The Universe Accelerating Expansion: A Counterexample

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Abstract. In this paper we build a counterexample that raises a fundamental distinction between recession movement of matter and space expansion. We prove that observing matter recession at an accelerating rate is not an indication for the acceleration of the universe expansion. More precisely, we show that the observed acceleration in the recession movement of galaxies is naturally due to a universe deceleration. The counterexample provides us with a possible space with independent movement that might produce the observed behavior of galaxies registered for the redshift $z < 0.5$ as well as for the redshift $z > 0.5$. This counterexample calls into question the recent interpretation of the accelerating recession movement of galaxies as a sign of universe acceleration.

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1 Introduction

It was observed and confirmed that distant supernovae (SNe) of type Ia appear dimmer than expected in a supposed matter dominated space ([2],[3],[6]). Cosmologists are led to the conclusion that the recent expansion of the universe has definitely been starting accelerating for approximatively 5 billion years. The SNe observations convey a shocking reverse of image about our universe understanding, from a matter dominated space to a vacuum dominated space, with a reference to the existence of vacuum energy that generates this acceleration, accounting for about 73% of the universe total density of energy. The SNe results combined with galaxies clustering and the cosmic microwave background data were interpreted in terms of concordance in favor of a flat and accelerating universe expansion. It is out of the scoop of this article to discuss the reliability and robustness of the observational measurements and data. However, the use of reliable interpretations of the observational data measurements and their physical properties in developing a lucid understanding of our universe global dynamic is a matter of questioning.

The strict application of the cosmological principles, such as homogeneity and isotropy, has encouraged astrophysicists to relate local properties of the observable universe to global properties of the whole universe. Nevertheless, to understand the universe real mechanism from astronomical observations and radar measurements is not a quite simple promenade precisely if the real shape of the universe might be different from the picture conveyed by our accepted models and interpretations. There is no dispute in considering the observed movement of galaxies, in the visible universe, as a consequence of the universe expansion, however to identify the observed matter movement with the whole universe dynamic is the real problem.

It was G. Lemaitre (1927, [4]) the first who suggested interpreting and relating the observed movement of galaxies to the space movement, rather than to the galaxies proper movement. More precisely, the recession movement of galaxies observed does no correspond to the proper velocity of galaxies: it is the space dilation that creates the recession movement of galaxies and then their apparent movement. However, to build a comprehensive understanding of the universe dynamic based on observations of matter movement, matter temperature, matter radiation and distribution is poorly sustainable if we don't know rigorously how the movement of recession of galaxies in the visible horizon, as well as the density and distribution of matter convey the global properties of the whole universe.

A counterexample of physical space is introduced in this paper that fits all astronomical observations, data and measurements, such as those from distant supernovae, cosmic microwave background radiation, and galaxy clustering, even though the space expansion is merely opposite to the recent rewarded interpretations.

2 The Counterexample

Let us consider an expanding space described by un infinite number of packed expanding spheres with same size and very large radius, where clusters of galaxies are located on the spheres surface. A section of the expanding space is illustrated in Fig.1. The space is given by the surface of those packed spheres and described by their simultaneous expansion.

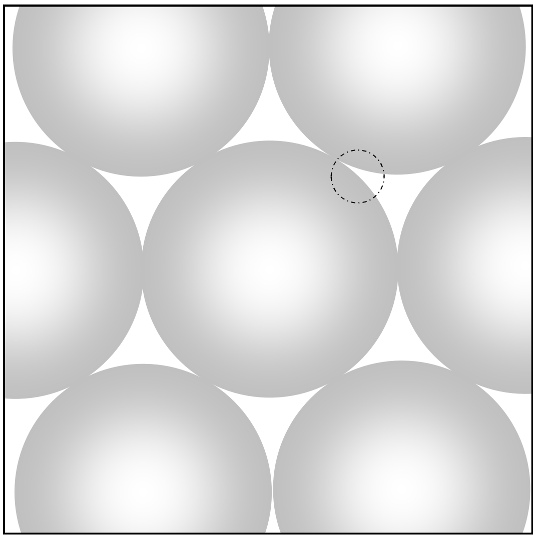

Figure 1: An illustration of 3D space given by the counterexample, where the accumulation of surface of packed spheres with same size constitutes the space in which matter and movement are located. The dashed circle represents the visible horizon centered on an observer. The nearly flatness of the visible horizon is a function of the size of the sphere radius: the larger the radius we have the more nearly flat visible horizon we obtain.

The expanding space satisfies the homogeneity and isotropy at large scale, moreover one sphere conveys the property of the whole universe (if each sphere has an accelerating or decelerating expansion, the whole universe will have the same nature of expansion), and the beginning of the space expansion is given by a zero radius.

To build our counterexample, the expansion of spheres with very large radius will be modeled to fit the observational data and measurements, that is to say the local flatness of the space and the accelerating recession movement of matter.

2.1 Accelerating and Decelerating Expanding Sphere

Let us consider an expanding sphere $\mathcal{S}$ of radius given by

$$R(t) = k(1 - e^{-at^2}), \tag{1}$$

with $k > 0$ an arbitrary constant, $a > 0$, and where $\mathcal{S}$ is one of the packed expanding spheres that constitute the introduced expanding space.

