Comparison of Precession Theories: An Argument for the Binary Model

By: Walter Cruttenden August 12, 2003

Introduction

There are two basic theories to explain the Earth's changing orientation to inertial space, a phenomenon known as "Precession of the Equinox" or often-just "Precession". The "Lunisolar" explanation is widely accepted while the "Binary" or "Oriental" explanation, although quite old, is hardly known. However, recent scientific evidence, as well as new mathematical models and an expanding knowledge of binary systems call into question the long accepted lunisolar theory and lends surprising support to the binary view.

This paper will explain and examine the two theories and provide a model of each. It concludes that the lunisolar model has serious flaws that need to be reexamined whereas the binary model also needs more research but better fits observation, uniformly explains known solar system anomalies and does not contradict any solar or lunar rotation equations. Interestingly, it also appears to be a better predictor of long-term precession trends and is supported by Kepler's laws on elliptical orbits.

The Lunisolar Theory

The current theory of precession is often referred to as the "lunisolar" theory because it states that the Earth's changing orientation to inertial space (a phenomenon widely known as precession) is principally due to the gravitational forces of the Moon and the Sun acting upon the oblate Earth[1]. The lunisolar forces are thought to produce enough torque to slowly move the Earth's spin axis in a clockwise motion so that after a period of approximately 25,770 years (at the current rate) the Earth would have completed one retrograde motion relative to the Sun and the fixed stars. In this theory the Earth is thought to act like a wobbling top.

It is an observable fact that the Earth's spin axis, and therefore the point of equinox, does change relative to inertial space, at the current rate of about 50 arc seconds annually. However, there is no evidence that this change in the spin axis occurs relative to the Sun, meaning it may not be caused by "local" lunisolar forces. This point will be made clear in the following pages.

Nicolaus Copernicus first put forth the idea of a "wobbling" spin axis in 1543 in his treatise *De revolutionbus.* Copernicus needed to explain the well-known phenomenon of the "precession of the equinox" (whereby the equinoctial point preccesses backward

[1] This paper is not concerned with nutation or Chandler wobble, minor short-term motions, which do not produce a complete rotation of the Earth relative to inertial space.

through the Zodiac at the rate of about one degree per 72 years) in order to explain the motions of the Earth. He said the axis must "wobble" or experience "libration " and dubbed this the "third motion" of the Earth. But he never said it was due to local forces. It was Sir Isaac Newton, who had just developed his theories of gravity that said if the Earth did wobble it must be due to the mass of the Sun and the Moon, the only bodies considered close enough or large enough to have such an effect. But Newton's equations never did match observed precession rates. Consequently, the equations were substantially revised by Jean-le-Rond D'Alembert who added factors for torque and inertia, but even this effort proved a poor predictor of precession rates. Since then precession calculations have been continually modified and now include many factors beyond the original "lunisolar forces", including the gravitational effect of the inner and outer planets, tidal influences, effects of the 300 largest asteroids, and even a possible elliptical movement of the Earth's soft core. But as is apparent the calculations have become more of a "plug" whereby inputs are gradually added or modified to fit the observation rather than being predictive or resting on solid theory.

Recently, an Italian scientist, Carlo Santagata[2] completed a treatise examining Newton's and D"Alembert's work and subsequent equations. He finds numerous problems and shows that not only do current lunisolar equations fail to account for relativistic factors, but he concludes there must be another completely different explanation for the phenomenon we call precession. And Eugen Negut, a French Canadian mathematician provides an insightful argument that precession cannot display the dynamics of a spinning top because it has no "supporting point" in space. He makes a strong case that the axis could not "wobble" without a supporting point and that there must be another cause. Also, two German Canadian scientists, Karl Heinz Homman and Uwe Homann have produced some compelling time equivalency and related equations to show that the time required to complete lunisolar precession mechanics do not fit the observed motions of the Earth. And here at the Binary Research Institute we have found that lunar rotation equations do not support lunisolar theory, that precession is accelerating and acts more like a body that follows Kepler's laws. Also, there are at least half a dozen circumstantial arguments indicating precession is a result of something other than local forces.

In summary, a number of independent groups, all studying the same problem of lunisolar mechanics have concluded that precession is most likely caused by something other than a local wobbling of the Earth.

The Binary Model

The binary theory says that our Sun is part of a binary (or multiple star) system and is therefore gravitationally bound to a companion star resulting in the Sun's curved motion through space around the common center of gravity[3]. This motion, combined with an

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[2] Carlos Santagata, in his paper "*On Newton's Paradoxes"* (May 2002) points out some of the paradoxes and erroneous assumptions inherent in Lunisolar Precession Theory.

[3] Note: When I speak of the Sun (or Solar System) "curving" through space, I am referring to this orbital motion around the center of gravity between our system and the companion star. This angular velocity is much greater than the angular velocity of our Solar System orbiting the center of the galaxy, since the former takes 24,000 years and the latter takes approximately 240 million years according to current estimates.

oblate Earth that has even minor local gravitational binding (a la lunisolar forces on a small scale), would cause a constant reorientation of the Earth's spin axis relative to inertial space, commensurate with the motion of the binary, plus or minus the local effects. In this case the observable of precession would be due principally to the geometric effect of a solar system that itself curves through space (around the binary center of gravity). In this model, the solar system acts as a distinct reference frame that contains all the motions of the planets and their moons, which maintain all their relative gravitational relationships, as the system as a unit moves in a spiral motion relative to inertial space, just as a galaxy moves relative to inertial space.

