

# A new light estimation of Dark Matter, Dark Energy and the Ternary Space-Times, based on the special theory of relativity and space genesis

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**Abstract** Published studies have stated that the mass of dark matter and the mass of dark energy are approximately five times and fourteen times greater in mass, respectively, than ordinary substances such as atoms. However, it has not been successfully realized until today to detect and thus to prove the existence of dark matter and dark energy. There should be some fundamental problems to be addressed and the universal space-time itself must have its own hidden characteristics. I estimated here in this article the universal space-time by using the special theory of relativity i.e. the combined velocity and the increasing mass. The results suggest that “the ternary space-times” created in the inflationary epoch during the very early universe exist in the modern universe and that each of these space-times has its own specific light velocity.

**Keywords** Dark matter, dark energy, ternary space-time, negative light velocity, relativity theory

## 1. Introduction

The ESA (European Space Agency)’s Planck space telescope revealed in 2013 that the total mass-energy of the universe had a composition of 68.3% dark energy, 26.8% dark matter and 4.9% normal matter that makes up stars and galaxies (baryons) [1]. Baryons are ordinary substances such as atoms and elementary particles that exist in the real world. Dark matter is the substance with the mass and influences gravitation. The existence of dark matter is perceived in terms of the rotation curve of a disk galaxy [2], visible light observations of strong effects by gravitational lens and X-ray observations of bullet clusters. There have been previous attempts to prove the existence of dark matter by using the thesis of unknown elementary particles, modified Newtonian dynamics and other methods.

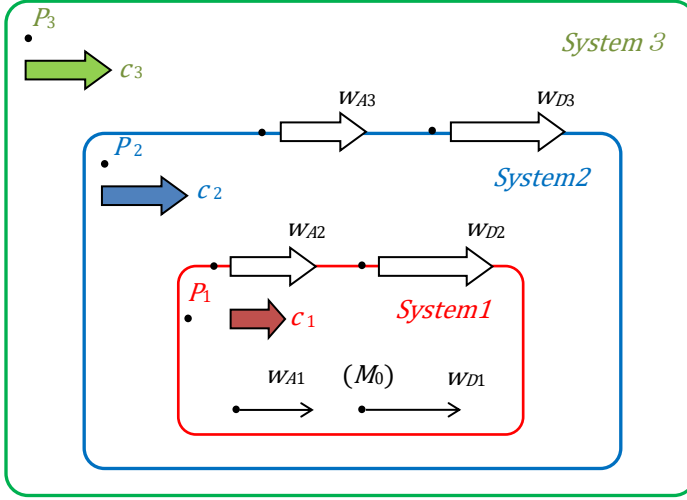
The existence of dark energy is more mysterious than that of dark matter. Baryons and dark matter pull against each other in accordance with the law of universal gravitation. In contrast, dark energy has a repulsive force, i.e., it affects negative pressure and thus accelerates the expansion of the universe. The phenomena regarding the accelerated expansion of the universe are based on results that were obtained from the astronomical observations of the Hubble telescope [3]. Some scientists have associated these phenomena with the cosmological constant of Einstein’s general theory of relativity rather than with dark energy.

However, addressing the unresolved issues of dark matter and dark energy remains a priority for many astronomical projects.

In this work, I applied the special theory of relativity, the first approximation of the general theory of relativity, to three different space-times (where each of these systems has its own light velocity). I calculated and estimated baryons, dark matter and dark energy by using the formulas of the special theory of relativity for both the combined velocity and the increasing mass. The results strongly support my theory that the ternary space-times universe was created in the inflationary epoch during the very early universe.

## 2. Methods

### 2.1. The combined velocity and the increasing mass



First, consider applying the special theory of relativity to three different space-times.

Fig.1 A model of the space-times and the symbols

A model of the space-times that are to be considered is shown in Fig.1.  $P_1$ ,  $P_2$  and  $P_3$  are the rest frames of the System 1, 2 and 3, respectively. The System 1 space-time moves at the light velocity  $c_1$  in the System 2 space-time, which is the same as the superstring theory.  $c_2$  and  $c_3$  are the same in the System 2 and the System 3 space-times.

Galaxy A is the Milky Way galaxy, while galaxy D is a virtual galaxy, the aggregate of all the galaxies in the universe.

Here,  $c_1$  is the light velocity,  $w_{A1}$  is the movement speed of galaxy A and  $w_{D1}$  is the movement speed of galaxy D in the rest frame  $P_1$  in the System 1 space-time, respectively.  $c_2, w_{A2}, w_{D2}$  and  $c_3, w_{A3}, w_{D3}$  are the corresponding parameters for the System 2 and the System 3 space-times, respectively.

Formulae for the combined velocities of  $w_{A2}, w_{D2}, w_{A3}$  and  $w_{D3}$  for galaxies A and D in the rest frames  $P_2$  and  $P_3$  are provided as shown below, since the combined velocity law is completed in the accelerated motion.

$$(1) \quad w_{A2} = \frac{w_{A1} + c_1}{1 + w_{A1} c_1 / c_2^2} \quad w_{D2} = \frac{w_{D1} + c_1}{1 + w_{D1} c_1 / c_2^2} \quad w_{A3} = \frac{w_{A2} + c_2}{1 + w_{A2} c_2 / c_3^2} \quad w_{D3} = \frac{w_{D2} + c_2}{1 + w_{D2} c_2 / c_3^2}$$

The relative speed  $w_{AD1}$  between  $w_{D1}$  and  $w_{A1}$  is presented as shown below when  $(w_{D1})$  and  $(-w_{A1})$  are substituted into the combined velocity. The corresponding relative speeds are also shown for the System 2 and the System 3 space-times.