The expansion velocity of the sphere $\mathcal{S}$ is given by

$$R'(t) = 2akte^{-at^2} \geq 0, \tag{2}$$

and the acceleration of the sphere expansion is given by

$$R''(t) = 2ake^{-at^2}(1 - 2at^2). \tag{3}$$

Then we have

$$\begin{cases} R''(t) > 0, \quad \text{for} \quad 0 < t < \frac{1}{\sqrt{2a}}, & \text{accelerating expansion of } \mathcal{S} \\ R''(t) < 0, \quad \text{for} \quad t > \frac{1}{\sqrt{2a}}, & \text{decelerating expansion of } \mathcal{S} \end{cases} \tag{4}$$

2.2 Accelerating and Decelerating Recession Movement of Matter

Since matter location and movement in the space of the counterexample are only allowed on the surface of the packed spheres, the expanding distance between galaxies on the sphere $\mathcal{S}$ depends on the variation of the radius $R(t)$ of $\mathcal{S}$ and on the central angle $\theta(t)$. Indeed,

$$L(t) = R(t)\theta(t). \tag{5}$$

where in general the central angle $\theta(t)$ is a positive function that has a differential of second order. The recession velocity of galaxies on $\mathcal{S}$ is then given by

$$V(t) = \frac{dL(t)}{dt} = R'(t)\theta(t) + R(t)\theta'(t). \tag{6}$$

Using (1) in (5), we obtain the distance between galaxies as

$$L(t) = k(1 - e^{-at^2})\theta(t), \tag{7}$$

and the recession velocity of galaxies (6) is given by

$$V(t) = \frac{dL(t)}{dt} = 2kate^{-at^2}\theta(t) + k(1 - e^{-at^2})\theta'(t). \tag{8}$$

The acceleration of the recession movement of matter is then given by

$$\Gamma(t) = \frac{dV(t)}{dt} = R''(t)\theta(t) + 2R'(t)\theta'(t) + R(t)\theta''(t), \tag{9}$$

and using (1) in (9) gives

$$\Gamma(t) = 2kae^{-at^2}(1-2at^2)\theta(t) + 4kate^{-at^2}\theta'(t) + k(1-e^{-at^2})\theta''(t), \tag{10}$$

denoted by

$$\Gamma(t) = \Gamma\Big(t, \theta(t), \theta'(t), \theta''(t)\Big). \tag{11}$$

If galaxies are fixed on the surface of the expanding sphere (Fig.2), then any central angle $\theta(t)$ between galaxies and the sphere center remains constant as the sphere expands. The substitution of $\theta(t) = \theta_0 = cst$ in (10) gives

$$\begin{cases} \text{For} \quad R''(t) > 0, & \Longrightarrow \Gamma\Big(t, \theta_0, 0, 0\Big) > 0 \\ \text{For} \quad R''(t) < 0, & \Longrightarrow \Gamma\Big(t, \theta_0, 0, 0\Big) < 0, \end{cases} \tag{12}$$

which means that if the space has an accelerating expansion, the recession movement of galaxies will accelerate, and if the space has a decelerating expansion, the recession movement of galaxies will decelerate. The case ($\theta(t) = cst$) must be excluded since matter is free of movement in the universe (galaxies have their proper movement under any external force other that the movement due to the space expansion as it was confirmed by observation).

To obtain an acceleration in the recession movement of galaxies as the space expansion decelerates as well as a deceleration in the recession movement of galaxies as the space

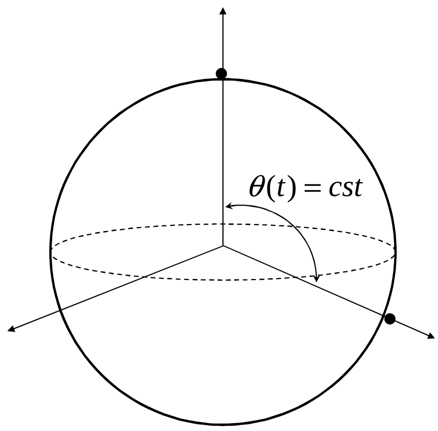

Figure 2: This figure is an illustration of 3D space given by a sphere with two distant galaxies on it. If galaxies are fixed on the sphere surface (the central angle between galaxies is constant), then as the surface of the sphere expands with accelerating expansion or a decelerating expansion, galaxies will recede from each other with an accelerating recession movement or a decelerating recession movement. In that case the movement of matter is an indication of the space movement with same nature.

