Space Doesn't Expand and New Proof of Hubble's Law

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After the expansion of universe was observed in the 1920s, [1] [2] physicists and astronomers introduced the concept of "space expands" into physics and many observations and research results were used based on this. [3] [4] However, we can't explain why space expands and why it has a specific velocity and is no observations of expansion of space. This study proves that the expansion of the universe and Hubble's law doesn't result from the expansion of space, but is a dynamical result from the movement of galaxies in space. We could confirm that Hubble's law was always valid when the effect of acceleration was smaller than initial velocity. We can define the center of the universe and find it. Also, this shows that cosmological red shift comes out from the Doppler effect of light. Expansion of space was explained that it was related to red shift and scale factor. Therefore, it is influencing many areas of astronomy and cosmology. Therefore, if this discovery is true, all matters related to red shift and scale factor should be reviewed.

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I. Introduction

By *Lemaître* and Hubble in the 1920s, expansion of universe, red shift of the galaxy, and recession velocity based on Earth were observed, [1] [2] scientists introduced the concept of "space expands" into physics to explain this.

Observed cosmological red shift was similar to the Doppler shift which occurs when the light source becomes further away from the observer in space, but it was replaced with the concept that space itself expands. [3] [4]

From the two facts of observation of all distant galaxies receding with Earth in the center and that Earth isn't the center of universe, it is presumed that cosmological red shift isn't Doppler shift of the galaxy moving in space.

Moreover, because scale factor is separated and marked by the solution of field equation and this can be corresponded to expansion of space, it was thought that observed cosmological red shift results from the expansion of space. [3]

A recent study put some other interpretation on the expansion of space. [5] [6]

However, significant matters related to expansion of space haven't been proved or explained during the 80s until today and these results aren't being observed.

1. Expansion of space isn't an obvious matter.

Thinking of space expanding, there are 3 cases.

A. Expansion

B. Contraction

C. Maintenance - Condition without expansion and contraction

These three conditions can be possible and there is no thought that "expansion" among these is the most natural value. If force does not exists, it is natural that any physical quantity has the same value, so "maintenance" is the most natural value.

2.If space expands, the expansion speed of space can vary from - infinity to + infinity. There is no basis that a specific value among these should be chosen.

3.We have never observed the expansion of space.

The physical meaning of "space expands" is that all space expands.

A. Space between an atomic nucleus and electrons also expands.

B. Space between the Sun and Earth also expands.

C. Space between galaxies also expands.

Like the above content, it means that all space expands. Scientist who claim expansion of space, space all expands in A, B, C, but

For A, binding is consisted by electromagnetic force, space actually expands but position is compensated by electromagnetic force in time we don't feel, and therefore it is explained that is why we can't observe that effect. [4]

For B, space between the Sun and Earth expands every second, but position is immediately compensated because the Sun and Earth is strongly combined by gravity and explains that is why we can't observe that effect. [4]

On the other hand, for C, space between galaxies also expands, but it is explained that expansion of space appears in C because their gravitational binding is weak. [4]

It is a possible explanation.

However, this is a possible explanation for Hubble's law, but it is clear that we didn't observe the "expansion of space."

Thus, we have never directly observed expansion of space between electrons and protons, and energy loss used in compensation of position was never measured, and was never measured between Earth and Sun either.

4.Expansion of the universe and expansion of space isn't the same concept.

The fact that the universe expands shows that distance between galaxies become further. This can be explained from the expansion of space between galaxies, but this can be explained even when galaxies have +r direction initial speed in condition where space doesn't expand.

5. The metaphor of a balloon is 4 dimensional or 2 dimensional, the observed Hubble's law is an observational matter in 3 dimensional space.

Balloon analogy [4] is just a pedantic metaphor, not a precise explanation.

This study proves that Hubble's law is a natural result from the dynamics of galaxies in 3 dimension and tries to prove the fact that all far away galaxies have recession speed with Earth in the center.

II. Proof of Hubble's law through dynamics

1. After accelerating expansion (inflation) of early universe has almost finished, particles started to have some velocity.

This velocity distribution naturally has higher velocity when it is further away from the center of the universe and has lower velocity when it is closer to the center.

A. Big bang simulation in the zero energy universe [Video for Big bang Simulation] [7] [8]

Even if the velocity of particles is zero in the early universe, there are particles with higher velocity in further areas from the center and particles close to the center have relatively low velocity by accelerating expansion of early universe . When positive mass gravitationally contracts to form a galaxy, momentum must be conserved, so higher initial velocity continues to exist as it becomes further away from the center of universe.

B. Natural distribution of velocity in the 3D space Thinking in another way, 3 dimensional space can be divided into 3 areas (from the center) to far, middle, and close area. Even if the velocity of the far area is lower than the middle area, middle area particles exceed far area particles when time passes because the velocity of middle particles are higher. As a result, velocity distribution of particles shows that the velocity of far areas is highest, middle area is second, and the close area becomes third.