$$(2) \quad w_{AD1} = \frac{w_{D1} - w_{A1}}{1 - w_{A1} w_{D1} / c_1^2}$$

$$w_{AD2} = \frac{w_{D2} - w_{A2}}{1 - w_{A2} w_{D2} / c_2^2} = \frac{(w_{D1} - w_{A1}) c_2^2}{c_2^2 - w_{A1} w_{D1}}$$

$$w_{AD3} = \frac{w_{D3} - w_{A3}}{1 - w_{A3} w_{D3} / c_3^2} = \frac{(w_{D1} - w_{A1}) c_2^2 c_3^2 (c_2^2 - c_1^2)}{w_{A1} w_{D1} (c_1^2 c_3^2 - c_2^4) + (w_{D1} + w_{A1}) c_1 c_2^2 (c_3^2 - c_2^2) + c_2^4 (c_3^2 - c_1^2)}$$

The rest mass  $M_0$  is common to all three systems and can be described by using the mass of motion  $m_{D2}$  at the relative speed  $w_{AD2}$  between  $w_{D2}$  and  $w_{A2}$  in the System 2 space-time. Corresponding descriptions are also provided for both the System 1 and the System 3 space-times.

$$M_0 = m_{D1} \sqrt{1 - \left(\frac{w_{AD1}}{c_1}\right)^2} = m_{D2} \sqrt{1 - \left(\frac{w_{AD2}}{c_2}\right)^2} = m_{D3} \sqrt{1 - \left(\frac{w_{AD3}}{c_3}\right)^2}$$

Substitute  $w_{AD1}$ ,  $w_{AD2}$  and  $w_{AD3}$  into the equations.

$$(3) \quad M_0 = m_{D1} \sqrt{1 - \left[\frac{(w_{D1} - w_{A1}) c_1}{c_1^2 - w_{A1} w_{D1}}\right]^2} = m_{D2} \sqrt{1 - \left[\frac{(w_{D1} - w_{A1}) c_2}{c_2^2 - w_{A1} w_{D1}}\right]^2}$$

$$= m_{D3} \sqrt{1 - \left[\frac{(w_{D1} - w_{A1}) c_2^2 c_3 (c_2^2 - c_1^2)}{w_{A1} w_{D1} (c_1^2 c_3^2 - c_2^4) + (w_{D1} + w_{A1}) c_1 c_2^2 (c_3^2 - c_2^2) + c_2^4 (c_3^2 - c_1^2)}\right]^2}$$

It then becomes necessary to solve  $c_2/c_1$  and  $c_3/c_1$ , where  $w_{A1} = \alpha \cdot c_1$  and  $w_{D1} = \beta \cdot c_1$ .

$$\left(\frac{c_2}{c_1}\right)^4 (1 - K) - \left(\frac{c_2}{c_1}\right)^2 [\alpha^2 + \beta^2 - 2\alpha\beta K] + (1 - K)\alpha^2\beta^2 = 0$$

$$(4) \quad \left(\frac{c_2}{c_1}\right) = \delta_2 \sqrt{\frac{1}{2(1 - K)} [\alpha^2 + \beta^2 - 2\alpha\beta K + (\alpha - \beta)\delta_1 \sqrt{(\alpha + \beta)^2 - 4\alpha\beta K}]}$$

Also,

$$\left(\frac{c_3}{c_1}\right)^4 (1 - L)(A^2 + \alpha)^2(A^2 + \beta)^2$$

$$- \left(\frac{c_3}{c_1}\right)^2 A^4 [(A^2 - 1)^2(\alpha - \beta)^2 + 2(1 - L)(A^2 + \alpha)(A^2 + \beta)(1 + \alpha)(1 + \beta)]$$

$$+ (1 - L)A^8(1 + \alpha)^2(1 + \beta)^2 = 0$$

$$(5) \quad \left(\frac{c_3}{c_1}\right) = \frac{A^2 \delta_4 \sqrt{(A^2 - 1)^2(\alpha - \beta)^2 + 2(1 - L)(A^2 + \alpha)(A^2 + \beta)(1 + \alpha)(1 + \beta)} + (A^2 - 1)(\alpha - \beta)\delta_3 \sqrt{(A^2 - 1)^2(\alpha - \beta)^2 + 4(1 - L)(A^2 + \alpha)(A^2 + \beta)(1 + \alpha)(1 + \beta)}}{(A^2 + \alpha)(A^2 + \beta) \sqrt{2(1 - L)}}$$

where  $\delta_1 = \pm 1$ ,  $\delta_2 = \pm 1$ ,  $\delta_3 = \pm 1$  and  $\delta_4 = \pm 1$ .

$$\text{Here, I insert } K = \left(\frac{m_{D1}}{m_{D2}}\right)^2 \frac{(1 - \alpha^2)(1 - \beta^2)}{(1 - \alpha\beta)^2} \quad L = \left(\frac{m_{D1}}{m_{D3}}\right)^2 \frac{(1 - \alpha^2)(1 - \beta^2)}{(1 - \alpha\beta)^2} \quad A = \frac{c_2}{c_1}$$

## 2.2. Mass ratio

Next, I introduce the new variables  $\varepsilon_1$ ,  $\varepsilon_2$  and  $\varepsilon_3$  in the forms of  $m_{D1} = m\varepsilon_1$ ,  $m_{D2} = m(\varepsilon_1 + \varepsilon_2)$  and  $m_{D3} = m(\varepsilon_1 + \varepsilon_2 + \varepsilon_3)$  rather than the variables  $m_{D1}$ ,  $m_{D2}$  and  $m_{D3}$ . The mass densities of dark energy, dark matter and baryons are given based on the mass ratio of the galaxy D motion when observed at the Milky Way galaxy A. Therefore, the corresponding mass densities are  $\varepsilon_1$ ,  $\varepsilon_2$  and  $\varepsilon_3$ , respectively.

There are  $2^4 \times 3! = 96$  possible combinations for the ratios  $c_2/c_1$  and  $c_3/c_1$ . The adoption conditions to determine the appropriate solution are described as follows.

- ① The time-space in which dark energy first appears as a result of the system transition has a light velocity with the opposite sign to that of the other two velocities.
- ② The light velocity is faster than any other movement speed of galaxy in any space-time.

