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Rotating axial tilt of planet derived from precession of the planet

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Mass of the San (M) is 99.86% of the total mass of the solar system. Most of the interstellar medium is taken up by the Sun. 0.14% of the mass of solar system rotating in the heliocentric gravity according to Kepler's third law $(r^3/T^2) = G(M+m)/4\pi^2$, here m is mass of an orbiting substance.

A giant impact is difficult for the planets to maintain a circular orbit after the collision.

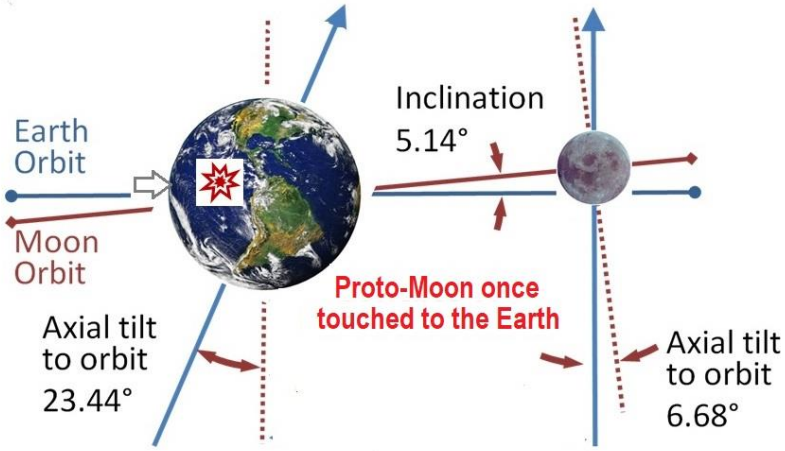

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Fig.1 A model that the Moon lightly touched the Earth and the Earth's axis of rotation began precession.

Following points are discussed in connection with the theory that the Moon lightly touched the Earth and the Earth's axis of rotation began precession.

1) When cosmic dust came into slow contact in an orbital, the small solids adhered each other by a point bond due to short-range force. Local chemical interactions formed a lump.
2) The energy of the rotation motion and the gravitational potential are in equilibrium from Virial theory. When an orbiting material shifts to a state where the center of gravity is high, the rotation speed increases. The momentum of orbiting matter is added to the planet when it falls, so the rotation speed of the planet is accelerated.
3) Uranus is an icy planet with fast rotation speed and slow orbiting speed. So, a precession of rotation axis of Uranus shifted the rotation axis to the direction of the Sun. So, Uranus' rotation turned sideways.

Proposal of a formation model of solar system

Water does not collect from the cosmic space in the area of current terrestrial planets because solid of water sublimates into molecules of steam. Water collected in comets as ice seldom reach the Earth. The sea water of the Earth must have been taken in as ice before the appearance of snow lines. The proposing model is shown in Fig.2