The theory is only briefly mentioned in a number of very old text books but was most succinctly described by the Indian scholar, Sri Yukteswar, in his 1894 book *The Holy Science*: "We learn from Oriental astronomy that moons revolve around their planets, and planets with their moons round the sun; and the sun with its planets and their moons, takes some star for its dual and revolves around it in about 24,000 years of our earth – a celestial phenomenon which causes the backward movement of the equinoctial points around the zodiac". This simple description implies three things: **1**.Our sun is part of a binary star system. **2**. The period of revolution is about 24,000 years (close to the current precession rate). **3**.It is the binary motion that "causes" the precession of the equinox. Immediately I can hear some western critics say, "What does a 19th century Indian know about astrophysics and solar system mechanics? He must be wrong. And what's with the word "Holy" in the same sentence with science – this guy has no credibility". Moreover it contradicts the current theory so they dismiss the model without ever testing it and comparing it to the western lunisolar model. Unfortunately this is not science, this is bias. In the interests of science and progress, let us examine the two theories with an open mind and after proper debate, choose the model that best explains known observables, and therefore most likely represents physical reality. The details of how a binary motion might cause the Earth to change orientation to inertial space (precess) without causing a wobble of the Earth's spin axis relative to the Sun, are the focus of the Binary Research Institute. Based on several years of study this institution has found that precession occurs relative to objects outside the solar system (the fixed stars, quasars, other galaxies, etc.) but does not occur relative to objects within the solar system (the moon, eclipses and other planetary occultations, comet debris, etc.).
It is hoped that this paper will encourage other scientists to recognize the problems of lunisolar theory and participate in better understanding the hypothesized motions of a binary system.

Consideration of Binary Prevalence

It should be noted that both models were put forth at a time in the West when there was little or no knowledge of the extent of binary star systems. However, it is now estimated that more than 80% of all stars may be part of a binary or multiple star relationship[4]. Since we now know that numerous star types such as black holes or neutron stars and many brown dwarfs are essentially impossible to see, and very often difficult to detect, the number of multiple star systems must be higher than a census of strictly visible stars

[4] From NASA's Chandra X-Ray Observatory website

would indicate. Furthermore, because very long cycle binary systems would logically take very long periods of time to notice or verify as binary motions, it would not be unrealistic to expect the verified percentage to move toward the upper estimate over time. Consequently, our Sun and solar system would be looking more and more like an anomaly if it were indeed a single star system as opposed to a partner in a multiple star system.

If we are in a binary system, and Newton's laws work just as well outside the solar system as inside the solar system, then the Sun's dual would most likely need to be a dark companion such as a brown dwarf or theoretical old neutron star even some large planet like mass that also has a very long orbit period making any of its effects difficult to notice[5]. It could even be a not too distant black hole that is not currently consuming matter and therefore currently difficult to detect.

Another possibility is that MOND (Modified Newtonian Dynamics) or some variation of local gravitational dynamics might come into play at long distances outside the solar system. This of course would open the possibility that the Sun may have a visible companion (and coincidentally would solve much of the dark matter problem). We cannot expound on this particular possibility without significant further research but we can not rule it out either given the growing evidence that something is moving our solar system in an elliptical pattern far tighter than any galactic motion would produce.

Historical Perspective: Not only were Copernicus and Newton unaware of binary prevalence, they also assumed a "static Sun" when they first postulated a heliocentric system with a wobbling Earth. They had no knowledge of invisible stars like black holes or brown dwarfs, and they were unaware that our Sun is moving at great speed through local space or that it could possibly be gravitationally bound to any other extra-solar system mass (this is obviously before knowledge of any galaxies or galactic motion). Consequently, it is not expected that they would consider anything outside the solar system as a causative factor in producing a solar system (or Earth from our point of view) that displays an apparent wobble relative to the fixed stars.

Model Comparisons

Although modern science does recognize that our solar system is located somewhere about two thirds out on one of the Milky Way galaxy's spiral arms, and that it is likely that we would orbit the center of the galaxy in a period of about 240 million years, the current model of precession surprisingly still assumes a static motion for our Sun. In inquiries made to NASA's VLBI Group and JPL, about why no motion of the solar system is computed into current lunisolar precession theory equations, we hear that "any

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[5] Any binary system with a partner star more than 5 times the distance between the host star and its farthest planet should be able to support a planetary system without jeopardy to the stability of their orbits, according to Geoff Marcy, Professor of Astronomy at the University of California, Berkeley

motion relative to inertial space is considered to be so small that it would only end up as noise in the precession calculations". The exact words in an email from Dan Mac Millan, at NASA's VLBI Group are:

"The answer to your question is that we do not account for the geometric effect of galactic rotation. It is a very small effect. A galactic rotation period of 240 million years -> a rotation rate of ~26 nrad/yr. If the radio sources we observed were at distances approximately equal to the distance to the galactic center (~3x10^4 light years), then this rotation rate would translate to an error of about 15-20 cm/yr in our estimates of intercontinental baselines. But the distances to the extragalactic radio sources are ~10^9 light years so the effect is much smaller ~ 0.01 mm/yr. Our current precision is at the 0.1-0.5 mm/yr level so we are not sensitive to this effect."

If the only motion of our Sun and the solar system is around the center of the galaxy then NASA is correct, any change in orientation (precession) due to the "geometric effect" would be smaller than current rounding errors. However, if the solar system were moving in any intermediate orbits on its way around the galaxy, i.e. a 24,000-year binary orbit, then the "geometric effect" would be 10,000 times greater. Yet because it is automatically "presumed" that there is little or no geometric effect due to the motion of our solar system no one is looking for any such effect <u>on any scale.</u> Consequently all major change in orientation (meaning the entire 50 arc seconds of annual Earth reorientation to inertial space) is attributed to the only other assumed cause; lunisolar wobble, even if that cause is unproven.

Incidentally, for those who interpret Newton's laws to claim that a binary motion would not result in any reorientation of the Earth, it should be realized that "if" the gravitational influence of the Sun and Moon acting upon the oblate Earth is the cause of "any" axial motion, no matter how slight, this effect would have to be maintained whether of not it took place within a single sun system or a binary system. For example, if the lunisolar forces amounted to one arc second of change in orientation per year the periodicity of a precession cycle, without accounting for any other forces, would equate to about 1.3 million years. However, if this took place within a solar system that was part of a binary system with a periodicity of 24,000 years, then the periodicity of the observed change in orientation relative to inertial space from Earth would be much closer to the binary orbit cycle. Hence, it could be said that even slight lunisolar forces insure that a binary motion would result in a geometric change in orientation relative to inertial space. Thus one cannot argue for lunisolar theory and at the same time argue against a binary motion being able to produce a change in Earth orientation.

