ANGULAR MOMENTUM IN THE SOLAR SYSTEM

The Bible teaches that the solar system, along with the rest of the universe, was created from nothing by the spoken word of God several thousand years ago.[1] In the biblical creation account, Genesis 1:16 mentions that God "made the stars also." **The planets of the solar system are included in the word "star" as the "wandering stars" known to the ancients.** Indeed, the modern word "planet" is from the Greek for "wanderer." The earth, of course, was created on the first day of the Creation Week as recorded in Genesis 1:1.

Incidentally, non-creationists have acknowledged that the 7-day week has no basis in astronomy and is most straightforwardly understood as the commemoration of the Creation Week established by God Himself.[2] Other non-creationists have gone on record with the observation that **all major civilizations (other than ours) believed in a beginning around 4000 BC.**[3]

On the other hand, the modern evolutionary paradigm teaches that the universe began about 14 billion years ago as a result of a gigantic explosion called the Big Bang. About 10 billion years ago the debris from the Big bang coalesced into galaxies, and about 5 billion years ago the solar system (and presumably countless others) was recognizable as the sun and planets emerged by "accretion" from a cloud of gas and dust, called the "primordial nebula," in our cosmic neighborhood within the Milky Way Galaxy.

This so-called "nebular hypothesis" for the origin of the solar system was proposed about 200 years ago. The claims of Darwin in the mid 1800s that biological evolution had occurred made "cosmic evolution" via the nebular hypothesis appear acceptable, and the nebular hypothesis is believed by many to explain the true origin of the solar system. However, the nebular hypothesis has been plagued by insoluble problems ever since it was introduced. Two of these problems are introduced below.

PROBLEM #1: CONSERVATION OF ANGULAR MOMENTUM IN THE SOLAR SYSTEM

Since the primordial nebula never truly existed, it is impossible to say with any certainty how large it would have been. However, the average distance between stars in our part of the galaxy is about 10 light-years, or about 250 trillion miles (≈ 500 trillion km). We will therefore take the initial diameter of the primordial nebula as about 10% of this, or 10 trillion miles (≈ 20 trillion km). The Milky Way has a rotation period of about 200 million years, and we will take this as the initial rotation period of the nebula.[4] We take the mass of the nebula as equal to the present mass of the solar system.

The nebular hypothesis claims that, over the time interval from 10 billion to 5 billion years ago, the primordial nebula decreased in size to the present radius of the solar system. There are various criteria for measuring the size of the solar system,[5] but the simplest is to let the radius be the average orbital distance of Pluto – one of the largest known planetary dwarf objects (PDO) -- from the sun.[6]

The law of angular momentum conservation requires that the resulting angular momentum of the solar system must have increased to compensate for the nebula's decreasing diameter. In the absence of external torque or friction forces, the law of conservation of angular momentum is that

$$L_1 = L_2$$

where L_1 = initial angular momentum of the nebula, $kg \cdot m^2/s$
L_2 = initial angular momentum of solar system, $kg \cdot m^2/s$

Since $L = I\omega$, we have

$$I_1\omega_1 = I_2\omega_2$$

where I_1 = moment of inertia of nebula initially, $kg \cdot m^2$
ω_1 = angular velocity of nebula initially, rad/s
I_2 = moment of inertia of solar system now, $kg \cdot m^2$
ω_2 = predicted angular velocity of solar system now, rad/s

Solving for ω_2, we have

$$\omega_2 = I_1\omega_1/I_2 \qquad (1)$$

To evaluate I_1, we take the nebula to be a flat homogeneous disk with $I_1 = \frac{1}{2}mr_n^2$, where m = nebula or solar system mass, and r_n = radius of the nebula $\approx 1 \times 10^{16}$ m. Since most of the solar system mass is in the sun, m ≈ solar mass $m_{sun} = 1.99 \times 10^{30}$ kg. The angular velocity of the nebula, ω_1, is taken to be one revolution every 200 million years or $\approx 1 \times 10^{-15}$ rad/s.

