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Local Effect of Space-Time Expansion ---- How Galaxies Form and Evolve

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Abstract: *generalize gravitational theory of central field to the expanding space-time, and realize the unification of structure of big scope space-time and physical phenomena of small scope, and reasonably and systematically explain gravitational anomalies of solar system such as extra receding rate of lunar orbit, the increase of astronomical unit, the secular change of day length , the earth's expansion as well as the extra acceleration of artificial aerocrafts and so on, which cannot be treated by current knowledge. Besides, it is disclosed that galaxies form from continued growth but not the assemblage of existent matter after big bang, new matter continuously creates in the interior of celestial bodies, celestial bodies, galaxies and space simultaneously enlarge at the same proportion, and it is the local effect of space-time expansion that determines formation and evolution of galaxies.*

Keywords: *central field theory of gravitation; convex lens effect; continuous creation of matter*

1. INTRODUCTION

In the early 20th century Hubble found that distant galaxies were going far away from us, and the farther galaxies were, the higher their recession speed was, this phenomenon was explained as universal expansion or space-time expansion. However, it is obviously not sensible only to understand space-time expansion for galaxies to leave far away from one another, that is to say, inside galaxies or in small scope there should also be corresponding response (Carrera, M., Giulini, D. 2010; Cooperstock et al.,1998; Mashhoon et al.,2007; Sereno, Jetzer, 2007) which is the inevitable requirement of space-time's continuity. Generally say, the centrifugal force of a celestial body revolving round a center is balanced with its gravity, once considering space-time expansion, similar to adding a small but cumulative perturbation, its orbit is sure to adjust in response. Hence the small scope effect of space-time expansion can never be overlooked and in a sense it is more important to practice. In fact, with scientific experiments and observations developed deeper and deeper, the effect of space-time expansion has already been found in small scope. For example, the earth is found going away from the sun, and the earth itself is growing too (both mass and volume), the velocity of Milky Way arms is increasing namely faster and faster, after considering tidal effect the moon has still other motion to leave the earth, as well found a variety of spacecrafts to work to deviate the prediction of classic theory, and so on some problems for current physics not to able to explain. To illustrate how space-time expansion affects the evolution and formation of celestial bodies or galaxies is the key point of this paper, and before this some authors had already discussed such questions, but their discussion did almost not relate to the formation of galaxies or stayed still in big bang framework thus their discussions were not deep and these anomalous questions had not yet gotten to be removed radically (Adkins et al. 2007; Nandra et al., 2012; Kopeikin, 2012). This paper accepts F. Hoyle's thought that matter creates continuously, however new matter creates only in the interior of celestial bodies instead of all space, so as to avoid the shortcoming of F. Hoyle's theory. We think gravitational theory cannot have any true progress if reject the idea matter creates continuously and go to insist matter had created at the moment of big bang.

In order to make our discussion easy to understand, the paper begins with generalizing Newton's theory of central gravitational field to expanding space-time, and gradually comes to the global behavior of space-time expansion, and systematically treat these new questions and phenomenons which can not be explained with current knowledge.

2. THE OVERVIEW OF NEWTON'S THEORY IN A CENTRAL GRAVITATIONAL FIELD

So-called central motion refers to that a less object (mass m) revolves round a bigger one (mass M), and the bigger object may be thought at rest. For such central motion the track of object is cone curve, in the polar coordinate system (r,θ), the Newton's classical track equation is (Wu De Ming, 1999)

$$r = \frac{L^2}{GMm^2(1 + e\cos\varphi)} \tag{1}$$

Here $e = \sqrt{1 + \frac{2El^2}{G^2M^2m^3}}$, stands for eccentricity of the cone curve, and L stands for angular momentum of revolving object, E stands for its mechanical energy, both L and E are conserved.