Then,  $|c_3| > |w_{A3}|, |w_{D3}|$        $|c_2| > |w_{A2}|, |w_{D2}|$        $|c_1| > |w_{A1}|, |w_{D1}|$ .

Apply two conditions of the light velocities to 96 combinations. Then six appropriate solutions remain as shown in Table1 according to the combinations of  $\varepsilon_1, \varepsilon_2$  and  $\varepsilon_3$ .

- ③ Furthermore, apply the principle of energy minimum in the rest mass-energy  $E$  to the System 1, 2 and 3 space-times.

Baryons, dark energy and dark matter appear all together in the System 3 space-time which has the light velocity  $c_3$  (300,000 km/s =  $c_0$ ) in our real world. This is a boundary condition.

The rest mass-energy  $E_1$  in the System 1 space-time is as follows.

$$E_1 = M_0 c_1^2 = m_{D1} c_1^2 \sqrt{1 - \left(\frac{w_{AD1}}{c_1}\right)^2} = m\varepsilon_1 (c_1/c_3)^2 c_0^2 \sqrt{1 - \left(\frac{w_{AD1}}{c_1}\right)^2}$$

The rest mass-energy  $E_2$  in the System 2 space-time is as follows.

$$(6) \quad E_2 = m(\varepsilon_1 + \varepsilon_2) (c_2/c_3)^2 c_0^2 \sqrt{1 - \left(\frac{w_{AD2}}{c_2}\right)^2}$$

The rest mass-energy  $E_3$  in the System 3 space-time is as follows.

$$E_3 = m(\varepsilon_1 + \varepsilon_2 + \varepsilon_3) c_0^2 \sqrt{1 - \left(\frac{w_{AD3}}{c_3}\right)^2}$$

The calculated rest mass-energy in the System 1,2 and 3 space-times for 6 appropriate solutions is shown in Table 2 to adopt the minimum rest mass-energy.

The most appropriate solution of the minimum rest mass-energy is shown in Table 3 to compare the light velocity ratio in the real world (i.e. the System 3 space-time) with that in the System 1 and 2 space-times.



Table 2 Selection of the appropriate solution satisfied with the condition of light velocity and minimum rest mass energy

$\varepsilon 1$	0.68 dark energy				0.68 dark energy				0.27 dark matter				0.05 baryon				0.27 dark matter				0.05 baryon							
$\varepsilon 2$	0.27 dark matter				0.05 baryon				0.68 dark energy				0.68 dark energy				0.05 baryon				0.27 dark matter							
$\varepsilon 3$	0.05 baryon				0.27 dark matter				0.05 baryon				0.27 dark matter				0.68 dark energy				0.68 dark energy							
$c1/c1$	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
$\alpha = W_{a1}/c_1$	-0.90	-0.30	0.30	0.90	-0.90	-0.30	0.30	0.90	-0.90	-0.30	0.30	0.90	-0.90	-0.30	0.30	0.90	-0.90	-0.30	0.30	0.90	-0.90	-0.30	0.30	0.90	-0.90	-0.30	0.30	0.90
$\beta = W_{d1}/c_1$	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90
Wad1/c1	0.00	-0.82	-0.94	-0.99	0.00	-0.82	-0.94	-0.99	0.00	-0.82	-0.94	-0.99	0.00	-0.82	-0.94	-0.99	0.00	-0.82	-0.94	-0.99	0.00	-0.82	-0.94	-0.99	0.00	-0.82	-0.94	-0.99
$E1/m c_0^2$	0.84	4527	2437	0.62	0.84	5414	2867	0.90	0.33	1301	744	0.09	0.06	227	130	0.01	0.33	1715	1000	0.30	0.06	228	131	0.01	0.33	1715	1000	0.30
$c2/c1$	-0.90	-0.29	-0.28	-0.83	-0.90	-0.27	-0.27	-0.82	-0.90	-0.30	-0.30	-0.87	-0.90	-0.30	-0.30	-0.89	0.90	0.28	0.28	0.82	0.90	0.30	0.30	0.89	0.90	0.30	0.30	0.89
Wa2/c1	-0.90	-0.26	0.28	0.83	-0.90	-0.24	0.26	0.81	-0.90	-0.29	0.30	0.87	-0.90	-0.30	0.30	0.89	-0.90	-0.25	0.27	0.82	-0.90	-0.30	0.30	0.88	-0.90	-0.30	0.30	0.88
Wd2/c1	-0.90	-0.01	-0.01	-0.34	-0.90	-0.01	-0.01	-0.28	-0.90	-0.01	-0.01	-0.56	-0.90	-0.01	-0.01	-0.79	-0.90	-0.01	-0.01	-0.31	-0.90	-0.01	-0.01	-0.68	-0.90	-0.01	-0.01	-0.68
Wad2/c1	0/0	0.26	-0.28	-0.83	0/0	0.23	-0.26	-0.81	0/0	0.29	-0.30	-0.87	0/0	0.30	-0.30	-0.89	0/0	0.25	-0.27	-0.82	0/0	0.30	-0.30	-0.89	0/0	0.30	-0.30	-0.89
$E2/m c_0^2$	#VALUE!	371	197	0.43	#VALUE!	408	215	0.60	#VALUE!	116	65.85	0.07	#VALUE!	20.38	11.71	0.01	#VALUE!	134	77.38	0.20	#VALUE!	20.46	11.77	0.01	#VALUE!	134	77.38	0.20
$c3/c1$	-0.90	-0.01	-0.01	-0.34	-0.90	-0.01	-0.01	-0.28	0.90	0.01	0.01	0.56	0.90	0.01	0.01	0.79	-0.90	-0.01	-0.01	-0.31	-0.90	-0.01	-0.01	-0.68	-0.90	-0.01	-0.01	-0.68
Wa3/c1	-0.90	0.00	0.00	0.00	-0.90	0.00	0.00	0.00	-0.90	0.00	0.00	0.00	-0.90	0.00	0.00	0.00	-0.90	0.00	0.00	0.20	-0.90	0.00	0.00	0.65	-0.90	0.00	0.00	0.65
Wd3/c1	-0.90	-0.01	-0.01	-0.34	-0.90	-0.01	-0.01	-0.28	-0.90	-0.01	-0.01	-0.56	-0.90	-0.01	-0.01	-0.79	-0.90	-0.01	-0.01	-0.30	-0.90	-0.01	-0.01	-0.68	-0.90	-0.01	-0.01	-0.68
Wad3/c1	0/0	-0.01	-0.01	-0.34	0/0	-0.01	-0.01	-0.28	0/0	-0.01	-0.01	-0.56	0/0	-0.01	-0.01	-0.79	0/0	-0.01	-0.01	-0.30	0/0	-0.01	-0.01	-0.68	0/0	-0.01	-0.01	-0.68
$E3/m c_0^2$	#VALUE!	0.39	0.22	0.07	#VALUE!	0.39	0.22	0.07	#VALUE!	0.15	0.09	0.03	#VALUE!	0.03	0.02	0.01	#VALUE!	0.15	0.09	0.03	#VALUE!	0.03	0.02	0.01	#VALUE!	0.15	0.09	0.03