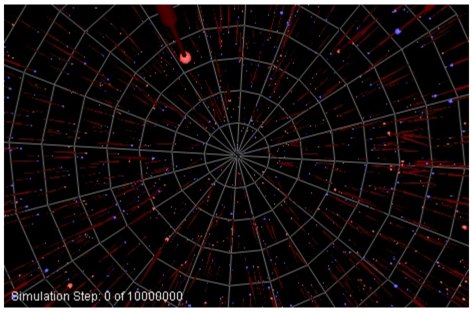

Figure 1: Velocity distribution of galaxies at early universe. Red arrows show the velocity vector of particles. [8] It can be known that the magnitude of velocity vector is bigger as it become further from the center.

C. Velocity distribution when some kind of anti-gravitational source exists If some kind of anti-gravitational source or effect in 3 dimension exists, M exists with even density, the above velocity distribution can exist.

$$m\vec{a} = +\frac{G(\frac{4\pi}{3}r^3\rho)m}{r^2}\hat{r} \tag{1}$$

$$\vec{a} = +\frac{4\pi G}{3}\rho r\hat{r} \tag{2}$$

If anti-gravitational source is evenly distributed in accelerating expansion time like the inflation of early universe, a bigger acceleration a exists as r becomes larger and velocity distribution has a higher velocity as the radius of the universe becomes larger. As a result, higher velocity exists for particles of far area from the center of the universe after accelerating expansion ends.

The 3 explanations shown above mean that higher velocity for larger R(distance from the center of universe) after accelerating expansion in the early universe isn't a peculiar phenomenon. If speed in small area in the early universe distributes from 0 to c and if some time passes, velocity distribution will be in order as above.

2. Derivation of Hubble's law in space without expansion

A. Decelerating expansion time

First to look into the possibility of this model, let's look into the case in which the direction of V_{a1} and V_{b1} is the same.

$$V_{a1} = V_{a0} + (-a_1 t_1) \quad (3)$$

$$V_{b1} = V_{b0} + (-a_1 t_1) \quad (4)$$

V_{a0}, V_{b0} : It is the speed in which A and B galaxy has when an accelerating expansion (like inflation) ends.

$-a_1$: Acceleration by force (maybe gravity) occurred from some unknown energy source. It is the acceleration of decelerating expansion because decelerating expansion seems to have taken place in the early universe. It is actually a function of time. To make the problem simple, we plan to solve the problem making it as a constant.

t_1 : Total time of universe decelerating expansion.

$$R_{a1} = R_{a0} + V_{a0}t_1 - \frac{1}{2}a_1 t_1^2 \quad (5)$$

$$R_{b1} = R_{b0} + V_{b0}t_1 - \frac{1}{2}a_1 t_1^2 \quad (6)$$

The above equations are equations of speed and distance when acceleration is constant.

B. Accelerating expansion time

After decelerating expansion ends, there was a time of accelerating expansion. Acceleration is given as a_2 this time and the duration time is set as t_2.

$$V_{an} = V_{a1} + a_2 t_2 = (V_{a0} - a_1 t_1) + a_2 t_2 \quad (7)$$

$$V_{bn} = V_{b1} + a_2 t_2 = (V_{b0} - a_1 t_1) + a_2 t_2 \quad (8)$$

V_{an},V_{bn} is the now speed of galaxy a and galaxy b.

$$\begin{aligned} R_{an} &= R_{a1} + V_{a1}t_2 + \tfrac{1}{2}a_2 t_2^2 \\ &= R_{a0} + (V_{a0}t_1 - \tfrac{1}{2}a_1 t_1^2) + (V_{a0} - a_1 t_1)t_2 + \tfrac{1}{2}a_2 t_2^2 \\ &= R_{a0} + V_{a0}(t_1 + t_2) - a_1 t_1 t_2 - \tfrac{1}{2}a_1 t_1^2 + \tfrac{1}{2}a_2 t_2^2 \end{aligned} \quad (9)$$

$$\begin{aligned} R_{bn} &= R_{b0} + V_{b1}t_2 + \tfrac{1}{2}a_2 t_2^2 \\ &= R_{b0} + (V_{b0}t_1 - \tfrac{1}{2}a_1 t_1^2) + (V_{b0} - a_1 t_1)t_2 + \tfrac{1}{2}a_2 t_2^2 \\ &= R_{b0} + V_{b0}(t_1 + t_2) - a_1 t_1 t_2 - \tfrac{1}{2}a_1 t_1^2 + \tfrac{1}{2}a_2 t_2^2 \end{aligned} \quad (10)$$

C. Deriving Hubble's law (when direction is the same)

$V_{rel} = V_{bn} - V_{an}$ is the relative speed of galaxy a and galaxy b.

$$\begin{aligned} V_{rel} &= V_{bn} - V_{an} \\ &= (V_{b0} - a_1 t_1) + a_2 t_2 - (V_{a0} - a_1 t_1) - a_2 t_2 = V_{b0} - V_{a0} \end{aligned} \quad (11)$$

$$\begin{aligned} R_{rel} &= R_{bn} - R_{an} = (R_{b0} - R_{a0}) + (V_{b0} - V_{a0})(t_1 + t_2) \\ &\simeq (V_{b0} - V_{a0})t \end{aligned} \quad (12)$$

Because the galaxies or particles in the early universe were concentrated in a very close distance, it can be set as

$$(R_{b0} - R_{a0}) = 0 \quad (13)$$

$$t = t_1 + t_2 \quad (14)$$

This is the age of the universe.

