proton can be hadronized to be changed to the proton or another baryon with the bound quarks. Also, this unobservable proton can be excited enough to emit the free quarks which cannot be observed electromagnetically with the normal photon of γ(0,0). For the p-p inelastic scattering, the unobservable quark space with the six free quarks can be formed by absorbing the energy from the high energy electrons. This unobservable proton can be hadronized to be changed to the two baryons with the bound quarks. Also, this unobservable quark

space with the six free quarks can be excited enough to emit the free quarks which cannot be observed electromagnetically with the normal photon of $\gamma(0,0)$. It will be interesting to investigate how to observe the effect of the emitted free quarks indirectly or directly through the neutral bosons and charged bosons with the zero CC charges.

The leptons charges should be conserved for the particle reactions and decays. The neutrinos have the different lepton charges as shown in Table 1. This indicates that the neutrinos are not the Majorana particle. Also, the charge forces have the three different parts of $F_c = F_c(EC) + F_c(LC) + F_c(CC)$ through $\gamma(0)$ for the bastons, through $\gamma(0,0)$ for the leptons and hadrons and through $\gamma(0,0,0)$ for the quarks and hadrons in Fig. 4 [1,31]. At the present time, $F_g(mm) = 8 \ 10^{-37}F_c(mm) \approx 10^{-36}F_c(mm)$ for the proton. $F_c = F_c(EC) + F_c(LC) + F_c(CC) \approx F_c(EC) = k \frac{EC1 EC2}{r^2}$ because $k(EC) > k(LC) > k(CC)$ [31,6,7]. The lepton charge force of $F_c(LC)$ plays an important role for the neutrinos with the zero EC charges and non-zero LC charges [31, 6,7]. Here it is assumed that the k and G values are similar for the leptons and quarks. Also, because the conserved lepton charges the lepton flavors cannot be mixed like the because of the conserved electric charges the electric charges cannot be mixed. Therefore, the neutrino oscillation effects are re-interpreted as the lepton charge force effects of the neutrinos. This lepton charge force effects for the neutrinos are not described in the present paper and can be seen in Ref. [31] for more details.

8.   Summary

Three generations of leptons and quarks correspond to the lepton charges (LC) in the present work. Then, the leptons have the electric charges (EC) and lepton charges (LC). The quarks have the EC, LC and color charges (CC). Three heavy leptons and three heavy quarks are introduced to make the missing third flavor of EC. Then the three new particles which have the electric charges (EC) are proposed as the bastons (dark matters). The three dark matters (B1, B2, B3), three heavy leptons (Le, Lμ, Lτ) and three heavy quarks (Q1, Q2, Q3) are introduced. Therefore, the particles have the charge configurations of (EC, LC, CC) in the present model. Because the mesons have the zero CC charge state and the baryons have the complete three-dimensional CC charge state separated from the one-dimensional EC and LC charge states, the charge configurations of the baryons and mesons can be assigned as (EC,LC) the same as the charge configurations of the leptons. It is called as the hadronization with the quark confinement in terms of the charge configuration. Then the hadrons can be observed experimentally to us on the x1x2x3 space by the electromagnetic interactions with the leptons. The EC, LC and CC charges are aligned along the time axes as shown in Fig. 1. Then, each quantized charge is associated with the corresponding space axis as shown in Table1 and Fig. 1. The EC, LC and CC charges can be added and subtracted like the scalars on the three-dimensional quantized spaces. From this definition of the charges, the EC, LC and CC charges should be conserved in the particle decay and reaction processes. It is called the EC, LC and CC charge conservations [1,6,7]. The decreasing coupling constant (α_s) of the strong force [19], neutron lifetime anomaly [20] and the pressure distribution inside the proton [21] are explained by introducing the unobservable proton of p^u and hadronization. The rest mass of 1.4 TeV/c^2 is assigned to the Le particle with the EC charge of -2e [24,25]. This rest mass of Le is smaller than the tentative previous rest mass (25.3 TeV/c^2) of Le [1]. The proposed rest mass (26.12 eV/c^2) of the B1 dark matter [1] is indirectly confirmed from the supernova 1987A data [26]. The rest mass of the electron neutrino (ν_e) of $3.494 \ 10^{-3}$ eV/c^2 is obtained from the QFT vacuum energy density equal to the experimental vacuum energy density.