For $e < 1,\ E = -\frac{GmM}{2a}$, the curve is ellipse, and a is the semi-major axis. And for $E = 0$, $e = 1$, the curve is parabola. For $E = \frac{GMm}{2a}$, $e > 1$, the curve is hyperbola, a stands for the half distance between two vertexes. The differential equations of dynamics are

$$\frac{dr}{dt} = \pm\sqrt{\frac{2}{m}\left[E - V(r) - \frac{L^2}{2mr^2}\right]} \tag{2}$$

$$\frac{d\varphi}{dt} = \frac{L}{mr^2} \tag{3}$$

Here $V(r) = -\frac{GMm}{r}$ is the potential energy of revolving object. In Newton theory both m and M are constant. About equation (1), (2) and (3) readers may refer to any textbooks of theoretical mechanics

3. GENERALIZE NEWTON'S THEORY TO THE EXPANDING SPACE-TIME

The paper is a continuation of reference [9] and [10] which were published before by us, and there expansion and contraction of universe were proved cyclic, galaxies and celestial bodies were proved bigger and bigger with expansion of universe, and universal density and pressure keep invariant all along, new matter creates continuously in the interior of galaxies or celestial bodies, the mass of any galaxy or celestial body changes with time t and meets $m \propto R^3(t)$ or

$$\frac{m(t_1)}{m(t_2)} = \frac{R^3(t_1)}{R^3(t_2)} \tag{4}$$

Here $R(t)$ is so-called scale factor of universe, which was defined by Roberson-Walker metric and had already been worked exactly out in reference [9] or [10]. And equation (4) reflects the connection of locality and globality, and describes how the mass of a galaxy or celestial body changes with time, and t_1 , t_2 stand for two arbitrary moments.

Notice that Newton's theory is the approximation of low speed of general relativity, and generally saying, celestial bodies' speed are not very high, therefore the generalization of Newton's theory is enough qualified to deal with practical questions, and the rigorous result calculated complicatedly with general relativity is not very necessary， nevertheless we will still give rigorous description of general relativity in the end.

Now we set out to generalize Newton gravitational theory to expanding space-time. And may as well take ellipse motion for example, Newton classical equation is

$$\frac{4\pi^2 a^3}{T^2} = GM \tag{5}$$

T is the revolution period of object, namely the time which the object revolves round the center across 2π angle to cost， and M is the mass of the central body， a is ellipse's semi-major axis.

Now consider the expansion of space-time, namely take M for variable with respect to time t and meets equation (4), and differentiate equation (5) we attain

$$\frac{da}{dt} = aH + \frac{2a}{3T}\frac{dT}{dt} \tag{6}$$

Here $H = \frac{dR}{Rdt}$ ， which is just Hubble parameter and is a function of time and shows the speed of universal expansion.

The last term of equation (6) stands for so-called tidal effect, which has nothing to do with universal expansion, and the term aH stands for the effect of universal expansion. In fact, as $a \to \infty$ ， dT becomes zero because equation（6) must return to the usual Hubble law under such condition， therefore it is reasonable to explain the last term of equation (6) for tidal effect.

Equation (6) indicates that only considering space-time expansion the points on the ellipse go far away from the center and meet Hubble law, the ellipse becomes larger and larger while the speed of revolving object continuously increases, however the period T is invariant.

Extend the result to whole universe, the global picture of universal expansion turns up immediately: not only the space between galaxies enlarges all the time but also galaxies theirselves enlarge meanwhile at the same proportion, but the periods of revolution or rotation of galaxies or celestial bodies keep invariant. The such situation of universal expansion is similar to we look towards the sky at night to use a magnifying glass----- all things including the space magnified in the same time. Thus we say that space-time expansion possess convex lens effect, which is certain requirement of universal isotropic and is the fundamental mechanism of formation and evolution of galaxies or celestial bodies. Obviously Hubble parameter $H(t)$ plays the magnification. Why the period of rotation of celestial body is also invariant as revolution can so be understood: any celestial body can be divided into innumerable small parts and every part can be looked as a object revolving round the common axis, this is to say, look rotation for the integration of revolutions.

So far we say that the local effect of global space-time expansion is actually the dynamics and kinematics of formation and evolution of galaxies or celestial bodies. And as for the mechanism of mass growth of galaxies or celestial bodies readers may see reference [9] or [10].

The convex lens effect of space-time expansion requires the radius of any celestial body or galaxy changes with time and meets $r \propto R(t)$ or

$$\frac{r(t_1)}{r(t_2)} = \frac{R(t_1)}{R(_2)} \tag{7}$$

which indicate the mean density of galaxy or celestial bodies invariant although their volume increase.