Back to our earlier point, the lunisolar theory is unwittingly based on a static sun and solar system model (relative to inertial space) thereby requiring any annual change in the orientation of the Earth to the fixed stars to be accounted for by strictly local forces. Whereas the binary model is not dependent on local forces to twist the Earth backward on its axis because it attributes the Earth's change in orientation (precession) primarily to the geometric effect of a binary motion, i.e., a solar system that curves through space. This is a key difference between the two models as it relates to precession.

Interestingly, they both produce the same "observables":

They both say the point of the equinox will slowly precess through each of the twelve signs of the zodiac over one precession cycle.

They both say the spin axis of the Earth will change pole stars over time. For example, the pole star was Thuban about 5,000 years ago and now the north pole of the spin axis points close to Polaris, but in about 12,000 years it will be close to Vega.

Finally, they both say the “current” precession rate is about 50 arc seconds annually.

Although both models produce the same “observables” they do it in much different ways. The main configuration of the lunisolar model is a static solar system with an oblate Earth that must be wobbled by the nearby forces of the Sun and the Moon. Those forces are presumed to exert tremendous torque upon the Earth, enough to make it complete one retrograde motion on its axis and one retrograde motion relative to the Sun in the same period of time as we observe the Earth complete one precession cycle relative to the fixed stars: about 25,770 years at the current rate.

The binary model has all the same assumptions about the Earth, which is that it is oblate and gravitationally bound by the Sun and somewhat affected by the Moon. But in the binary model the Moon is not required to produce the large force necessary to completely twist the Earth around in the observed precession period although it may likely produce enough of an influence to hold it in place (synchronous position[6]) resulting in the “geometric effect” of precession. As the solar system slowly curves through space in its binary motion, it indirectly causes the Earth to slowly change orientation to inertial space without completing any retrograde motion relative to the Sun. Once again, this is an important distinction in the two models:

In the lunisolar wobble model the Earth changes orientation to inertial space by 50 arc seconds due to local forces and therefore must also change orientation relative to the Sun by this same amount each year. But in the binary model the change in orientation is due to motion of the entire solar system and therefore the Earth does not change orientation relative to the Sun equinox to equinox. Therefore, in the binary model the period of time from equinox to equinox represents a 360-degree motion of the Earth around the Sun not 360 degrees less 50 arc seconds as in the lunisolar model. It is clear the binary model involves another reference frame that has heretofore not been recognized; a solar system that moves relative to inertial space.

[6] Synchronous motions are common in our Solar System – the moon is synchronous, always showing the same side to the earth, likewise four of Jupiter’s moons and most of Saturn’s moons exhibit the same synchronicity. Also, Venus is synchronous with the Sun - Venus makes exactly one rotation on its axis as it makes one revolution around the sun.

To visualize the difference of the two models by looking at the motion of the equinox: The lunisolar model requires an equinox that slips relative to the fixed stars and slips along the ecliptic at the same rate because the twisting of the spin axis is caused by local forces. Whereas the binary model also has an equinox that slips relative to the fixed stars but remains fixed relative to the ecliptic, because there is little or no local twisting. Again, precession in the binary system is not due to local forces but is due to the motion of the solar system, which produces an Earth that changes orientation relative to the fixed stars because of what NASA terms "geometric effect". As we will show, only one model can reflect physical reality.

Missing Motion and the Lunar Witness

Perhaps the best way to understand the different ways to look at precession in the two models is to consider an analogy; compare it to the different ways of looking at the Earth's motion in Ptolomey's time. There were two models back then: the heliocentric (Sun in the center of the solar system) mentioned by several Greeks including Aristarchus of Samos and preferred by Archimedes, and the geocentric (Earth in the center of the solar system) preferred by Ptolemy. Galileo Galilee wrote his famous book *Dialog on the Two Chief World Systems, Ptolemaic and Copernican* on this very subject.

Long after Aristarchus, Ptolemy "proved" the Sun went around the Earth: Everyone could see the Sun rose in the East and set in the West, and no one in Ptolemy's circle at the time knew the Earth rotated, therefore the only way to explain the Sun's motion through the sky was to conclude the Sun itself went around the fixed Earth. As everyone now knows this conclusion is incorrect because there is a reference frame at work that was not even considered in Ptolomey's time: that is, the Earth is spinning on its axis. Of course it is the spinning Earth that causes the Sun to "appear" to go round the Earth when in actuality the spinning Earth is the cause of the "apparent" motion of the Sun.

Although this European belief held for almost a thousand years, the Moon never confirmed the incorrect motion of the Sun and Earth. Had one bothered to look carefully, as the Oriental and Mesoamerican cultures did, they would notice the phases of the Moon were out of synch with the Moon's revolutions around the Earth. The only way the Moon could go around Earth every 27.3 days, yet a new Moon could only be seen every 29.5 days, was if the Earth itself was curving around the Sun. This is proved with relatively simple rotation equations but unfortunately, no European seemed to correlate the two facts for over a thousand years.

Likewise, a similar misunderstanding; a missing motion or reference frame, might be the case in misdiagnosing the cause of the precession of the equinox; the solar system is moving! And failure to understand lunar rotation equations, eclipse cycles and planetary occultations relative to lunisolar theory is resulting in another incorrect conclusion about the mechanics of our solar system. Specifically, the phenomenon known as "precession of the equinox" has been attributed to a local event: torque primarily from the Sun and the Moon. The logic goes something like this: Careful observers can see the Earth does not realign with the fixed stars at the time of the vernal equinox, it is off by about 50 arc seconds per year. Copernicus said this is because the Earth's pole "wobbles", and Newton said that if it did wobble it must be due to the gravity of the Sun and the Moon acting upon the oblate Earth. The combination of these two principal forces is supposed to cause the pole to shift clockwise by the observable 50 arc seconds per year, meaning the equinox would arrive 50 arc seconds short of that point in the Earth's orbit path that the equinox occurred at last year. Because the observable can be seen and there were no other known theories, this "lunisolar" theory of precession has become widely accepted.

While the observable is true, the purported cause may not be. Just as Ptolemy failed to consider another motion, the spinning Earth, and therefore came to the wrong conclusion when observing the Sun going around the Earth, so too might modern scientists be forgetting to account for a motion. This time the missing motion is the solar system curving through space. With the solar system spinning and curving through space (like a galaxy) at about 50 arc seconds per year, and just minimal torque upon the Earth, the larger solar system motion would gradually reorient the Earth to inertial space (precess) at about this same rate. Could it be this motion of the solar system that causes precession, and not lunisolar forces? What is the proof? Again the Moon plays witness to the Earth's motion.

