Dark Energy in the Zero Energy Universe

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Gravity is the force conquering the structure of the universe. By recognizing the components of the universe, we are estimating the quantity of components composing the universe through size of gravity and gravitational potential energy (GPE). In this paper, it is being shown that the universe can be born and expanded through pair creation of positive energy (mass) and negative energy (mass) from zero energy condition [1]. Also, GPE is composed by 3 units of U_{++}, U_{--}, and U_{-+} when negative and positive energy exists, U-+ (GPE between negative mass and positive mass) has positive values and is the component that makes repulsive gravitational effect [2]. U-+ corresponds with the inner energy of the system and can be interpreted as dark energy. Also, situations in which U-+ has much higher value than $|U_{--}| + |U_{++}|$ depending on the distribution of negative mass and positive mass is possible. This doesn't mean that 72.1% of dark energy independently exists, but means that explanation from GPE occurring from 4.6%(or 27.9%) of negative energy, which is the same as 4.6%(or 27.9%) of positive energy, is possible. Moreover, 4.6%(or 27.9%) of negative energy is the energy which is inevitably required from zero energy, which is the most natural total energy value in the universe. This discovery implies that our belief that size of gravitational effect and size of components of the universe would always 1:1 correspond was wrong.

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I. Introduction

Gravity is the force conquering the structure of the universe. By recognizing the components of the universe, we are estimating the quantity of components composing the universe through size of gravity and GPE.

In estimating some kind of unknown energy quantity of universe components, gravity has been a crucial part. For example, if the universe is composed of some materials and these materials are always moving in equal velocity, unknown repulsive energy to offset this attraction was needed and it was assumed that the size of this energy is the same as the size of the energy of materials and the direction should be the opposite.

From the observation on accelerating expansion of the universe in 1998 [3] [4], we assumed that a repulsive energy bigger than the total energy of visible matter need to exist and called this dark energy. Also, this dark energy has been accepted as an independent energy different from matter or dark matter [5].

We have trusted the above analysis on gravity and GPE had clear validity. However, through current numerical computation, we found that there was possibility of severe errors in this analysis through gravitational effect.

Negative mass is stable at the state of high energy. So the problem of the transition of the energy level of minus infinity does not occur, and thus positive mass and negative mass can exist in the same space-time [2] [6].

In this paper, we show that the universe led to the current structure of the universe, if we assume pair creation of positive energy and negative energy in the early universe. We looked for size of GPE when negative and positive energy (mass) both exist and try to explain this GPE value regarding to the current size of dark energy.

II. Birth of the universe from zero energy state

[Video for Big bang Simulation] [1]

This is a computer simulation that shows you that the universe led to the current structure of the universe with pair creation of positive energy (mass) and negative energy (mass) from the zero energy state.

A. Birth of the Universe from "Nothing"

1)There was a pair creation of positive and negative energy in the early universe.

2)The total energy of universe is 0. Hawking and Guth et al. argued that GPE is negative energy, and that such GPE can offset all positive mass energy during a period of inflation [7].

3)The acceleration in the expansion of the universe observed suggests the existence of positive energy out of mass energy, and alternatively, it corresponds to what

the overall GPE of the universe has positive value, indicating that GPE will not able to offset positive energy.

4)Nothing but the GPE doesn't completely offset mass energy. And for the birth of the universe from "nothing" and energy conservation at the birth of the universe, "negative mass", which corresponds to "negative energy", is needed.

5)The basic principle of physics of "lower state of energy is stable!" is wrong. So it should be modified to "lower state of energy as far as positive mass is concerned and higher state of energy as far as negative mass is concerned is stable!" [2] [6].

6)"Transition to the energy level of minus infinity", which was used to deny the existence of negative mass, did not occur, whereas a. Relativistic energy eq., b. Dirac eq., c. field equation existed [3], suggesting the existence of negative mass.

B. Structure of Void

1)The presence of primitive void due to a pair annihilation of positive mass and negative mass.