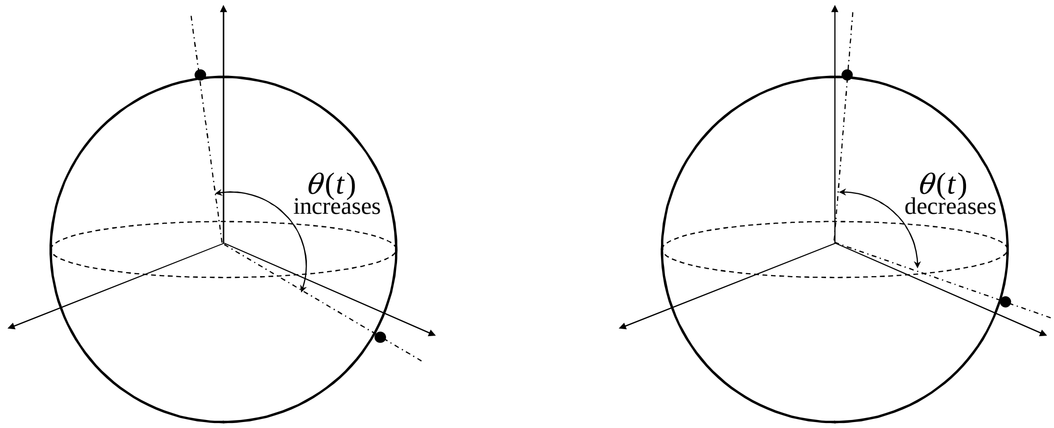

Figure 3: The left figure is an illustration of 3D space given by a sphere with two distant free galaxies on it. The recession of galaxies could be accelerated if the central angle $\theta(t)$ is increasing meanwhile the radial expansion is decelerating. The right figure is an illustration of 3D space given by a sphere with two distant free galaxies on it. The recession of galaxies could be decelerated if the central angle $\theta(t)$ is decreasing meanwhile the radial expansion is accelerating.

accelerates (Fig.3), we need to find a variable central angle $\theta(t)$ solution of the following second order differential inequalities:

$$\begin{cases} \Gamma\Big(t, \theta(t), \theta'(t), \theta''(t)\Big) > 0, & \text{corresponding to an accelerating recession movement} \\ \Gamma\Big(t, \theta(t), \theta'(t), \theta''(t)\Big) < 0, & \text{corresponding to a decelerating recession movement.} \end{cases} \tag{13}$$

The solutions of the inequalities (13) are families of functions $\theta(t)$. We will provide and elaborate only the case of one solution for each inequality that matches our objectives.

2.2.1 An Accelerating Recession Movement in a Decelerating Expanding Space

Using equation (4), the deceleration period of the expanding sphere $\mathcal{S}$ of radius (1) corresponds to the period $t > \frac{1}{\sqrt{2a}}$, and an accelerating recession movement of galaxies during that period can be obtained by solving the second order differential inequality:

$$\Gamma\Big(t, \theta(t), \theta'(t), \theta''(t)\Big) > 0, \quad \forall t > \frac{1}{\sqrt{2a}}. \tag{14}$$

The solution set of (14) is a family of functions

$$\Big\{\theta(t) \ / \ \forall t > \frac{1}{\sqrt{2a}}, \ \ \Gamma\Big(t, \theta(t), \theta'(t), \theta''(t)\Big) > 0, \ \ \theta'(t) > 0, \ \theta(t) > 0\Big\} \tag{15}$$

and the solution set is not empty since $\theta(t) = t^2$ is a solution of (14).

Indeed, for $\theta(t) = t^2$, the equality (10) and (11) give

$$\Gamma\Big(t, t^2, 2t, 2\Big) = 2kae^{-at^2}(1 - 2at^2)t^2 + 8kat^2e^{-at^2} + 2k(1 - e^{-at^2}), \tag{16}$$

then

$$\Gamma\Big(t, t^2, 2t, 2\Big) = 2ke^{-at^2}(-2a^2t^4 + 5at^2 - 1) + 2k \tag{17}$$

where the sign analysis of $\Gamma'\Big(t, t^2, 2t, 2\Big)$ yields $\Gamma\Big(t, t^2, 2t, 2\Big) > 0$ for all $t > 0$.

More precisely using (4) we have

$$R''(t) < 0, \quad \text{and} \quad \Gamma\Big(t, t^2, 2t, 2\Big) > 0, \qquad \text{For} \quad t > \frac{1}{\sqrt{2a}}, \tag{18}$$

which illustrates the current observed accelerating recession movement of matter through the observation of Supernovae of type Ia. However this acceleration is obtained in a space with a decelerating expansion.

2.2.2 A Decelerating Recession Movement Before 5 Billion Years

The SNe data [3] favor a recent acceleration for the redshift $z < 0.5$ and a past deceleration for the redshift $z > 0.5$, hence cosmologists estimated that this acceleration began approximately 5 billion years ago and that the universe was decelerating before that period. In order to make the counterexample matching the real data of SNe of Type Ia for the redshift $z < 0.5$ as well as for the redshift $z > 0.5$, it is sufficient to put

$$\frac{1}{\sqrt{2a}} = (t_0 - 5) \quad Gyr \tag{19}$$

where t_0 is the age of the universe.

If the age of the universe is estimated up to $t_0 = 14.5\ Gyr$, then $\frac{1}{\sqrt{2a}} = 9.5\ Gyr$, that gives in our counterexample $a = \frac{1}{180.5}$. The value of a can change following the estimated age of the universe, as well as the inflection point between the acceleration and deceleration periods.

