doi:10.20944/preprints201805.0203.v1

Article

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

Jae-Kwang Hwang

JJJ Physics Laboratory Brentwood, TN 37027 USA; jkhwang.kohl@gmail.com

Abstract: The properties of the dark matters, 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. The decreasing coupling constant of the strong force and neutron lifetime anomaly 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. 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 and force range of the massive g(0,0,0) graviton with the Planck size are $m_g = 3.1872\cdot10^{-31}$ eV/c^2 and $x_r = 3.0955\cdot10^{23}$ 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 $9.2865\cdot10^{23}$ m = 30 Mpc equal to the force range of the massive g(0) graviton with the rest mass of $1.0624\cdot10^{-31}$ eV/c^2. The reason why the gravitational force between normal matters is very weak when compared with other forces is explained by the graviton evaporation and photon confinement. Because of the huge number (N) of the evaporated gravitons into the x1x2x3 space, it is concluded that the gravitational force between dark matters should be much stronger than the gravitational force between the normal matters and the repulsive electromagnetic force between dark matters. 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. And the space evolution can be described by using these graviton evaporation and repulsive electromagnetic force, too.

Keywords: Fermionic dark matters; Neutron life-time anomaly; Massive graviton; Hadronization; Dark energy; Galaxy structure; Three-dimensional quantized space model.

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 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 , 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 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.

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 3.

	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)				-5/3	ν_μ	μ	Lμ	-1	c	s	Q2
X6	corresponds to each				-8/3	ν_τ	τ	Lτ	-2	t	b	Q3
Total	dimensional axis.				-5				-3			
									CC			
X7	Baryon: CC = -5 (3 quarks)								-2/3(r)			
X8	Meson: CC = 0 (quark - anti quark)								-5/3(g)			
X9	Paryon: LC = -5 (3 leptons)								-8/3(b)			
Total	Koron: LC = 0 (lepton - anti lepton)								-5			

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 as the EC, LC and CC charge conservations [1]. See the uploaded pdf files of the talks given at 2018 APS April meeting and Pheno 2018 conference for more details of the new physical concepts to be explained in this paper.

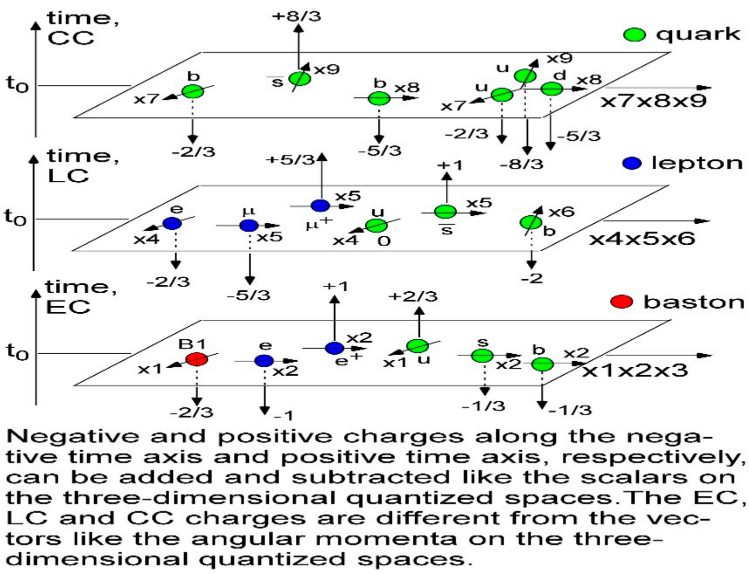
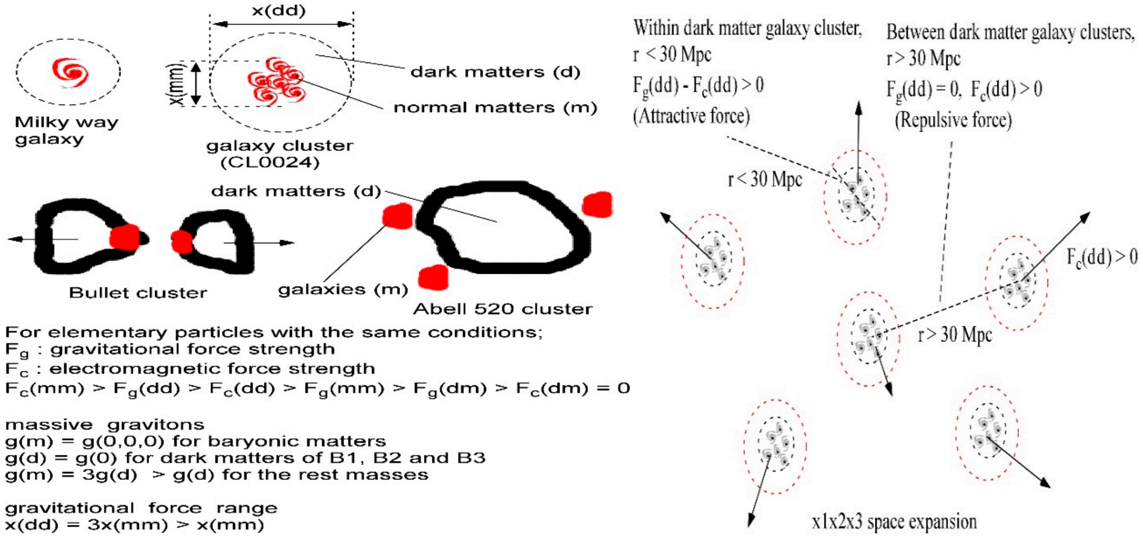


