Theory of periodical bursts of the Sun and the planets

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ABSTRACT: Raise the theory of periodical bursts of the Sun and the planets. Point out that the Jovian planets, main-belt asteroids, and the terrestrial planets originated from periodical bursts of the Sun from 4.8 billion to 4.4 billion years ago. A large amount of objects from the last burst of the Sun caused the Late Heavy Bombardment. Point out that planets also burst periodically and their bursts gave birth to their regular satellites, and the rings of Jovian planets. Many facts of the solar system were systematically explained with the theory.

Keywords:
Origin, solar system; Terrestrial planets; Jovian planets; Meteorites

I. Introduction

Three major theories about how the planets formed have been proposed: the ejection theory, the capture theory, and the nebula theory. Modern nebula theory is widely accepted. It stated that the Sun and planets formed from the same dense cloud of interstellar dust and gas. Because some calcium and aluminium-rich inclusions (CAIs) in some chondrites are found to be the oldest known solids in the solar system, dating from around 4.568 million years ago, this date is often used to define the start of the solar system. Planets and asteroids are thought to be formed at the same time or millions of years' later.

But, "the work of scientists Alex Halliday and D-C. Lee on the short-lived isotope hafnium-187 has been used to infer that the planet Mars formed relative quickly -- within a few tens of millions of years of the start of the solar system -- because isotopic studies show that Martian rocks contained this isotope when the planet formed. In contrast, the Earth formed much later when all the hafnium-187 had already decayed away." (Smith C. et al., 2009) Much later but how much later? Modern nebula theory cannot give a systematic and satisfactory answer to this and many other facts of the solar system, such as the relations existing among the revolution periods of the planets, and the similarity and dissimilarity of their angular speeds of rotation. For convenience, Ceres, the largest asteroid, was considered as a planet in this paper, and it represents other main-belt asteroids.

This paper tries to give a systematic answer to many facts of the solar system with the theory of periodical bursts of the Sun and the planets. All planets were formed from protoplanets which burst from the Sun 4.8 to 4.4 billion years ago, with velocities a little greater than the circular velocity (436.9 km/s) at the surface of the Sun and the corresponding revolution period T_0 (0.0003179 years). The protoplanets were little suns with a surface temperature about 6400 K, the present temperature of the photosphere of the Sun. First, in tens of millions of years, the protoplanets of Ceres and other main-belt asteroids cooled down and solidified. The smaller protoplanets of asteroids solidified relatively fast and without differentiation, and parts of them became chondrites and primitive achondrites found on Earth. The larger protoplanets of asteroids solidified relatively slowly and with differentiation, and became the differentiated meteorites found on Earth, such as the iron meteorites from the cores of the asteroids, the stony-iron meteorites from the mantles of the asteroids , and the differentiated achondrites from the crusts or upper mantles of the asteroids. For example, the differentiated HED achondrites came from 4 Vesta, the second largest asteroid.

2. Periodical bursts of the Sun and origins of the planets

Then, in billions of years, the protoplanets of terrestrial planets cooled down and solidified, at least at the surface. Before solidification, Mars burst twice and gave birth to its two satellites, and Earth burst once and gave birth to its only satellite, the Moon. Before its burst, it took Earth more than 50 million years to differentiate and form its core and mantle, and then give birth to the Moon (Meijer de R.J. et al., 2013).

The Moon formed about 4.44 billions years ago (Halliday A. N., 2014). Earth formed more than 50 million years earlier from the burst of the Sun, about 4.5 billions years ago. It usually took several million years for the condrules to solidify after the solidification of the CAIs (Hou W. et al., 2003), so it took more than 30 million years for the smallest protoplanets of asteroids to cool down from its birth from the Sun and solidify. The burst of the protoplanets of asteroids can be estimated to happen about 4.6 billions years ago. So the period of the bursts of the Sun is estimated to be 0.5 billions years. The estimated moments of origin of planets from the bursts of the Sun are listed in the last column of Table 1.