Table 3 Light velocity ratio between in Real World and in the System 1 and 2 of the appropriate solution ( $-0.9 < \alpha < 0.9, -0.9 < \beta < 0.9$ )

<b>c1/c1</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>
$\alpha = Wa1/c1$	-0.90	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.90	-0.90	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.90	
$\beta = Wd1/c1$	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
Wad1/c1	0.00	-0.65	-0.82	-0.88	-0.92	-0.94	-0.97	-0.99	0.65	0.00	-0.37	-0.53	-0.66	-0.76	-0.88	-0.97	
<b>c1/c3</b>	<b>1.1</b>	<b>15.0</b>	<b>90.1</b>	<b>891</b>	<b>891</b>	<b>90.1</b>	<b>15.0</b>	<b>1.3</b>	<b>15.0</b>	<b>1.7</b>	<b>14.2</b>	<b>148</b>	<b>148</b>	<b>14.3</b>	<b>1.9</b>	<b>1.8</b>	
<b>c2/c1</b>	<b>-0.90</b>	<b>-0.60</b>	<b>-0.30</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.30</b>	<b>-0.60</b>	<b>-0.89</b>	<b>-0.60</b>	<b>-0.60</b>	<b>-0.30</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.30</b>	<b>-0.58</b>	<b>-0.60</b>	
Wa2/c1	-0.90	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.89	-0.07	-0.60	-0.30	-0.10	0.10	0.30	0.58	0.54	
Wd2/c1	-0.90	-0.07	-0.01	0.00	0.00	-0.01	-0.07	-0.79	-0.60	-0.60	-0.07	-0.01	-0.01	-0.07	-0.52	-0.60	
Wad2/c1	0/0	0.60	0.30	0.10	-0.10	-0.30	-0.60	-0.89	-0.60	0/0	0.30	0.10	-0.10	-0.30	-0.58	-0.60	
<b>c2/c3</b>	<b>-1.0</b>	<b>-9.0</b>	<b>-27.0</b>	<b>-89.1</b>	<b>-89.1</b>	<b>-27.0</b>	<b>-9.0</b>	<b>-1.1</b>	<b>-9.0</b>	<b>-1.0</b>	<b>-4.3</b>	<b>-14.8</b>	<b>-14.8</b>	<b>-4.3</b>	<b>-1.1</b>	<b>-1.1</b>	
<b>c3/c1</b>	<b>0.90</b>	<b>0.07</b>	<b>0.01</b>	<b>0.00</b>	<b>0.00</b>	<b>0.01</b>	<b>0.07</b>	<b>0.79</b>	<b>0.07</b>	<b>0.60</b>	<b>0.07</b>	<b>0.01</b>	<b>0.01</b>	<b>0.07</b>	<b>0.51</b>	<b>0.54</b>	
Wa3/c1	-0.90	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.07	-0.60	-0.03	0.00	0.00	0.00	0.02	0.53	
Wd3/c1	-0.90	-0.07	-0.01	0.00	0.00	-0.01	-0.07	-0.79	-0.01	-0.60	-0.07	-0.01	-0.01	-0.07	-0.51	-0.54	
Wad3/c1	0/0	-0.07	-0.01	0.00	0.00	-0.01	-0.07	-0.79	0.07	0/0	-0.07	-0.01	-0.01	-0.07	-0.51	-0.54	
c3/c3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
<b>c1/c1</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>
$\alpha = Wa1/c1$	-0.90	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.90	-0.90	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.90	
$\beta = Wd1/c1$	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	
Wad1/c1	0.82	0.37	0.00	-0.21	-0.39	-0.55	-0.76	-0.94	0.88	0.53	0.21	0.00	-0.20	-0.39	-0.66	-0.92	
<b>c1/c3</b>	<b>90.1</b>	<b>14.2</b>	<b>3.3</b>	<b>41.6</b>	<b>41.8</b>	<b>4.0</b>	<b>4.8</b>	<b>5.8</b>	<b>891</b>	<b>148</b>	<b>41.6</b>	<b>10.0</b>	<b>12.0</b>	<b>24.1</b>	<b>38.3</b>	<b>48.0</b>	
<b>c2/c1</b>	<b>-0.30</b>	<b>-0.30</b>	<b>-0.30</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.28</b>	<b>-0.30</b>	<b>-0.30</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.09</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.10</b>	
Wa2/c1	-0.01	-0.07	-0.30	-0.10	0.10	0.27	0.21	0.17	0.00	-0.01	-0.02	-0.10	0.09	0.04	0.03	0.02	
Wd2/c1	-0.30	-0.30	-0.30	-0.02	-0.02	-0.26	-0.30	-0.30	-0.10	-0.10	-0.10	-0.10	-0.09	-0.10	-0.10	-0.10	
Wad2/c1	-0.30	-0.30	0/0	0.10	-0.10	-0.28	-0.30	-0.30	-0.10	-0.10	-0.10	0/0	-0.09	-0.10	-0.10	-0.10	
<b>c2/c3</b>	<b>-27.0</b>	<b>-4.3</b>	<b>-1.0</b>	<b>-4.2</b>	<b>-4.2</b>	<b>-1.1</b>	<b>-1.4</b>	<b>-1.7</b>	<b>-89.1</b>	<b>-14.8</b>	<b>-4.2</b>	<b>-1.0</b>	<b>-1.1</b>	<b>-2.4</b>	<b>-3.8</b>	<b>-4.8</b>	
<b>c3/c1</b>	<b>0.01</b>	<b>0.07</b>	<b>0.30</b>	<b>0.02</b>	<b>0.02</b>	<b>0.25</b>	<b>0.21</b>	<b>0.17</b>	<b>0.00</b>	<b>0.01</b>	<b>0.02</b>	<b>0.10</b>	<b>0.08</b>	<b>0.04</b>	<b>0.03</b>	<b>0.02</b>	
Wa3/c1	-0.01	-0.07	-0.30	-0.01	0.00	0.04	0.20	0.17	0.00	-0.01	-0.02	-0.10	0.03	0.04	0.03	0.02	
Wd3/c1	0.00	-0.03	-0.30	-0.02	-0.02	-0.25	-0.19	-0.15	0.00	0.00	-0.01	-0.10	-0.08	-0.03	-0.01	-0.01	