2)The presence of void due to gravitational contraction between positive mass and repulsive effect between negative mass.

C. Birth and Expansion of the Universe from singular point(or domain)

1)Even though all the mass of the universe come together in one small area on Big Bang, it does not have the same density as the black hole due to offsetting of density between positive mass and negative mass. Therefore it can be expandable.

2)The law of motion of positive mass and negative mass naturally explains that "expansion after birth" is the essential characteristics of the universe.

3)The expansion of the universe takes place in the state of total rest mass energy of "0" and, clusters of galaxies and the void structure can be achieved.

4)Energy conservation and momentum conservation exists without giving the initial velocity, and expansion of the universe occurs.

5)It does not require any other force except already known force, gravity.

III. Significant characteristics of dark energy and GPE

A. Simulation background and method

1) Physical background

a)Initial energy value of the universe It looks more natural when an initial energy value of universe is 0. Therefore, negative energy is needed to offset positive energy of matters.

If there was pair creation of positive and negative energy in the beginning of the universe, it is estimated that the total value of all positive energy will totally offset the total energy of all negative energy. If we consider only rest mass energy and GPE, the relation below will be valid [2].

$$\begin{aligned} E_T &= 0 = (+E) + (-E) = 0 \\ &= \sum (+m_+c^2) + \sum (-m_-c^2) + \sum U = 0 \end{aligned} \tag{1}$$

$(m_+ > 0, m_- > 0)$

b) $m_- = m_+$

To reach zero energy, size of m_+ and m_- should be different enough as the size of GPE, or GPE can be put as 0 through appropriate placement of particles while making m_- and m_+ equal.

The size of m_+ and m_- can be a different during pair creation [2], but this paper has purpose in showing possibility of various GPE values depending on the placement of particles which are pair produced, so the case in which m_+ is equal to m_- will be looked into.

c) GPE

If negative mass and positive mass coexist, GPE consists of the below three items [2].

$$U_T = U_{-+} + U_{--} + U_{++} \tag{2}$$

$$\begin{aligned} U_T &= \sum_{i,j}^{i=j=n} \left(-\frac{G(-m_{-i})m_{+j}}{r_{-+ij}}\right) \\ &+ \sum_{i,j,j>i}^{i=j=n} \left(-\frac{G(-m_{-i})(-m_{-j})}{r_{--ij}}\right) + \sum_{i,j,j>i}^{i=j=n} \left(-\frac{Gm_{+i}m_{+j}}{r_{++ij}}\right) \end{aligned} \tag{3}$$

$$\begin{aligned} U_T &= \sum_{i,j}^{i=j=n} \left(+\frac{Gm_{-i}m_{+j}}{r_{-+ij}}\right) \\ &+ \sum_{i,j,j>i}^{i=j=n} \left(-\frac{Gm_{-i}m_{-j}}{r_{--ij}}\right) + \sum_{i,j,j>i}^{i=j=n} \left(-\frac{Gm_{+i}m_{+j}}{r_{++ij}}\right) \end{aligned} \tag{4}$$

GPE between positive masses are negative value.

$$U_{++} = \sum_{i,j,j>i}^{i=j=n} \left(-\frac{Gm_{+i}m_{+j}}{r_{++ij}}\right)$$

GPE between negative masses are negative value.

$$U_{--} = \sum_{i,j,j>i}^{i=j=n} \left(-\frac{Gm_{-i}m_{-j}}{r_{--ij}}\right)$$

GPE between positive mass and negative mass are positive value.

$$U_{-+} = \sum_{i,j}^{i=j=n} \left(+\frac{Gm_{-i}m_{+j}}{r_{-+ij}}\right)$$

When the number of negative mass is n_-, and the number of positive mass is n_+, total potential energy is given as follows.

$U_T = (n_- \times n_+)U_{-+} + (\frac{n_-(n_- - 1)}{2}U_{--} + \frac{n_+(n_+ - 1)}{2}U_{++})$

For example, two pairs exist.