Figure 1. EC, LC and CC charges are aligned along the time axis.

 doi:10.20944/preprints201805.0203.v1

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. And the electromagnetic force between the dark matters is much weaker than the electromagnetic force between the matters 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



(a) (b)

Figure. 2. (a) The dark matters and normal matters are compared. (b) The repulsive electromagnetic force of F_c(dd) between the dark matters causes the x1x2x3 space expansion. The gravitional force for the dark matters has the force range (x(dd)) of 30 Mpc as explained in sections 2 and 3. See Fig. 3.

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 which are confined on the x4x5x6 space. This explains the reason why each quark is not observed experimentally to us on the x1x2x3 space.

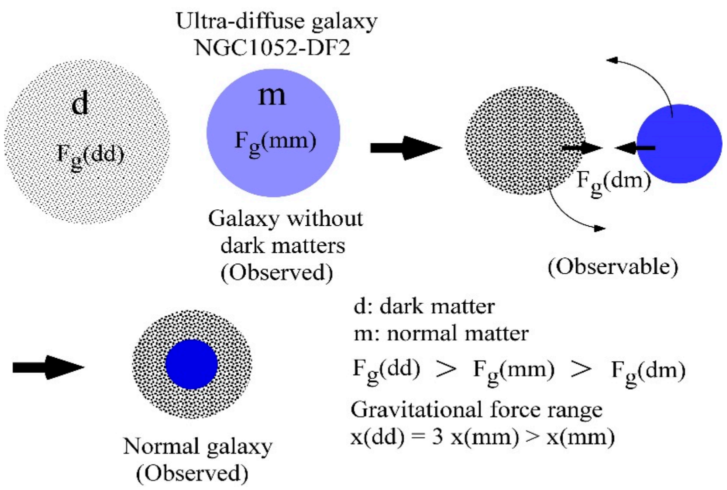
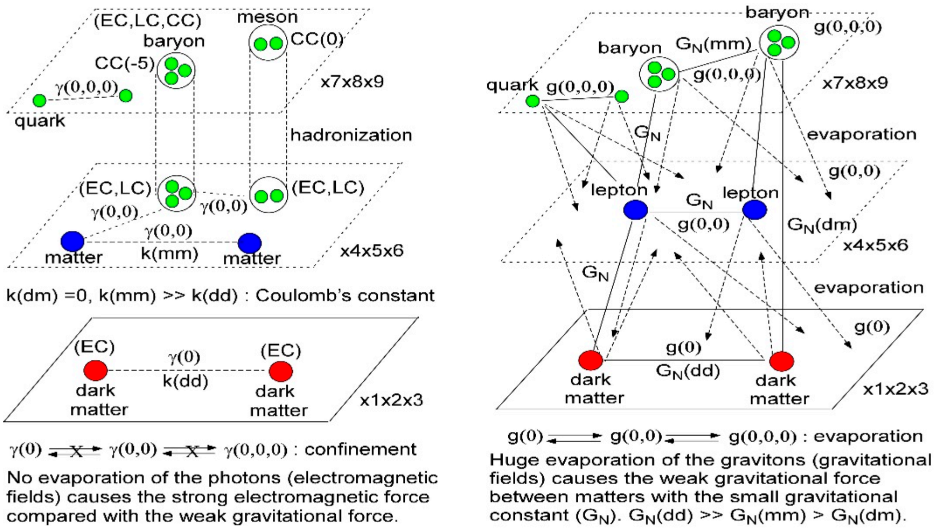


Figure. 3. The galaxy without the dark matters and the galaxy with the dark matters are explained. See Fig. 2. See sections 2 and 3.

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



(a) (b)

Figure 4. (a) Photon confinement and (b) 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 matters. Between the dark matters the gravitational force is stronger than the electromagnetic force.