The photons and gravitons are defined to have the zero charges of EC, LC and CC in three-dimensional quantized space model. The difference between the graviton and photon is that the graviton and photon build the three-dimensional quantized space wave without the charge dependence and the electromagnetic wave with the charge dependence, respectively. This means that the g(0), g(0,0) and g(0,0,0) gravitons are changed to each other and can be spread out and evaporated to other three-dimensional quantized spaces in Fig. 4. It is defined as the graviton evaporation in the present work. And because the photon forms the electromagnetic wave with the charge dependence, the $\gamma(0)$, $\gamma(0,0)$ and $\gamma(0,0,0)$ photons are confined within their corresponding three-dimensional quantized spaces of the x1x2x3, x4x5x6 and x7x8x9 spaces, respectively. It is defined as the photon confinement. The dark matter force through the Z/W/Y(EC) bosons, the weak force through the Z/W/Y(EC,LC) bosons and the strong force through the Z/W/Y(EC,LC,CC) bosons are confined into the x1x2x3, x4x5x6 and x7x8x9 spaces, respectively, because of the charge dependence. The graviton does not have the charge dependence of EC, LC and CC. This implies that the g(0), g(0,0) and g(0,0,0) gravitons can be transformed to each other. Therefore, the gravitons can be spread out and evaporated to other three-dimensional quantized spaces. This transformation is defined as the evaporation of the gravitons into other three-dimensional quantized spaces.

$F_c = F_c(EC) + F_c(LC) + F_c(CC) \approx F_c(EC) = k \frac{EC1 EC2}{r^2}$ because $k(EC) > k(LC) > k(CC)$ [6,7]. The lepton charge force of $F_c(LC)$ plays an important role for the neutrinos with the zero EC charges and non-zero LC charges [31,6,7]. Here it is assumed that the k and G values are similar for the leptons and quarks. Then $F_c(mm) \approx 10^{36}F_g(mm)$, $F_g(dd) = 10^6 F_g(mm)$ and $F_c(dd) = 10^{-12}F_g(mm)$ for a proton-like particle in Figs. 2, 3, 7 and 9. The G, k and F values are compared in Fig. 9. Because of the huge number (N) of the evaporated gravitons, the very small Coulomb's constant of about 10^{-48}k and large gravitation constant of $10^6 G_N$ are expected for the charged dark matters. Therefore, $F_c(mm) > F_g(dd) > F_g(mm) > F_g(dm) > F_c(dd) > F_c(dm) = 0$ for the proton-like particle in Figs. 2, 3, 7 and 9. As shown in Figs. 2 and 4, for the dark matters, $F_g(dd) > F_c(dd)$ in the force strength, for the matters $F_g(mm) \ll F_c(mm)$ and between the matter and dark matter $F_g(dm) > F_c(dm) = 0$. Here F_g and F_c are the gravitational force strength and electromagnetic force strength, respectively. And, it is concluded that the Coulomb's constant (k) is constant because of the photon confinement but the gravitation constant has been changing because of the graviton evaporation along with the space evolution as shown in Figs. 4-7 and 9.

And the graviton is originated from the space excitation. This means that the new spaces created from the evaporated gravitons can induce the accelerated space expansion. Therefore, in the present work, the dark energy density is considered as the energy density of the evaporated gravitons. Because the massive g(0) graviton has the force range of 30 Mpc, the galaxy clusters should get farther

and farther because of the repulsive electromagnetic force of $F_c(dd)$ as shown in Fig. 2. Therefore, the x1x2x3 space expansion is caused by both of the $F_c(dd)$ repulsive force between the dark matter galaxy clusters and the evaporated gravitons into the x1x2x3 space. In order to understand the dark energy, the $F_c(dd)$ repulsive force and the evaporated gravitons need to be considered for the further research.