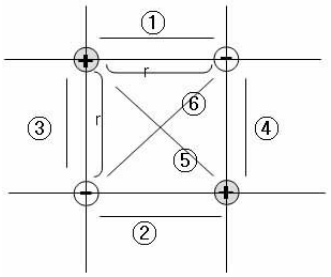

Figure 1: two pairs

$$U_T = (U_1+U_2+U_3+U_4)+(U_5+U_6) = 4U_{-+}+1U_{--}+1U_{++} \quad (5)$$

Gravitational potential shows significant characteristic when negative mass and positive mass both exist. While n^2 positive gravitational potential is produced above, $n^2 - n$ negative gravitational potential are produced. Therefore, total GPE can have various values.

d)Vacuum Energy

Vacuum energy value which is currently known is an energy value that is too big [8]. If this vacuum energy exists, it is difficult to explain why it isn't easily found around us.

In the hypothesis of the pair creation of negative mass and positive mass, Vacuum energy will become exactly 0 because vacuum is the space in which pair creation and pair annihilation of positive and negative energy occurs.

e)Characteristics of the negative mass

For characteristics of the negative mass, refer to below video.

[Video for characteristics of the negative mass] [9]

2)Simulation Program

To look into the characteristic of GPE, we used the simulation program named Gravitation3D made by Roice Nelson [10].

3)Simulation setting

a)Definition of parameter

A few parameters were needed to be defined for simulation.

Distance between pair creation negative energy and positive energy(distance of 1 pair) : d_0

Minimum distance between particle pairs for density modification during pair creation : d_m

Radius of pair creation range : R_0=500

Particle number of pair creation : N_0=2000ea (1000 pair)

b)Finding mean value

Through Gravitation3D program, 1000 particle pairs (total 2000ea particles) were produced by random and one mean value (GPE) of each distance value was found 5 times each.

c)Verification on program

To check if the calculated results of the program were correct, we calculated the GPE when 1, 2, and 3 pairs (consist of 15ea potentials) of particles existed by hand and confirmed that this value corresponded to the calculated results of the program.

B. Computer simulation

[Video for results of simulation] [11]

1) Distance=0.01

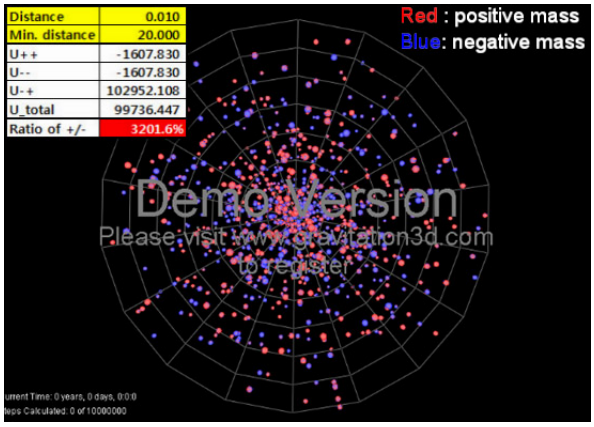

Figure 2: Distance 0.01

It was found out that U_{-+} value having positive value could be much higher than $|U_{++} + U_{--}|$. Thus, even though the size of positive mass and negative mass was equal, it could be known that repulsive GPE could be much higher than attractive GPE.

2) Distance =0.10

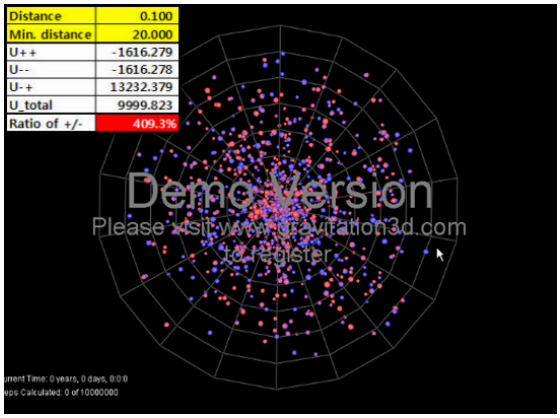

Figure 3: Distance 0.10

We will describe that an unknown repulsive energy U_{-+} higher that attraction of visible matter exists for the energy value of above.