Deriving the relation between V_{rel} and R_{rel},

$$V_{rel} = V_{bn} - V_{an} = V_{b0} - V_{a0} = \frac{1}{t}R_{rel} = HR_{rel} \quad (15)$$

It can be known that Hubble's law comes out.

Especially, the Hubble constant is H=1/t and this is a result that the Hubble constant in Hubble's law corresponds to the reciprocal of the age of universe. Considering decelerating expansion and accelerating expansion and movement of relative particles, the actual age of the universe is $0.993t_H$. It is very close to 1. [3]

Therefore, the above model contains simple equation, but has possibility.

Thus, the recession velocity and Hubble's law between galaxies don't come from some vague concept(unknown concept without empirical experience) of "expansion of space" and shows possibility that it comes from a simple movement equation called $R = V_0 t + \int\int a(t)d^2t$.

In $R = V_0 t + \int\int a(t)d^2t$, if a(t) (acceleration) is small, this is because a $V_{rel} = \frac{1}{t}R_{rel} = HR_{rel}$ shape Hubble's law comes out.

D. The observation of "all galaxies become further from us and all galaxies have recession velocity from Hubble's law" isn't from the expansion of space, it is result of dynamics that galaxies show.

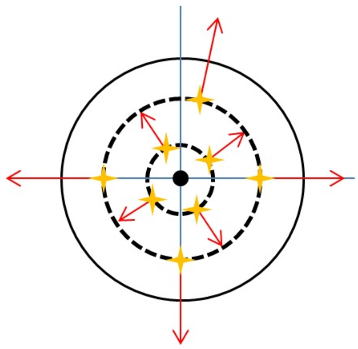

Figure 2: Hubble's observation of all galaxies receding with Earth in the center

It is assumed that interpretation issues of observation results above applied most in physicists and astronomers introducing expansion of space. When observed from Earth, it is observed that all galaxies recede from Earth and the recession velocity also follow all relations of $\vec{V} = H\vec{R}$.

To explain this, if position of the Earth is the center of expansion, namely if position of the Earth is the center of universe, this issue can be simply solved but it can be clearly known that Earth isn't the center of the universe from the observation of the universe until now.

It is because Earth isn't the center of the solar system, but is clear to be just a planet and that the solar system isn't the center of the galactic system either.

Therefore, physicists and astronomers had to find a way to explain this and as this couldn't be explained by dynamics, a new concept that "space expands" was introduced. To explain more specifically, it is assumed that the stereotype that Hubble's observation isn't valid in places where expansion isn't in the center had influence.

[Derivation of Hubble's law]

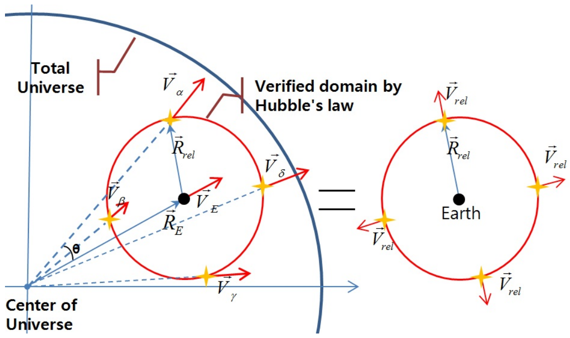

Figure 3: Hubble's law doesn't result from the expansion of space, but is a dynamical result from the movement of galaxies in space.

Set as
$|\vec{a}_{E1}| = |\vec{a}_{\alpha 1}| = |\vec{a}_{\beta 1}| = |\vec{a}_{r1}| = |\vec{a}_{\delta 1}| = a_1$,
$|\vec{a}_{E2}| = |\vec{a}_{\alpha 2}| = |\vec{a}_{\beta 2}| = |\vec{a}_{\gamma 2}| = |\vec{a}_{\delta 2}| = a_2$

$$\vec{V}_{E1} = \vec{V}_{E0} - \vec{a}_{E1} t_1 \tag{16}$$

$$\vec{V}_{\alpha 1} = \vec{V}_{\alpha 0} - \vec{a}_{\alpha 1} t_1 \tag{17}$$

$$\begin{aligned}\vec{V}_{En} &= \vec{V}_{E1} + \vec{a}_{E2} t_2 = (\vec{V}_{E0} - \vec{a}_{E1} t_1) + \vec{a}_{E2} t_2 \\ &= ((V_{E0} - a_1 t_1) + a_2 t_2)\hat{x}\end{aligned} \tag{18}$$

Set as x-axis.