Astronomical observation shows that in early universe large galaxies existed ever, evidently this fact is not consistent with the theory of big bang, but no contradiction with the present conclusion.

Now take the earth for example to demonstrate the expansion of celestial bodies. Take today's Hubble parameter $H_0 = H(t_0) = 72 km.s^{-1}.Mpc^{-1} = 0.72 \times 10^{-10} / yr$, the subscript " 0 " represents today, and space-time expansion requires the radius of the earth to meet $r \propto R(t)$, hence $dr = Hrdt$, a year today the radius of the earth increase by $\Delta r_0 = H_0 r_0 \Delta t$ =0.46mm, here Δt for 1 year, and correspondingly from equation (4) the mass of the earth changes to meet $dm = 3Hmdt$, so a year today the mass of the earth increases by $\Delta m_0 = 3H_0 m_0 \Delta t = 13 \times 10^{14} kg$, which means vacuum donates energy to the earth for $\Delta E_0 = \Delta m_0 c^2 = 11.7 \times 10^{31} J$ a year , obviously it is the remarkable energy that makes the earth inside engender a variety of motions including earthquake and volcano burst, and in reality the break of the crust caused by earthquake is just the performance of the expansion of the earth but not the effect of plate collision, it is merely a imagination for the plates to impact. It is the expansion of every part of the earth in the same time that makes seas enlarge and continents also enlarge and look as if continents are receding from one another. By means of comparing ancient geographic map with today's one, physicists conclude that the earth's radius increases by 0.5mm a year, which is amazing in accordance with the above theoretical result. At present, there have been already a lot of observational evidences of the earth's expansion (Qi Ji, 2013; Liu liao，zhao zheng, 2004; W.B. Shen et al. 2011). Moreover, the increase of astronomical unit is easily calculated for 11m a year but not so-called 7cm (Z. Altamimi et al.,2011; R. Renka et al. 1997; A. Paulson et al. 2007), and it is impossible to find the increase of astronomical unit in view of current observational technique if astronomical unit increases by 7cm only.

Note that the increase of astronomical unit verifies the mass of the sun to increase because the period of revolution of the earth has not been found to change (Golden Gadzirayi Nyambuya, 2014; X. Wu et al., 2011).

it is easily proved that the gravity acceleration g of celestial body's surface increases with space-time expansion. In fact, $g = GM / r^2 = 4\pi G\rho r / 3$ and $\rho = const$, radius $r \propto R(t)$ we have $dg = Hgdt$, or

$$\frac{g(t_1)}{g(t_2)} = \frac{R(t_1)}{R(t_2)} \tag{8}$$

Equation (8) indicates that ancient gravity was smaller than today's that and verifies the fact ancient animals were bigger than today's ones, for example dragonflies were as big as today's hawks, or else they would be collapsed by their own weight. The thermal pressure p_t of surface is $p_t = \rho g h$ h is a small distance from the surface to the center, thus at different moments we have

$$\frac{p_t(t_1)}{p_t(t_2)} = \frac{\rho g(t_1)h}{\rho g(t_2)h} = \frac{g(t_1)}{g(t_2)}$$

And on the other hand, according to gas equation $p_t = \frac{\rho}{\mu} RT$, then the temperature of surface at different moments meets

$$\frac{T(t_1)}{T(t_1)} = \frac{p_t(t_1)}{p_t(t_2)} = \frac{g(t_1)}{g(t_2)} = \frac{R(t_1)}{R(t_2)}$$

which implies the temperature of surface of celestial body is higher and higher, for example 2700 million years ago the temperature of the sun's surface was

$$T(t_1) = \frac{R(t_1)}{R(t_0)} T(t_0) \approx \frac{T(t_0) t_1}{t_0} = \frac{6000 \times (1.37 - 0.27)}{1.37} = 4817K$$

The following discussion deals with the changes of orbit and speed of revolving object owe to space-time expansion, and all neglects the tidal effect for the moment

The convex lens effect of space-time expansion requires the angular speed $\omega = \omega(\varphi, t)$ of revolving object round a central body to meet

$$\omega(\varphi, t_1) = \omega(\varphi + 2n\pi, t_2) \tag{9}$$

which makes sure its revolving period invariant, namely $dT = 0$.