3) Distance =0.19

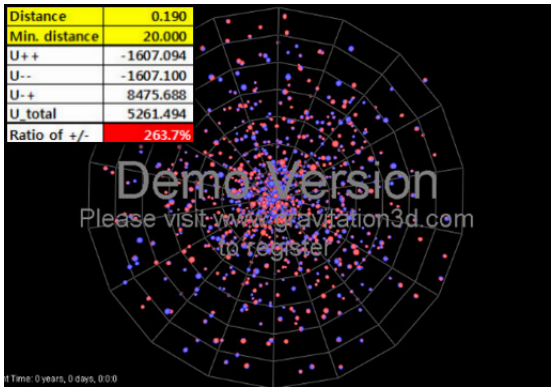

Figure 4: Distance 0.19

According to the observance result of WMAP, it is predicted that current dark energy, dark matter, and matter is approximately 72.1%, 23.3%, and 4.6%, respectively [5].

Dark matter and matter correspond to negative gravitational potential because they have attractive gravitational potential and dark energy correspond to positive gravitational potential because it produces repulsive effect.

Therefore, observation ratio of current universe is 72.1/27.9 = 2.584. Is shows similar condition to 2.63 which was found above. If conditions are changes, ratio of negative gravitational potential and positive gravitational potential can have various conditions close to 2.58.

4) Distance =1.00

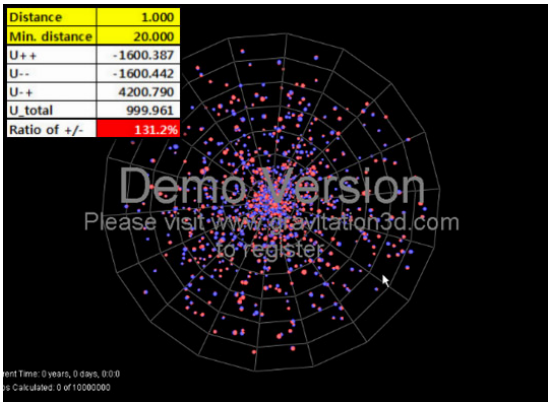

Figure 5: Distance 1.00

Particle pairs show to overlap (in the process being expressed in visible size) because of distance between negative mass and positive mass composing singular particle pairs are relatively close. Overlapping is unrelated to the calculation of GPE.

It can be known that distance between singular particle pairs are much smaller compared to the distance between other particle pairs. One particle pair corresponds to the cluster of galaxies in the universe structure. From movement characteristic of negative mass and positive mass, galaxies and cluster of galaxies have clustering structure of negative mass in the outside of the galaxy [2].

5) Distance =10.00

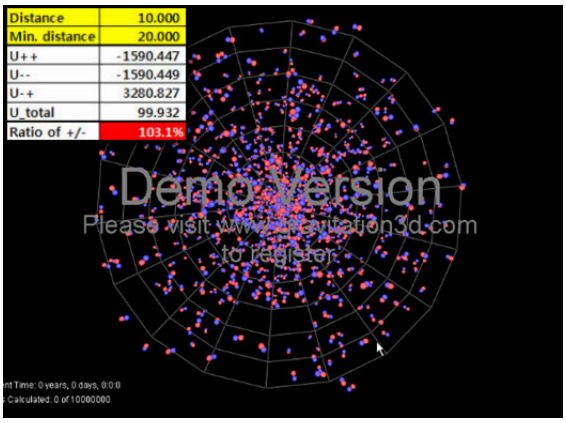

Figure 6: Distance 10.00

C. Accelerating expansion of the universe [11]

Expansion of the universe means increase of the distance between cluster of galaxies or the galaxy while the sizes of individual galaxies are the same.

