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A New Theory of the Origin of the Solar System and the Expansion of the Universe

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Abstract
Although many hypotheses have been put forward on the origin of the Solar System, yet they all have unsolvable problems. So the author of this paper, through a study on the origin of the Moon and the Earth, has discovered some formation mechanisms and orbit-variation mechanisms of natural satellites and planets, therefore could reveal the formation and evolution of the Solar System and other galaxies in the universe. Especially, the author could also explain why the eight planets around the Sun are prograde planets, why the orbits of the eight planets almost lie in the same plane, and why most planets rotate around their own axes from west to east. Additionally, the author could also explain the expansion of the universe as well as the cause of global climate change.

1. Introduction

Although early in 1543 Poland astronomer Copernicus published "On the Revolutions of Heavenly Spheres", in which he proposed heliocentrism, thus made great contributions to human correctly understanding the Solar System, yet in nearly 500 years, the origin and evolution of the Solar System remained a mystery. Although people have put forward various hypotheses, including more than 40 kinds of hypothesis which have more impacts, yet so far no one is perfect, they all have unsolvable problems [1]. Among these hypotheses, the most widely accepted hypothesis of planetary formation is Kant and Laplace nebular hypothesis, which maintains that 4.6 billion years ago, the Solar System formed from the gravitational collapse of a giant molecular cloud which was light years across. Most of the mass collected in the centre, form the Sun; the rest of the mass flattened into a proto-planetary disc, out of which the planets, moons, and other bodies in the Solar System formed. However, since the dawn of the space age in the 1950s and the discovery of extra-solar planets in the 1990s, the theory has been both challenged and refined to account for new observations [2,3]. But even if the refined hypotheses still cannot explain some basic facts. Why the planets can move around the Sun? Why all the orbits of the planets are prograde? Why all the planets (except Pluto) have orbital planes that are inclined by less than 6 degrees with respect to each other? Why Terrestrial planets are dense, rocky and small, while jovian planets are gaseous and large? Why Mercury and Venus, which originally had more matter near the disc centre to form their moons, haven't had their own moons? Hence, the existing hypotheses are incredible.

Recently, the author of this paper, through a study on the origin of the Moon and the Earth, has discovered some formation mechanisms and orbit-variation mechanisms of natural satellites and planets, therefore, could reveal the formation and evolution of the Solar System and other galaxies, the expansion of the universe and the cause of global climate change.

2. The formation and Evolution of the Moon

2.1. The Disadvantages of the Existing Hypothesis

Several mechanisms have been proposed for the Moon's formation 4 billion years ago. One is fission theory [4], i.e., some people suggest that the Moon was originally part of the Earth during the birth of the Solar System, when the young Earth was almost completely molten, but then the Moon detached from the Earth's crust through centrifugal force, which would require too great an initial spin of the Earth. Another is capture theory, i.e., some people postulate that the Moon was formed somewhere in space, then moved through space until it came into contact with the Earth's gravitational force and began its orbit around the Earth, but that would require an unfeasibly extended atmosphere of the Earth to dissipate the energy of the passing Moon. In addition, if this theory were true, the Moon would have crashed into the Earth or drifted far out of the Earth's orbit. Still, another one is co-formation or condensation theory [5, 6], which posits that the Moon and the Earth were condensed from a solar nebula at the same moment in the same place, and then the Moon began to orbit around the Earth. This theory answers the question of why the Moon is in its fixed location near the Earth, but falls short when it comes to explaining the depletion of metallic iron in the Moon.

The prevailing hypothesis today is that the Earth-Moon system formed as a result of a giant impact: a Mars-sized body hitting the newly formed proto-Earth, blasting material into orbit around it, which accreted to form the Moon [7]. However, meteorites show that other inner Solar System bodies such as Mars and Vesta have very different oxygen and tungsten isotopic compositions to the Earth, while the Earth and Moon have near-identical isotopic compositions. Published in 2012, an analysis of titanium isotopes in Apollo lunar samples showed that the Moon has the same composition as the Earth, which conflicts with the impact event hypothesis for its formation. In addition, the large amount of energy released in the giant impact event and the subsequent reaccretion of material in Earth orbit would have melted the outer shell of the Earth, forming a magma ocean. The newly formed Moon would also have had its own lunar magma ocean; estimates for its depth range from about 500 km to the entire radius of the Moon. But such is not the case. So the impact event hypothesis is still debated [8].

Now that the Moon is neither a pre-formed celestial body nor a result of a giant impact, it must have been produced by the Earth. But normally, the Earth's rotation is not fast enough to throw the Moon joined tightly with the Earth into the lunar orbit. Hence, the material composing the Moon must have been launched by a special force into some orbits around the Earth to form the Moon.

2.2. A New Theory for the Formation and Evolution of the Moon

Many scientific studies have shown that, about 4.5 billion years ago, at the beginning of the formation of the Earth, frequent volcanic eruptions began to occur on the Earth, because then the Earth was much closer to the Sun and moved much more quickly around the Sun than now, making immense heat be accumulated inside the Earth, thus causing frequent and violent volcanic eruptions. During some violent volcanic eruptions or celestial body's impacts on the Earth, obviously the probability of volcanic eruptions is much larger than that of celestial body's impacts, some volcanic ash or rock debris could have achieved a velocity no less than the first cosmic velocity to enter some orbits around the Earth, forming layers of nebular around the Earth. Especially, when the direction of a volcanic eruption coincide with the direction of the Earth's rotation, the erupted debris could easily achieve a velocity no less than the first cosmic velocity; when the direction of a volcanic eruption contradicts with the direction of the Earth's rotation, the erupted debris have more difficulty achieving such a velocity. So there were more prograde debris than retrograde debris in the same orbit around the Earth. Hence, the prograde planetsimals could merge more prograde particles and bump less into retrograde particles, therefore easily grow up to be a Moon. That is why the moon is a prograde satellite.