Using equation (4), the acceleration period of the expanding sphere $\mathcal{S}$ of radius (1) corresponds to the period $0 < t < \frac{1}{\sqrt{2a}}$, and a decelerating recession movement of galaxies during that period can be obtained by solving the second order differential inequality:

$$\Gamma\Big(t, \theta(t), \theta'(t), \theta''(t)\Big) < 0, \quad \text{for} \quad 0 < t_0 < t < \frac{1}{\sqrt{2a}}. \tag{20}$$

The solution set of (20) is a family of functions

$$\Big\{\theta(t) \ / \ \exists t_0 > 0,\ \forall t \in \,]t_0, \frac{1}{\sqrt{2a}}[,\ \Gamma\Big(t, \theta(t), \theta'(t), \theta''(t)\Big) < 0,\ \theta'(t) < 0,\ \theta(t) > 0\Big\} \tag{21}$$

and the solution set is not empty since the function $\theta(t) = \theta_0(1 - \alpha t)$, with $0 < \alpha < \sqrt{2a}e^{-\frac{1}{2}}$ and $\theta_0 > 0$ is a solution of (20).

Indeed, for $\theta(t) = \theta_0(1 - \alpha t)$, the equalities (10) and (11) yield

$$\Gamma\Big(t, \theta_0(1-\alpha t), -\theta_0\alpha, 0\Big) = 2kae^{-at^2}(1-2at^2)\theta_0(1-\alpha t) - 4kate^{-at^2}\theta_0\alpha \tag{22}$$

that is to say

$$\Gamma\Big(t, \theta_0(1-\alpha t), -\theta_0\alpha, 0\Big) = 2ka\theta_0 e^{-at^2}\Big(2a\alpha t^3 - 2at^2 - 3\alpha t + 1\Big) \tag{23}$$

where the use of the sign analysis of $f''(t)$ with $f(t) = 2a\alpha t^3 - 2at^2 - 3\alpha t + 1$, and the intermediary value theorem give the existence of $t_0 > 0$ solution of the equation

$$\Gamma(t, \theta_0(1-\alpha t), -\theta_0\alpha, 0) = 0, \tag{24}$$

such that we have

$$\begin{cases} \Gamma\Big(t, \theta_0(1-\alpha t), -\theta_0\alpha, 0\Big) > 0, & \text{for } 0 < t < t_0; \\ \Gamma\Big(t, \theta_0(1-\alpha t), -\theta_0\alpha, 0\Big) < 0, & \text{for } t_0 < t < \frac{1}{\sqrt{2a}}. \end{cases} \tag{25}$$

Therefore we obtain a space with a past accelerating expansion in which the recession movement of matter was decelerating, that is to say

$$R''(t) > 0, \quad \text{and} \quad \Gamma\Big(t, \theta_0(1-\alpha t), -\theta_0\alpha, 0\Big) < 0, \qquad \text{for} \quad t_0 < t < \frac{1}{\sqrt{2a}}, \tag{26}$$

which fairly illustrates the observed decelerating recession movement of matter for the redshift $z > 0.5$. However this deceleration is obtained in a space with an accelerating expansion for the redshift $z > 0.5$.

2.3 Counterexample and Observation

We have built a counterexample that describes the observed movement of matter in our universe for the redshift $z < 0.5$ as well as for the redshift $z > 0.5$, and this counterexample sets two movements apart: the recession movement of matter and the space expanding movement (Fig.4). When the universe expansion is accelerating, the observed recession movement of matter is decelerating, and when the universe expansion starts decelerating, the observed recession movement of matter starts accelerating. What is the physical interpretation behind this change of properties? Is it possible to interpret the recession movement of galaxies via the universe movement? Is it possible that the acceleration of the expansion of the space creates the decelerating recession movement of matter, meanwhile a decelerating expansion of the space creates the accelerating recession movement of matter observed today?

2.3.1 Universe Acceleration/Deceleration and Inertial Force

In the investigation for adequate solutions of the second order differential inequalities (13) we excluded the case where the central angle θ is constant, because this case describes the movement of matter fixed in the space. However, galaxies in our universe are free in their position, they can have their proper movement under any external force. If the space between galaxies is stretched, making the distance between galaxies increasing, and making the apparent position of any galaxy changing with respect to the others, then there must exist