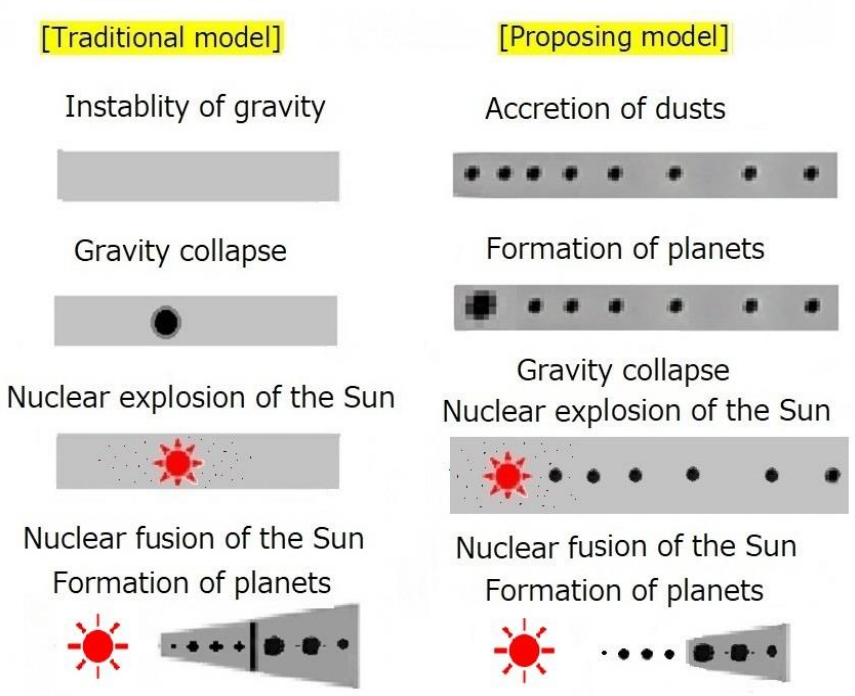

Fig.2 Traditional and new models of solar system formation

Primordial planets must had grown in the environment before the Sun began nuclear fusion.

Lump of dusts grows in a cold environment over time. The lump was not formed by the gravitational force, but to the local Coulomb force that is more than 10^{30} times stronger. It has a structure with many gaps, but as it grows, the inside becomes high temperature and pressure due to gravitational energy, and the internal structure is reorganized by chemical reaction.

When the center of gravity of a satellite moves closer to the central planet under the influence of the gravity of the central planet, anisotropy occurs in the gravitational coupling with the host planet, and the rotation period of the satellite is synchronized with the orbital period.

Objects that have grown considerably cannot easily escape from their orbit, which is in equilibrium. 4.6 billion years ago, a fusion explosion of the primordial sun ejected a large amount of material from the Sun.

At that time, we proposed a scenario that the orbital motion of the Moon, which had grown in the Earth's geostationary orbit, was disturbed and touched the Earth.

Why does the planet's rotation period shorten as the mass of the planet increases?

—When space dust comes into quiet contact, it is chemically bonded at the contacts by a close-range force such as Coulomb force.—

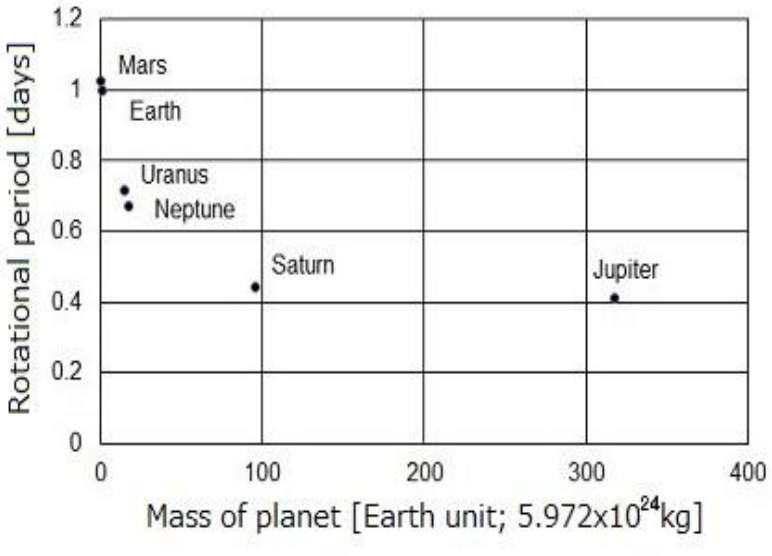

Fig.3 Characteristics of shortening rotational period as the mass of a planet increases

As shown in Fig.3, the rotation period of a planet with a large mass is shorter.

The orbiting speed of planet is almost fixed by the orbit with the mass (M) of the Sun. It means that the rotating materials large and small is the same rotational speed. Therefore, when it comes into quiet contact, it adheres to the contact point due to the force of van der Waals, etc., and the lump becomes larger.

When the lump approaches the center of gravity, it shifts to an orbit with increased kinetic energy and increases its orbital speed. The kinetic momentum of matter falling at that high speed accelerates the rotation speed of the planet.

In the case of satellites, when they are born and grow in the geostationary orbit of the host planet, the center of mass shifts to the planetary side, causing anisotropy in the gravitational coupling. When the rotation speed of the mother planet increases, the orbital speed of the satellite is accelerated by anisotropic gravitational coupling, and it moves away from the mother planet due to an increase in centrifugal force.