Table 1. Solar and Planetary Data

Body	Mass, kg	Orbit Radius, m	Orbit Period
Sun	1.99×10^{30}	6.95×10^{8}	≈ 29 d*
Mercury	3.28×10^{23}	5.8×10^{10}	88.0 d
Venus	4.82×10^{24}	1.08×10^{11}	224.7 d
Earth	5.98×10^{24}	1.49×10^{11}	365.3 d
Mars	6.34×10^{23}	2.28×10^{11}	687.0 d
Jupiter	1.88×10^{27}	7.78×10^{11}	11.86 y
Saturn	5.63×10^{26}	1.43×10^{12}	29.46 y
Uranus	8.61×10^{25}	2.87×10^{12}	84.02 y
Neptune	9.99×10^{25}	4.49×10^{12}	164.8 y
Pluto	5×10^{23}	5.90×10^{12}	247.7 y

*The sun's radius and rotational period are for the sun itself.

In evaluating I_2, we refer to Table 1 above. I_2 is the sum of the I values for the sun and the planets. Taking the sun as a homogeneous sphere, $I_{sun} = 0.4\, m_{sun}r_{sun}^2$. The planets can be treated as point masses, so for each planet $I_{planet} = m_{planet}r_{planet}^2$, where r_{planet} is the orbit radius of the planet. Table 2 shows the results of these calculations.[7] Thus the total moment of inertia of the solar system $\approx 3 \times 10^{51}$ $kg \cdot m^2$.

Using Equation (1), therefore, the nebular hypothesis predicts that the present rotational velocity of the matter of the solar system should be 3×10^{-4} rad/s or 1500 revolutions per year. How does this compare with the solar system as it actually exists?

Of the sun and planets, the sun has the highest rotational velocity, at 2.51×10^{-6} rad/s. **This is less than 1% of the angular velocity of 3×10^{-4} rad/s which it should have if the nebular hypothesis were true.** Thus the solar system as it actually exists is very different from the solar system expected by the nebular hypothesis. **There was not a**

Table 2. Angular Momentum Data for Sun and Planets

Body	ω, rad/s	Type of Body	I, kg·m^2	L, kg·m^2/s
Sun	2.51×10^{-6}	Homogeneous sphere	3.84×10^{47}	2.41×10^{42}
Mercury	8.26×10^{-7}	Point mass	1.10×10^{45}	9.11×10^{38}
Venus	3.24×10^{-7}	"	5.62×10^{46}	1.82×10^{40}
Earth	1.99×10^{-7}	"	1.33×10^{47}	2.64×10^{40}
Mars	1.06×10^{-7}	"	3.30×10^{46}	3.49×10^{39}
Jupiter	1.68×10^{-8}	"	1.14×10^{51}	1.91×10^{43}
Saturn	6.76×10^{-9}	"	1.15×10^{51}	7.78×10^{42}
Uranus	2.37×10^{-9}	"	7.09×10^{50}	1.68×10^{42}
Neptune	1.21×10^{-9}	"	2.01×10^{51}	2.45×10^{42}
Pluto	8.04×10^{-10}	"	1.74×10^{49}	1.40×10^{40}

conservation of angular momentum as the solar system allegedly formed from the nebula. The angular momentum of the nebula would have been

$$L_1 = I_1\omega_1 \approx (1 \times 10^{62}\ \text{kg}\cdot\text{m}^2)(1 \times 10^{-15}\ \text{rad/s}) = 1 \times 10^{47}\ \text{kg}\cdot\text{m}^2/\text{s}$$

From Table 2, the total momentum of the solar system now is $L_2 \approx 3 \times 10^{43}$ kg·m^2/s. This is only 0.03% of the angular momentum L_1 of the primordial nebula. **Where did the momentum go?** This question has no satisfactory answer.

PROBLEM #2: MOMENTUM TRANSFER FROM THE SUN TO THE PLANETS

According to the nebular hypothesis, the sun should have more angular momentum than any other solar system body. This is because the sun has about 1000 times the mass of any planet, and thus should have retained angular momentum from the nebula in the same proportion.