Structure of galaxies or cluster of galaxies surrounding negative masses in the pair creation model of negative and positive mass is implied.

In this simulation, d0, which is the distance between negative and positive mass, is maintained as a constant in this simulation, or the radius value of the size of the universe increases when d0 decreases.

Distance	1	Distance	1	Distance	1	Distance	1	Distance	1
Min. dist	10	Min. dist	10	Min. dist	10	Min. dist	10	Min. dist	10
Radius	500	Radius	1000	Radius	1500	Radius	2000	Radius	2500
U++	-1804.07	U++	-943.21	U++	-655.28	U++	-498.35	U++	-398.93
U--	-1804.06	U--	-943.23	U--	-651.66	U--	-498.35	U--	-398.94
U-+	4608.08	U-+	2886.40	U-+	2310.50	U-+	1996.65	U-+	1797.83
U_tot	999.95	U_tot	999.96	U_tot	999.96	U_tot	999.95	U_tot	999.95
Ratio +/-	127.71%	Ratio +/-	153.01%	Ratio +/-	176.79%	Ratio +/-	200.33%	Ratio +/-	225.33%
Distance	1	Distance	1	Distance	1	Distance	1	Distance	1
Min. dist	10	Min. dist	10	Min. dist	10	Min. dist	10	Min. dist	10
Radius	3000	Radius	3500	Radius	4000	Radius	4500	Radius	5000
U++	-325.53	U++	-293.34	U++	-255.08	U++	-229.33	U++	-207.35
U--	-325.51	U--	-293.34	U--	-255.08	U--	-229.33	U--	-207.37
U-+	1650.99	U-+	1586.63	U-+	1510.11	U-+	1458.61	U-+	1414.68
U_tot	999.95	U_tot	999.95	U_tot	999.96	U_tot	999.95	U_tot	999.96
Ratio +/-	253.59%	Ratio +/-	270.44%	Ratio +/-	296.01%	Ratio +/-	318.02%	Ratio +/-	341.11%

Figure 7: Change of potential energy by change of R radius. Pay attention on the change of negative GPE and positive GPE ratio!

D. Change of the GPE followed by the density difference between negative mass and positive mass [12]

Potential energy can have various values depending on the density difference of negative and positive mass. There is also difference in acceleration of negative and positive mass, and this brings change in potential energy.

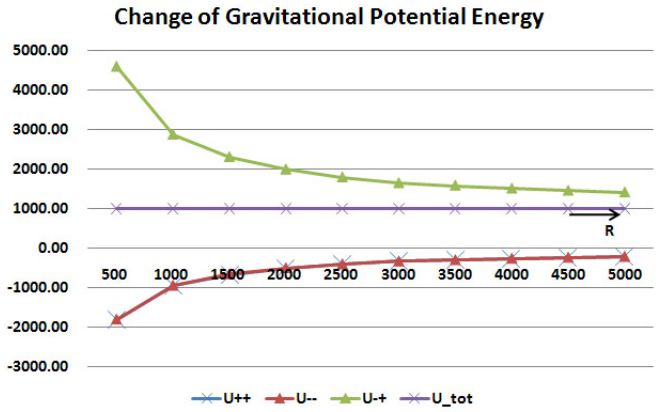

Figure 8: As R, which corresponds to the radius of the universe, increases, absolute values of GPE all decrease while the total GPE is mostly maintained.