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)

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 γ(0,0) photons in Fig. 4. And the decreasing coupling constant of the strong force and neutron lifetime anomaly 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 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. 3 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 γ(0), γ(0,0) and γ(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 is the reason why the gravitational force between the matters is so weak when compared with other forces in Fig. 4. 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 in Table 2 [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, 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. 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 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*1.616 10^{-35} m = 3.232 10^{-35} m. From the equation of E=9.866 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 10^{27} eV. The energy (E = 3.0526 10^{27} eV) of the present Planck range boson obtained from the uncertainty principle is consistent with the reduced Planck energy (2.435 10^{27} eV) and the Planck energy (1.2209 10^{28} eV) of the Planck

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 May 2018 doi:10.20944/preprints201805.0203.v1

mass. The Planck energy (1.2209 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 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.

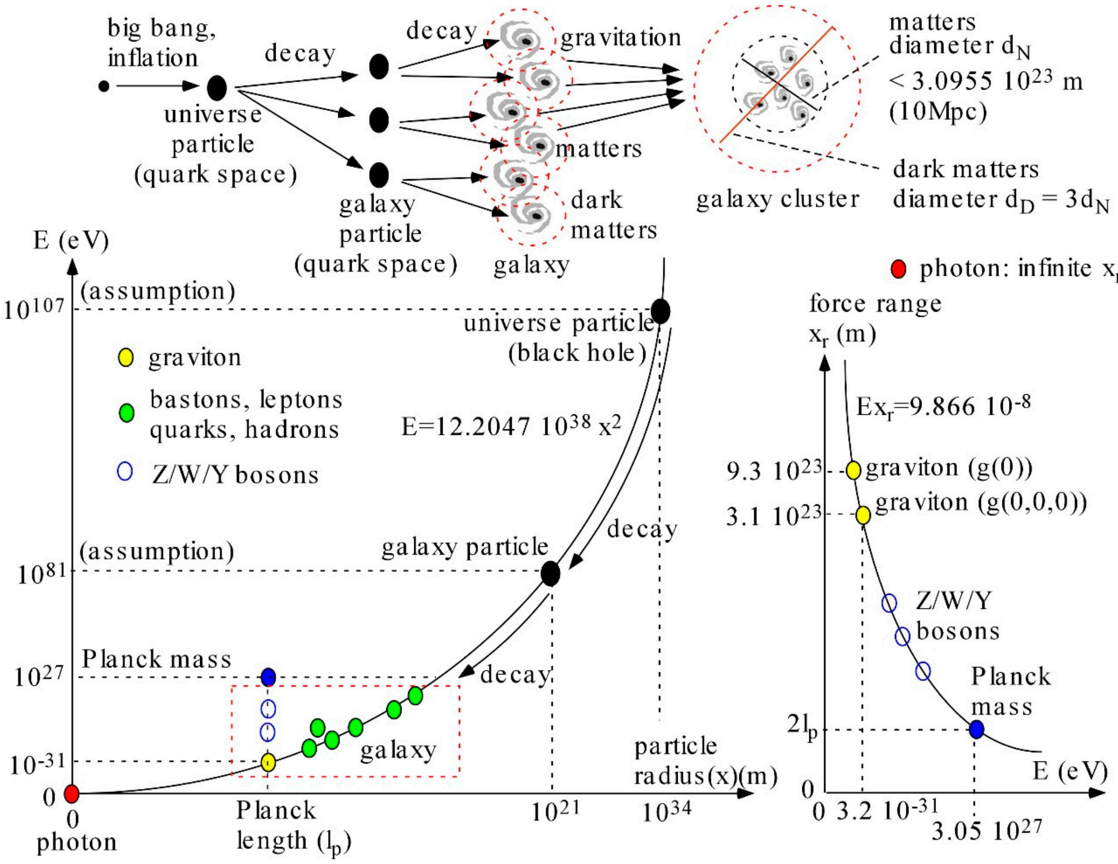
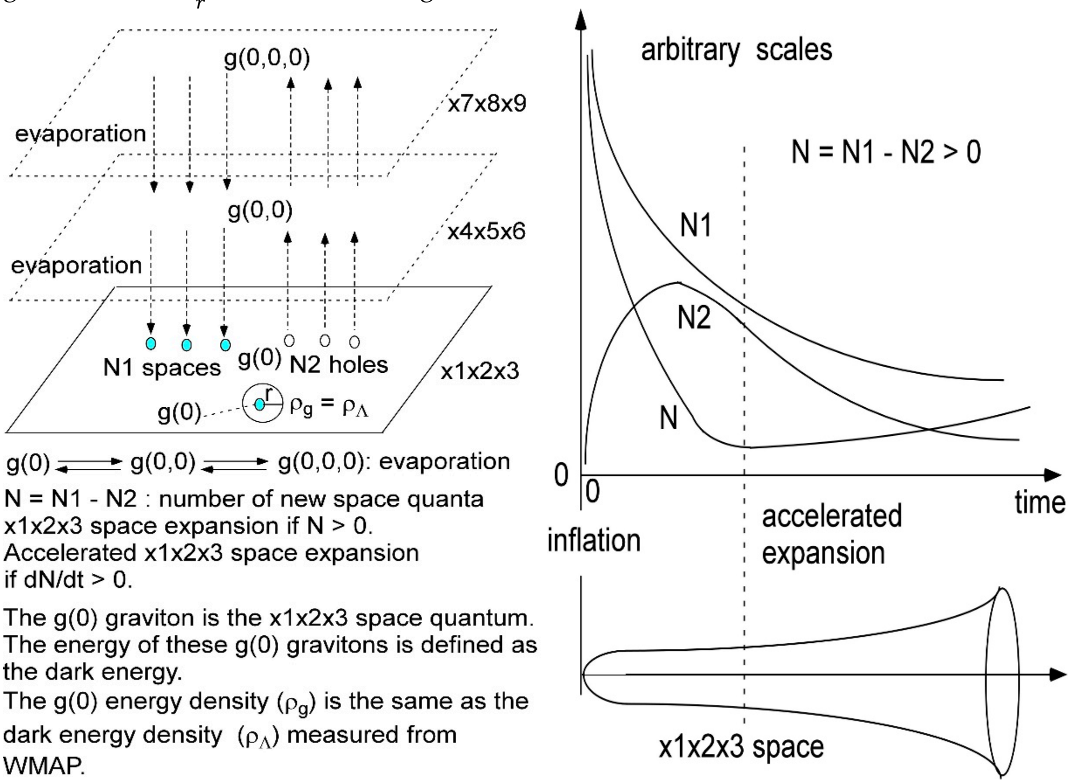