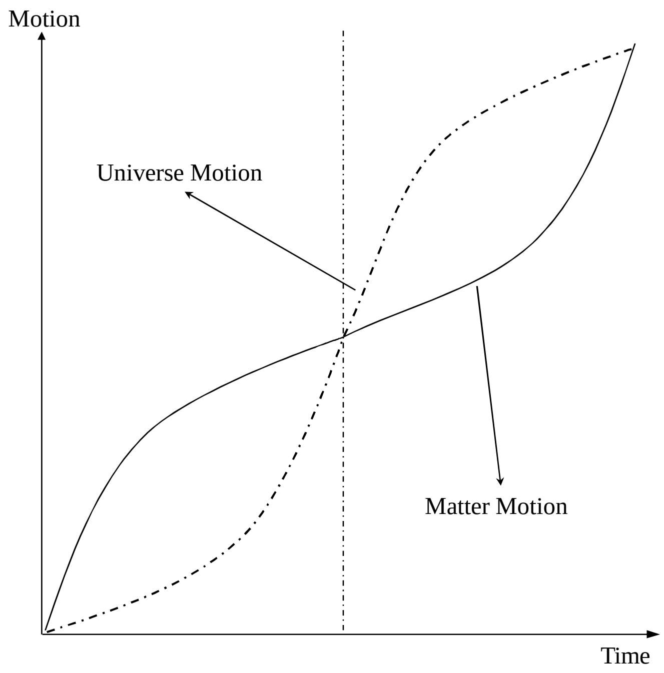

Figure 4: The counterexample sets two movements apart: the recession movement of matter and the space expanding movement. In that case the recession movement of matter does not reflect the global properties of the space movement. Matter recession movement can be accelerated while the space expansion is decelerating and inversely.

an inertial force due to the galaxies resistance to the universe expansion. This inertial force located in galaxy center depends on galaxy mass and universe acceleration. We define the new inertial force due to the resistance of galaxies to the space expansion as F_i given by the magnitude

$$F_i = (Galaxy\ Mass) \times (Universe\ Acceleration) \tag{27}$$

The existence of this inertial force may provide a rational explanation for the observed acceleration of recession of galaxies at the redshift $z < 0.5$ in a decelerating space, as well as a rational explanation for the past deceleration at the redshift $z > 0.5$ in an accelerating space. In this case there is no need to add any external energy to explain the recession movement of matter. Following the counterexample we have

$$\begin{cases} R''(t) > 0 \quad \text{and} \quad \Gamma\Big(t, \theta_0(1-\alpha t), -\theta_0\alpha, 0\Big) < 0, & \text{for } t_0 < t < \frac{1}{\sqrt{2a}} \\ R''(t) < 0 \quad \text{and} \quad \Gamma\Big(t, t^2, 2t, 2\Big) > 0, & \text{for } t > \frac{1}{\sqrt{2a}} \end{cases} \tag{28}$$

that is to say

$$\text{For} \quad t_0 < t < \frac{1}{\sqrt{2a}} \qquad \Rrightarrow \begin{cases} \text{Space accelerating expansion} \\ \text{Decelerating recession movement of galaxies.} \end{cases} \tag{29}$$

$$\text{For} \quad t > \frac{1}{\sqrt{2a}} \qquad \Rrightarrow \begin{cases} \text{Space decelerating expansion} \\ \text{Accelerating recession movement of galaxies.} \end{cases} \tag{30}$$

For $t > \frac{1}{\sqrt{2a}}$, as the space starts decelerating, each galaxy is subject to the inertial force F_i function of its mass and the space deceleration. The action of the inertial force is opposite to the space deceleration, and then this force will act as a repulsive force to add a recession movement to galaxies other than the recession movement due to the space expansion, which induces the acceleration observed from earth (see the right illustration of Fig.5). The effect of this inertial force on galaxies fits the observation of the accelerating recession movement of galaxies for the redshift $z < 0.5$. Moreover, for $t_0 < t < \frac{1}{\sqrt{2a}}$ the space was accelerating, and the recession movement of matter was decelerating due to the action of the inertial force on galaxies (see the left illustration of Fig.5). The inertial force opposite to the universe acceleration pulls galaxies to each other, and together with the space expansion induces a decelerating recession movement of galaxies that corresponds to the one estimated to be happened in the past for the redshift $z > 0.5$.

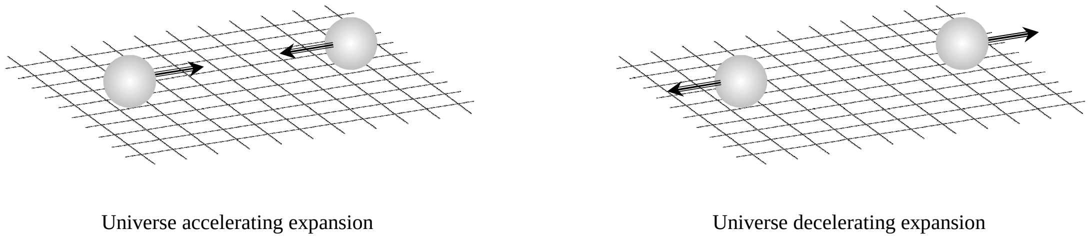

Figure 5: The left figure is an illustration of two dimensional space grid. If the grid expands via simultaneous expansion of its squares and if the grid has an accelerating expansion, the two balls will feel an inertial force due to this acceleration, and any observer on one ball will see the other ball receding with a decelerating recession velocity under the effect of the inertial force (balls will move to each other under the effect of inertial force, which decelerates the recession movement despite the accelerating expansion of the grid). The right figure represents an illustration of two dimensional space grid. If the grid expands via simultaneous expansion of its squares and if the grid has an decelerating expansion, the two balls will feel an inertial force due to this deceleration (that will act as a repulsive force opposite to the deceleration of the space). Observer on one ball will see the other ball receding with an accelerating recession velocity under the effect of the inertial force (balls will recede from each other under the effect of inertial force as well as under the effect of the space expansion, which accelerate the observed recession movement of balls despite the decelerating expansion of the grid).