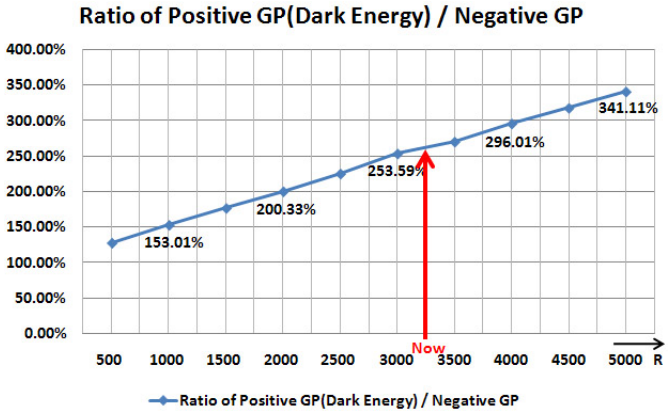

Figure 9: However, ratio of positive gravitational potential (Dark Energy) and negative gravitational potential increases as the universe expands and this is seen to mean that percentage of repulsive effect increases compared to the attractive effect of ordinary matter.

Negative mass expands faster than positive mass in situations when density of negative mass is higher than positive mass density. It could be confirmed through the simulation of even distribution condition passing.

E. Future of the universe

1)As the pair creation hypothesis of negative and positive mass predicts that dark energy is conserved and density of dark energy decreases following the expansion of the universe, it is predicted that the universe will expand like Figure 10.c.

2)Density difference of negative and positive mass and movement difference of negative and positive mass implies the possibility of vibration expansion standard to total GPE of 0. Therefore, Figure 10. b model above is possible [10].

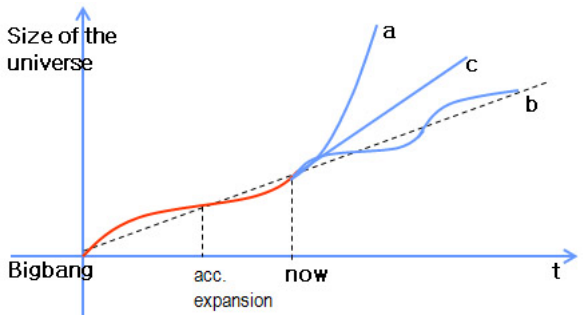

Figure 10: Accelerating expansion and decelerating expansion followed by the density difference between negative mass and positive mass.

F. Centripetal force effect in the galaxy from dark matter(negative mass) halo out of the galaxy

[Video for Centripetal force effect from negative mass] [13]

If the negative mass is disposed at the outline, the test mass vibrates, and a kind of restoring force (This corresponds to the centripetal force when considering rotation of the galaxy) exists.

This suggests that the halo, dark matter (negative mass) of the external Galaxy could get additional effects of centripetal force to the inner Galaxy.

G. Maybe, dark energy is constant

Currently, dark energy is being observed as though it has a constant value. Generally, density of subjects that have local energy distribution should change to $1/r^3$, so this model is difficult to explain the constant value. Therefore, it is easy to consider it as a wrong model.

Distance	0.30		0.01	
Min distance	1.00		1.00	
Radius	200.00		400.00	
U++	-5061.60		-2564.88	
U--	-5059.32		-2564.90	
U-+	13454.50		104909.24	
U_tot	3333.58		99779.45	
Ratio of +/-	132.94%		2045.10%	
V	33,510,293		268,082,347	800.0%
U++ + U-+	-10120.92		-5129.78	50.7%
|ρ--+ρ++|	0.000302		0.000019	6.3%
ρ-+	0.000402		0.000391	97.5%
ρ_tot	0.000099		0.000372	374.1%
Ratio -/+	132.94%		2045.10%	1538.4%

Figure 11: Where R_0=200, it is the situation where the radius has increased in double to R=400 when the distance of the particle pairs has decreased to 1/30. It is the result randomly producing 1000 particle pairs and finding gravitational potential energy value.

Looking into the above results, the ρ_{-+} value that corresponds to the repulsive gravitational potential energy density (dark energy density) is almost being maintained as a constant even though the volume was increase to 8 times.