The orbit of the young Moon was much closer to the Earth than it is today. There were a lot of Earth ejecta in the orbit around the Earth, such as volcanic ash, water vapor, and aerosol, which could stay in the stratosphere for a very long time. Hence, the Moon, like a snowball, has unceasingly merged these ejecta to become larger and larger, and farther and farther away from the Earth. This can be proved as follows [9]: When the Moon moved around the Earth normally, the centrifugal force produced by the Moon's rotation around the Earth and the Earth's gravitation pull on the Moon had the same size but opposite directions, as is shown in Fig. 1. Let M be the mass of the Earth, m_1 be the mass of the Moon, r_m be the radius of the Moon, r be the centroid distance between the Earth and the Moon, v be the tangential velocity of the Moon around the Earth, then:

$$\frac{Gm_1M}{\mathrm{r}^2}=\frac{m_1v^2}{r} \quad \rightarrow \quad v=\sqrt{\frac{GM}{r}} \tag{1}$$

Near the orbit of the Moon, there were also many smaller prograde planetsimals moving around the Earth's centre in circular orbits of radius $r_x(r-r_m<r_x<r)$ with velocity v_x. Since $v_x=\sqrt{\frac{GM}{r_x}}>\sqrt{\frac{GM}{r}}$, which implies $v_x>v$, these smaller planetsimals would finally catch the Moon. When a smaller planetsimal approached the Moon, the Moon's gravitation force would accelerate the motion of the planetsimal, making the planetsimal's velocity become much

larger than v_x. Let m_2 be the mass of the planetsimal, v_y be its velocity when it impacted the Moon, then the centrifugal force of the Moon merged with the planetsimal was:

$$m_1 \cdot \frac{v^2}{r} + m_2 \cdot \frac{v_y^2}{r} > (m_1 + m_2) \cdot \frac{v^2}{r} = G(m_1 + m_2).\frac{M}{r^2} \quad (2)$$

That is, the centrifugal force produced by the Moon's rotation around the Earth was larger than the Earth's gravitation pull on the Moon, therefore the moon's center of gravity has a trend moving away from the Earth.

Especially, if a planetsimal or asteroid was large enough, it would impact the Moon fiercely, making the Moon's velocity increase to a larger value v_2, then:

$$(m_1 + m_2) \cdot \frac{v_2^2}{r} > (m_1 + m_2) \cdot \frac{v^2}{r} = G(m_1 + m_2).\frac{M}{r^2} \quad (3)$$

therefore, the Moon's center of gravity moved a reasonable distance from the Earth.

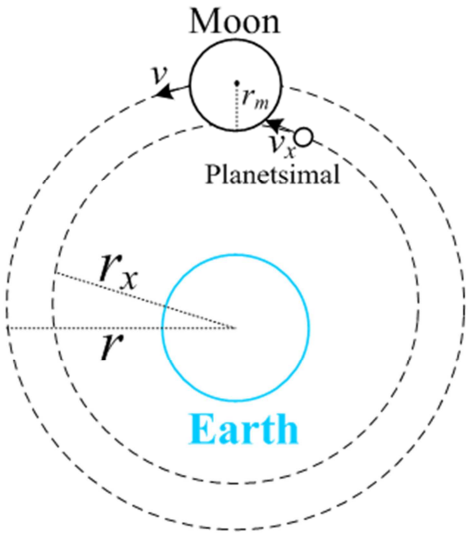

Fig. 1. *The orbits of the Moon and planetsimals.*

Another reason for the Moon moving away from the Earth is the increase in the Earth's rotation speed. This is because the Earth originated from a satellite of the planet that formed the Sun later. Originally, the mass of the Earth was small, there was no atmosphere on it, and it was near its mother star, so it was almost synchronously tidally locked with the mother star, unable to rotate on its own axis, like Mercury and Venus. Afterwards, it has unceasingly incorporated the nebula materials near the orbits to become larger and larger, and gradually moved away from its mother star, just like the Moon moving away from the Earth. With the increase of Earth's mass, it could absorb more and more water vapor to form its own atmosphere, even forming a massive hydrosphere. When its mother star became a star constantly giving off light and heat, the Earth's hemisphere near the mother star was exposed to the sunlight, so the temperature of this hemisphere was generally higher than that of the other hemisphere, making more vapor evaporated from this hemisphere than from the other hemisphere, even forming massive clouds impacting high mountains or massive storms blocking the planet's revolution in this hemisphere. Hence, during the planet's revolution around its mother star, the planet's hemisphere near the mother star encountered more air resistance than the other hemisphere, causing the earth to rotate from west to east. And with the growth of Earth's atmosphere and hydrosphere, the speed of the Earth's rotation will become higher and higher. The observation result of American National Institute of Standard Technology in 1999 also shows that the Earth's rotation is speeding up. Due to Earth's tidal activity , inner fluid activity , volcanic activity, or great earthquake, Earth's figure axis is often shifted away from the north-south axis, which it spins around once every day at a speed of about 1,000 mph (1,604 kph), making Earth's center of mass draw a circular trace around the north-south axis in the space during Earth's rotation. For example, 2011 Tohoku earthquake has shifted Earth's figure axis by about 25 centimeters and accelerated Earth's spin [10]. Hence, under the drag of the gravitational force of the Earth whose rotation is speeding up gradually, the Moon's revolution around the Earth is also speeding up, thus increasing the centrifugal force of the Moon, finally making the Moon move away from the earth. That is why people have observed that the Moon is moving away from the earth gradually.

For the same reason, batch after batch of volcanic ejecta or planetsimals were moved away from the Earth or other planets, and sent to the Moon, making the Moon become a giant satellite in four billion years.

Some people may believe that the Moon is moving away from the Earth is caused by the Earth's tides raised by the Moon: Because the tidal bulges on the Earth exert a gravitational pull on the Moon. The Earth rotates faster (once every 24 hours) than the Moon orbits (once every 27.3 days), thus the bulge tries to "speed up" the Moon, making the Moon move away from the Earth. In fact, they have distorted Newton's theory of tides. Although Newton had proved that the Moon's gravitational pull can raise the tides on the Earth, he didn't mention that the tidal bulges on the Earth can speed up Moon's revolution. Since the mass of a tidal bulge is much less than the mass of the Moon, it has almost no gravitational pull on the Moon. Even if a raised wave ahead has a little gravitational pull on the Moon, a raised wave behind has also a little gravitational pull on the Moon, which can offset the gravitational pull of the wave ahead. Especially, when the mass of the Moon was still small, its gravitational pull on the ocean water wasn't strong enough to raise Earth's tides, not to mention Earth's tidal bulges exerting a gravitational pull on the Moon or speeding up Moon's revolution. Hence, their viewpoint is wrong.