If the Earth itself were coming up about 50 arc seconds short of the equinoctial point that it was at the prior year, then lunar equations would show the Earth goes around the Sun 50 arc seconds short of 360 degrees in an equinoctial year. But the equations do not show this. They show that the Earth goes around the Sun, relative to the Sun, 360 degrees in an equinoctial year. Yet anyone can see that the Earth in relation to inertial space appears to move around the Sun 360 degrees only in a sidereal year. Indeed, fixed-star to fixed-star has almost become the litmus test for what is or isn't a 360 degree movement. But like Ptolemy's Sun, that appears to orbit round the Earth, motions in space can be deceiving.

Lunar rotation equations clearly show the Earth goes around the Sun 360 degrees in an equinoctial year, and contrary to observations of the Earth's orientation relative to inertial space, these same equations show the Earth orbits the Sun 360 degrees plus 50 arc seconds in a sidereal year. Interestingly, if one only plugs the sidereal data into the rotation equations, they show the Earth moves 360 degrees relative to the fixed stars in a sidereal year, yet this orbit path of the Earth around the Sun takes 20 minutes longer and is 22,000 miles wider in circumference than the Earth's actual path around the Sun. Now obviously, the Earth does not have two different orbit paths around the Sun each year. So which is right? Mathematically, they are both correct; the Earth does move 360 degrees around the Sun in a solar year and does appear to move 360 degrees relative to the fixed stars in a longer sidereal year. The startling conclusion is, while the Earth is moving 360 degrees counterclockwise around the Sun in a solar year, the entire solar system (containing the Earth Sun reference frame) is moving clockwise relative to inertial space. The relationship between the mathematical calculations supports no other conclusion.

It is the missing motion of the solar system curving through space, like a mini galaxy, that modern scientists have failed to calculate in their lunisolar precession theory. But the

Moon does not lie. Its movement is exact and it acts like a witness to the Earth's motion. Since Ptolemy, we have learned the only way the Sun can appear to move around the Earth, and be confirmed by lunar data, is because the Earth is spinning on its axis. Likewise, the only way the Earth's axis can appear to precess or wobble relative to inertial space, and be confirmed by lunar equations is if the solar system is curving through space. [See appendix A for lunar rotation equations]

Precession only occurs relative to objects outside the solar system – the Earth does not precess or change orientation relative to objects within the solar system

Further evidence that precession is not due to local wobbling can be found in studying eclipse data and planetary occultations. If precession, is a result of local wobbling (which must cause the axis to slip by 50 arc seconds per year along the ecliptic as well as relative to the fixed stars) then anything outside the Earth would have to reflect this precession. But this is not the case. While we do use a sidereal frame (that incorporates precession) to find the new position of the fixed stars each year, we do not use this frame to find out where planetary conjunctions will occur. Moreover, the Earth's wobble is not taken into account when trying to pinpoint the timing or umbra location of an eclipse. This topic is a bit difficult to understand for anyone that does not fully comprehend the implied theoretical aspects of lunisolar precession mechanics. The point is that while precession theory works in determining orientation to points outside the solar system it does not work and is not applied to locating fixed points within the solar system. One example of the is the Perseid meteor shower:

Perseids Meteor Shower shows that the Earth goes around the Sun 360 degrees in a tropical year.

There are certain meteor showers that can be seen regularly on the same date each year. They are thought to be the result of the Earth, moving along its orbital path around the Sun, crossing through that point in space where a comet once intersected our orbit path. The leftover debris hitting our atmosphere is the cause of these annual meteor showers that come and go like clockwork. One of the strongest and most well known is the Perseid Meteor which peaks each year every August 11th and 12th (my birthday). Ever since I can remember this meteor shower has occurred on my birthday.

The Perseid was first mentioned by the Chinese in 36 AD and is mentioned again in Japanese, Korean and Chinese chronicles through the 8th, 9th, 10th and 11th centuries according Gary Kronks in his journal on meteors and comets. Sometime around the mid 1500's, after the St. Lawrence feast day had been established as August 10th, people began to call this meteor shower the "Tears of Saint Lawrence", because right after the feast day the meteor shower would peak for a day or two. Still today the peak of this meteor shower is August 11th and 12th.

As long as the Earth goes around the Sun 360 degrees equinox to equinox, and we keep our current system of leap corrections* we should continue to see this meteor shower peak every August 11th and 12th for centuries to come. This is because our current calendar system of time loses less than 1 day every 3200 years relative to the actual motion of the equinox within the calendar. In other words the equinox remains fixed within the calendar moving only slightly for differences between the calendar days (365) and the Earth's actual rotations in a tropical year (365.2422) and always quickly adjusted by leap days every four years.

BUT WAIT, lunisolar precession theory says the Earth does not go around the Sun 360 degrees every equinox. It says it comes up 50 arc seconds short of 360 degrees every tropical year and this is why we see the fixed stars precess by 50 arc seconds per average tropical year. But if the Earth does not go around the sun 360 degrees then the Perseid meteor shower should reflect precession and slip through the calendar 1 day in every 72 years, meaning it should have moved almost six days exactly since the Gregorian Calendar Reform in 1582. We know the fixed stars "outside the solar system" have indeed appeared to move by this much in that time period due to precession but why hasn't the Perseid reference point "within the solar system" changed by this same amount of precession? If precession is caused by local sources wobbling the Earth then anything and everything outside the Earth should appear to move at the same rate, excluding proper motion.

Answer: The Earth does not change orientation to the Perseid meteor shower, or to the Moon, or to eclipses, or to any points of planetary occultations or to anything within the solar system, because local wobbling of the Earth does not cause precession. What we call precession only occurs relative to the fixed stars and objects "outside the solar system" because precession is actually due to the motion of the solar system itself. The solar system containing the Earth moves as a single reference frame at the rate of about 50 arc seconds annually relative to inertial space. All bodies within that reference frame maintain their relative gravitational relationships, the Earth does not experience precession within that frame, and therefore only the tropical frame applies. All bodies outside that reference frame must be adjusted for precession and the sidereal frame applies.