Table 1：Revolution Periods, Their Relation, Rotation Periods (Spohn T. et al., 2014), Angular Speeds of Rotation of Planets, and Estimated Moments of their Origin from Burst of the Sun

Sequence number n and Name of Planets	Revolution Period T_n (years)	Relation of Revolution Periods T_n/T_{n-1}	Rotation Period (days or hours)	Angular Speed of Rotation ω'_n (10^{-6}/s)	Estimated Moment of Origin from Burst of the Sun (billion years ago)
n=0,Protoplanet	0.0003179				
n=1,Mercury	0.2408	757.5	58.646 d.	1.2434	4.4
n=2,Venus	0.6152	2.555	243.020 d.	0.30006	4.45
n=3,Earth	1.0000	1.625	23.935 h.	72.920	4.5
n=4,Mars	1.8808	1.8808	24.622 h.	70.885	4.55
n=5,Ceres	4.601	2.446	9.075 h.	192.3	4.6
n=6,Jupiter	11.862	2.578	9.925 h.	175.6	4.65
n=7,Saturn	29.457	2.4833	10.656 h.	163.79	4.7
n=8,Uranus	84.011	2.8520	17.24 h.	101.2	4.75
n=9,Nepture	164.79	1.9615	16.1 h.	108.3	4.8

As shown in the second and third columns of Table 1, there is a relation of revolution periods: $1.6<T_n/T_{n-1}<2.9$ for n>1, and $T_1/T_0=757.52$. The planets slowed down from velocities a little greater than the circular velocity (436.9 km/s) at the surface of the Sun to present velocities, and the corresponding revolution period increased from T_0 (0.0003179 years) to present T_n (n>0) because of the strong solar wind near the Sun more than 4 billions years ago, which was 10 million times stronger (Zhao J.-N., 2006) than it is now at the orbit of Earth, 1 AU from the Sun. The strong solar wind pushed the planets away from the Sun and caused them to accumulate a speed away from the Sun, while the medium in the solar wind slowed down their revolution around the Sun. On average, Earth was 33 meters farther from the Sun every year, from the original distance of 6.95500×10^5 km 4.5 billion years ago to the present distance of 1.4959787066×10^8 km. And its velocity was 9×10^{-5} m/s slower every year, from the original velocity of 436.9 km/s 4.5 billion years ago to the present velocity of 29.7857 km/s.

As shown in the fourth and fifth columns of Table 1, Mercury and Venus have similiar angular speed of rotation, about 1×10^{-6}/s. Mercury is smaller than Venus, so it cooled down and solidified earlier than Venus. Earth and Mars have similiar angular speed of rotation, about 70×10^{-6}/s. Mars is smaller than Earth, so it cooled down and solidified earlier than Earth. Ceres, Jupiter and Saturn have similiar angular speed of rotation, about 180×10^{-6}/s. Ceres is much smaller than Jupiter and Saturn, so it cooled down and solidified much earlier than Jupiter and Saturn. Uranus and Nepture have similiar angular speed of rotation, about 100×10^{-6}/s. The jovian planets are much larger than the terrestrial planets, so they have not solidified until now. In fact, Jupiter is still a little sun, with "temperatures higher than current models can explain" and "hot enough to vaporize metal and rock", such as the Galileo probe, which "is now a part of Jupiter's atmosphere"(West R. A., 2006). The angular speeds of rotation show the violent degree of the bursts of the Sun, first high (for Nepture and Uranus), then highest (for Saturn, Jupiter, and Ceres), and then low (for Mars and Earth) ,and at last lowest (for Venus and Mercury).

The last burst of the Sun 4.35 billion years ago produced a large amount of objects. When these objects reached the terrestrial planets and the Moon, they caused the Late Heavy Bombardment.

3. Periodical bursts of planets and origins of their satellites and rings

Mars burst twice and Earth burst once, as mentioned above. The relations of revolution periods of their satellites are listed in Table 2, and those of the regular satellites of the jovian planets are listed in Table 3 and 4. The jovian planets are much larger than Mars and Earth, and they burst more times than Mars and Earth. Their bursts gave birth to their regular satellites and their rings. All regular satellites were formed from protosatellites which burst from planets, with velocities a little greater than the circular velocities (7.913 km/s for Earth as an example) at the surface of the planets and the corresponding revolution periods T_0 (0.05877 days for Earth as an example). The bursts of the planets are not as violent as those of the Sun, so regular satellites born from the bursts of a planet are in the state of synchronous rotation, keeping the same hemisphere toward the planet.