In addition, volcanic eruptions on the Moon was another force driving the Moon away from the Earth. At the beginning of the formation of the Moon, it's a cool homogeneous sphere. But with the continuous increase in the mass and volume of the Moon, the heat inside the moon accumulated continuously, including the heat caused by the air flow friction generated by the high-speed rotation of the moon around the Earth (this rotation speed could reach 7.9 km/s when the Moon was near

to the earth) and the high-speed rotation of the Earth-Moon system around the Sun when the Earth was near to the Sun, the heat generated the moon's own gravitational contraction process, the heat generated by the chemical reactions inside the original moon, etc. It is just the original energy accumulated to a certain extent that made the original lunar material melted and differentiated, forming the different layers of the moon: crust, mantle and nucleus.

The early orbit of the Moon was much closer to the Earth's atmosphere than it is now, especially the near side of the moon has a large surface soaking in the earth's atmosphere, so the Moon had absorbed much water vapor from the Earth's atmosphere to form many large ice-covered or water-covered regions. Now NASA (National Aeronautics and Space Administration) has found that lots of water ice still exists at lunar poles. On the other hand, in the process of the Moon revolving around the Earth, the western hemisphere of the Moon is always at the head of the moving satellite. The friction between the western hemisphere of the Moon and air is much more violent than that between the eastern hemisphere of the Moon and air, producing more heat and therefore making the temperature in the western hemisphere of the Moon higher than that in the eastern hemisphere. Hence, the air flow in the western hemisphere of the Moon is more active than that in the eastern hemisphere, therefore it's more difficult to form water ice in the western hemisphere of the Moon than in the eastern hemisphere.

Due to the constant erosion of water, many places of the lunar crust were broken. When the water permeated through the crack in the crust to contact magma, the water gasified immediately, causing violent volcanic eruption. Since the eastern hemisphere of the Moon had more water-ice than the western hemisphere, the probability and strength of volcanic eruption in the eastern hemisphere is higher than that in the western hemisphere. The synthesis of the volcanic eruptions in both hemispheres accelerated the revolution of the Moon around the Earth, making the Moon move from an orbit near the Earth to another orbit farther away from the earth. This can be proved as follows:

(1) Speeding up the Moon's revolution enlarging its orbit around the Earth.

Assume that the Earth's mass is M and the Moon's mass is m, and the Moon moves around the Earth in a circular orbit of radius r_1 to do uniform circular motion, as is shown in Fig. 2, then the Moon's rotation speed $V_1=\sqrt{\frac{GM}{r_1}}$. If the Moon at position A is accelerated by a pushing force, the Earth's gravitational pull on the Moon is less than the centripetal force required by the Moon's uniform circular motion around the Earth, thus doing centrifugal motion to enter an elliptic orbit. So we can assume that when the Moon's orbital speed at point A is increased from V_1 to V_{A2}, it can enter elliptical orbit 2 whose perigee distance is r_1 and apogee distance is r_2. Assume also that the Moon's orbital speed at point B is V_B. According to the law of conservation of mechanical energy, when the Moon moves from perigee A to apogee B, we have:

$$\tfrac{1}{2}MV_{A2}^{\ 2}=\tfrac{1}{2}MV_{B}^{\ 2}+\Delta E_p \tag{4}$$

where ΔE_p is defined as follows:

$$\Delta E_p=\int_{r_1}^{r_2}\frac{GMm}{r^2}dr=GMm(\tfrac{1}{r_1}-\tfrac{1}{r_2}) \tag{5}$$

According to Kepler's second law, we also know

$$\tfrac{1}{2}V_{A2}\cdot\Delta t\cdot r_1=\tfrac{1}{2}V_B\cdot\Delta t\cdot r_2 \tag{6}$$

for any time interval Δt.

From Eqs. (4)-(6), we can deduce the following formula:

$$V_{A2}=\sqrt{\frac{2r_2}{r_1+r_2}}\sqrt{\frac{GM}{r_1}}=\sqrt{\frac{2r_2}{r_1+r_2}}V_1 \tag{7}$$

Similarly, in order to make the Moon in a circular orbit of radius r_1 enter elliptical orbit 3 whose perigee distance is r_1 and apogee distance is r_3, the Moon's orbital speed at point A should be increased from V_1 to V_{A3} :

$$V_{A3}=\sqrt{\frac{2r_3}{r_1+r_3}}\sqrt{\frac{GM}{r_1}}=\sqrt{\frac{2r_3}{r_1+r_3}}V_1 \tag{8}$$

From Eqs. (7) and (8), we can deduce the following formula:

$$V_{A3}=\sqrt{\frac{r_1+r_2}{2r_2}}\sqrt{\frac{2r_3}{r_1+r_3}}V_{A2}=\sqrt{\frac{r_3(r_1+r_2)}{r_2(r_1+r_3)}}V_{A2} \tag{9}$$

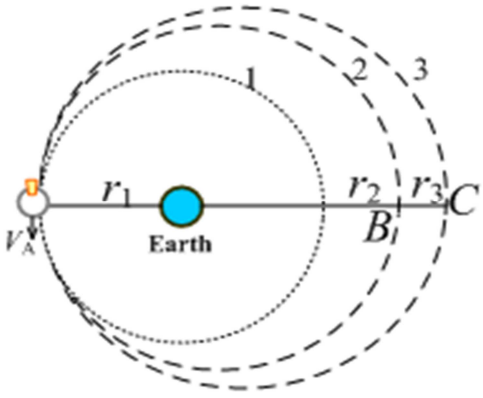

Fig. 2. *Speeding up the Moon's revolution enlarging the Moon's orbit.*

$$V_{A3}-V_{A2}=(\sqrt{\frac{r_3(r_1+r_2)}{r_2(r_1+r_3)}}-1)V_{A2} \tag{10}$$

i.e., if the Moon's orbital speed V_{A2} at perigee A of elliptical orbit 2 is increased by $(\sqrt{\frac{r_3(r_1+r_2)}{r_2(r_1+r_3)}}-1)V_{A2}$, then the Moon can be transferred from elliptical orbit 2 to orbit 3.