2.3.2 Matter Movement Versus Universe Movement

The recorded redshift and brightness of a distinguishable class of astronomical objects used as "a standard candle" in the counterexample space expansion leads to the same information concerning the accelerating recession movement of galaxies. However, observation of Type Ia supernovae, in a space similar to the counterexample space, will not be able to distinguish the real properties of the whole universe from the accelerated movement of galaxies. Indeed, interpreting and identifying the recession movement of galaxies to the universe movement provide a contradiction with the counterexample space (matter accelerates even though space decelerates). The identification of the universe movement to the matter recession movement is true within the counterexample space if the central angle between galaxies remain constant (see Fig.2) during the space expansion, which means that galaxies are fixed on the expanding space. However, if the central angle between galaxies is not constant (see Fig.3) this identification is not anymore true since observation confirmed the free movement of galaxies in our universe. knowing that the expansion of the sphere $\mathcal{S}$ has a radial expansion direction perpendicular to the direction of the sphere surface expansion, and that galaxies are free of movement on the surface of $\mathcal{S}$ then observing galaxies receding from each other in our universe at an accelerating rate is not an indication of the acceleration of the universe expansion (see Fig.6).

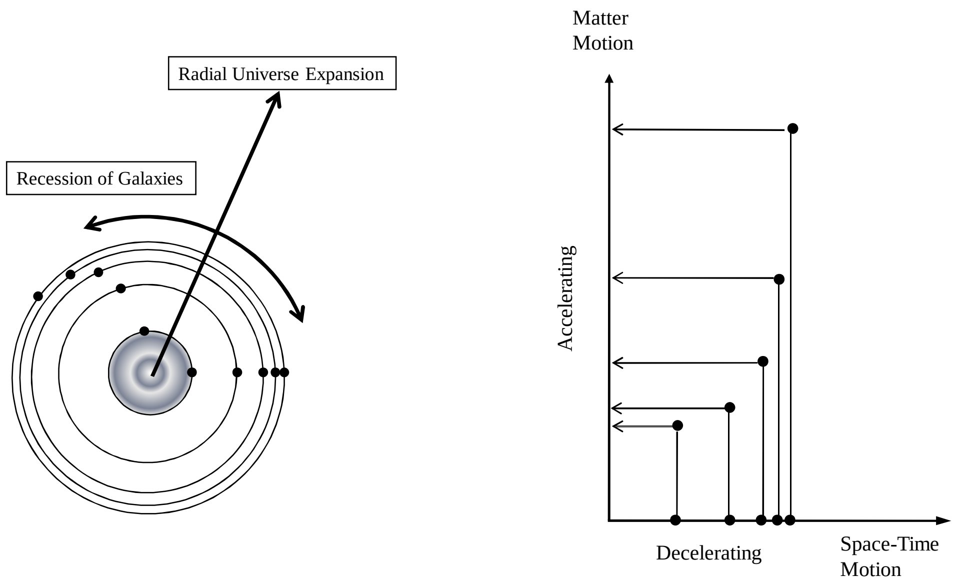

Figure 6: The left figure is an illustration of the expansion of 2D sphere $\mathcal{S}$ together with matter recession movement on it. If the radial expansion of the sphere is perpendicular to the recession movement of matter on its surface, the recession movement of matter could accelerate while the sphere expansion is decelerating. The right figure represents the diagram of the sphere decelerating expansion versus matter accelerating recession movement. The perpendicular nature of the observation direction to the sphere radial expansion makes the universe mechanism unrevealed via observation if matter is free of movement on it.

However the incorporation of these observational measurements in a given dynamical picture of the universe based on some model that fits many local experimental measurements and observations, could alter the right interpretation of observation, and then affect the comprehensive understanding of the whole universe. Besides, the incorporation of observational measurements and data in a model which hypotheses for example that the expansion history of the cosmos is determined entirely by its mass density has no sense if the universe seems to be a vacuum dominated space in the end as stated by the recent interpretation.

The counterexample does not question the data brought from supernovae observation of type Ia but it provides us with a new interpretation of the observed acceleration of recession of galaxies, as well as a possible space with independent movement that might produce the observed behavior of galaxies registered for the redshift $z < 0.5$ as well as for the redshift $z > 0.5$.

2.3.3 Surface of Last Scattering: Global or Local View

Everything in our universe is either matter/energy or radiation, the cosmic microwave background photons in our universe are the most ancient photons one can observe and measure since it is considered as a remnant of the Big Bang. Some information, such as the universe curvature and the universe density parameter, can be estimated straightforward from the measurement of the cosmic microwave background fluctuations. Measurement indicates that the geometry of our universe is approximately flat with an uncertainty of 2%, where the cosmological estimation of the density parameter is about $\Omega_0 = 1.02 \pm 0.02$, that is to say the density parameter $1 \leq \Omega_0 \leq 1.04$, which means that the universe geometry is nearly flat universe but not globally flat. The story might end here if the words "not globally flat" have not been forgotten. The universe is considered as a flat universe but not locally flat, and many fundamental consequences result from this assertion.