Precession of the Earth's rotation axis caused by a light contact accident of the Moon with the Earth

The current axis of rotation of the Earth is tilted by 23.4°, and its inclination is in precession for 26,000 periods. It has been considered that the precession of the Earth is like a spinning top, but the precession of the Earth's rotation axis has no fulcrum. The Earth does not have the effect of shifting the center of gravity.

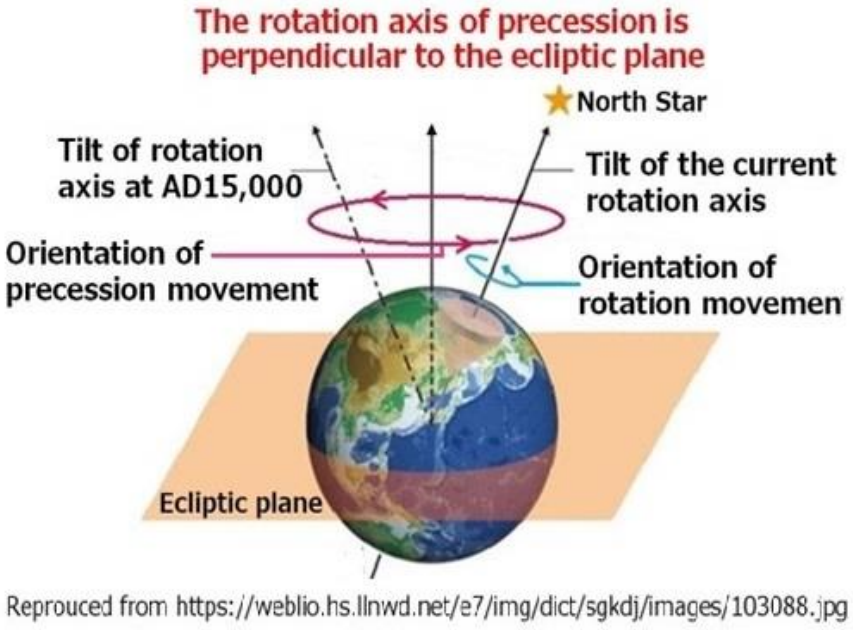

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Fig.4 Precession of the Earth's rotation axis maintained by the gyroscopic effect

If the Earth's center of gravity is biased toward the Sun due to the Sun's gravity, precession will occur around the direction of the Sun. The precession of the Earth's rotation axis is perpendicular to the Sun's equatorial plane, and the direction of the Earth's precession axis of rotation is different from the direction of the gravity.

In a large collision such as “the Giant Impact”, the impact is too great to explain the precession of the actual Earth's rotation axis or the inclination of the Moon's orbit.

The gyroscopic effect of a high-speed rotating object is related to precession because its rotation state is maintained stably. Therefore, the theory that the Earth's rotation axis began to precession due to the contact of the Moon shown in Fig.1 was proposed.

Why the axis of rotation of Uranus fell sideways

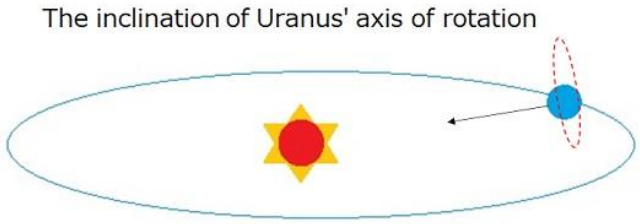


Fig. 5 Precession of Uranus' axis of rotation toward the Sun

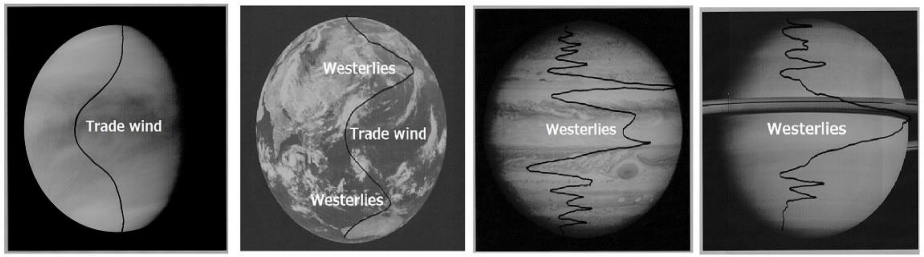
The orbital period of Uranus is 84 Earth years. On the other hand, the rotation period is 17.24 hours.