Referring to equation (1) and considering space-time expansion the track equation of revolving object is

$$r = r(\varphi, t) = \frac{L^2}{GMm^2(1 + e\cos\varphi)} \tag{10}$$

Notice that now, L, m, M are all variables with respect to time t, and m, M meet equation (4), $L = m\omega r^2$. Easily prove that eccentricity $e = \frac{c}{a} = \sqrt{1 + \frac{2EL^2}{G^2M^2m^3}}$ is still invariant. In fact, write the semi-major axis $a = k_1 R(t)$, the semi-minor axis $b = k_2 R(t)$, k_1, k_2 are two constants, we have

$$e = \frac{c}{a} = \frac{\sqrt{a^2 - b^2}}{a} = \frac{\sqrt{k_1^2 - k_2^2}}{k_1} = \text{Constant}$$

which indicates the ellipse's figure not to change though it is enlarging. However the difference between long axis and short axis increases with time because of $a - b = (k_1 - k_2)R(t)$.

And if time t takes different values, equation (10) represents a series of concentric ellipses. And from equation (10) we have

$$\frac{r(\varphi, t_1)}{r(\varphi + 2n\pi, t_2)} = \frac{R(t_1)}{R(t_2)} \tag{11}$$

Correspondingly the orbit speed $v = v(\theta, t)$ of revolving object meets

$$\frac{\mathrm{v}(\varphi, t_1)}{\mathrm{v}(\varphi + 2n\pi, t_2)} = \frac{R(t_1)}{R(t_2)} \tag{12}$$

where $n = 0 \pm 1, \pm 2 \cdots$. And further we have $\frac{\partial \mathrm{v}(\varphi, t)}{\partial t} = \mathrm{v}(\varphi, t) H(t)$, which indicates the revolving object has the mean tangential acceleration, this is just the effect of space-time expansion but not exist real tangential force. This result demonstrates the recent observation that the revolving speed of the Milky Way arm is becoming faster and faster, and obviously not understood by conventional knowledge.

It is easy to prove equation (12), since $E = -\frac{GMm}{2a} = -\frac{GMm}{r(\varphi, t)} + \frac{mv^2(\varphi, t)}{2}$, we have

$\frac{v^2(\varphi,t)}{2} = -GM(\frac{1}{2a} - \frac{1}{r(\varphi,t)}) = -Gk_3R^3(t)(\frac{1}{2k_1R(t)} - \frac{1}{k_2R(t)})$, which means (12) holds, here k_1, k_2, k_3 are three constants.

So far we see that some conserved laws including energy or momentum conserved law no longer strictly hold once considering space-time expansion, they are merely the approximation in small time and small scope

Equation (7) ~ equation (12) are enough qualified to describe various motions in a central gravitational field and not only fit to deal with elliptic motion.

Below, through several specific example that deal with the speed and position of revolving object show the applications of the new theory in practice.

Example1: refer to figure1. Assume time t_1 object is at point D, speed is v_D , and if not considering space-time expansion its track is the interior small ellipse , now decide the position and speed of time t_2 under considering space-time expansion.

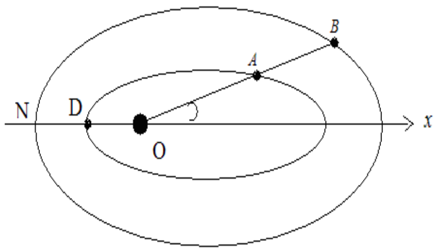

Fig1. *sketch map of a moving particle on different ellipses at different time*

Solving: at time t_2 point D arrives at point N to meet Hubble law，the real position of revolving object at time t_2 is sure on the ellipse that passes point N, may as well think at point B, and join point O (center body position) to point B, then point A is the position that object should arrive at according to classical theory at time t_2 , the speed v_A is easily solved using classical theory

Since $ON = OD\frac{R(t_2)}{R(t_1)}$, $OB = OA\frac{R(t_2)}{R(t_1)}$, here OD, v_D is already known.