Solar System Anomalies

The lunar equations and the lack of observable precession relative to the Moon, eclipse junctions, comet debris and other points within the solar system, in all likelihood disprove lunisolar theory, but they do not in themselves prove we are in a binary system. However, there are several additional significant arguments based on anomalies in other solar system theories that appear to give weight to the binary model. Below is a brief list of known solar system anomalies:

- **Angular Momentum**: Why is there an anomalous distribution of angular momentum in the solar system, and why do the Jovian planets have most of the angular momentum when the Sun has most of the mass?[7] New theories say it disappeared. Did 99% of the Sun's angular momentum really just disappear while the planets lost none of their angular momentum?

- **Sheer Edge**: Why, just beyond the Kuiper Belt, does our solar system seem to have an unusual sheer edge to it?[8] This is surprising for a single sun system. Did a rogue planet or other large mass come by in the recent past and eject everything beyond 53 AU?

- **Sidereal vs. Solar Time**: Why is the time difference between a sidereal and solar "day" (about 4 minutes) attributed to the curvature of the Earth's orbit (around the Sun), but the delta between a sidereal and solar "year" is attributed to precession? Why are these very similar phenomenon attributed to completely different physics? Is it possible that the time difference between the two years might also be due to the same physics; orbital curvature? Could precession also be the result of orbital curvature?

- **Comet Paths**: Why are many comet paths concentrated in a non-random pattern?[9] Is there something disturbing long cycle comets in a particular section of space?

- **Acceleration of Rate of Precession**: Why has the annual rate of precession increased almost every year over the last 100 years? (Fig. 1) What could cause it to speed up (or eventually slow down)?

Rate of Precession

Lets begin with the last issue first: the acceleration of the annual rate of precession. As can be seen from the chart below, the precession rate (now 50.29 arc seconds per year) has been accelerating over the last 100 years. This means the calculated time required to complete one precession cycle has been falling. Note that the precession rate was under 50.255 arc seconds before 1900 when Simon Newcomb first began to keep accurate records, (meaning a complete precession cycle would have taken about 25,790 years), but now just 100 years later, the rate is 50.29 arc seconds per year and the computed time to complete one full cycle is down under 25,770 years. That is a decline of 20 years of periodicity in just 100 years of record keeping. Also, the trend is fairly consistent year over year and it is accelerating. If the local gravity theory of lunisolar precession were correct, and this trend was extrapolated back a few hundred thousand years then precession would have been virtually non-existent even though the Sun and Moon exerted about the same gravitational influence as they do now. And if this trend were extrapolated forward a few million years the Earth might be wobbling so severely it

[7] B. W. Caroll and D. A. Ostlie 1996
[8] R. L. Allen, G. M. Bernstein, and R. Malhotra, 2001
[9](J. J. Matese, P. G. Whitman, and D. P. Whitmire, 1999 and J. B. Murray, 1999

would retrograde a day for every day it spins, and essentially stop moving or go into reverse!

Following is a chart with points representing the actual annual calculated precession rates for the last 100 plus years. The early calculations are by Simon Newcomb and the later by Williams or the Astronomical Almanac. We have drawn a line in the middle of the dots to show the slope of the trend. If precession were the result of our Sun's motion around another object (causing a reorientation of the Earth) then according to Kepler's laws any trend line would reflect the signature of an elliptical orbit. Interestingly, this specific trend line, based on 100 years of an elliptical curve, indicates that precession's periodicity would equate to about 24,000 years. Since the rate is now almost 26,000 years, then according to Kepler's third law we can be certain that we only recently left apoapsis, probably about 1500 years ago or around 500 AD.

Currently, the average precession rate, or change in orientation relative to the fixed stars, equates to about one degree of change in orientation every 71.5 years. Based on a 24,000 year binary model, the precession rate should continue to accelerate for the next 10,500 years until it reached about 1 degree of change in orientation every 62 years at which point, according to the physics of elliptical orbits, it would reverse.

So in the binary model the physics of a change in the precession rate are due to the motion of bodies in elliptical orbits and follow Kepler's law. Therefore, a change in the trend rate of precession was expected in the binary model and it means future precession rates are predictable if one understands the eccentricity of the orbit. However, in the lunisolar model (local gravity) the changing trend in precession rates was entirely unexpected and has led scientists to search for possible causes that would lead to an accelerating trend in the rate of precession over the last 100 years. While it is certain that lunisolar theorists will come up with something to save their theory, such as: the Earth's core must be elliptical in shape or the gravity of the Sun or the Moon is changing, the fact that lunisolar precession theorists must come up with another plug must once again raise questions about the soundness of that theory.