The graviton is the three-dimensional space particle (quantum). In other words, the gravitational wave is the three-dimensional space wave. Because the evaporated gravitons are spread out on the wide three-dimensional space, the density of the evaporated gravitons can be very small and constant as the density of the dark energy does. Then, the energy of the evaporated gravitons added on the x1x2x3 space is considered as the dark energy. The dark energy density of 7×10^{-27} kg/m^3 was observed from the WMAP data. The x1x2x3 space volume including one g(0) graviton can be calculated. The obtained radius and volume of the x1x2x3 space sphere containing one g(0) graviton are 1.8624×10^{-14} m and 27.061×10^{-42} m^3, respectively. Here, the g(0) graviton rest mass of 1.063×10^{-31} eV/c^2 is used in the calculation. The x1x2x3 spaces created by the evaporated gravitons can explain the inflation and expansion of the x1x2x3 space, and the energy of the evaporated gravitons can be considered as the dark energy. And, it is concluded that the accelerated expansion of the x1x2x3 space could be originated from the small bangs and the faster decreasing rate (dN2/dt) in Fig. 6. Also, it is shown that the particle evolution can be explained in the relation with the universe evolution. And the photons have the charge dependence of EC, LC and CC. This means that the g(0), g(0,0) and g(0,0,0) photons cannot be transformed to each other. Therefore, the photons are confined within the corresponding three-dimensional quantized space like the elementary particles. This explains that the dark matters of bastons interact with the matters by the gravitational force but not by the electromagnetic force. Also, note that the black holes can be the quark (x7x8x9) spaces having the very high energy. The black holes can be slowly evaporated by emitting the gravitons, which cause the expansion of the x1x2x3 space by increasing the number (N) of the evaporated gravitons in Fig. 6. In Fig. 7, the inflation and expansion of the x1x2x3 space are caused by the new spaces created by the evaporated gravitons corresponding to the dark energy. Because of the huge number (N) of the evaporated gravitons into the x1x2x3 space in Figs. 4, 6 and 7, the gravitational force between the dark matters on the x1x2x3 space should be much stronger than the gravitational force between the matters of the baryons, leptons and mesons and the electromagnetic force between dark matters. And the weak gravitational force with the small $G_N(dm)$ value between the dark matters and normal matters can explain why the dark matters are distributed as observed in the gravitational lensing measurements of the bullet cluster, Abell 1689 cluster and Abell 529 cluster. Recently, the ultra-diffuse galaxy called as NGC1052-DF2 without the dark matters was found [17]. The formation of the galaxy without the dark matters can be explained under the assumptions of $F_c(dd) < F_g(dm) < F_g(mm) < F_g(dd) < F_c(mm)$ and $x(dd) = 3x(mm)$ in Fig. 3. The transition from the galaxy without the dark matters to the galaxy with the dark matters are shown in Fig. 3, too.

The rest mass energies of the previously known particles are shown as the function of the possible sizes (radius, x (m)) of the particles from the equations of $E(eV) = 8.1365 \times 10^{38} x^2$ for the leptons ($\nu_\varepsilon, \nu_\mu, \nu_\tau, \varepsilon, \mu, \tau$) with the charge configuration of (EC,LC) and $E(eV) = 12.2047 \times 10^{38} x^2$ for the quarks and hadrons (quarks, p, baryons, mesons) with the charge configuration of (EC,LC,CC). The equation of $E(eV) = 12.2047 \times 10^{38} x^2$ is obtained from the measured proton size (charge radius: $8.768(69) \times 10^{-16}$ m) and proton energy ($E=938.27 \times 10^6$ eV) [5]. The particle size prediction from these equations is within the reasonable range for the known particles in Table 2. The energy of the Planck size particle with the charge configuration of (EC,LC,CC) is 3.1872×10^{-31} eV from the equation of $E(eV) = 12.2047 \times 10^{38} x^2$. This Planck size particle is considered as the g(0,0,0) graviton for the quarks, baryons and mesons. The normal matters are made of the protons and neutrons connected to the g(0,0,0) graviton. The range of the gravitational force for the normal matters can be calculated by using the rest mass (3.1872×10^{-31} eV/c^2) of the Planck size particle in the equations of $E_B=9.866 \times 10^{-8}/x_r$ (eV) (x_r: m) and $m = E_B/c^2$. The obtained range of the gravitational force is 3.0955×10^{23} m = 10.0 Mpc. Of course, this is the diameter of the largest galaxy cluster controlled by the gravitational force. The rest mass of the g(0) graviton is 1.0624×10^{-31} eV/c^2, which is 1/3 of the rest mass of the g(0,0,0) graviton. Therefore, the force range of the g(0) graviton is 30.0 Mpc = 9.2865×10^{23} m. The g(0) graviton decides the diameter of the dark matter distribution around the galaxy cluster. The galaxy cluster is made mostly of the baryons of protons and neutrons. The diameter of the largest dark matter distribution around the largest galaxy cluster is 30.0 Mpc = 9.2865×10^{23} m while the diameter of the largest galaxy cluster is 3.0955×10^{23} m = 10.0 Mpc. For each galaxy, the diameter of the dark matter distribution is three times bigger than the diameter of the normal matter distribution if all other conditions except the garviton are the same for the normal matters and dark matters. It is because the g(0,0,0) graviton mass for the hadrons is three times bigger than the g(0) graviton mass for the dark matters. Therefore, in the present work, it is concluded that the graviton can be called as the Planck size particle (boson) with the spin of 2. Therefore, the mass and force range of the massive graviton are taken as $m_g=3.1872 \times 10^{-31}$ eV/c^2 and $x_r = 3.0955 \times 10^{23}$ m = 10.0 Mpc. Because of the massive graviton, the gravitational potential needs to be changed to $U = -\frac{Gm_1m_2}{r}e^{-m_gr}$ following the Yukawa force effect. Here, m_g is E_g/c^2.