The protoplanetal wind pushed the satellites away from the planet and caused them to accumulate a speed away from the planet, while the medium in the protoplanetal wind slowed down their revolution around the protoplanet. On average, the Moon was 8.5 cm farther from Earth every year, from the original distance of 6378 km 4.44 billion years ago to the present distance of 384.40×10^3 km. Currently, the Moon "recede from Earth at 3.79 cm/year" (Hiesinger H. et al., 2014). And its velocity was 1.55×10^{-6}m/s slower every year, from the original velocity of 7.913 km/s 4.44 billion years ago to the present velocity of 1.0259 km/s.

Table2：Revolution Periods (Spohn T. et al., 2014) and Their Relation of the Satellites of Earth and Mars

Sequence number n and Name of Satellite of Earth	Revolution Period T_n (days)	Relation of Revolution Periods T_n/T_{n-1}	Sequence number n and Name of Satellites of Mars	Revolution Period T_n (days)	Relation of Revolution Periods T_n/T_{n-1}
n=0,Protosatellite	0.05877		n=0,Protosatellite	0.0696	
n=1,Moon	27.322	464.9	n=1,Phobos	0.319	4.58
			n=2,Deimos	1.262	3.96

As it is shown in the relation of revolution periods in Table 3 and Table 4, the periodicity of the bursts, of Jupiter from n=3 to n=6, of Saturn from n=1 to n=11, of Uranus from n=1 to n=11, and of Neptune from n=3 to n=5, is very clear. It is the result of the steady bursts of the planets. Before and after the steady bursts, the periodicity is not so clear and the bursts of the planets may not be so steady.

Table 3：Revolution Periods (Spohn T. et al., 2014) and Their Relation of the Satellites of Jupiter and Neptune

Sequence number n and Name of Satellites of Jupiter	Revolution Period T_n (days)	Relation of Revolution Periods T_n/T_{n-1}	Sequence number n and Name of Satellites of Neptune	Revolution Period T_n (days)	Relation of Revolution Periods T_n/T_{n-1}
n=0,Protosatellite	0.1238		n=0,Protosatellite	0.109	
n=1,J15 Adrastea (J16 Metis)	0.295 (0.298)	2.383 (2.407)	n=1,N3 Naiad	0.294	2.70
n=2,J5 Amalthea	0.498	1.688 (1.671)	n=2,N4 Thalassa	0.311	1.06
n=3,J14 Thebe	0.675	1.355	n=3,N5 Despina	0.335	1.08
n=4,J1 Io	1.769	2.621	n=4,N6 Galatea	0.429	1.28
n=5,J2 Europa	3.551	2.007	n=5,N7 Larissa	0.555	1.29
n=6,J3 Ganymede	7.155	2.015	n=5,S/2004 N1	0.950	1.71
n=7,J4 Callisto	16.69	2.333	n=6,N8 Proteus	1.122	1.18

Table 4：Revolution Periods (Spohn T. et al., 2014) and Their Relation of the Satellites of Saturn and Uranus

Sequence number n and Name of Satellites of Saturn	Revolution Period T_n (days)	Relation of Revolution Periods T_n/T_{n-1}	Sequence number n and Name of Satellites of Uranus	Revolution Period T_n (days)	Relation of Revolution Periods T_n/T_{n-1}
n=0, Protosatellite	0.1751		n=0, Protosatellite	0.1238	
n=1,S18 Pan	0.575	3.28	n=1,U6 Cordelia	0.335	2.71
n=2,S35 Daphnis	0.597	1.04	n=2,U7 Ophelia	0.376	1.12
n=3,S15 Atlas	0.602	1.01	n=3,U8 Bianca	0.435	1.16