$$\begin{aligned}\vec{V}_{\alpha n} &= \vec{V}_{\alpha 1} + \vec{a}_{\alpha 2} t_2 = (\vec{V}_{\alpha 0} - \vec{a}_{\alpha 1} t_1) + \vec{a}_{\alpha 2} t_2 \\ &= (V_{\alpha 0} - a_1 t_1 + a_2 t_2)\cos\theta \hat{x} + (V_{\alpha 0} - a_1 t_1 + a_2 t_2)\sin\theta \hat{y}\end{aligned} \tag{19}$$

$$\begin{aligned}\vec{R}_{En} &= \vec{R}_{E1} + \vec{V}_{E1} t_2 + \tfrac{1}{2}\vec{a}_{E2} t_2^2 \\ &= (\vec{V}_{E0} t_1 - \tfrac{1}{2}\vec{a}_{E1} t_1^2) + (\vec{V}_{E0} - \vec{a}_{E1} t_1) t_2 + \tfrac{1}{2}\vec{a}_{E2} t_2^2 \\ &= (t_1 + t_2)\vec{V}_{E0} - t_1 t_2 \vec{a}_{E1} - \tfrac{1}{2} t_1^2 \vec{a}_{E1} + \tfrac{1}{2} t_2^2 \vec{a}_{E2}\end{aligned} \tag{20}$$

$$\vec{R}_{En} = [(t_1 + t_2)V_{E0} - t_1 t_2 a_1 - \frac{1}{2} t_1^2 a_1 + \frac{1}{2} t_2^2 a_2]\hat{x} \tag{21}$$

$$\begin{aligned}\vec{R}_{\alpha n} &= \vec{R}_{\alpha 1} + \vec{V}_{\alpha 1} t_2 + \tfrac{1}{2}\vec{a}_{\alpha 2} t_2^2 \\ &= (\vec{V}_{\alpha 0} t_1 - \tfrac{1}{2}\vec{a}_{\alpha 1} t_1^2) + (\vec{V}_{\alpha 0} - \vec{a}_{\alpha 1} t_1) t_2 + \tfrac{1}{2}\vec{a}_{\alpha 2} t_2^2 \\ &= (t_1 + t_2)\vec{V}_{\alpha 0} - t_1 t_2 \vec{a}_{\alpha 1} - \tfrac{1}{2} t_1^2 \vec{a}_{\alpha 1} + \tfrac{1}{2} t_2^2 \vec{a}_{\alpha 2}\end{aligned} \tag{22}$$

$$\begin{aligned}\vec{R}_{\alpha n} &= [(t_1 + t_2)V_{\alpha 0} - t_1 t_2 a_1 - \tfrac{1}{2} t_1^2 a_1 + \tfrac{1}{2} t_2^2 a_2]\cos\theta \hat{x} \\ &+ [(t_1 + t_2)V_{\alpha 0} - t_1 t_2 a_1 - \tfrac{1}{2} t_1^2 a_1 + \tfrac{1}{2} t_2^2 a_2]\sin\theta \hat{y}\end{aligned} \tag{23}$$

[Relative Velocity]

$$\begin{aligned}\vec{V}_{rel} &= \vec{V}_{\alpha n} - \vec{V}_{En} \\ &= [(V_{\alpha 0}\cos\theta - V_{E0}) + (-a_1 t_1 + a_2 t_2)(\cos\theta - 1)]\hat{x} \\ &+ (V_{\alpha 0} - a_1 t_1 + a_2 t_2)\sin\theta \hat{y}\end{aligned} \tag{24}$$

[Relative Distance]

$$\begin{aligned}\vec{R}_{rel} &= \\ & t\{[(V_{\alpha 0}\cos\theta - V_{E0}) + \tfrac{1}{t}(-t_1 t_2 a_1 - \tfrac{1}{2} t_1^2 a_1 + \tfrac{1}{2} t_2^2 a_2)(\cos\theta - 1)]\hat{x} \\ &+ [V_{\alpha 0} + \tfrac{1}{t}(-t_1 t_2 a_1 - \tfrac{1}{2} t_1^2 a_1 + \tfrac{1}{2} t_2^2 a_2)]\sin\theta \hat{y}\}\end{aligned} \tag{25}$$

$(t = t_1 + t_2)$

1) When θ is zero.

$$\vec{V}_{rel} = (V_{\alpha 0} - V_{E0})\hat{x} \tag{26}$$

$$\vec{R}_{rel} = t(V_{\alpha 0} - V_{E0})\hat{x} \tag{27}$$

Therefore, $\vec{V}_{rel} = \frac{1}{t}\vec{R}_{rel} = H\vec{R}_{rel}$

2) When θ is small.

$$\vec{V}_{rel} \simeq (V_{\alpha 0} - V_{E0})\hat{x} + (V_{\alpha 0} - a_1 t_1 + a_2 t_2)\theta\hat{y} \tag{28}$$

$$\vec{R}_{rel} \simeq t\{(V_{\alpha 0} - V_{E0})\hat{x} + [V_{\alpha 0} + \frac{1}{t}(-t_1 t_2 a_1 - \frac{1}{2} t_1^2 a_1 + \frac{1}{2} t_2^2 a_2)]\theta\hat{y}\} \tag{29}$$

Hubble's law is valid for the 2 following cases.

i) $V_{E0}, V_{\alpha 0} \gg -a_1 t_1 + a_2 t_2$
When initial speed is much larger than speed change by deceleration and acceleration :

* Because there is high possibility that there was a time of accelerating expansion of the early universe, particles gained high speed after inflation and the galaxy composed by these particles also had high speed, so the above supposition has validity.