It is not matter of improving the quantities or the qualities of measurement, it is not matter of questioning the reliability of the CMB data or the methodology in finding the curvature of the observed universe, rather than questioning the global interpretation, and this is due to the following:

1) The space provided by the counterexample is given by an infinite number of packed spheres, the simultaneous expansion of spheres describes the universe expansion. If Each sphere was expanding since the beginning of the universe expansion (13.7 Billion years for example), an observer located on the surface of the sphere $\mathcal{S}$ will have a visible horizon given by a sphere of radius 13.7 billion light years centered on the observer, and that sphere will never encompass the center the sphere $\mathcal{S}$, otherwise the observer will see the beginning of the cosmological expansion (because properties of the whole universe reside within one sphere as consequences of homogeneity and isotropy of the space). That is why the CMB measurement and data is and will remain a local measurement and data (see Fig.7), and the curvature provided by the CMB anisotropy is a local curvature that means the space is locally flat. However the global flatness of the universe is still unknown, and this will press to question the rational need for the existence of the dark energy if the acceleration of the recession movement of matter can be explained rationally by the existence of an inertial force due to galaxies resistance to the universe expansion.

2) Moreover, if we look back to CMB data concerning the universe total density, we have: The measurement of the universe density of matter from Boomerang-98 and Maxima ([1],[5])

gives:

$$\text{Boomerang-98 and Maxima}: \begin{cases} 0.85 < \Omega_{Tot} < 1.25, & \text{at } 68\% \text{ confidence level} \\ 0.88 < \Omega_{Tot} < 1.12, & \text{at } 95\% \text{ confidence level} \end{cases} \Rrightarrow \Omega_{Av} > 1. \tag{31}$$

The best fit from Wilkinson Microwave Anisotropy Probe (WMAP), ([9],[10],[7]) gives:

$$\text{WMAP only}: \begin{cases} \Omega_{Tot} = 1.02 \pm 0.02, & \text{1 year data release} \\ \Omega_{Tot} = 1.099^{+0.100}_{-0.085}, & \text{5 years data release} \\ \Omega_{Tot} = 1.080^{+0.093}_{-0.071}, & \text{7 years data release} \end{cases} \Rrightarrow \Omega_{Av} > 1. \tag{32}$$

The WMAP data combined with measurement from supernovae Type Ia and from Baryon acoustic oscillation (BAO), ([10],[7]) gives:

$$\text{WMAP+SNe/H}_0\text{+BAO}: \begin{cases} \Omega_{Tot} = 1.0050^{+0.0060}_{-0.0061}, & \text{5 years data release} \\ \Omega_{Tot} = 1.0023^{+0.0056}_{-0.085}, & \text{7 years data release} \end{cases} \Rrightarrow \Omega_{Av} > 1 \tag{33}$$

The classical calculus of average of the universe density data for all the measurement gives $\Omega_{Av} > 1$ which is in favor of a local spherical space rather than a flat space. Suggesting that the spatial curvature of the universe is very close to zero and not zero is not sustainable for a flat space globally if the current comoving distance to the particle which emitted the registered CMB representing a radius always less than the radius of one sphere, and one sphere is nothing with respect to an infinite number of packed spheres. It is a local measurement.

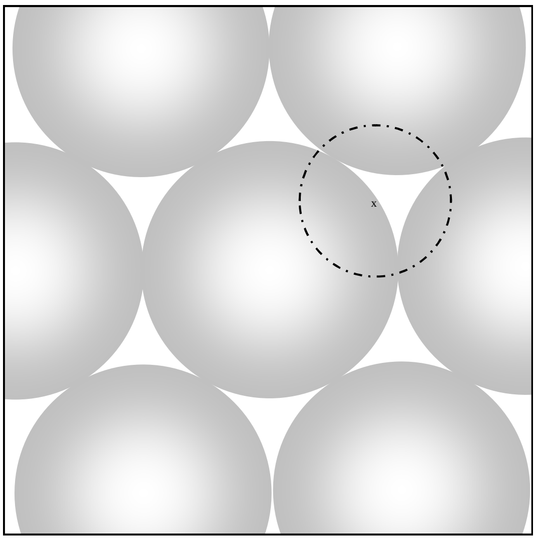

Figure 7: Illustration of 3D space given by the counterexample, that consists of an accumulation of packed spheres with same size, where matter location and movement is on their surface. The dashed circle represents the visible horizon on the spheres centered on an observer. The size of the visible horizon in 3D universe is given by a sphere of radius one light year times the universe age. Following the counterexample the visible horizon will never encompass the center of one sphere (where the observer is located), otherwise the observer would observe the Big Bang, and this means that what we can observe and measure with all our technologies and tools is and will remain local with respect to the universe size.