Wad3/c1	0.01	0.07	0/0	-0.02	-0.02	-0.25	-0.21	-0.17	0.00	0.01	0.02	0/0	-0.08	-0.04	-0.03	-0.02	
c3/c3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
<b>c1/c1</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>
$\alpha = Wa1/c1$	-0.90	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.90	-0.90	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.90	
$\beta = Wd1/c1$	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
Wad1/c1	0.92	0.66	0.39	0.20	0.00	-0.21	-0.53	-0.88	0.94	0.76	0.55	0.39	0.21	0.00	-0.37	-0.82	
<b>c1/c3</b>	<b>891</b>	<b>148</b>	<b>41.8</b>	<b>12.0</b>	<b>10.0</b>	<b>23.9</b>	<b>38.2</b>	<b>47.9</b>	<b>90.1</b>	<b>14.3</b>	<b>4.0</b>	<b>24.1</b>	<b>23.9</b>	<b>3.3</b>	<b>4.8</b>	<b>5.8</b>	
<b>c2/c1</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.09</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.30</b>	<b>-0.30</b>	<b>-0.28</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.30</b>	<b>-0.30</b>	<b>-0.30</b>	
Wa2/c1	0.00	-0.01	-0.02	-0.09	0.10	0.04	0.03	0.02	-0.01	-0.07	-0.26	-0.10	0.10	0.30	0.21	0.17	
Wd2/c1	0.10	0.10	0.10	0.09	0.10	0.10	0.10	0.10	0.30	0.30	0.27	0.04	0.04	0.30	0.30	0.30	
Wad2/c1	0.10	0.10	0.10	0.09	0/0	0.10	0.10	0.10	0.30	0.30	0.28	0.10	-0.10	0/0	0.30	0.30	
<b>c2/c3</b>	<b>-89.1</b>	<b>-14.8</b>	<b>-4.2</b>	<b>-1.1</b>	<b>-1.0</b>	<b>-2.4</b>	<b>-3.8</b>	<b>-4.8</b>	<b>-27.0</b>	<b>-4.3</b>	<b>-1.1</b>	<b>-2.4</b>	<b>-2.4</b>	<b>-1.0</b>	<b>-1.4</b>	<b>-1.7</b>	
<b>c3/c1</b>	<b>0.00</b>	<b>0.01</b>	<b>0.02</b>	<b>0.08</b>	<b>0.10</b>	<b>0.04</b>	<b>0.03</b>	<b>0.02</b>	<b>0.01</b>	<b>0.07</b>	<b>0.25</b>	<b>0.04</b>	<b>0.04</b>	<b>0.30</b>	<b>0.21</b>	<b>0.17</b>	
Wa3/c1	0.00	-0.01	-0.02	-0.08	0.10	0.04	0.03	0.02	-0.01	-0.07	-0.25	-0.03	0.00	0.30	0.21	0.17	
Wd3/c1	0.00	0.00	0.00	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.30	0.00	0.00	
Wad3/c1	0.00	0.01	0.02	0.08	0/0	-0.04	-0.03	-0.02	0.01	0.07	0.25	0.04	0.04	0/0	-0.21	-0.17	
c3/c3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
<b>c1/c1</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>
$\alpha = Wa1/c1$	-0.90	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.90	-0.90	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.90	
$\beta = Wd1/c1$	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
Wad1/c1	0.97	0.88	0.76	0.66	0.53	0.37	0.00	-0.65	0.99	0.97	0.94	0.92	0.88	0.82	0.65	0.00	
<b>c1/c3</b>	<b>15.0</b>	<b>1.9</b>	<b>4.8</b>	<b>38.3</b>	<b>38.2</b>	<b>4.8</b>	<b>1.7</b>	<b>1.8</b>	<b>1.3</b>	<b>1.8</b>	<b>5.8</b>	<b>48.0</b>	<b>47.9</b>	<b>5.8</b>	<b>1.8</b>	<b>1.1</b>	
<b>c2/c1</b>	<b>-0.60</b>	<b>-0.58</b>	<b>-0.30</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.30</b>	<b>-0.60</b>	<b>-0.60</b>	<b>-0.89</b>	<b>-0.60</b>	<b>-0.30</b>	<b>-0.10</b>	<b>-0.10</b>	<b>-0.30</b>	<b>-0.60</b>	<b>-0.90</b>	
Wa2/c1	-0.07	-0.52	-0.30	-0.10	0.10	0.30	0.60	0.54	-0.79	-0.60	-0.30	-0.10	0.10	0.30	0.60	0.90	
Wd2/c1	0.60	0.58	0.21	0.03	0.03	0.21	0.60	0.60	0.89	0.54	0.17	0.02	0.02	0.17	0.54	0.90	
Wad2/c1	0.60	0.58	0.30	0.10	-0.10	-0.30	0/0	0.60	0.89	0.60	0.30	0.10	-0.10	-0.30	-0.60	0/0	
<b>c2/c3</b>	<b>-9.0</b>	<b>-1.1</b>	<b>-1.4</b>	<b>-3.8</b>	<b>-3.8</b>	<b>-1.4</b>	<b>-1.0</b>	<b>-1.1</b>	<b>-1.1</b>	<b>-1.1</b>	<b>-1.7</b>	<b>-4.8</b>	<b>-4.8</b>	<b>-1.7</b>	<b>-1.1</b>	<b>-1.0</b>	
<b>c3/c1</b>	<b>0.07</b>	<b>0.51</b>	<b>0.21</b>	<b>0.03</b>	<b>0.03</b>	<b>0.21</b>	<b>0.60</b>	<b>0.54</b>	<b>0.79</b>	<b>0.54</b>	<b>0.17</b>	<b>0.02</b>	<b>0.02</b>	<b>0.17</b>	<b>0.54</b>	<b>0.90</b>	
Wa3/c1	-0.07	-0.51	-0.19	-0.01	0.00	0.00	0.60	0.54	-0.79	-0.54	-0.15	-0.01	0.00	0.00	0.00	0.90	
Wd3/c1	0.00	0.02	0.20	0.03	0.03	0.21	0.60	0.00	0.00	0.53	0.17	0.02	0.02	0.17	0.54	0.90	
Wad3/c1	0.07	0.51	0.21	0.03	0.03	0.21	0/0	-0.54	0.79	0.54	0.17	0.02	0.02	0.17	0.54	0/0	
c3/c3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