* $-a_1 t_1 + a_2 t_2 \approx 0$: When the effects of deceleration and acceleration are offset by each other.

Considering decelerating expansion and accelerating expansion and movement of relative particles, the actual age of the universe is $0.993 t_H$. It is very close to 1 [3]. Namely, our universe has a state of $-a_1 t_1 + a_2 t_2 \approx 0$.

* Zero Energy Universe : In principle, the total energy is zero. So deceleration and acceleration terms are small. [9] [10]

$$\vec{V}_{rel} \simeq (V_{\alpha 0} - V_{E0})\hat{x} + (V_{\alpha 0} - a_1 t_1 + a_2 t_2)\theta\hat{y} \\ \simeq (V_{\alpha 0} - V_{E0})\hat{x} + V_{\alpha 0}\theta\hat{y} \tag{30}$$

$$\vec{R}_{rel} \simeq t[(V_{\alpha 0} - V_{E0})\hat{x} + V_{\alpha 0}\theta\hat{y}] \tag{31}$$

Therefore, $\vec{V}_{rel} = \frac{1}{t}\vec{R}_{rel} = H\vec{R}_{rel}$ Hubble's law is valid.

ii) Hubble's law is valid in $t_1 = t_2, a_1 = 3a_2$ condition.

Because the term of decelerating expansion and accelerating expansion is almost similar from the current observation, it can be set as $t_1 = t_2$ [3] [11]. This condition is the result gained from the condition of assuming expansion of space. Therefore, if the result of this study is true, it can be revised.

$$\vec{V}_{rel} \simeq [(V_{\alpha 0}(1 - \tfrac{\theta^2}{2!}) - V_{E0}) + (-a_1 t_1 + a_2 t_2)(-\tfrac{\theta^2}{2!})]\hat{x} \\ +(V_{\alpha 0} - a_1 t_1 + a_2 t_2)\theta\hat{y} \\ = [(V_{\alpha 0}(1 - \tfrac{\theta^2}{2}) - V_{E0}) + a_2 t_2 \theta^2]\hat{x} + (V_{\alpha 0} - 2a_2 t_2)\theta\hat{y} \tag{32}$$

$$\vec{R}_{rel} \simeq t\{[(V_{\alpha 0}(1 - \tfrac{\theta^2}{2!}) - V_{E0}) \\ +\tfrac{1}{2t_2}(-3a_2 t_2^2 - \tfrac{1}{2}3a_2 t_2^2 + \tfrac{1}{2}a_2 t_2^2)(-\tfrac{\theta^2}{2!})]\hat{x} \\ +[V_{\alpha 0} + \tfrac{1}{2t_2}(-3a_2 t_2^2 - \tfrac{1}{2}3a_2 t_2^2 + \tfrac{1}{2}a_2 t_2^2)]\theta\hat{y}\} \\ = t\{[(V_{\alpha 0}(1 - \tfrac{\theta^2}{2}) - V_{E0}) + a_2 t_2 \theta^2]\hat{x} + (V_{\alpha 0} - 2a_2 t_2)\theta\hat{y}\} \tag{33}$$

Therefore, $\vec{V}_{rel} = \frac{1}{t}\vec{R}_{rel} = H\vec{R}_{rel}$ is valid.

3) When θ is big.

$$\vec{V}_{rel} = [(V_{\alpha 0}\cos\theta - V_{E0}) + (-a_1 t_1 + a_2 t_2)(\cos\theta - 1)]\hat{x} \\ +(V_{\alpha 0} - a_1 t_1 + a_2 t_2)\sin\theta\hat{y} \tag{34}$$

$$\vec{R}_{rel} = \\ t\{[(V_{\alpha 0}\cos\theta - V_{E0}) \\ +\tfrac{1}{t}(-t_1 t_2 a_1 - \tfrac{1}{2}t_1^2 a_1 + \tfrac{1}{2}t_2^2 a_2)(\cos\theta - 1)]\hat{x} \\ +[V_{\alpha 0} + \tfrac{1}{t}(-t_1 t_2 a_1 - \tfrac{1}{2}t_1^2 a_1 + \tfrac{1}{2}t_2^2 a_2)]\sin\theta\hat{y}\} \tag{35}$$

i)$V_{E0}, V_{\alpha 0} \gg -a_1 t_1 + a_2 t_2$

$$\vec{V}_{rel} \simeq (V_{\alpha 0}\cos\theta - V_{E0})\hat{x} + V_{\alpha 0}\sin\theta\hat{y} \tag{36}$$

$$\vec{R}_{rel} \simeq t[(V_{\alpha 0}\cos\theta - V_{E0})\hat{x} + V_{\alpha 0}\sin\theta\hat{y}] \tag{37}$$

Therefore, $\vec{V}_{rel} = \frac{1}{t}\vec{R}_{rel} = H\vec{R}_{rel}$ is valid.