Figure 5. Relation between the particle and universe evolutions is shown. The particle evolution equation is from Table 2. The force range equation is from the uncertainty principle of $\Delta E \Delta t \geq \hbar/2$.

The gravitational force between two matters is explained by the force carrying graviton (g). The largest gravitational system is the galaxy cluster which has been known to have the largest diameter around 10 Mpc = 3.08568 10^{23} m [8]. Therefore, in the present work, the gravitational force range is taken roughly as x_r = 3.08568 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 $10^{-8}/x_r$ (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 10^{-31} eV/c^2. The obtained rest mass (3.19735 10^{-31} eV/c^2) of the g(0,0,0) graviton is remarkably consistent with the rest mass (3.1872 10^{-31} eV/c^2) of the Planck size particle calculated by using the equation of E(eV) = 12.2047 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 normal matters are made mainly of the protons and neutrons. 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 $10^{-8}/x_r$ (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 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 10^{-31} eV/c^2. 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 10^{-31} eV/c^2. 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 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

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 May 2018 doi:10.20944/preprints201805.0203.v1

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 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 10^{-31} eV/c^2 and x_r = 3.0955 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.



(a) (b)

Figure 6. (a) Graviton evaporation and (b) the accelerated expansion of the x1x2x3 space. See Fig. 7.

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 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 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 normal 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 and 6. 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 and 6. 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 Fig. 4, 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. And it is discussed in Figs. 4-6 and sections 3 and 4 that the gravitational force between the dark matters through the g(0) gravitons are much 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.

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.