From equation (2) we have $t_2 - t_1 = \int_{OD}^{OA} \frac{dr}{\sqrt{\frac{2}{m}\left[E + \frac{GMm}{r} - \frac{l^2}{2mr^2}\right]}}$, so OA can be decided,

notice that here M , m , l take the values of time t_1 , and are treated as constants in the course of integral. And according to $\frac{1}{2}mv_D^2 - \frac{GMm}{r_D} = \frac{1}{2}mv_A^2 - \frac{GMm}{r_A}$, we can decide v_A , here $r_D = OD$.

Finally using $v_B = v_A\frac{R(t_2)}{R(t_1)}$, we can decide the real speed v_B at time t_2 .

Example2. Vertically upward projectile motion. Refer to figure 2, assume a object is thrown up straightly at time t_1 and speed v_1 from the ground, try to decide the speed and position at time t_2 .

Solving: once considering space-time expansion, the real position that object arrive at is point B' but not point B which the object should arrive at according to classical theory at time t_2.

According to classical method we have $v_B = v_1 - gt_2$, $r_B = v_1 t_2 - \frac{1}{2} g t_2^2$, so the real position r_2 and speed v_2 are given by $r_2 = \frac{r_B R(t_2)}{R(t_1)}$, $v_2 = v_B \frac{R(t_2)}{R(t_1)}$

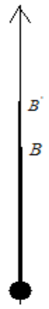

Fig2. *Sketch map of motion orbit of a particle in expanding space-time*

This results show that the real position and speed are higher than that of the prediction of classical theory，and the real speed to return to the ground is bigger than the its initial thrown speed, this is also beyond the prediction of classical theory (Lorenzo Iorio,2015; James G. Williams et al. 2014; Louise Riofrio, 2012).

Example3. Investigate the secular change of distance of perigee or apogee of the moon due to space-time expansion, and referring to the data from tidal rhythmites study the mean speed of lunar recession over the past 450myr, as well the the change of length of sidereal day.

Solving: today, the distance of perigee of the moon is $d_1 = 36.3 \times 10^4 km$, and according to Hubble law in a year the distance increases by $\Delta d_1 = H_0 d_1 \Delta t = 26.13mm$, here Δt takes 1 year, and on the other hand, the distance of apogee is $d_2 = 40.6 \times 10^4 km$, for alike reason the distance of apogee increases in a year by $\Delta d_2 = H_0 d_2 \Delta t = 29.23mm$, thus the increase of the difference of distances of apogee and perigee due to space-time expansion is $\Delta d_2 - \Delta d_1 = 3.1mm$ a year, and observational value is around 6mm, which means tide only make the increase by 2.9mm a year. Correspondingly the semi-major axis increases by $\frac{\Delta d_2 + \Delta d_2}{2} = 27.68mm$, and the observational is around 3.8cm (Lunar laser Ranging data), which means tide make the semi-major axis increase only 1.03cm a year today. If attribute all the change of 3.8cm to tidal effect, through careful calculation James Williams found the change of eccentricity of lunar orbit 3 times smaller than observation (Lorenzo Iorio, 2014; M. W. Kalinowski, 2015).

The above result show that the influence of the tide is quite small to lunar orbit and the effect of space-time expansion is the main dynamic for universe to evolve. And only when the scale of celestial body is not too small compared with the distance between two celestial bodies the effect of tides is distinct.

Now calculate the average speed of lunar recession over the past 450myr. Tidal rhythmites tell us that during the Ordovician (begin 485myr ago and end 443myr ago) a year had 382.7 sidereal days and 13.81 sidereal months（Zhou Yao qi, Chen Hai Yun, 2002). Since the period of revolution of the earth does not change neglecting the tides of sun-earth system, that is to say the length of a year keeps invariant, so the length of a sidereal month was then

$\frac{365.24\times 24hr}{13.81}=634.7hr$, and today is $\frac{365.24\times 24hr}{13.37}=655.6hr$. To use $\frac{4\pi^2 a^3}{T^2}=GM_e$ and $R(t)=A\sin\left(t\sqrt{\frac{4\pi G\rho}{3}}\right)$ (see reference [10]), here A is a constant, and universal observed density $\rho=3.1\times 10^{-24}kg/m^3$, we have, for two moments t_0, t_1

$$\frac{a^3(t_0)}{T^2(t_0)}\div\frac{a^3(t_1)}{T^2(t_1)}=\frac{M_e(t_0)}{M_e(t_1)}=\frac{R^3(t_0)}{R^3(t_1)} \tag{13}$$