ex.1) $\theta = \frac{\pi}{2}$

$$\vec{V}_{rel} = -(V_{E0} - a_1 t_1 + a_2 t_2)\hat{x} + (V_{\alpha 0} - a_1 t_1 + a_2 t_2)\hat{y} \tag{38}$$

$$\vec{R}_{rel} = t\{-(V_{E0} + \tfrac{1}{t}(-t_1 t_2 a_1 - \tfrac{1}{2}t_1^2 a_1 + \tfrac{1}{2}t_2^2 a_2)]\hat{x} \\ +[V_{\alpha 0} + \tfrac{1}{t}(-t_1 t_2 a_1 - \tfrac{1}{2}t_1^2 a_1 + \tfrac{1}{2}t_2^2 a_2)]\hat{y}\} \tag{39}$$

If, $V_{E0}, V_{\alpha 0} \gg -a_1 t_1 + a_2 t_2$

$$\vec{V}_{rel} \simeq -V_{E0}\hat{x} + V_{\alpha 0}\hat{y} \tag{40}$$

$$\vec{R}_{rel} \simeq t(-V_{E0}\hat{x} + V_{\alpha 0}\hat{y}) \tag{41}$$

Therefore, $\vec{V}_{rel} = \frac{1}{t}\vec{R}_{rel} = H\vec{R}_{rel}$. Hubble's law is valid.

ex.2) $\theta = \pi$

$$\vec{V}_{rel} = [(-V_{\alpha 0} - V_{E0}) - 2(-a_1 t_1 + a_2 t_2)]\hat{x} \tag{42}$$

$$\vec{R}_{rel} = t[(-V_{\alpha 0} - V_{E0}) - \frac{2}{t}(-t_1 t_2 a_1 - \frac{1}{2}t_1^2 a_1 + \frac{1}{2}t_2^2 a_2)]\hat{x} \tag{43}$$

If, $V_{E0}, V_{\alpha 0} \gg -a_1 t_1 + a_2 t_2$

$$\vec{V}_{rel} \simeq (-V_{\alpha 0} - V_{E0})\hat{x} \tag{44}$$

$$\vec{R}_{rel} \simeq t(-V_{\alpha 0} - V_{E0})\hat{x} \tag{45}$$

Therefore,$\vec{V}_{rel} = \frac{1}{t}\vec{R}_{rel} = H\vec{R}_{rel}$ is valid.

When initial speed is much larger than velocity change from deceleration and acceleration, Hubble's law is valid is a very wide area. Also this initial speed is the velocity gained from the accelerating expansion of the early universe.

ii) If $t_1 = t_2, a_1 = 3a_2$

$$\vec{V}_{rel} = [(V_{\alpha 0}\cos\theta - V_{E0}) + (-3a_2 t_2 + a_2 t_2)(\cos\theta - 1)]\hat{x} \\ +(V_{\alpha 0} - 2a_2 t_2 + a_2 t_2)\sin\theta\hat{y} \\ = [(V_{\alpha 0}\cos\theta - V_{E0}) - 2a_2 t_2(\cos\theta - 1)]\hat{x} \\ +(V_{\alpha 0} - a_2 t_2)\sin\theta\hat{y} \tag{46}$$

$$\vec{R}_{rel} = t\{[(V_{\alpha 0}\cos\theta - V_{E0}) - 2a_2 t_2(\cos\theta - 1)]\hat{x} \\ +(V_{\alpha 0} - 2a_2 t_2)\sin\theta\hat{y}\} \tag{47}$$

Therefore,$\vec{V}_{rel} = \frac{1}{t}\vec{R}_{rel} = H\vec{R}_{rel}$ is valid.

E. Direct meaning of proof

1) Hubble's law is valid is a very wide area in 3 dimensional space when the initial speed of galaxies is much larger than the velocity change by deceleration and acceleration (in the same meaning, when velocity change by deceleration and acceleration is smaller compared to initial speed).

2) This means that even though initial velocity isn't much bigger than the effect by deceleration and acceleration, Hubble's law can be valid in some specific condition. For example, $t_1 = t_2, |-a_1| = 3a_2$

3) Even though Earth isn't the center of the universe, the belief (something not experienced such as "expansion of space") isn't necessarily needed to explain the reason all galaxies recede from Earth.

III. Meaning including proof

Hubble's law isn't a matter only explained by special condition such as "center of the universe" or a new concept that we haven't experienced such as "expansion of space".

Hubble's law is a result of dynamics valid in almost all areas when change of acceleration is small in the universe.

1. Even if $-a_1(t)$ and $+a_2(t)$ is a function of time, Hubble's law is always valid when the effect of decelerating expansion and accelerating expansion is smaller than initial velocity.

To derive the Hubble's law, we presumed decelerating expansion in the early term and accelerating expansion of the later term. $-a_1$ and $+a_2$ was set as a constant in this process. However, more closely speaking, $-a_1$ and $+a_2$ is a function of time.

2. When the effect of decelerating expansion and accelerating expansion has some specific ratio, Hubble's law can be valid.

For example : $t_1 = t_2, |-a_1| = 3a_2$

3. Hubble's law doesn't come from the expansion of space, but results from dynamics from velocity of individual galaxies.