n=4,S16Prometheus	0.613	1.02	n=4,U9 Cressida	0.464	1.07
n=5,S17 Pandora	0.629	1.03	n=5,U10 Desdemona	0.474	1.02
n=6,S11 Epimetheus (S10 Janus)	0.694 (0.70)	1.10 (1.11)	n=6,U11 Juliet	0.493	1.04
n=7,S53 Aegaeon	0.808	1.16 (1.15)	n=7,U12 Portia	0.513	1.04
n=8,S1 Mimas	0.942	1.17	n=8,U13 Rosalind	0.558	1.09
n=9,S32 Methone	1.01	1.07	n=9,U27 Cupid	0.613	1.10
n=10,S49 Anthe	1.04	1.03	n=10,U14 Belinda	0.624	1.02
n=11,S33 Pallene	1.14	1.10	n=11,U25 Perdita	0.638	1.02
n=12,S2 Enceladus	1.37	1.20	n=12,U15 Puck	0.762	1.19
n=13,S3 Tethys (S13 Telesto, S14 Calypso)	1.89 (the same, the same)	1.38	n=13,U26 Mab	0.923	1.21
n=14,S4 Dione (S12 Helene, S34 Polydeuces)	2.74 (the same, the same)	1.45	n=14,U5 Miranda	1.410	1.53
n=15,S5 Rhea	4.518	1.65	n=15,U1 Ariel	2.520	1.787
n=16,S6 Titan	15.95	3.530	n=16,U2 Umbriel	4.140	1.643
n=17,S7 Hyperion	21.28	1.334	n=17,U3 Titania	8.710	2.104
n=18,S8 Iapetus	79.33	3.728	n=18,U4 Oberon	13.46	1.545

4. Conclusions

"Unfortunately, we currently lack a self-consistent model for the origin of the solar system and other planetary systems." (Chambers J. E. et al., 2014) And "no satisfactory explanation has ever been proposed" (Lewis J. S. ,2004) for the Titius-Bode Law. This paper tried to provide such a self-consistent model for the origin of the solar system and other planetary systems and give a satisfactory explanation for the Titius-Bode Law and many facts of the solar system. The estimated moments of origin of planets from the bursts of the Sun in Table 1 may not be accurate, and the moments of origin of regular satellites from the bursts of the planets are not given, because we still lack samples from planets and satellites, except those from Mars, asteroids and the Moon. With the explorations of the solar system in the future, more samples will give us the exact ages of the planets and satellites, and the exact moments of origin of planets and satellites. Then the theory of periodical bursts of the Sun and the planets will become mature from its birth at this moment.

References

Chambers J. E., Halliday A. N., 2014. The Origin of the Solar System, in Spohn T., Breuer D., Johnson T. V. (Eds), Encyclopedia of the Solar System (3rd Edition), p. 29

Halliday A. N., 2014. The Origin and Earliest History of the Earth, in Holland H., Turekian K. (Eds), Treatise on Geochemistry (2nd Edition,Volume 2), pp. 149-211

Hiesinger H., Jaumann R., 2014. The Moon, in Spohn T., Breuer D., Johnson T. V. (Eds), Encyclopedia of the Solar System (3rd Edition), p.495
Hou W. , Xie H.-S., 2003. Causes of Formation of Meteorites and Origin of the Earth, p.166
Lewis J. S. ,2004. Physics and Chemistry of the Solar System(2nd Edition), p.56
Meijer de R.J., Anisichkin V.F., van Westrenen W.,2013. Forming the Moon from terrestrial silicate-rich material.Chemical Geology 345, pp. 40-49. doi:10.1016/j.chemgeo.2012.12.015
Smith C., Russell S., Benedix G., 2009. Meteorites, pp. 49-61
Spohn T., Breuer D., Johnson T. V., 2014. Encyclopedia of the Solar System (3rd Edition), pp.1235-1236,1236-1243
West R. A., 2006. Atmospheres of the Giant Planets, in McFadden L.A, Weissman P.R., Johnson T. V. (Eds), Encyclopedia of the Solar System (2rd Edition), p.383
Zhao. J.-N. 2006. New Concepts of the Universe(2nd Version), p.108