### 3. Results

Next, the trial calculations were performed and the results are discussed below.

Since the absolute value of the galaxy movement speed is unknown, I calculated the light velocities in both the System 2 space-time and the System 3 space-time by changing the galaxy movement speed from -0.9 to +0.9 times faster than the light velocity in the System 1 space-time.

There are three requirements as to the physical condition: the light velocity related to the negative pressure based on dark energy is negative, the light velocity is faster than the speed of galaxy, and the rest mass-energy is minimum. In that case, only one combination from 96 possible combinations is left as the most appropriate solution. That is,

$$(\varepsilon_1: \text{baryons, } 0.049; \quad \varepsilon_2: \text{dark energy, } 0.683; \quad \varepsilon_3: \text{dark matter, } 0.268), \quad (\delta_1 = \delta_2 = \delta_3 = -1, \quad \delta_4 = +1).$$

The results of the trial calculations are given in Table 1 and Table 2 with 96 solution samples

The System 2 space-time has the negative light velocity; in contrast, the System 1 space-time and the System 3 space-time both have the positive light velocities.

The light velocity in the System 1 space-time has the highest value and the absolute light velocity in the System 2 space-time is greater than that in the System 3 space-time.

As a result, equations for the sole appropriate solution are arranged as follows.

$$(7) \quad \left(\frac{c_2}{c_1}\right) = -\sqrt{\frac{1}{2(1-K)} \left[ \alpha^2 + \beta^2 - 2\alpha\beta K - (\alpha - \beta)\sqrt{(\alpha + \beta)^2 - 4\alpha\beta K} \right]}$$

$$(8) \quad \left(\frac{c_3}{c_1}\right) = \frac{+A^2 \sqrt{\frac{(A^2 - 1)^2(\alpha - \beta)^2 + 2(1-L)(A^2 + \alpha)(A^2 + \beta)(1 + \alpha)(1 + \beta)}{-(A^2 - 1)(\alpha - \beta)\sqrt{(A^2 - 1)^2(\alpha - \beta)^2 + 4(1-L)(A^2 + \alpha)(A^2 + \beta)(1 + \alpha)(1 + \beta)}}}{(A^2 + \alpha)(A^2 + \beta) \sqrt{2(1-L)}}$$

$$\text{Here, I insert } K = \left(\frac{\varepsilon_1}{\varepsilon_1 + \varepsilon_2}\right)^2 \frac{(1 - \alpha^2)(1 - \beta^2)}{(1 - \alpha\beta)^2} \quad L = \left(\frac{\varepsilon_1}{\varepsilon_1 + \varepsilon_2 + \varepsilon_3}\right)^2 \frac{(1 - \alpha^2)(1 - \beta^2)}{(1 - \alpha\beta)^2} \quad A = \frac{c_2}{c_1}$$

$$\varepsilon_1: \text{baryons, } 0.049 \quad \varepsilon_2: \text{dark energy, } 0.683 \quad \varepsilon_3: \text{dark matter, } 0.268$$

$$\alpha = w_{A1}/c_1, \quad \beta = w_{D1}/c_1$$

By changing the speed of galaxy movement  $\alpha$  and  $\beta$  from -0.9 to +0.9 times faster than the light velocity  $c_1$ ,  $c_2/c_1$  changes from -0.9 to -0.1 times and  $c_3/c_1$  changes from 0 to 0.9 times i.e.,  $c_1 > |c_2| \geq c_3$ .

### 4. Denying the presence of the System 4 space-time

Since the System 1, the System 2 and the System 3 space-times exist, it is highly likely that the System 4 space-time also similarly exists. This calls for investigating the possibility of the System 4 space-time existence.