For example, assuming the mass of the original Moon is 7.349e20 kg, it moved in an elliptical orbit whose perigee

distance r_1 = 8,200,000 m and apogee distance r_2 = 8,220,000 m, and the Moon's orbital speed at perigee is V_{A2} = 6,975.75 m/s. In order to make the Moon be transferred from this orbit to an extended elliptical orbit of apogee distance r_3 = (r_2 + 0.035) m, the Moon's orbital speed at perigee should be increased by 7.41648e-6 m/s.

Generally, as shown in Fig. 3a, for any point D on semi-elliptic orbit 2 starting from perigee A to apogee B, assume the Moon's orbital speed at point A and point D are V_{A2} and V_D respectively, the distance between D and the Earth is r_4, then according to Kepler's second law, we have:

$$V_{A2} \cdot r_1 = V_D \cdot r_4 \tag{11}$$

If the Moon's orbital speed at point D is increased by a propulsive force, making V_D become V_4, then the Moon is transferred to a larger elliptic orbit marked as 4. Since the perigee distance of the elliptic orbit is invariant, its apogee distance must be increased. Assume when the Moon's orbital speed at point A of orbit 2 is increased from V_{A2} to V_{A4}, the Earth can also enter orbit 4, then:

$$V_{A4} \cdot r_1 = V_4 \cdot r_4 \tag{12}$$

From Eqs. (11) and (12), we can obtain:

$$V_{A4} - V_{A2} = \frac{r_4}{r_1}(V_4 - V_D) \tag{13}$$

$$V_4 - V_D = \frac{r_1}{r_4}(V_{A4} - V_{A2}) \tag{14}$$

i.e., if an increase as much as ΔV in the Moon's orbital speed at point A of orbit 2 can make the Moon be transferred to orbit 4, then only an increase as much as $\frac{r_1}{r_4}\Delta V$ ($\frac{r_1}{r_4}$<1) in the Moon's orbital speed at point D of orbit 2 is required to make the Moon be transferred to orbit 4. Hence, the probability of an increase in the Moon's orbital speed causing an extension of the Moon's orbit is large.

Similarly, as shown in Fig. 3b, for any point D on semi-elliptic orbit 2 starting from apogee B to perigee A, if the Moon's orbital speed at point D is increased by a propulsive force, then the Moon is transferred to an elliptic orbit (marked as 4) with longer perigee distance.

(2) Thrusting-forward volcanic eruptions increase the Moon's orbital speed

As is shown in Figs. 3 and 4, during the Moon's revolution around the Earth, when a volcano continuously erupted and sent a huge amount of material into the stratosphere with great speed contrary to the tangential direction of the Moon's revolution, it could produce a tremendous impetus on the Moon, increasing the Moon's orbital speed. Hence, we can also employ the principle of rocket flight to calculate the increment of the Moon's orbital speed.

At a given instant t, let the mass of the Moon be M and its speed be v, then during the period from time t to time t + dt, the volcanoes erupted substance of mass dm, the velocity of these substances erupted from the Moon be u, making the Moon's speed increase dv. Therefore, at the time t + dt, the mass of the Moon is M + dM, its *speed* is v + dv, the mass of the erupted substances is dm (if dt is very small, such as dt ≤ 1, these substances can be regarded separated substances flying in the air) and the speed of these substances is (v + dv － u). Since the Earth's gravitation pull on the moon and the centrifugal force produced by the Moon's revolution around the Earth had the same size but opposite directions, the resultant external force exerted on the Moon is zero, therefore according to theorem of momentum, we have:

$$Mv = [M + dM](v + dv) + dm(v + dv - u)] \tag{15}$$

Notice that dM = -dm, we have

$$dv = -u \cdot dM / M \tag{16}$$

Let v = v_i and M = M_i when t = t_i, during the period from time t_i to time t_j, the volcanoes erupted some substances, then at instant t_j, v = v_j and M = M_j, therefore we obtain:

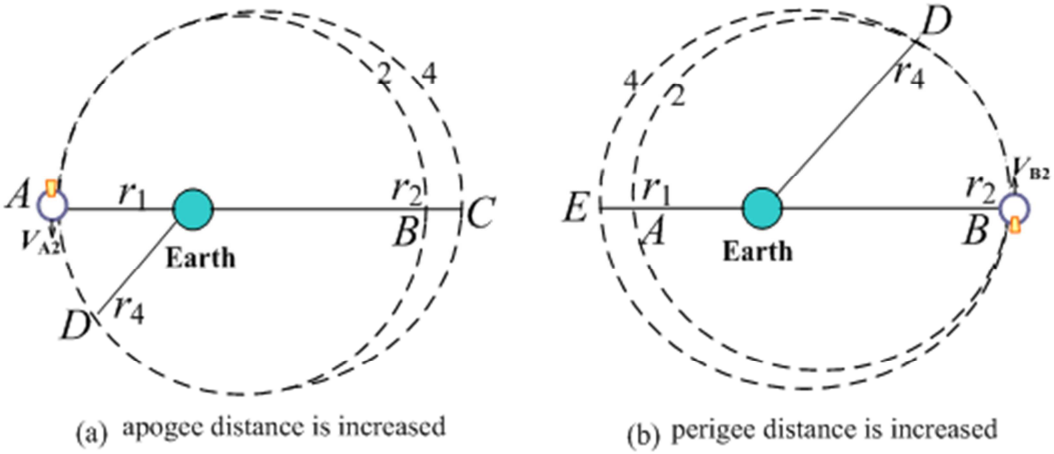

Fig. 3. *The Moon's orbit is extended due to the increase of speed*

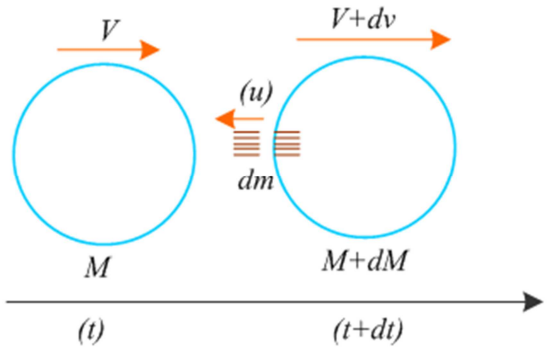

Fig. 4. *Thrusting-forward volcanic eruptions increasing the Moon's orbital speed.*