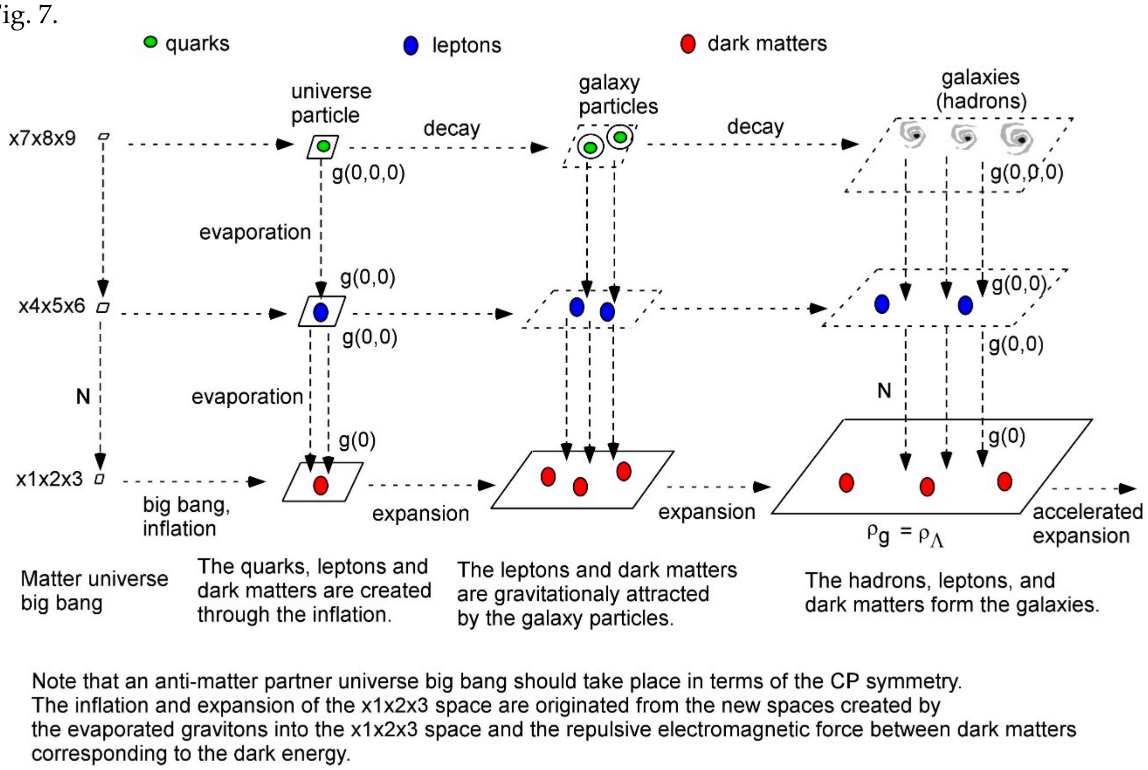


Figure 7. Particle and space evolutions. See Figs. 2, 4, 5 and 6.

Also, 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. Because of the strong gravitational force between the dark matters, the charged dark matters of the B1, B2 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 Fig. 2, 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 and electromagnetic force, 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 Fig. 4. 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 equally charged particles and $F_g(dm) < F_g(mm) << F_g(dd)$ for the particles with the same masses. 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

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 May 2018 doi:10.20944/preprints201805.0203.v1

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 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 Figs. 2 and 3. 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.

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. 4 is reasonable.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 May 2018 doi:10.20944/preprints201805.0203.v1

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 university particle and galaxy particles are matters which decay to the matters. Therefore, in

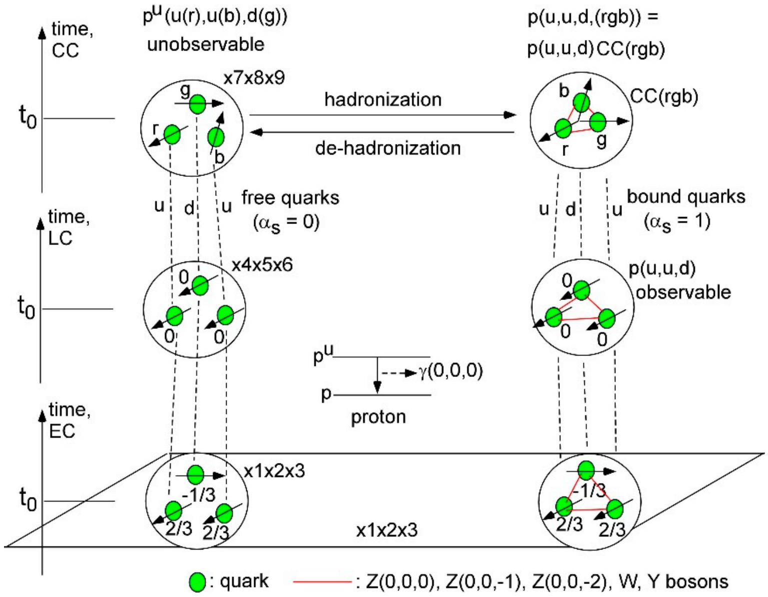


Figure 8. Comparison of the proton and un-observable proton.

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 [6,7]. 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 the elementary bosons, elementary fermions, the baryons and mesons are not the black holes because these particles can decay.

5. Decreasing coupling constant of the strong force and neutron lifetime anomaly

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. 8. 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

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 May 2018 doi:10.20944/preprints201805.0203.v1

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]. The charge configuration of the proton is p(uud, (rgb)) = p(uud)CC(rgb)). A p(uud) part of the proton can interact 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 γ(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 unobservable 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 unobservable proton (p^u) is p(u(r),u(b),d(g)) in Fig. 8. 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 γ(0,0) photons and the leptons.