In the above mechanism, particle A (positive mass) and particle B (negative mass) is evenly distributed, and particle A and particle B do change by $1/r^3$, but any physical quantity that comes out of their relation is possible by constant value.

Of course, dark energy in our model is a variable that essentially depends on time.

H. Observation value of WMAP

1)Pair Creation

Assuming pair creation of negative and positive energy in the beginning of the universe, it is seen that law of conservation of energy should be valid for each pairs for law of conservation of energy to be valid. According to calculation of the previous paper, it is predicted that size of negative must bigger than size of positive. So $m_- > m_+$ [2]

2)Some interpretation

According to the observance result of WMAP, it is predicted that current dark energy, dark matter, and matter is approximately 72.1%, 23.3%, and 4.6%, respectively [5].

Now, let's correspond to the GPE as follows.

Matter = U_{++} = Negative GP

Dark Matter = U_{--} = Negative GP

Dark Energy = U_{-+} = Positive GP

			Ratio
Matter	U++	4.6	1
Dark matter	U--	23.3	5.065
Dark Energy	U-+	72.1	15.674
Ratio of +/-		2.584	

-m-	-2.25	
m+	1.00	
Distance	1.38	
R	7000.00	
Min. distance	20.00	Ratio
U++	-146.76	1
U--	-742.98	5.063
U-+	2290.88	15.610
U_tot	1401.14	
Ratio of +/-	2.575	

Figure 12: In condition of $-m_- = -2.25m_+$, results shown above were gained. This doesn't prove that the size of current negative mass is 2.25 times as positive mass. However, the above result implies that there is possibility to explain that the size ratio of the 3 predicted energy by using the "hypothesis of pair creation of negative and positive mass."

The ratio above is valid between the 3 physical parameters. Case of this ratio being valid was found through simulation. (view to Figure 11)

I. Results of simulation

1) Even though negative and positive mass have the same size, total GPE can have +, 0, - values depending on the placement of each.

2) U_{-+} value is higher as d_0 is smaller and the total GPE also have a high positive value.

3) Looking into the numerical calculation of B)-1)-B)-4), it can be seen that positive gravitational potential value U_{-+} can have much higher values than negative gravitational potential values.(138% - 3,201%) If we consider the distance of Planck length level, this value can have very high values enough to explain inflation. From the observation result of WMAP, we know that dark energy value, which generates repulsion, is 2.58 times the total of matter and dark matter. Until now, it is predicted that dark matter produces attraction. Closely look into numbers B)-3).

4) Because we judge components of the universe by gravity or GPE, it can be assumed that there is dark energy of 2.63 times or inner energy of 2.63 times regarding the situation of U_{-+} value having approximately 2.63 times U_{++} and U_{--} values in number B)-3). There are several situations satisfying 2.58 times. Even if 100ea (unit mass +10) positive masses exist and 1000ea (unit mass -1) negative masses exist, it satisfies about 2.58 times.

5) The above results show that 72.1% of dark energy doesn't exist independently, but implies that there is possibility that negative energy having the same size of positive energy can emerge.

6) This "increase of dark energy" doesn't come from a newly generated space, but shows feature of GPE which is made by negative mass and positive mass.

IV. Conclusion

From the simulation result of chapter II and accelerating expansion of the universe, there is possibility that our universe is composed of negative and positive energy (mass). From analysis results of chapter III, total GPE has 3 components and it is known that the total of this GPE can have positive, negative and zero values.

No one has seen dark energy or dark matter. We must remember that we only recognize it through gravitational effect.

When we judge the components of the universe, we judge the components by gravitational effect rather than mass energy.

Therefore, when GPE U-+ exists larger than GPE U which is generated by materials, we will be confused to think that some mass energy bigger than the mass energy of materials exists.

This discovery implies that our belief that size of gravitational effect and size of components of the universe would always 1:1 correspond was wrong.

Therefore, it is necessary to try to calculate and observe negative mass more strictly, laying aside the abstract aversion of negative mass.

Acknowledgments

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