This is not at all the case. Referring to Table 2, Jupiter has the highest angular momentum L of any solar system body, and **the planets collectively have on the order of 10 times the angular momentum of the sun.**[8] Rather than abandoning the nebular hypothesis, however, advocates have sought to explain how the sun could have lost or transferred its angular momentum to the planets. One explanation is that the magnetic field of the sun has caused the sun's rotation to slow over the last 5 billion years in a process called "magnetic braking." Neither this or any other theory has truly explained the dilemma of the high angular momentum of the planets.

Conclusions: Despite continued faith in the nebular hypothesis, even its believers recognize that its problems have not been answered. The foremost astronomical journal in the United States has acknowledged that the problem of angular momentum transfer from the sun has not been explained by observing that "a proper understanding of the angular momentum evolution [of the sun] has not been reached."[9]

The problem of momentum transfer from the sun is really a "pseudo-problem" generated by false expectations of how the solar system must have originated. The truth is that God created the solar system with certain properties, including its high planetary momentum, for the ultimate purpose of providing a stable home for life on earth (Isaiah 45:18). An unstable solar system would not be safe for earth and its life. High planetary momentum confers stability and guarantees a stable home for life on earth.

Notes

1 Psalm 33:6, "By the word of the Lord were the heavens made ..." See J. Henry, "What Is the Age of the Universe?," <creationconcepts.org>, 2001.

2 "For those who take the biblical account of the creation both seriously and literally, the length of the seven-day week presents no problem ... It was first practiced by God when creating the universe" (E. Zerubavel, *The Seven-Day Circle:The History and Meaning of the Week*, Free Press, 1985, p. 6).

Zerubavel points out that the week is not tied to the lunar cycle: "Those who believe that our seven-day week has derived from the lunar cycle seem to forget that the latter is not really a twenty-eight day cycle" (ibid., p. 9). **The week is not tied to any celestial phenomena at all:** "The year, month and day all have clear astronomical bases. Our 7-day week, however, does not have an obvious link with any heavenly cycle" (Duncan Steele, *Marking Time*, Wiley, 2000, p. 73).

3 "Many disparate civilizations have, for unknown reasons, assumed beginnings of time occurring a few thousand years B.C."; more specifically, "within a few centuries of 4000 B.C." (ibid., pp. 135, 40). Steele is an atheist (ibid., p. 111) with no interest in showing that the universe is young.

4 Since only a few thousand years have passed since Creation, the Milky Way has completed only a very small portion of its first rotation.

5 These criteria place the edge of the solar system variously (1) at the location of the Kuiper belt, a collection of comets and asteroids about twice as far from the sun as Pluto; (2) at the heliopause, which is the edge of the region of space permeated by gases (called the solar wind) emanating from the sun to a distance of several hundred billion miles out; (3) at the location of the hypothetical "Oort cloud" of comets, believed to be about 2 light-years out. The Oort cloud is an evolutionary construct and has not been shown to exist.

In a biblical scenario, the Kuiper belt is material ejected from the inner solar system, and not, as the nebular hypothesis supposes, material left over from the accretion of the solar system out of the nebula. Likewise, the heliopause is the boundary of gases ejected from the sun. Thus the orbit of Pluto would appear to be an appropriate estimate of solar system size.

6 In late 2006 Pluto was redefined as a PDO, not a planet. **Discovery of PDOs like Sedna has multiplied difficulties for the nebular hypothesis**. The nebular hypothesis views PDOs as members of the putative Kuiper Belt which is supposed to be the source of short period comets, thus explaining how it is that short period comets can appear young in an old solar system.

But the discovery and analysis of PDOs reveals that they have dissimilar composition from comets. **The discovery of PDOs thus strengthens the case that short period comets do indeed indicate a young solar system.**

7 The sun is not a homogeneous sphere but has density increasing toward its center, and the planets are not precisely point masses. Further, the sun is not a perfect sphere, and planetary orbits are not perfect circles. Thus the results in Table 2 are approximate and differ from more precise calculations. Finally, the moment of inertia due to the rotation of each planet on its axis has not been included, but is minor compared to the overall moment of inertia of the solar system.

8 More precise calculations increase the discrepancy to a factor ≈ 100.

9 A. Brun, S. Turck-Chieze, and P. Morel, "Standard Solar Models in the Light of New Helioseismic Constraints," *Astrophysical Journal*, Vol. 506, p. 913.