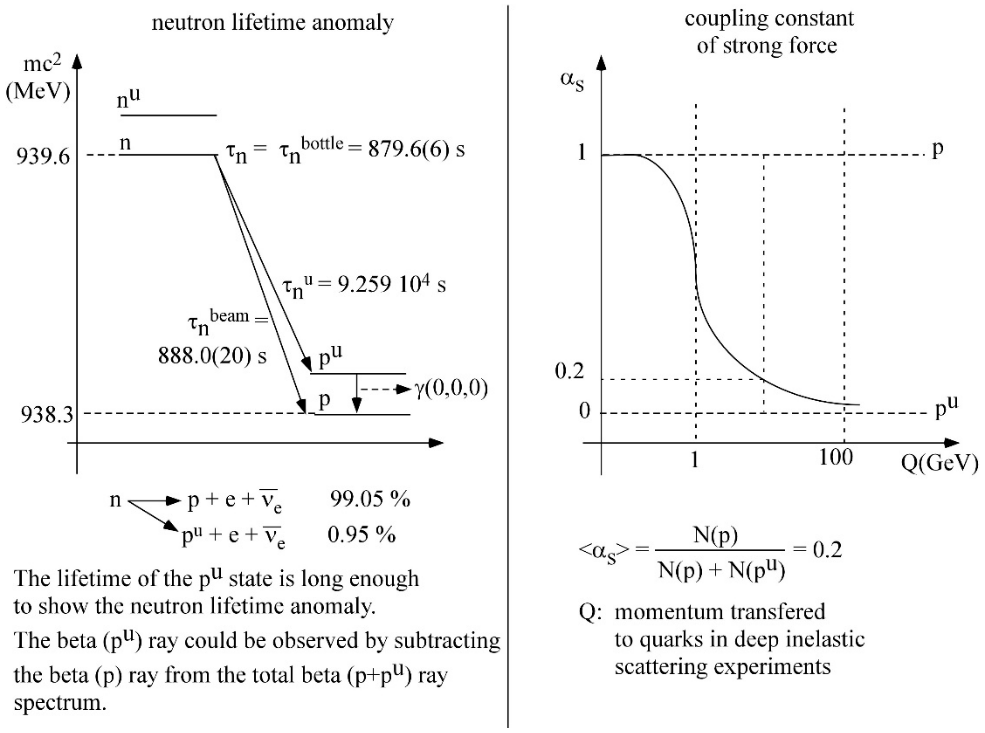


Figure 9. Decreasing coupling constant (α_s) of the strong force [18] and neutron lifetime anomaly [19]

The decreasing coupling constant (α_s) of the strong force [18] and neutron lifetime anomaly [19] are explained as shown in Fig. 9. 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 [18] is explained by introducing the unobservable proton in Fig. 9. The observed coupling constant (α_s) of the strong force [18] 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 [18]. Another example is the neutron lifetime anomaly [19] in Fig. 9. 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. 9. The unobservable process is $n \rightarrow p^u + e + \bar{\nu}_e$ and the observable process is $n \rightarrow p + e + \bar{\nu}_e$. The branching ratio of the unobservable process is 0.95 %.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 May 2018 doi:10.20944/preprints201805.0203.v1

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 [20,21]. In the present work, this gamma ray excess is proposed as the annihilation peak of Le and anti Le particles as shown in Fig. 10. 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

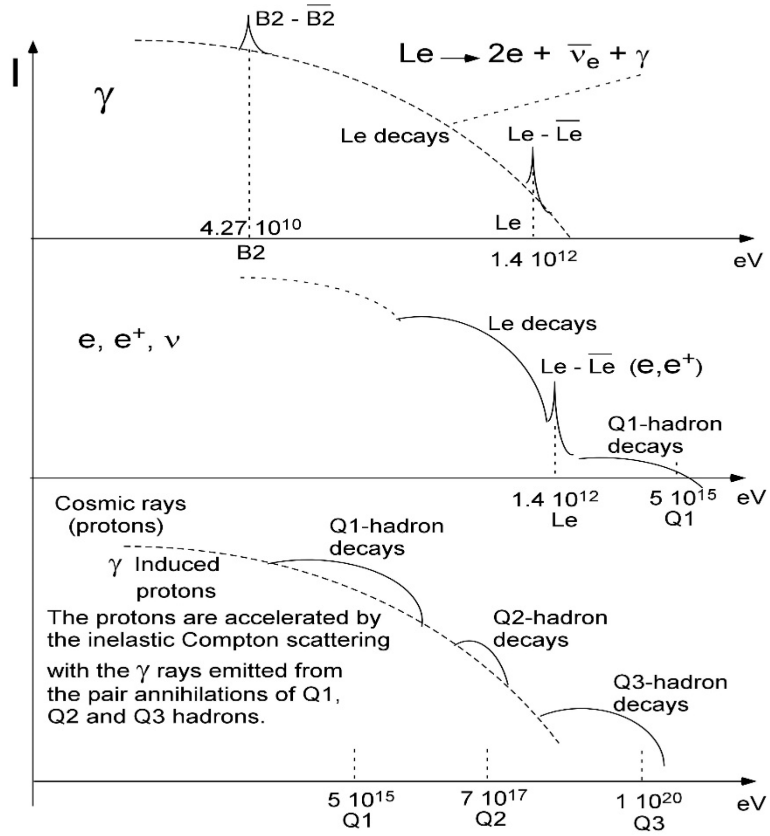


Figure 10. Cosmic gamma ray and cosmic ray [1,6].