$$\int_{v_i}^{v_j} dv = -u\int_{M_i}^{M_j} dM / M \tag{17}$$

$$v_j - v_i = u\ln(M_i / M_j) \tag{18}$$

Let the ratio of the mass of the entire Moon to the remaining mass after the first second of volcanic eruption be N_1, the ratio of the mass before the 2nd second of volcanic eruption to the remaining mass after the 2nd second of volcanic eruption be N_2, and so on. Let u_i be the speed of the substances erupted from the Moon in the i-th second of volcanic eruption, and v_i be the speed of the Moon after the i-th second of volcanic eruption, then:

$$\begin{aligned} v_1 - v_0 &= u_1\ln(N_1),\\ v_2 - v_1 &= u_2\ln(N_2),\\ v_3 - v_2 &= u_3\ln(N_3),\\ &\cdots\cdots,\\ v_k - v_{k-1} &= u_k\ln(N_k) \end{aligned} \tag{19}$$

Generally, we can assume that $u_1 = u_2 = \cdots = u_k = u$ and $N_1 = N_2 = \cdots = N_k = N$ for some positive number u and N, so:

$$v_k - v_0 = ku\ln(N) \tag{20}$$

Since there are more volcanoes in the western hemisphere of the Moon than in the eastern hemisphere of the Moon, we can moderately assume when the moon approached its perigee, a volcano group in the western hemisphere of the Moon eject together 1.54321e9 kg per second (which amounts the ejecta mass of a Vesuvius volcano per second), and the ejection velocity is 1,000 m/s (which amounts the eruption velocity of some volcanoes discovered by Voyager 1 on Jupiter's satellite, Io, whose velocity of spewing volcano substances could reach 1,000 m/s), then after one hours of propulsive eruption, the Moon's orbital speed can be increased by 7.55955e-6 m/s (> 7.41648e-6 m/s), making the Moon be transferred to an extended elliptical orbit whose apogee distance is 0.035 m longer than that of the previous orbit.

Just as what Eqs. (13) and (14) shows, a volcanic eruption of the same scale occurring at any point D on the semi-elliptic orbit from perigee A to apogee B can produce almost the same effect on the increase in the Moon's orbital speed, therefore produce almost the same effect on the variation of the Moon's orbit. Hence, the probability that the Moon's orbit changes several times along this long semi-elliptic orbit is very high. So it's very natural that the apogee distance is increased by 0.035 m in a year due to the variation of the Moon's orbit; meanwhile, it's also very natural that the perigee distance is increased by 0.035 m due to the variation of the Earth's orbit.

Table 1. *Moon's orbit variation caused by volcanic eruptions in different orbits*

Perigee distance; Apogee distance (m)	Moon's mass (kg)	Eruption velocity (m/s)	Erupted mass per second (kg/s)	Eruption duration at a time (h) × number of times	Yearly increase of Moon's apogee distance (m)
8,200,000; 8,220,000	7.349e20	1,000	1.54321e9	1 × 10	≥ 10 × 0.033
10,000,000; 11,000,000	2.940e21	1,000	1.54321e9	1 × 10	≥ 10 × 0.013
20,000,000; 22,000,000	7.349e21	1,000	1.54321e9	1 × 10	≥ 10 × 0.015
30,000,000; 33,000,000	1.470e22	1,000	1.54321e9	1 × 10	≥ 10 × 0.014
40000,000; 44,000,000	2.940e22	1,000	1.54321e9	1 × 10	≥ 10 × 0.011
50,000,000; 55,000,000	4.421e22	1,000	1.54321e9	1 × 10	≥ 10 × 0.010
60,000,000; 66,000,000	5.879e22	1,000	1.54321e9	1 × 10	≥ 10 × 0.0080
80,000,000; 88,000,000	6.614e22	1,000	1.54321e9	1 × 10	≥ 10 × 0.013
90,000,000; 99,000,000	7.349e22	1,000	1.54321e9	1 × 10	≥ 10 × 0.014
100,000,000; 110,000,000	7.349e22	1,000	1.54321e9	1 × 10	≥ 10 × 0.017
200,000,000; 210,000,000	7.349e22	1,000	1.54321e9	1 × 5	≥ 5 × 0.046
300,000,000; 310,000,000	7.349e22	1,000	1.54321e9	1 × 2	≥ 2 × 0.083
350,000,000; 360,000,000	7.349e22	1,000	1.54321e9	1 × 2	≥ 2 × 0.100
363,000,000; 380,000,000	7.349e22	1,000	1.54321e9	1 × 2	≥ 2 × 0.110

Similarly, Table 1 also shows some other data about the Moon's orbital variation corresponding to different scales of volcanic eruptions. According to such a calculation, the Moon could move a long distance away from the Earth in one billion years. But when the Moon was driven to an orbit much nearer to the Sun, the immense heat from the Sun could make the water vapor on the Moon be evaporated away, leaving a dry Moon. So it could no longer produce volcanic eruptions to drive itself away from the Earth. Now the drag of the Earth's gravitational force is the main force driving the Moon away from the earth.

2.3. The Advantages of the New Theory

The above theory established by reasoning can be well verified by modern artificial satellite launch experiments. It has many advantages over the existing explanations. It can answer many questions that the existing hypothesis couldn't explain.