Inside of the ice planet Uranus is a thick layer of liquid water in the middle. So, the distribution of temperature by longitude is averaged by high-speed rotation, but the tilt of the rotation axis causes a north-south temperature difference, and a north-south difference occurs in liquid water the intermediate layer.

When the center of gravity shifted in the north-south direction, a precession with which axial orients towards the Sun occurred.

Although the energy of the rotational motion of precession and the gravitational potential are equal in equilibrium, gradually the position of the center of gravity of precession shifts to a state where the position of the center of gravity is lower, and the direction of the rotation axis of precession is directed toward the Sun.

Why the axis of rotation of Venus was reversed

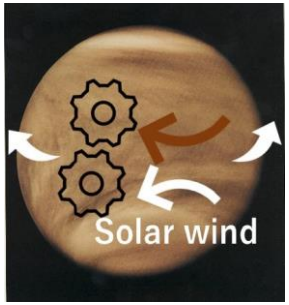


Venus Earth Jupiter Saturn

Fig.6 Atmosphere near equator of a planet are rotated by solar wind in clockwise direction.

Since the Sun rotates counterclockwise, the solar wind has a rotating component with a speed of about 500 km per second, and directly collides with the atmosphere near the planet's equator to drive the trade winds.

Fig.6. shows the flow of atmosphere on the planets where the solar wind is driving clockwise. The amount of solar wind on planets that strikes near the planet's equator decreases away from the Sun as shown in Fig.6.



Venus' atmosphere is thick, as much as about 90 atmospheres. The atmosphere near the equator of Venus, facing the Sun, is directly hit by the solar wind. Counterclockwise directional flow of the solar wind drives Venus' atmosphere in the clockwise direction, and a super rotation occurs that circles Venus in the clockwise direction in four days.

Assuming that the total amount of H^+ emitted by the Sun today is 10^9 kg/s, the amount reaching Venus is estimated from the ratio on the surface area of the sphere in the orbit to the cross-sectional area of the planet. The result is 0.782 kg/s.

As shown in Fig.7, the solar wind has a component that passes through the left and right sides of Venus and a counterclockwise rotation direction on the night side. The momentum of the counterclockwise rotation direction that hits directly changes the direction of clockwise rotation via the Venus' atmosphere to its rotation.

Fig.7 How the solar wind drives Venus' atmosphere

Conclusions

Cosmic dusts come into quiet contact in an orbit of heliocentric gravity in the early stages of planet formation. Lumps were formed at the point of contact by intermolecular bonds.

Asteroids are not spherical in shape. It have many voids, and the center of mass is shifted toward the center of gravity. Then, satellite's rotation and revolution are synchronized.

Planet's rotation and tilt of the axis of rotation exist even though the heliocentric gravity does not shift. Those were changed by experiences.

In Uranus, due to fast rotation and slow revolution, the thick liquid water layer inside differs from north to south, causing precession, and over time, the axis of rotation of precession became the direction of the Sun.

On Venus, the solar wind drives the atmosphere in the direction of clockwise rotation, and the direction of rotation is changed to clockwise direction over time.

We concluded that the precession of the Earth's axis of rotation is perpendicular to the ecliptic plane, and that the Earth's precession was caused by a single contact with the Moon in light contact.

References

[1] Karasawa S. (2023),*"Formation of Terrestrial Planets from the Viewpoints of Astrophysics and Material Science* – Formation of Planetesimals by Chemical Reactions at Contact Points between Solids-", Geology Earth Marine Science, Volume 5(2): 1-6, **DOI: 10.31038/GEMS.2023522**

[2] Video presentation, "Why is the Earth's rotation axis tilted?"
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