DAMP (Dark Matter Particle Explorer) [22]. 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. 10. 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) [22], is explained to be originated from the decay of Le particle as shown in Fig. 10. Here, $L_e \to 2e + \bar{\nu}_e$. And the cosmic gamma ray spectrum by CALET 5 year measurements [23] 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 [23]. 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.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 May 2018 doi:10.20944/preprints201805.0203.v1

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 [1,24]. The 42.7 GeV peak is proposed as the B2 annihilation peak. The calculated rest mass of the B2 dark matter is 26.12 eV/c^2 [1]. Then the anti-neutrino data emitted from SN 1987A [25] 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 annihilation of B1 and anti-B1 dark matters [1] that were coming from the SN1987A to the earth. 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) [25].

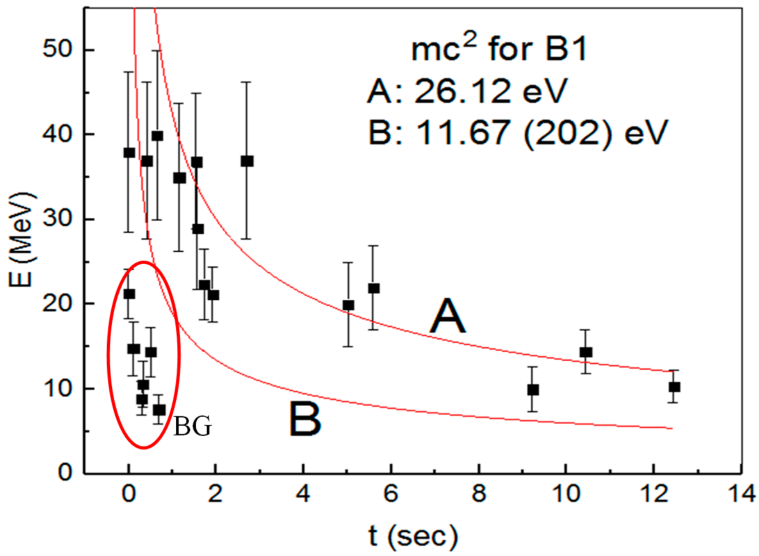


Figure 11. The proposed rest mass of the B1 dark matter [1] is indirectly confirmed from the supernova 1987A data [25].

In the present work, the alternative explanation is tried to explain the SN 1987A data [25]. 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) [25]. In Fig. 11, 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 [25]. 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. 11. The 5 data detected by the BNO detector considered as the background data are not shown in Fig. 11 [25]. 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. 10 is shown for the comparison with the curve A.

In Fig. 12, 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].

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

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 May 2018 doi:10.20944/preprints201805.0203.v1

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 [18] and neutron lifetime anomaly [19] 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 [22,23]. 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 [24].

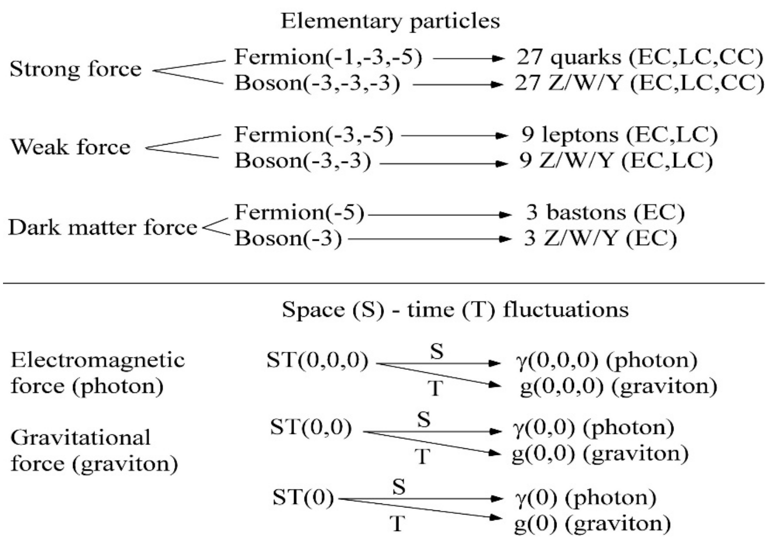


Figure 12. Elementary particles and space-time fluctuations are connected with the five forces [1,6,7].