Nevertheless, the marge of error with respect to a totally flat universe with $\Omega_{Tot} = 1$, as small as it is, allows to consider a spherical universe, as described by the counterexample, with very large radius. It is sufficient to have $\Omega_{Tot} = 1 + 10^{-10}$ to make it not flat at all. It is known that the normal curvature of a sphere of radius R is everywhere and in all direction given by R^{-1}. The curvatures is approximatively equal to zero for the visible horizon, that is to say the space illustrated in the counterexample is locally approximatively flat. The visible horizon centered on the Earth observer will appear locally flat regardless of the whole shape of the considered space, and the cosmic microwave background radiation detected on $\mathcal{S}$ can not distinguish between the visible horizon on the sphere $\mathcal{S}$ and a nearly flat space.

3 Insight Toward a Better Understanding of the Universe Dynamic and Mechanism

The acceleration of matter recession in our universe is believed to be originated by the vacuum energy called Dark Energy as suggested by the Nobel's Laureates ([8]), and the source of this dark energy remains a big mystery in our understanding of this cosmic phenomenon. Nevertheless, the suggestion of this mysterious energy is relatively needed in a simple picture of universe where the recession movement of matter reflects its mechanism, and it will be a just a question of time to find its source, origin and characteristics to build a rational understanding of it. However, no one can assert nowadays that what we observe today reflects really and surely the real universe mechanism. What if the real mechanism of our space is not as simple as we believe, that is straightforward reflected from the recession movement of matter on it? The counterexample introduced before raises an interesting fact, it questions deeply our understanding of the universe expansion nature and mechanism. The main contributions of this counterexample can be summarized as follow:

i) The recession movement of matter does not totally reflect the real nature of the space expansion, since the recession movement of matter can be accelerating while the expansion movement of the space is decelerating and the recession movement of matter can be decelerating while the expansion movement of the space is accelerating, as it was given by the counterexample.

ii) The recession movement of matter is only a consequence of the space expansion, and observing galaxies receding from each other at an accelerating rate is not an indication that the space is expanding at an accelerating rate.

iii) There must exist an inertial force located in the center of each galaxy that represents the resistance of galaxies to the universe expansion (where its magnitude is function of galaxy mass and universe acceleration).

iv) The acceleration of recession movement of matter on the space described in the counterexample is naturally due to the decelerating expansion of the spheres radius. Indeed as the spheres expand, the recession movement of galaxies is affected by the inertial force, that is to say the expanding deceleration of the space creates the accelerating recession movement of matter on it, meanwhile the expanding acceleration of the space creates the decelerating recession movement of matter on it due to the inertial force.

v) The acute need to postulate the existence of an unknown energy to explain the observed accelerating recession movement of matter via supernova of type Ia observation is not any more sustainable if the space is not totally flat and if there is a rational explanation of this acceleration via the effect of the inertial force on galaxies in a decelerating space.

vi) The notion "nearly flat" or "approximatively flat" with a small error does not address the real nature of the universe mechanism. If a small error to $\Omega = 1$ is neglected, then the existence of unknown energy that represents 70% of the critical density ρ_c (density of matter in a flat universe) needs to be postulated to explain the suddenly accelerating recession movement of galaxies we observe today.

vii) The determination of the real expanding nature of the whole universe is quite impossible to detect from observation if the observed recession movement of matter is perpendicular to the space expansion and matter is free of movement on it (Fig.6).

viii) The visible horizon centered on the observer is delimited by the size of the basic element of the space of the counterexample (which is one sphere), otherwise observer would see the beginning of the cosmic expansion (Fig.7), and this means that any CMB measurement is a local measurement with respect to the universe whole size. Therefore to suggest a curvature of the whole universe via CMB data is locally valid but globally not suitable.

ix) Despite the fact that the universe described by the counterexample fits the cosmological principles (isotropy and homogeneity), observation on one sphere provides an accelerating recession movement of matter which does not reflect the expanding real state of the whole universe. In the mean time the decelerating/accelerating expansion of one sphere conveys this deceleration/acceleration to the whole universe.

The counterexample provides a space with radial expansion locally and different expansion globally, where the property of the whole universe reside in the property of one expanding sphere in it. This last property impose a boundary to the visible horizon and makes all our measurement for the very large scale being local that omit any pretention to decide with no doubt that the universe global curvature can be obtained via wave data and measurement, that is to say, any interpretation of the astronomical measurement and data in favor of a flat universe is not rational in this regards.

By an irony of fate, neglecting a tiny error, as small as it is, in a parameter that characterizes the whole universe leads to add a new energy, accounting for about 73% of the total energy density of the universe, as the only source of a negative pressure that explains the acceleration of matter recession we observe today after approximatively 9.5 billion years of expansion. This is not only matter of how secure is our observational measurements, tools and approach, and not a matter of how many different groups work in the subject that confirmed approximatively the same result with different methods and small errors, rather than a matter of interpretation of the collected data and a rational establishment of a comprehensive understanding of the whole universe mechanism from it. The conclusion that the recent expansion of the universe definitely accelerates as well as the universe is flat is still not correct, however the recession movement of galaxies is definitely accelerates and the true mechanism of the universe is still missing in our understanding but it appears locally flat.

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