For the question "why the Earth and the Moon have nearly identical isotopic composition?", the answer is because most of the moon came from the ejecta of the Earth, they have nearly identical isotopic composition, which conflicts with the impact event hypothesis.

For the question "why the Moon lacks iron?", the answer is during the formation of the Earth, the original Earth material had melted and differentiated, forming the different layers of the Earth: crust, mantle and core. Iron as heavier element had sunk into Earth's core, and the lighter elements had floated into the upper layers. Most of Moon's material were erupted from the crust or mantle of the Earth, hence the Moon lacks iron.

For the question "the previous hypotheses couldn't account for the high angular momentum of the Earth-Moon system", the answer is that with the growth of Earth's atmosphere, the speed of the Earth's rotation will become higher and higher; under the drag of the Earth's gravitational force, the Moon's revolution around the Earth is also speeding up, thus making the Moon gradually move away from the Earth. So there should be no special restriction on the angular momentum of the Earth-Moon system.

For the question "why some planets have satellites while some planets don't have satellites?", the answer is since the surface temperature of Mercury and Venus is very high, their water vapor had been evaporated away by sunshine, therefore they couldn't produce violent volcanic eruptions to form their moons. But the other planets have had abundant water or ice, and have produced many violent volcanic eruptions to form their moons.

Since the above theory shows that the Moon is actually generated by the Earth, it can be called "generation theory".

3. The Formation and Evolution of the Sun

Since the Sun revolves around the centre of the Milky Way Galaxy, it must have been a satellite produced by a mother star. It had unceasingly incorporated the nebula materials near the orbits to become larger and larger, and gradually moved away from its mother star, like the Moon.

When the satellite grew up into a planet like the Earth, it was large enough to absorb much vapor from the cosmic space to form an extended atmosphere and even large bodies of water-ice on the planet. When the planet moved counter-clockwise around its mother star, the planet's hemisphere near the mother star was exposed to the "sunlight" from the mother star, so the temperature of this hemisphere was generally higher than that of the other hemisphere, making more vapor evaporated from this hemisphere than from the others, even forming clouds impacting high mountains or massive storms blocking the planet's revolution. Hence, during the planet's revolution around its mother star, the planet's hemisphere near the mother star encountered more air resistance than the other hemisphere, causing the planet to rotate from west to east.

The rotation of the planet around its axis caused it to bulge around the Equator, making the planet become an oblate spheroid and polar water tend to flow to the equatorial region. Hence, the equatorial region suffered water erosion much earlier and more serious than other places, therefore this region had the earliest volcanic eruptions of the planet. During violent volcanic eruptions, some ejecta could obtain high enough speed to enter some orbits around the planet, forming layers of nebular around the planet. And under the drag of the gravitational force of the planet whose rotation was speeding up gradually, these nebular materials were gradually moved away from the planet, forming a giant nebular sprawling across light-years. As stated in the previous section, there were more prograde particles than retrograde particles in the same orbit around the planet. Hence, the prograde planetsimals could merge more prograde particles and bump less into retrograde particles, therefore easily grew up into satellites. As the planet grew up into a fixed star, some of its satellites grew up into planets. That is why the eight planets around the Sun are prograde planets. In addition, since the gravity is weaker in the equator region than in the polar regions, the debris erupted by the volcanoes in the equator region could easily obtain high enough speed to enter some orbits around the planet, therefore easily grew up into satellites. That is why the orbits of the eight planets lie almost in the same plane, and the angle between this plane and the solar equatorial plane is very small.

The growth of the Sun has gone through several phases: first the Sun was just a satellite with small volume and mass, then it became an Earth-sized planet far away from the center of the Milky Way Galax, afterwards it met a series of impacts from some other planets running into it from behind, making it become a Jupiter-sized planet much farther away from the center of the Milky Way Galax. When the Sun grew into a protostar much larger than Jupiter, the pressure and density of hydrogen in the center of the protostar became great enough for it to begin thermonuclear fusion. When the protostar had

violent volcanic eruptions or collided with another giant celestial body, it initiated the thermonuclear fusion on the protostar. Only when the Sun is massive enough to capture gas and dust near its orbit to maintain its thermonuclear fusion, can it become a main-sequence star constantly giving out light and heat.

Since the mass of the Sun accounts for about 99.86% of the total mass of the Solar System, it is massive enough to capture enough gas and dust from space within the Solar System to maintain its thermonuclear fusion during its movement along its orbit, thus becoming a constant star to give out light and heat. In fact, during the fusion process, hydrogen is fused into helium, and then helium is fused into carbon, oxygen and other heavier elements. During incomplete combustion, carbon is not completely oxidized, producing carbon monoxide. The combustion of oxygen also produced water vapor. When these gases escape into space, they usually form clouds over some planets. When a lightning is caused by clouds colliding, carbon monoxide reacts with water at high temperature, forming carbon dioxide and hydrogen ($CO + H_2O \rightarrow CO_2 + H_2$). Meanwhile, electrolysis of water also produces oxygen and hydrogen. Thus the space can provide hydrogen for the Sun's thermonuclear fusion in endless cycles. Hence the Sun is a constant object giving off light and heat.

4. The Formation and Evolution of the Planets and Comets

As mentioned above, the eight planets in Solar System originated from the satellites of the protostar (or giant planet) that formed the Sun later. During the growth of the eight planets, they unceasingly incorporated the nebula materials from the protostar or interstella matter near the orbits to become larger and larger, and gradually moved away from its mother star under the impact of moving objects or the driving of volcanic eruptions or the drag of the gravitational force of the protostar whose rotation was speeding up. For the same reason, batch after batch of volcanic ejecta or planetsimals were moved away from the protostar, forming a giant nebular which was light years across.

4.1. The Formation and Evolution of Mercury

Now Mercury is the closest planet to the Sun, its surface temperature is from -300 F to 800 F, so it has no real atmosphere or water. But the Messenger spacecraft has discovered evidence of past volcanic activity on Mercury. This means that Mercury was a satellite formed when the Sun was still a protostar, like Jupiter's Io The early orbit of Mercury was much closer to the protostar than it is now, so it revolved around the protostar much more quickly then than now. The high-speed revolution of Mercury caused immense heat accumulated inside it, making the original material of Mercury melted and differentiated, forming the different layers of Mercury: crust, mantle and nucleus. Since Mercury has suffered less erosion by water than other planets, it has higher content of metal than other planets.