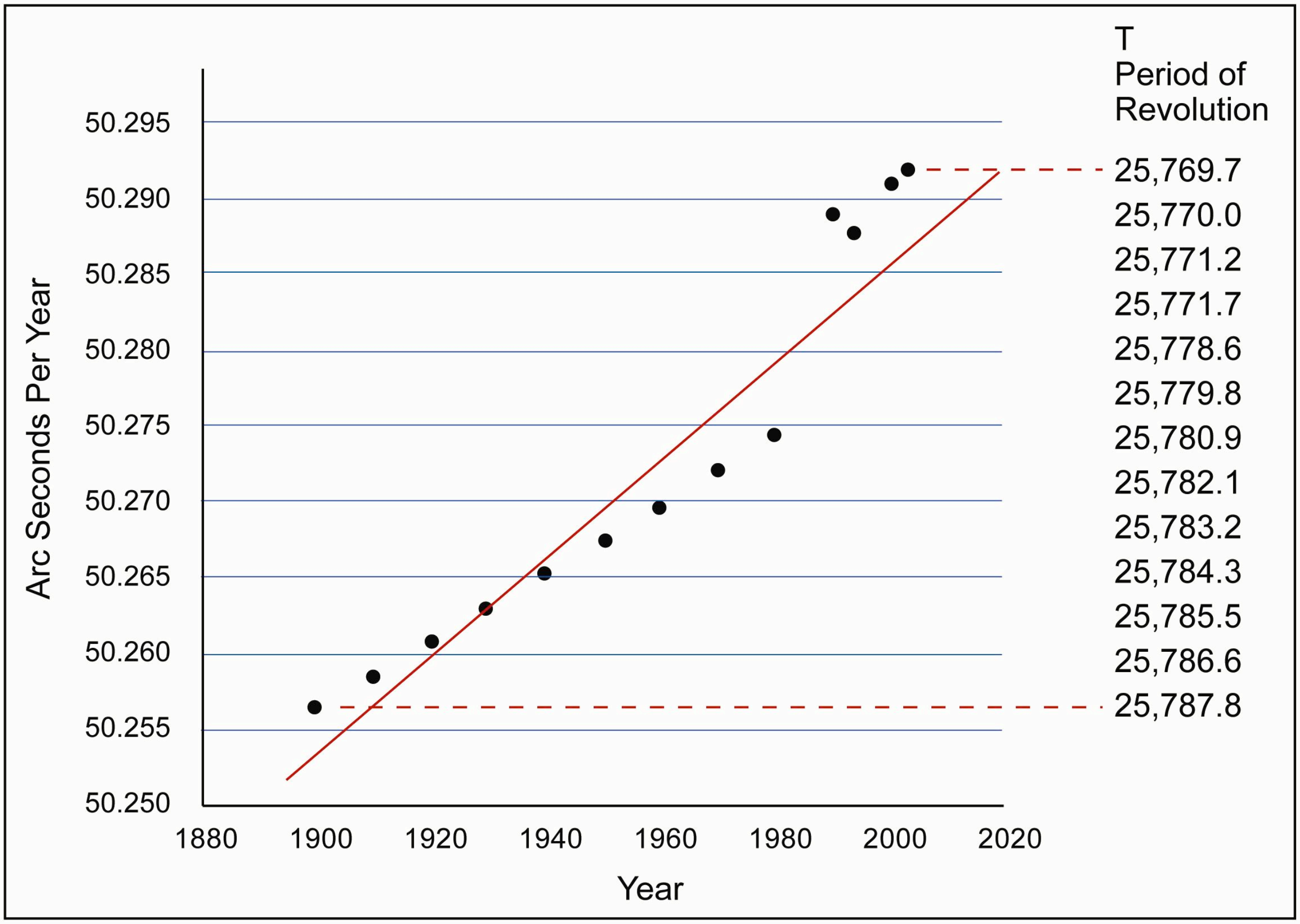

Figure 1 Cruttenden et al., Precession Trend

Figure 1. *Current trends in precession. Source: 1900-1980 The American Ephemeris and Nautical Almanac;*
1981-2002 The Astronomical Almanac. United States Naval Observatory

The fact of the matter is the gravity of the Sun and Moon have been very stable for millions of years and there should be no reason in the lunisolar model for this significant upward trend in the wobble rate. If anything it might be expected to slightly "decrease" under lunisolar theory as the Moon moves a fraction of an inch farther from Earth each year (according to laser measurements of reflectors on the Moon) and as the Sun burns up a small fraction of its mass each year. But frankly these amounts are so negligible relative to the mass and scale involved that the precession rate should be noticeably stable year after year – if these masses are indeed the cause of the wobble. Lunisolar theorists not only need to find new inputs to the precession formula for the sake of accuracy, they need to offset these slight diminishments in gravitational forces and come up with larger effects in the opposite direction. Interesting problems!

The binary theory has none of these real or theoretical problems. All orbits are elliptical orbits and therefore abide by Kepler's laws. This means bodies in these orbits will speed up as they leave apoapsis (farthest point of separation) and move toward each other, and conversely they will slow down as they leave periapsis (closest point) and move away from each other. Consequently, stars in a binary system will speed up for half of their orbit period then slow down for the other half.

Relating this to the Earth's precession in a binary model we would expect precession to accelerate if the system that carries the Earth (our Sun and solar system) were moving away from apoapsis (thereby accelerating the geometric effect), and then eventually decelerate as we pass and move away from periapsis. In other words the change in the precession rate is consistent with the binary model where the two stars have left their farthest point of separation but inconsistent with the lunisolar model. Also, the binary model has a logical reason for periodicity whereas the lunisolar model does not. It should be noted that Newton did not address the acceleration issue nor did D'Alambert correct for it. Unfortunately the theorists supporting the current paradigm still have to deal with the fact the axis does not wobble relative to the Sun – and this means we have to get entirely away from local causes for all but a fraction of the observed change in annual orientation.

Angular Momentum

It is a well known fact that the Sun contains most of the mass of the solar system (estimated at 99.9%) yet has less than 1% of the total angular momentum when it should be proportional to its mass. As can be seen in the chart below, Jupiter and Saturn have most of the angular momentum in the solar system.