And may as well take $t_0=1.37\times 10^{10}yr$, $t_1=(1.37-0.045)\times 10^{10}yr$, $T(t_1)=634.7hr$

$T(t_0)=655.6hr$, $a(t_0)=38.4\times 10^4 km$, from (13) we work out $a(t_1)=36.27\times 10^4 km$, which differs from the result 375000km of not considering equation (4). Thus the mean speed of the increase of lunar semi-major axis over the past 450myr is now

$$\frac{\Delta a}{\Delta t}=\frac{(38.4-36.27)\times 10^9 cm}{4.5\times 10^8 yr}=4.7cm/yr \tag{14}$$

Which indicates the past tidal action was stronger than today's that. And on the other hand to use the tidal formula $a^{11/2}\frac{da}{dt}=\text{const}$ (James C G. Walker, Kevin J. Zahnle, 1986) we may roughly estimate the recession speed during the Ordovician

$$\frac{da(t_1)}{dt}=(\frac{a_0}{a_1})^{11/2}\frac{da(t_0)}{dt}=(\frac{38.4}{36.27})^{11/2}\times 3.8cm/yr=5.2cm/yr \tag{15}$$

These results indicate that the past recession speed of the moon was higher than today. Notice that not considering the change of the earth's mass, the corresponding mean recession speed (James C G. Walker, Kevin J. Zahnle, 1986; Louise Riofrio, 2012) is $\frac{(38.4-37.5)\times 10^9 cm}{4.5\times 10^8 yr}=2cm/yr$ which shows the past tidal action was lower than today's tide and is obviously not compatible with tidal principle-------the farther distance, the smaller effect of tides.

Finally, estimate the change rate of length of sidereal day today.

During the Ordovician the length of sidereal day is $\frac{365.24\times 24hr}{382.7}=22.9hr$, and today is 23.9 hours.

Thus the mean change rate of the length of sidereal day over the past 450myr is

$$\frac{\Delta T_e}{\Delta t}=\frac{(23.9-22.9)\times 3600s}{4.5\times 10^8 yr}=0.8ms/cy \tag{16}$$

In addition, since space-time expansion does not change a variety of periods of motions, the change of length of day originate still from tidal interaction, and for tidal interaction angular momentum is conserved and therefore the following empirical equation (17) derived by R. G. Williamson to use tidal theory is still valid (R. G. Williamson, S. M. Klosko 1988)

$$\frac{d\Omega}{dt}=(49\pm 3)\frac{dn}{dt} \tag{17}$$

Where Ω is angular speed of rotation of the earth, and n is the angular speed of revolution of the moon. To use equation (6) the change rate of length of sidereal month is today

$$\frac{dT_m}{dt}=\frac{3T_m}{2a}(\frac{da}{dt}-Ha)=\frac{3\times 655.6\times 3600\times 1.03s}{2\times 38.4\times 10^9 yr}=9.4\text{ms/yr}$$

And using $\frac{dT_e}{T_e^2 dt}=(49\pm 3)\frac{dT_m}{T_m^2 dt}$ the changing rate of length of sidereal day is today calculated as

$$\frac{dT_e}{dt} = (0.61 \pm 0.05) ms / cy \tag{18}$$

This result is smaller than the average value of 0.8ms/cy, and therefore is reasonable and verify that the past tidal action is stronger than today's that. And other some works conclude that, according to eclipse records over 2700 years, the current change rate of day length is $(1.7 \pm 0.05) ms / cy$, which is obviously higher than the average value of 0.8ms/cy and therefore is unreasonable. Obviously the past eclipse records were not reliable enough. Note that since the past distance between the moon and the earth was smaller than today's that the past effect of tide must be stronger than today's that, in a word the past recession speed or the past changing rate of day length must be faster than today's that.

So far, so-called anomaly of lunar orbit clear up entirely.

4. LINK WITH EXACT DESCRIPTION OF GENERAL RELATIVITY

Our discussion is still founded in the framework of general relativity. Note that general relativity doesn't refuse matter creates continuously and equation (4), the basis of this paper, is just one of predictions of general relativity.