Apply the formula of "2.1. The combined velocity and the increasing mass" to the System 4 space-time.

$$w_{A4} = \frac{w_{A3} + c_3}{1 + w_{A3} c_3/c_4^2} \quad w_{D4} = \frac{w_{D3} + c_3}{1 + w_{D3} c_3/c_4^2}$$

The relative speed  $w_{AD4}$  between  $w_{A4}$  and  $w_{D4}$  is presented as shown below when  $(w_{D4})$  and  $(-w_{A4})$  are substituted into the combined velocity.



$$w_{AD4} = \frac{w_{D4} - w_{A4}}{1 - w_{A4}w_{D4}/c_4^2}$$

$$= \frac{(w_{D1} - w_{A1}) c_2^2 c_3^2 c_4^2 (c_2^2 - c_1^2)(c_3^2 - c_2^2)}{\left[ c_4^2 [c_2^2 (c_3^2 + c_1 c_2) + w_{A1} (c_2^3 + c_1 c_3^2)] [c_2^2 (c_3^2 + c_1 c_2) + w_{D1} (c_2^3 + c_1 c_3^2)] - c_2^2 c_3^4 (c_1 + c_2)^2 (w_{A1} + c_2)(w_{D1} + c_2) \right]}$$

The rest mass  $M_0$  is common to all four systems and can be described by using the mass of motion  $m_{D4}$  at the relative speed  $w_{AD4}$ .

$$M_0 = m_{D1} \sqrt{1 - \left(\frac{w_{AD1}}{c_1}\right)^2} = m_{D2} \sqrt{1 - \left(\frac{w_{AD2}}{c_2}\right)^2} = m_{D3} \sqrt{1 - \left(\frac{w_{AD3}}{c_3}\right)^2} = m_{D4} \sqrt{1 - \left(\frac{w_{AD4}}{c_4}\right)^2}$$

Substitute  $w_{AD1}$ ,  $w_{AD2}$ ,  $w_{AD3}$  and  $w_{AD4}$  into the equations.

It then becomes necessary to solve the quadratic equation of  $c_4$ , where  $w_{A1} = \alpha \cdot c_1$ ,  $w_{D1} = \beta \cdot c_1$  and

$$J = \left(\frac{m_{D1}}{m_{D4}}\right)^2 \frac{(1-\alpha^2)(1-\beta^2)}{(1-\alpha\beta)^2} = 1 - \left(\frac{w_{AD4}}{c_4}\right)^2$$

There are four solutions of  $c_4$ , which are  $\delta_5 = \pm 1$ ,  $\delta_6 = \pm 1$ .

$$c_4^2 \delta_5 \sqrt{1-J} [c_1 c_2^3 (1+\alpha) + c_3^2 (c_2^2 + \alpha c_1^2)] [c_1 c_2^3 (1+\beta) + c_3^2 (c_2^2 + \beta c_1^2)] + c_4 (\alpha - \beta) c_1 c_2^2 c_3^2 (c_2^2 - c_1^2) (c_3^2 - c_2^2) - \delta_5 \sqrt{1-J} c_2^2 c_3^4 (c_1 + c_2)^2 (\alpha c_1 + c_2)(\beta c_1 + c_2) = 0$$

Vary  $\alpha$  and  $\beta$  from  $-0.9$  to  $+0.9$ , respectively as numerical analyses. Set each parameter in the System 4 space-time as follows: baryons  $\varepsilon_1=0.049$ , dark energy  $\varepsilon_2=0.683$ , dark matter  $\varepsilon_3=0.268$  and the unknown energy body  $\varepsilon_4$  from  $0$  to  $0.1$ . The light velocities  $c_1$ ,  $c_2$  and  $c_3$  are adopted according to "2. Results".

The results of numerical analyses show that the sign of  $c_4/c_1$  of any  $\delta_5$  and  $\delta_6$  transits to  $\pm$  when  $\alpha$  and  $\beta$  vary from  $-0.9$  to  $+0.9$ . A trial calculation example is shown in table 4.

This indicates that the characteristics of the System 4 space-time are uncertain and as a result, the System 4 space-time itself and the fourary space-times do not exist.

Table 4 Trial calculation example of the light velocity in the System 4 space-time  
(in the case of  $\varepsilon_4=0.01, \delta_5=\delta_6=1$ )

$\beta = Wd_1/c_1$	$\alpha = Wa_1/c_1$	-0.9	-0.3	0.3	0.9
-0.9	$c_1/c_1$	1.000	1.000	1.000	1.000
	$c_2/c_1$	-0.900	-0.300	-0.300	-0.894
	$c_3/c_1$	0.900	0.011	0.011	0.788
	$c_4/c_1$	0.900	0.001	-0.000	-0.001
-0.3	$c_1/c_1$	1.000	1.000	1.000	1.000
	$c_2/c_1$	-0.300	-0.300	-0.284	-0.300
	$c_3/c_1$	0.011	0.300	0.252	0.172
	$c_4/c_1$	0.011	0.300	-0.038	-0.149
0.3	$c_1/c_1$	1.000	1.000	1.000	1.000
	$c_2/c_1$	-0.300	-0.284	-0.300	-0.300
	$c_3/c_1$	0.011	0.252	0.300	0.173
	$c_4/c_1$	0.011	0.252	0.300	0.000
0.9	$c_1/c_1$	1.000	1.000	1.000	1.000
	$c_2/c_1$	-0.894	-0.300	-0.300	-0.900
	$c_3/c_1$	0.788	0.172	0.173	0.900
	$c_4/c_1$	0.788	0.172	0.173	0.000

## 5. Discussion

In summary, I estimated the ternary space-times by using the formulae for both combined velocities and the increasing mass which are completed in the accelerated motion from the special theory of relativity.