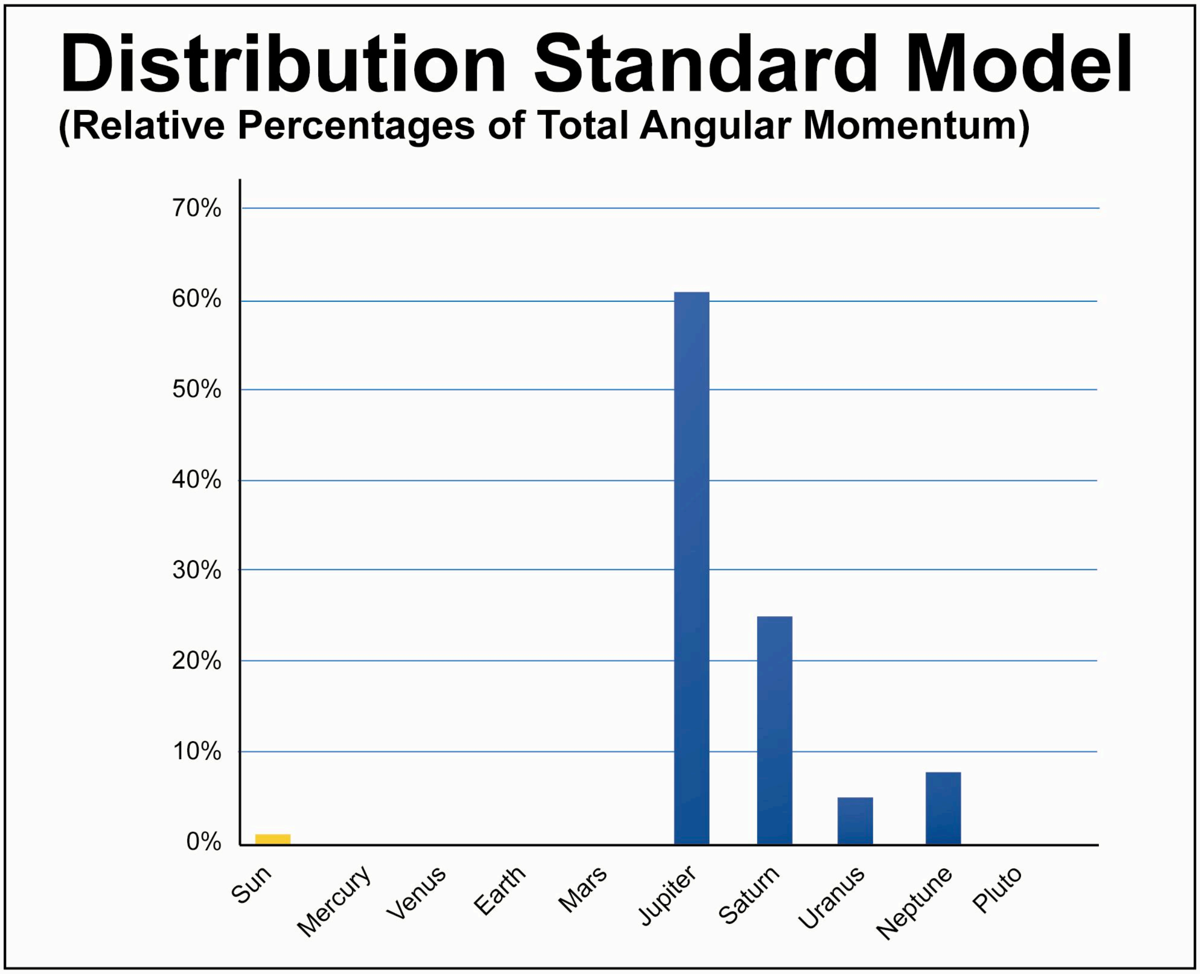

Figure 2 Cruttenden et al., Standard Model - Relative Percentages

Figure 2. *Angular momentum distribution of our solar system (standard model). Note that most is in the Jovian planets. The Sun has less than 1%.*

Indeed almost all the objects in the solar system have angular momentum proportional to their mass except the Sun. See how it stands out below:

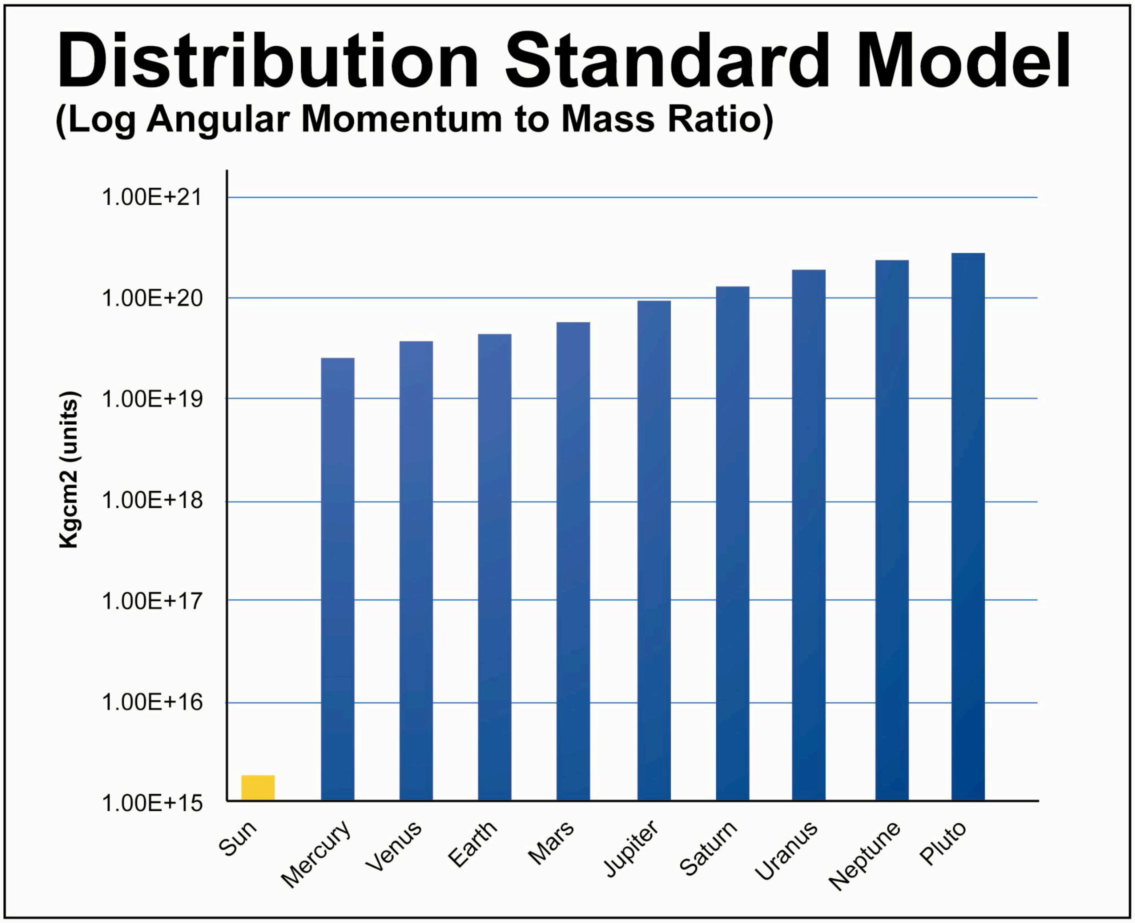

Figure 3 Cruttenden et al., Standard Model - Log Ratio

For years, this was perhaps one of the best known solar system anomalies because it was long thought that objects could not lose their angular momentum. It frustrated solar system theorists to no end so recently scientists have theorized that the Sun's angular momentum has "disappeared". While this does support the static Sun concept of lunisolar theory it raises other questions like: How did this happen and where did it go? The latest belief is that stars might lose their angular momentum if early in the formation process there were a very massive magnetic field and a lot more gas and dust which absorbed the angular momentum and then flew out of solar system. Under current theory the best guess is it might be somewhere between the Kuiper Belt and the Ort Cloud. At least that's the theory. Basically, it was there as required but because it is not there now (it disappeared) and young stars do seem to be able to expel gas, then it is now gone. I call this the "farts theory". It works but it stinks. If the early Sun lost 99% of its angular momentum then why didn't the early planets lose any of theirs? Maybe it is because this does not fit observation, observation that does not recognize the solar system as a moving reference frame.