Equation (7) ~ equation (12) are the generalization of Newton's theory to the expanding space-time, therefore they must be the approximations of general relativity under low speed and weak field. And now we prove as follows.

Birkhoff's law in general relativity indicates that in the gravitational field of spherical symmetry (namely central gravitational field), no matter how the gravitational source behaves, as long as the spherical symmetry keeps up the form of space-time metric is the same

$$ds^2 = -(1 - \frac{2Gk}{l})dt^2 + \frac{1}{1 - \frac{2Gk}{l}} dl^2 + l^2 (d\theta^2 + \sin^2\theta d\varphi^2) \tag{19}$$

This is to say, with t, l, θ, φ as independent coordinate variables equation (19) is a solution to vacuum field equation $R_{\mu\nu}$ =0. Here k is a constant and later will give specific value following specific gravitational source , and l is called standard radial coordinate or radial parameter (must remember that l does not means conventional distance to origin point, in the paper r is defined as the conventional radial distance). When the mass of central body changes and meets equation (4) its gravitational field is still described by (19), in other words equation (19) not only describes static source's gravitational field but also variable source's gravitational field, only requirement is the spherical symmetry to keep up. In the metric field, for a revolving object, its trajectory equation is

$$\frac{h^2}{l^4}\left(\frac{dl}{d\varphi}\right)^2 + \frac{h^2}{l^2} = (a^2 - 1) + \frac{2Gk}{l} + \frac{2Gkh^2}{l^3} \tag{20}$$

with $l^2 \frac{d\varphi}{ds} = h$, $\frac{dt}{ds} = \frac{a}{1 - \frac{2Gk}{l}}$, a and h are integral constants (see any a text of general relativity). In the distance neglecting $\frac{2Gkh^2}{l^3}$, equation (20) has the approximate solution

$$l = \frac{h^2}{Gk(1 - e\cos\varphi)} \tag{21}$$

correspond to (9) and (10), for specific source M(t) we conclude $l = \frac{r}{R(t)}$, $k = \frac{M(t)}{R^3(t)}$, equation (21) becomes (10), namely

$$r = \frac{R^4(t)h^2}{GM(t)(1-e\cos\varphi)} = \frac{L^2}{GM(t)m^2(t)(1-e\cos\varphi)} \tag{22}$$

This means different gravitation source, constant k is different, and $l = \frac{r}{R(t)}$ is equivalent to a coordinate transformation. Substituting $l = \frac{r}{R(t)}$, $k = \frac{M(t)}{R^3(t)}$ into (20) obtain the more rigorous equation

$$\frac{R^2h^2}{r^4}\left(\frac{dr}{d\varphi}\right)^2 - \frac{R\,h^2}{r^3}\frac{dr}{d\varphi}\frac{dR}{d\varphi} + \frac{h^2}{r^2}(\frac{dR}{d\varphi})^2 + \frac{R^2h^2}{r^2} = (a^2-1) + \frac{2GM(t)}{rR^2} + \frac{2GMh^2}{r^3} \tag{23}$$

Obviously it is a gradually magnifying and rotating spiral line, the points on the line go away from the center body of mass M (t) and meet Hubble law.

5. CONCLUSIONS

Anomaly of planet orbit including the increase of astronomical unit is the effect of universal expansion, galaxies or celestial bodies come from gradual growth but not the assemblage of existent material after big bang. While space enlarges celestial bodies or galaxies their selves also enlarge at the same proportion, new matter continuously generates inside celestial bodies or galaxies. Conventional conserved laws, such as energy or mass conserved laws, angular momentum conserved law as well as momentum conserved law are the approximation of small time and small scope, and in big time and big scope they are no longer strictly valid. The thought matter creates continuously is great and impossible to overthrow really, instead it must return to science. So-called failure of F. Hoyle's theory lies in his wrong modification to Einstein's field equation and don't mean the idea continuous creation of matter wrong. And another modification in reference [10] is quite viable, which is indispensable for people to know the true course of. Galaxy or celestial body formation. In the light of matter creates continuously, earthquakes are the behavior of the earth's expands and its inner energy or matter accumulate constantly so that break out sometime.

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