The System 1 space-time has baryons and the positive light velocity  $c_1$ . It moves at the light velocity  $c_1$  in the System 2 space-time and produces dark energy by the increasing mass. (See Fig.2)

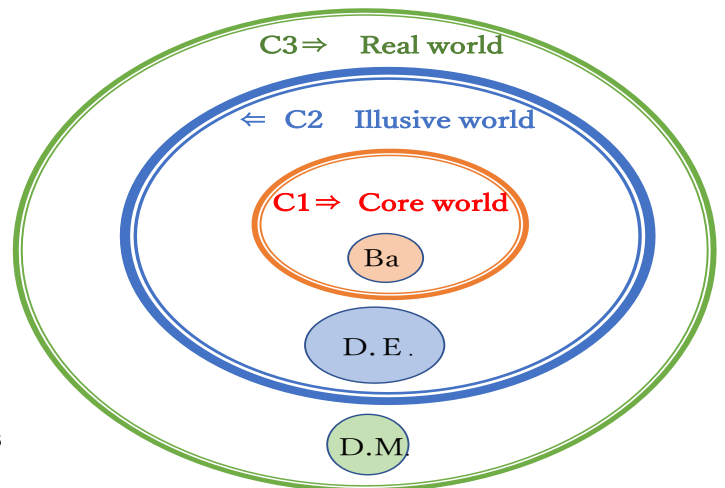


Fig.2 Image of the ternary space-times

The System 2 space-time has baryons, dark energy and the negative light velocity  $c_2$ . It moves at the light velocity  $c_2$  in the System 3 space-time and produces dark matter by the increasing mass.

The System 3 space-time has baryons, dark energy, dark matter and the positive light velocity  $c_3$ .

Dark matter is a product in the System 3 space-time, and the System 3 is the present “real world” with a positive light velocity (300,000 km/s).

Dark energy is a product in the System 2 space-time, and the System 2 is the “illusive world” with a

negative light velocity that is ten times faster ( $c_2/c_3 : -1.0 \sim -89$ ) than that in the real world. The System 2 also has negative pressure since this is a negative light velocity world, i.e., it represents the expansion of the universe itself.

Baryons is a product in the System 1 space-time and the System 1 is the “core world” with a positive light velocity that is hundred times faster ( $c_1/c_3 : 1.1 \sim 890$ ) than that in the real world.

Dark matter and dark energy are the magics of the ternary space-times and generated from baryons of the core world.

It is impossible to directly catch substances proper of dark matter in the System 3 space-time because this real world is separated from the System 1 where the core world exists due to the space-time curtain. Substances of dark energy in the System 2 space-time are the same as above.

The movement speed  $w$  of galaxies changes in the past, present and future. On the other hand, the light velocities  $c$  in each time-space do not change and are invariable.

the light velocity in the System 1  $c_1 > 0$ ,  
the light velocity in the System 2  $c_2 < 0$ ,  
the light velocity in the System 3  $c_3 > 0$  ,  
 $c_1 > |c_2| \cong c_3$

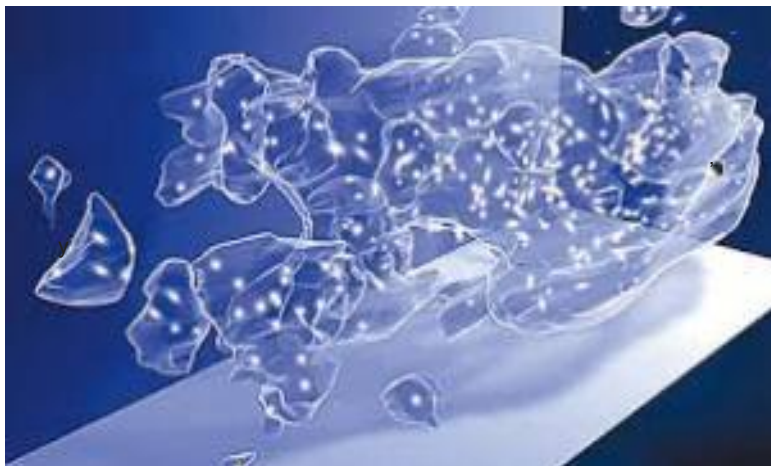
	the movement speed			the mass of motion		
	Sys. 1	Sys. 2	Sys. 3	Sys. 1	Sys. 2	Sys. 3
Baryons	$w_{D1}$	$w_{D2}$	$w_{D3}$	$\varepsilon_1 m$	$\varepsilon_1 m$	$\varepsilon_1 m$
Dark energy	—	$w_{D2}$	$w_{D3}$	—	$\varepsilon_2 m$	$\varepsilon_2 m$
Dark matter	—	—	$w_{D3}$	—	—	$\varepsilon_3 m$

It is difficult to apply the theory of relativity to the very early universe era when the sudden expansion of the universe occurred. However, it is possible to apply the theory of relativity to the era of after early universe.

When the universe transitted from the System 1 space-time to the System 2 space-time in inflationary epoch of the very early universe, the mass of motion  $\varepsilon_2 m$  increased in accordance with the equation  $E_2 = m(\varepsilon_1 + \varepsilon_2) c_2^2 \sqrt{1 - (w_{AD2}/c_2)^2}$  as an enlarged copy of inflaton  $\varepsilon_1 m$ . Inflaton in the System 1 space-time collapsed into standard model particles (electron, photon, neutrino, proton, neutron and etc.) with the lapse of time. On the other hand, inflatons which occurred in the System 2 and the System 3 space-times developed on their own over time and they seem to have been gravitating with/without electric characteristics.

The movement speeds of baryons and dark energy are equal since the speed  $w_{AD2}$  is common to baryons and dark energy in the System 2 space-time. The same can be said to the System 3 space-time. As a result, it can be concluded that dark matter (halo) is located around baryons (galaxy) as shown in Fig.3.

Fig.3 Image of dark matter and the galaxy [5]



White spots are galaxies and clear jellies are dark matters.

Courtesy of NASA, ESA ,R.Massey

Fig.4 Bullet Galaxy



Two blue areas are dark matters.

Courtesy of NASA, CXC, CfA

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### Author Contributions

F. I. developed the theory and wrote the manuscript.

### Competing Interests

The author declares no competing interests including financial and non-financial interests.