On the other hand, since the early orbit of Mercury was very close to the protostar, it had absorbed much water vapor from the protostar's atmosphere to form vast bodies of water-ice. Due to the constant erosion of water, a series of volcanic eruptions occurred on Mercury. Violent eruptions could change the orbit of Mercury around the protostar. In addition, the drag of the gravitational force of the protostar whose rotation was gradually speeding up could also make Mercury move away from the protostar. When it was driven to the current orbit, the protostar became a main-sequence star. The immense heat from the Sun could make the water vapor on the Mercury be evaporated away, leaving dry Mercury. So it couldn't produce violent volcanic eruptions to form its moon.

Since the atmosphere of Mercury is very thin, the temperature difference between day and night almost has no effect on the density of Mercury's atmosphere. Hence, unlike other planet or protostar, Mercury was almost synchronously tidally locked with the Sun, though the planet has a 3 : 2 spin-orbit resonance.

4.2. The Formation and Evolution of Venus

Venus is the second-closest planet to the Sun, but it is the hottest planet in the Solar System because Venus' atmosphere is thick with greenhouse gases, trapping and retaining a lot of the Sun's heat. Because the scorching heat would cause any to boil away, there is no liquid water on its surface, making the surface of Venus extremely dry. But spacecraft discovered evidence of many past volcanic activities on Venus. So like Mercury, Venus must have been a satellite formed when the Sun was still a protostar, like Jupiter's IO, and its early orbit was much closer to the protostar than it is now, therefore Venus had absorbed much water vapor from the protostar's atmosphere to form vast bodies of water-ice. Many violent volcanic eruptions could change the orbit of Venus around the protostar. The drag of the gravitational force of the protostar whose rotation was gradually speeding up could also make Mercury move away from the protostar. But after the protostar became a main-sequence star, the immense heat produced by the Sun had made the water vapor on the Venus be evaporated away, leaving dry Venus. Hence, it couldn't produce violent volcanic eruption to form a moon.

In addition, Venus's rotation is an exception. Because the surface temperature of Venus is very high, water vapor on Venus had been evaporated away early, therefore cannot affect the density of Venus' atmosphere. This means that the atmosphere density of Venus's hemisphere near the Sun is almost equal to that of the other hemisphere, but due to the difference of temperatures above the atmosphere, the atmosphere density of Venus's hemisphere near the Sun is slightly lower than that of the other hemisphere, making Venus rotate from east to west.

4.3. The Formation and Evolution of the Earth

Like Mercury and Venus, the Earth was also a satellite formed when the Sun was still a protostar, but it's formed much earlier than Mercury and Venus. With the continuous

increase in the mass and volume of the Earth, the heat inside the Earth accumulated continuously. Especially, the high-speed revolution around the protostar caused immense heat accumulated inside the Earth, making the original material of Earth melted and differentiated, forming the different layers of the Earth: crust, mantle and nucleus.

On the other hand, with the increase in the mass of the Earth, it has absorbed more and more vapor from space to form many water-ice regions. Due to the constant erosion of water, volcanic eruptions frequently occurred on the Earth, and the Moon was formed from the ejecta of the Earth. Violent eruptions could also change the orbit of the Earth around the protostar. In addition, under the drag of the gravitational force of the protostar whose rotation was gradually speeding up, the Earth gradually moved away from its mother star until it was driven near the current orbit. Then the protostar became a main-sequence star, and the Earth became a massive planet with its own large hydrosphere and extended atmosphere. When the Earth moved counter-clockwise around the Sun, the Earth's hemisphere near the Sun was exposed to the sunlight, so the temperature of this hemisphere was generally higher than that of the other hemisphere, making more vapor evaporated from this hemisphere than from the other hemisphere, even forming clouds impacting high mountains or massive storms blocking Earth's revolution. Hence, during Earth's revolution around the Sun, the Earth's hemisphere near the Sun encounters more air resistance than the other hemisphere, causing the Earth to rotate from west to east. This theory can also be used to explain the rotations of Jupiter, Saturn and Uranus.

4.4. The Formation and Evolution of Mars

Like the Earth, Mars was also a satellite formed when the Sun was still a protostar, but it's formed much earlier than the Earth. Mars has undergone a process like the formation and evolution of the Earth. It's the impact of floating objects or the driving of volcanic eruptions or the drag of the gravitational force of the protostar whose rotation was speeding up that made Mars move away from the protostar. Since Mars is much lighter than the Earth, it's easy to move Mars away from the protostar, and it has absorbed much less water vapor than the Earth, making it become a desert planet. With the accumulation of Mars mass, it will absorb more and more vapor to become a planet of water or ice, like the Earth or Jupiter.

Since Mars has much water-ice and an atmosphere, like the Earth, under the effect of sunlight, Mars rotates from west to east.

4.5. The Formation and Evolution of Jupiter, Saturn, Uranus and Neptune

Like Mars, Jupiter, Saturn, Neptune and Uranus were also satellites formed when the Sun was still a protostar, but they were formed much earlier than Mars. They have undergone a process like the formation and evolution of Mars. It's the impact of moving objects or the driving of volcanic eruptions or the drag of the gravitational force of the protostar whose rotation was speeding up that made them move away from the protostar, and farther away from the protostar than Mars.

When Jupiter was driven to an orbit near the current orbit, it had become a planet whose mass was larger than any other planets in the Solar System, so its orbit variation was slower than other planets. When a lighter planet from an inside orbit caught Jupiter, a violent collision would occur then. Such a collision would make part debris of the lighter planet draw back into some smaller inside orbits due to the decrease of their orbit speed, becoming planetsimals in asteroid belts, while large parts of the debris were gathered onto Jupiter, greatly increasing the mass of Jupiter and extending Jupiter's orbit due to the increase of its orbit speed. It's probable that Jupiter has absorbed multiple planets to become such a large planet. In addition, Jupiter is a liquid planet, and has a thick and dense atmosphere, and sunlight has a great effect on the atmosphere of Jupiter, hence not only Jupiter rotates from west to east but also rotates very fast.