Recently, the pressure distribution which the quarks experience was observed inside the proton by using the deeply virtual Compton scattering of the electrons [21]. There is a confining pressure near the surface of the proton. However, at the deep inside of the proton there is a strong repulsive pressure. The deeply virtual Compton scattering of the electrons [21] shows that the electrons interact electromagnetically with the bound quarks near the surface of the proton by exchanging the photons of $\gamma(0,0)$ and interact with the free quarks at the deep inside of the proton by exchanging the neutral bosons of Z(0,0) and Z(0,0,0) [1] as shown in Fig. 9.

References

[1] Jae-Kwang Hwang, Mod. Phys. Lett. **A32**, 1730023 (2017);
      http://meetings.aps.org/Meeting/APR18/Session/G09.6 (talk at 2018 APS April meeting)
      and talk at phenomenology 2018 symposium.
[2] Jae-Kwang Hwang, PoS on 35th Int. Cosmic Ray Conf. (ICRC2017), 933 (2017).
[3] A.F. Ali and S. Das, *Phys. Lett.* **B741**, 276 (2015).

[4] P.J. Mohr, B.N. Taylor and D.B. Newell, *Rev. Mod. Phys.* **80**, 633 (2008).

[5] R. Pohl et al., *Nature* **466**, 213 (2010).

[6] Jae-Kwang Hwang, https://www.researchgate.net/publication/313247136

[7] Jae-Kwang Hwang, https://www.researchgate.net/publication/297270485

[8] http://en.wikipedia.org/wiki/Galaxy_cluster (2015).

[9] L. Randall and R. Sundrum, Phys. Rev. Lett. **83**, 3370 (1999).

[10] L. Randall and R. Sundrum, arXiv:hep-th/9906064 (1999).

[11] https://map.gsfc.nasa.gov/

[12] S. Perlmutter et al., Astrophys. J. **517**, 565 (1999).

[13] A.G. Riess et al., Astron. J. **116**, 1009 (1998).

[14] D. Clower et al., Astrophys. J. **604**, 596 (2004).

[15] A.N. Taylor et al., Astrophys. J. **501**, 539 (1998).

[16] M. Jee et al., Astrophys. J. **783**, 1 (2014).

[17] P. van Dokkum et al., Nature **555**, 629 (2018).

[18] S.E. Rugh and H. Zinkernagel, arXiv:hep-th/0012253 (2000).

[19] S. Bethke, arXiv: hep-ex/0606035 (2006).

[20] B. Fornal and B. Grinstein, arXiv: 1801.01124 (2018).

[21] V.D. Burkert et al., Nature **557**, 396 (2018)

[22] V. Gammaldi, arXiv: 1412.7639 (2014).

[23] S. Federicici et al., arXiv: 1502.06355v1 (2015).

[24] S.F. Ge and H.J. He, arXiv: 1712.02744 (2017).

[25] O. Adriani et al., EPJ Web of Conf. **95**, 04056 (2015).

[26] Y.F. Liang et al., Phys. Rev. **D93**, 103525 (2016).

[27] R. Ehrlich, Astropart. Phys. **35**, 625 (2012).

[28] C. Weiniger, arXiv: 1204.2797v1 (2012).

[29] CMS collaboration, Phys. Lett. **B716**, 30 (2012).

[30] ATLAS collaboration, Phys. Lett. **B716**, 1 (2012).

[31] Jae-Kwang Hwang, https://www.researchgate.net/publication/311312119