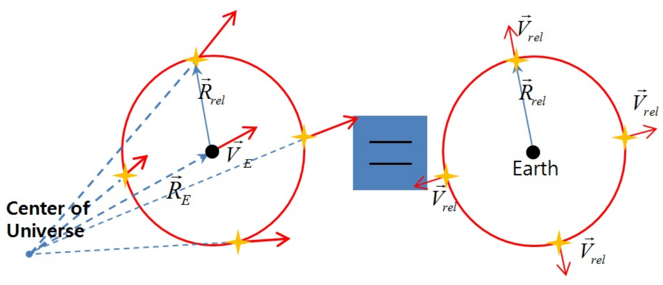

Figure 4: Hubble's law is a dynamical result from the movement of galaxies in 3D space. Two situations are same.

4. Therefore, red shift comes from the Doppler shift of light and implies that the existing equation of red shift should be revised.

Existing equation :

$$z = \frac{R_{obs}}{R_{emitted}} - 1 \tag{48}$$

R is scale factor.

Equation by this discovery :

$$z = \frac{\lambda_o}{\lambda_e} - 1 = \sqrt{\frac{1+\frac{V}{c}}{1-\frac{V}{c}}} - 1 \tag{49}$$

The two equations show similar results in close galaxies, but show difference in far galaxies. [3] [4]

5. Red shift was the role of a ruler measuring the distance of the universe, but if this model is true, the inaccuracy of the existing ruler is implied and all data (including distance, scale factor) through red shift should be reviewed.

6. We can define the center of the universe and find it. (Revival of absolute coordinate system)

A. Direction of center of the universe

Considering homogeneous, isotropy, and dependence of r of gravity, Hubble's law will be well valid as the direction is closer to the center direction. Draw several lines with Earth in the center and observe the galaxy in those lines by even interval. For example, 2,4,6,8,10Gly.

When θ is zero,

$$\vec{V}_{rel} = (V_{\alpha 0} - V_{E0})\hat{x} \tag{50}$$

$$\vec{R}_{rel} = t(V_{\alpha 0} - V_{E0})\hat{x} \tag{51}$$

Therefore, $\vec{V}_{rel} = \frac{1}{t}\vec{R}_{rel} = H\vec{R}_{rel}$

However, when θ is big,

$$\begin{aligned}\vec{V}_{rel} &= [(V_{\alpha 0}\cos\theta - V_{E0}) + (-a_1 t_1 + a_2 t_2)(\cos\theta - 1)]\hat{x} \\ &+ (V_{\alpha 0} - a_1 t_1 + a_2 t_2)\sin\theta \hat{y}\end{aligned} \tag{52}$$

$$\begin{aligned}&\vec{R}_{rel} = \\ &t\{[(V_{\alpha 0}\cos\theta - V_{E0}) \\ &+\tfrac{1}{t}(-t_1 t_2 a_1 - \tfrac{1}{2}t_1^2 a_1 + \tfrac{1}{2}t_2^2 a_2)(\cos\theta - 1)]\hat{x} \\ &+[V_{\alpha 0} + \tfrac{1}{t}(-t_1 t_2 a_1 - \tfrac{1}{2}t_1^2 a_1 + \tfrac{1}{2}t_2^2 a_2)]\sin\theta \hat{y}\}\end{aligned} \tag{53}$$

$-a_1 t_1, a_2 t_2$ term existing.

Therefore, the center of universe positions in the direction of smallest (or even) deviation of Hubble's law.

B. How to calculate the distance between the center of the universe and the earth

1) Find galaxy A which is located vertically direction from the center direction of the universe.

2) Find galaxies(B,C,...) which have the same relative distance from the earth and for an $0 < \frac{\theta_C}{2} \leq \frac{\pi}{6}$ angle with galaxy A.

3) Galaxy C has the same speed with the earth.

From relative velocity eq.(24)

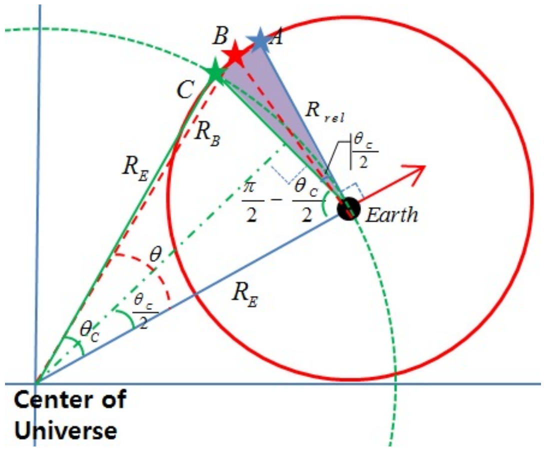

Figure 5: How to calculate the distance between the center of the universe and the earth.