Since Saturn has a larger equatorial radius and a lower density, it's easy to produce volcanic eruptions at the equatorial region to form a prominent ring system, composed mostly of ice particles with a smaller amount of rocky debris and dust. Saturn also rotates very fast from west to east.

Since the surface temperature of Uranus ranges from 49 k (-224.15 °C) to 57 k (-216.15 °C), the water-ice on Uranus cannot be evaporated by the Sun, i.e., the sunshine cannot affect the density of troposphere of Uranus. Hence, unlike the Earth, Mars, Jupiter, and so on, the sunshine cannot make Uranus rotate from west to east. On the contrary, sunshine can only cause the density of the stratosphere and thermosphere facing the Sun become lower, making Uranus rotate from east to west. In the long process of Uranus moving away from the protostar, it has produced both many volcanic eruptions whose eruption directions coincide with the direction of the Uranus's rotation and many volcanic eruptions whose eruption directions contradict with the direction of the Uranus's rotation, therefore forming both many prograde planetsimals and many retrograde planetsimals. Hence, Uranus has some prograde satellites and some retrograde satellites.

Neptune has also some prograde satellites and a retrograde satellite, which is Triton.

Since these planets had erupted more matter than Mars to form their satellites, each of them has only a small rocky or metallic core. But their mass are much greater than that of Mars, so they can attract more gas to become gas giants composed largely of hydrogen and helium.

4.6. The Formation and Evolution of Asteroid Belt

Under the drag of the gravitational force of the protostar that formed the Sun later, batch after batch of the protostar's ejecta or planetsimals were moved away from the protostar and sent to the space between Mars and Jupiter, gradually merging into many asteroids. In addition, there were probably some planets in some orbits between Mars and Jupiter. During their orbital

variation, some planet's orbits intersected with each other, causing great impacts, such as the impacts between some planets and Jupiter. Part of the debris from these impacts entered some orbits between Mars and Jupiter, which gradually merged into many asteroids, forming the Asteroid Belt [11].

4.7. The Formation of Comets

Comets are small Solar System bodies produced by the collisions of some outer planets. Originally, some comets moved around the Sun in an orbit beyond Pluto. When a comet runs into another comet from behind, the revolution speed of the comet at the back would decrease greatly, probably making the comet enter an orbit with decreased perihelion distance, even enter the inner Solar System. Its proximity to the Sun causes its icy surface to sublimate and ionise, creating a coma: a long tail of gas and dust often visible to the naked eye. When a comet passes the Earth, the Earth would absorb much water vapor from the comet.

5. The Structure of Cosmic Galaxies

According to the Solar System's formation law described above: a protostar can produce several planets around it, and each planet can also produce several satellites around the planet; a fix star might have its own mother-star; after growing into a planet, a satellite can also produce its next generation of satellites. Hence, we can conclude that the basic structure of a galaxy is a hierarchical structure composed of many generations of stars, like a tree, and the entire universe contains many such galaxies, like an endless forest.

6. The Expansion of the Universe

In 1929, American astronomer Hubble first discovered the larger phenomenon that the distance between stars was increasing, and put forward the theory of the expansion of the universe. This discovery led directly to birth of "The Big Bang Theory", which proposes that the universe was once extremely compact, dense, and hot. Some original event, a cosmic explosion called the big bang, occurred about 13.7 billion years ago, and the universe has since been expanding and cooling. Obviously, it hasn't given out the reasonable cause or result of the cosmic explosion. Since then, the astrophysics community has believed that the universe is in a constant rate of expansion until Saul Permutter, Brian Paul Schmit and Adam Guy Riees discovered the accelerating expansion of the universe through observation of several dozen distant supernovaes in 1998, who then won the Nobel Prize in Physics 2011 [12]. But human still can't completely explain the phenomenon that the universe is expanding at an ever-accelerating rate.

If the formation theory of the Solar System propounded by the author is applied to explain this phenomenon, the validity of the accelerating expansion of the universe can be proved. Because any galaxy in the universe is a hierarchical structure composed of many generations of stars, and any generation of star have unceasingly incorporated the nebula materials near the orbits to become larger and larger, and gradually move away from their parent stars under the impact of moving objects or the driving of volcanic eruptions or the drag of the gravitational force of their parent star whose rotation is gradually speeding up, meanwhile becoming cooling due to the decrease of "sunlight" from their parent stars. Before this theory, the acceleration was thought to be driven by dark energy, but what that dark energy is remains an enigma—the three winners of Nobel Prize are not sure. According to the author's theory, for the same star, even if it moves in different orbits, two volcanic eruptions of the same scale would generate the same increase in orbital speed; but in different orbits, the same increase in orbital speed will generate different orbit variations, i.e., the farther the star is from its parent star, the bigger the orbit variation is. In addition, for the same child star, under the drag of the gravitational force of its parent star, the same increase in parent star's rotation speed will cause different revolution speed variations of the same child star in different orbits, i.e., the farther the child star is from its parent star, the bigger the revolution speed variation is and therefore the bigger the orbit variation is, thus causing the phenomenon—the accelerating expansion of the universe.

7. Conclusion

In view of that the existing hypotheses for the Solar System formation have many problems with them, the author studied the origin of the Solar System again, and first revealed the formation mechanism of the Moon. According to the formation mechanism of the Moon and the Earth, the author further revealed the formation and evolution mechanism of the Solar System, including the formation and evolution of eight planets, asteroid belt, and comets. The author has also explained why the eight planets around the Sun are prograde planets, why the orbits of the eight planets almost lie in the same plane, and why some planets rotates around its axis from west to east while some planets rotates from east to west. Moreover, using this theory, the author could also explain the expansion of the universe as well as the cause of global climate change. Hence, the new theory is really a natural and scientific theory about the formation and evolution of the Solar System and other galaxies in the universe.

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