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. 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. 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. This graviton evaporation explains the reason why the gravitational force between the matters compared with the electromagnetic force, strong force and weak force is very weak. 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 are 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 $F_g(dm) < F_g(mm) \ll F_g(dd)$ 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.

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 ($\nu_\varepsilon, \nu_\mu, \nu_\tau$, ε, 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 from the equation of E(eV) = 12.2047 10^{38} x^2. This Planck size particle is considered as the g(0,0,0) graviton for the quarks, baryons and mesons.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 May 2018 doi:10.20944/preprints201805.0203.v1

The matters are made of the protons and neutrons connected to the g(0,0,0) graviton. The range of the gravitational force for the 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 $10^{-8}/x_r$ (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 10^{-31} eV/c^2 and x_r = 3.0955 10^{23} m = 10.0 Mpc. Because of the massive graviton, the gravitational potential needs to be changed to $U = -\frac{Gm_1m_2}{r}e^{-m_g r}$ following the Yukawa force effect. Here, m_g is E_g/c^2.

Conflicts of Interest: The author declares no conflicts of interest.

References

1. Jae-Kwang Hwang, New fermionic dark matters, extended Standard Model and cosmic rays, *Mod. Phys. Lett. A* **2017**, *32*, 1730023.
2. Jae-Kwang Hwang, Cosmic rays and new fermionic dark matters, PoS on 35th Int. Cosmic Ray Conf. (ICRC2017) 2017, 933.
3. A.F. Ali and S. Das, Cosmology from quantum potential, *Phys. Lett. B* **2015**, *741*, 276-279.
4. P.J. Mohr, B.N. Taylor and D.B. Newell, CODATA recommended values of the fundamental physical constants: 2006, *Rev. Mod. Phys.* **2008**, *80*, 633.
5. R. Pohl et al., The size of the proton, *Nature* **2010**, *466*, 213-216.
6. Jae-Kwang Hwang, Unified explanations of dark matters, cosmic rays and elementary particles, 2018, https://www.researchgate.net/publication/313247136.
7. Jae-Kwang Hwang, Three-dimensional quantized spaces, universe, elementary particles, quantum mechanics, general relativity theory and dark matters, 2018, https://www.researchgate.net/publication/297270485
8. http://en.wikipedia.org/wiki/Galaxy_cluster (2015).
9. L. Randall and R. Sundrum, Large Mass Hierarchy from a Small Extra Dimension, *Phys. Rev. Lett.* **1999**, *83*, 3370-3373.
10. L. Randall and R. Sundrum, An Alternative to Compactification, arXiv:hep-th/9906064.
11. https://map.gsfc.nasa.gov/
12. S. Perlmutter et al., Measurements of Ω and Λ from 42 High-Redshift Supernovae, *Astrophys. J.* **1999**, *517*, 565-586.
13. A.G. Riess et al., Observational Evidence from Supernovae for an Accelerating Universe and a Cosmological Constant, *Astron. J.* **1998**, *116*, 1009-1038.
14. D. Clower et al., Weak lensing mass reconstruction of the interacting cluster 1E0657-558: Direct evidence for the existence of dark matter, *Astrophys. J.* **2004**, *604*, 596-603.
15. A.N. Taylor et al., Gravitational Lens Magnification and the Mass of Abell 1689, *Astrophys. J.* **1998**, *501*, 539-553.
16. M. Jee et al., *HUBBLE SPACE TELESCOPE*/ADVANCED CAMERA FOR SURVEYS CONFIRMATION OF THE DARK SUBSTRUCTURE IN A520, *Astrophys. J.* **2014**, *783*, 78.
17. P. van Dokkum et al., A galaxy lacking dark matter, Nature **2018**, *555*, 629-632.
18. S. Bethke, Experimental Tests of Asymptotic Freedom, arXiv: hep-ex/0606035.
19. B. Fornal and B. Grinstein, Dark Matter Interpretation of the Neutron Decay Anomaly, arXiv: 1801.01124.

20. V. Gammaldi, Highlights on gamma rays, neutrinos and antiprotons from TeV Dark Matter, arXiv: 1412.7639.
21. S. Federicici et al., Analysis of GeV-band gamma-ray emission from SNR RX J1713.7-3946, arXiv: 1502.06355v1.
22. S.F. Ge et al., Flavor structure of the cosmic-ray electron/positron excesses at DAMPE, *Phys. Lett. B* **2018**, *781*, 88-94.
23. O. Adriani et al., The CALorimetric Electron Telescope (CALET) for high-energy astroparticle physics on the International Space Station, *EPJ Web of Conf*. **2015**, *95*, 04056.
24. Y.F. Liang et al., Search for a gamma-ray line feature from a group of nearby galaxy clusters with Fermi LAT Pass 8 data, Phys. Rev. D **2016,** *93*, 103525.