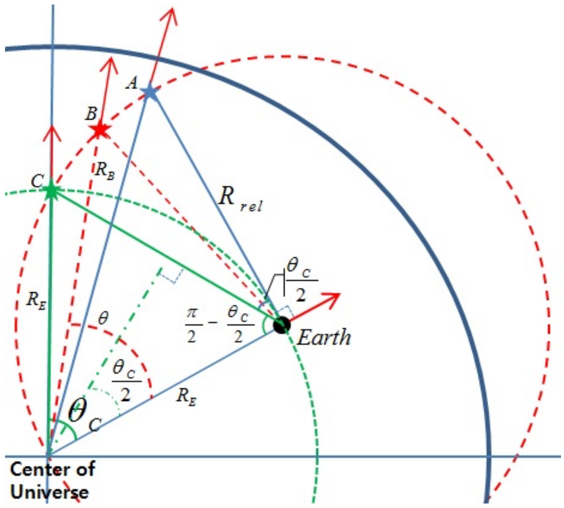

Figure 6: When θ is $\frac{\pi}{3}$.

$$
\begin{aligned}
a_c &= \left|\frac{V_{rel-y}}{V_{rel-x}}\right| \\
&= \left|\frac{(V_{B0}-a_1t_1+a_2t_2)\sin\theta}{(V_{B0}\cos\theta-V_{E0})+(-a_1t_1+a_2t_2)(\cos\theta-1)}\right|
\end{aligned}
\tag{54}
$$

Set as $-a_1t_1+a_2t_2=x$

$$
\begin{aligned}
a_c &= \left|\frac{(V_{B0}+x)\sin\theta}{(V_{B0}\cos\theta-V_{E0})+x(\cos\theta-1)}\right| \\
&= \left|\frac{(1+\frac{x}{V_{B0}})\sin\theta}{(\cos\theta-\frac{V_{E0}}{V_{B0}})+\frac{x}{V_{B0}}(\cos\theta-1)}\right|
\end{aligned}
\tag{55}
$$

$(0<\theta\leq\frac{\pi}{3};\ \frac{x}{V_{B0}}<<1)$

If $|\vec{R}_B|=|\vec{R}_E|$, V_{B0} is same with V_{E0}

$$
\begin{aligned}
a_c &\simeq \left|\frac{(1+\frac{x}{V_{B0}})\sin\theta}{(\cos\theta-1)+\frac{x}{V_{B0}}(\cos\theta-1)}\right| = \left|\frac{(1+\frac{x}{V_{B0}})\sin\theta}{(\cos\theta-1)(1+\frac{x}{V_{B0}})}\right| \\
&= \frac{\sin\theta}{(1-\cos\theta)} = \frac{\sin\theta_C}{(1-\cos\theta_C)}
\end{aligned}
\tag{56}
$$

Find a galaxy that corresponds with a_c, by putting values of several galaxies into it.

Especially, it passes $V_B = V_E$ from $V_B > V_E$ and changes into $V_B < V_E$, as θ gets bigger. This relation can be used for finding a point that V_B is same with V_E

$$
\begin{aligned}
&2R_E\sin\tfrac{\theta_C}{2} = R_{rel} \\
&R_E = \frac{R_{rel}}{2\sin\frac{\theta_C}{2}} \\
&R_E = \frac{V_{rel}}{2H\sin\frac{\theta_C}{2}}
\end{aligned}
\tag{57}
$$

Center of the universe :

$$
R_E = \frac{V_{rel}}{2H\sin\frac{\theta_C}{2}} = \frac{c}{2H\sin\frac{\theta_C}{2}}\left(\frac{(z+1)^2-1}{(z+1)^2+1}\right) \tag{58}
$$

$\frac{\theta_C}{2}$ is an angle between galaxy A and C.

7. When space doesn't expand, the maximum value of recession velocity will become light velocity c.

8. The change of red shift eq. influences the "discovery that the universe accelerating expands." [12] [13] Therefore, there is necessity to review accelerating expansion.

** About the Inflation and CMB.

To explain the flatness and horizon problem, expansion faster than light (inflation) was assumed. [14] However, positive energy and negative energy are cancelled in the zero energy universe. In the field equation, if stress-energy term is zero, curvature term is zero. So, zero energy universe is flat. Therefore to explain flatness, there is no need to assume expansion faster than light.

The horizon problem occurs from the Hubble radius which is derived from the assumption that space expand. [14] If particles don't have velocity faster than light, all areas in the early universe will be inside the area of light(radiation) and are all causally connected. Therefore, thermal equilibrium takes place.

Horizon problem doesn't occur and expansion faster than light isn't needed.

For CMB with the biggest red-shift value, now, z is 1089.

$$
V_{rel} = \left(\frac{(z+1)^2-1}{(z+1)^2+1}\right)c = 0.9999983166c \tag{59}
$$

If this model is right, CMB results from the recession velocity of materials by the expansion of the universe.

Why CMB reaches to the earth from all directions, is because there are objects back away from the earth in all directions with the expansion of the universe, and the maximum value of their relative velocity to the earth is close to C. Why particles have a high velocity as above, is because there was an extremely big gravitational potential energy(U_{-+}) in a zero energy state in the early universe. [9]

IV. Conclusion

From the observation of the universe, we found Hubble's law and introduced the concept that "space expands" into physics and astronomy to explain this.

However, not only can't we explain the reason of expansion, expansion velocity also couldn't be reasonably explained so the expansion of space isn't an observed fact.

According to these research results, Hubble's law comes out from dynamics that galaxies from 3 dimensional space has and for effect of acceleration smaller than initial velocity, it can be confirmed that Hubble's law is valid in a very wide area.

Red shift and scale factor by expansion of space has much influence in much areas of astronomy and cosmology. Therefore, we must review all these related matters.

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