The binary theory offers a simple solution to the problem, that is that the Sun's angular momentum is still there! It never went anywhere and it is still proportional to its mass. Just as we calculate the planets angular momentum based on their spin and orbital motion so should we calculate the Sun's based on its spin and orbital motion. But if the Sun's only orbital motion is in a small circle around its own edge driven by the orbit of Jupiter or if it is strictly around the center of the galaxy, then we have the angular momentum deficit problem. But look and see what happens if we include the Sun's motion in a 24,000 year binary orbit:

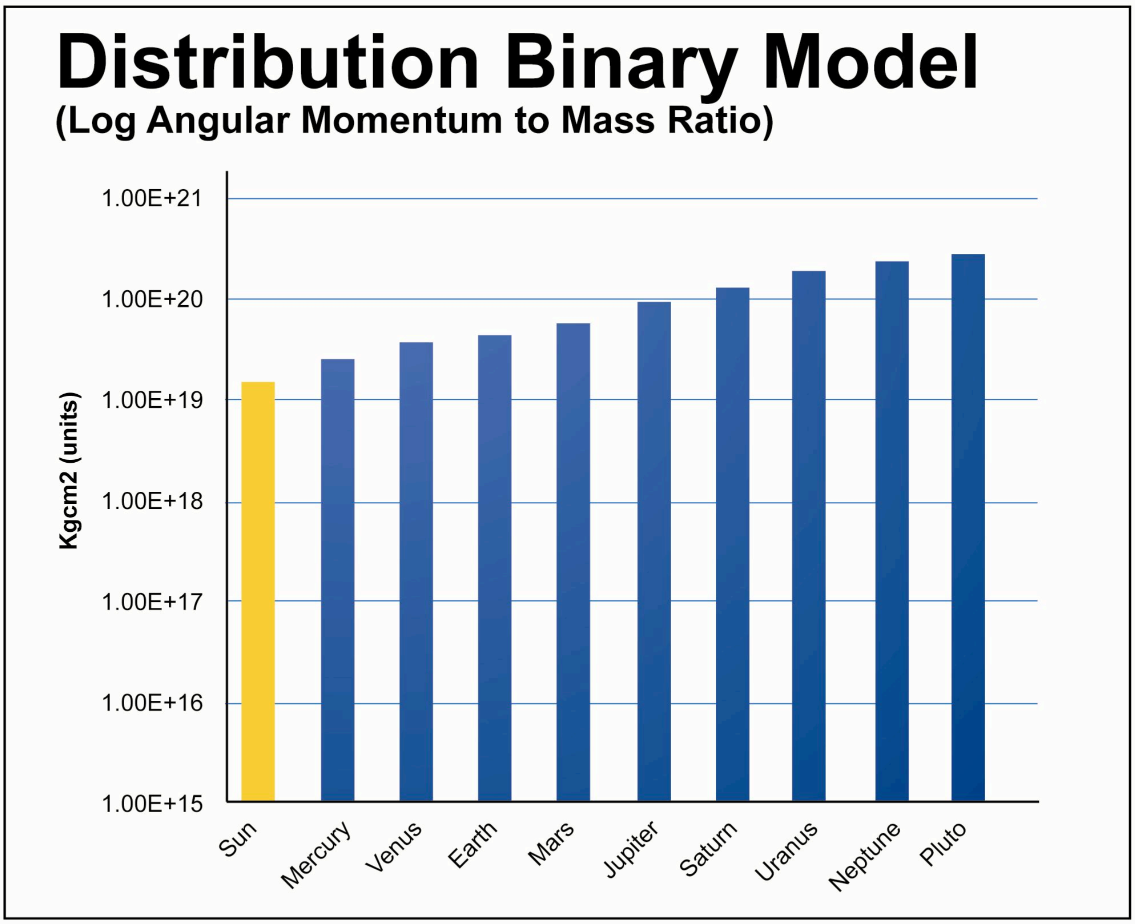

Figure 4 Cruttenden et al., Binary Distribution

Figure 4. *Binary model; log angular distribution to mass ratio assuming the solar system is in a binary orbit with an object 8% of the Sun's mass at a distance of 1000 A.U.*

Viola! It was there all the time! But in a binary model the Sun's angular momentum is in its movement through space in a binary orbit, not just in its spin axis (just like the planets). In this model we do not need any new physics or disappearing magnet field or disappearing matter, we just need to consider that the solar system might be moving through space in an elliptical orbit motion. Not coincidentally, that orbit would be almost equivalent to the current periodicty of precession!

Sheer Edge and Non-random comet paths

It is a well known fact that an unusually large percentage of long cycle comets (over 30%) seem to come from a relatively small angle of space. A binary model might help explain this non-random distribution of long-cycle comet paths[10], without requiring the existence of a tenth planet or huge quantities of dark matter within the solar system. Perhaps the companion star causes enough gravitational agitation near the Ort cloud (the theoretical source of most long cycle comets) to generate a disproportionate number of comets from its general area of motion. Frankly, we do not know but obviously if we were in a binary system with a distant companion that object would have to have some effect on the outer edges of our solar system.

On a related note, the recent finding that our solar system has a sheer edge[11] might be readily explainable, indeed expected in a binary system.

[10] D. P. Whitmire, J. J. Matese and P. G. Whitman, 1999 and J. B. Murray, 1999
[11] R. L. Allen, G. M. Bernstein, and R. Malhotra, 2001

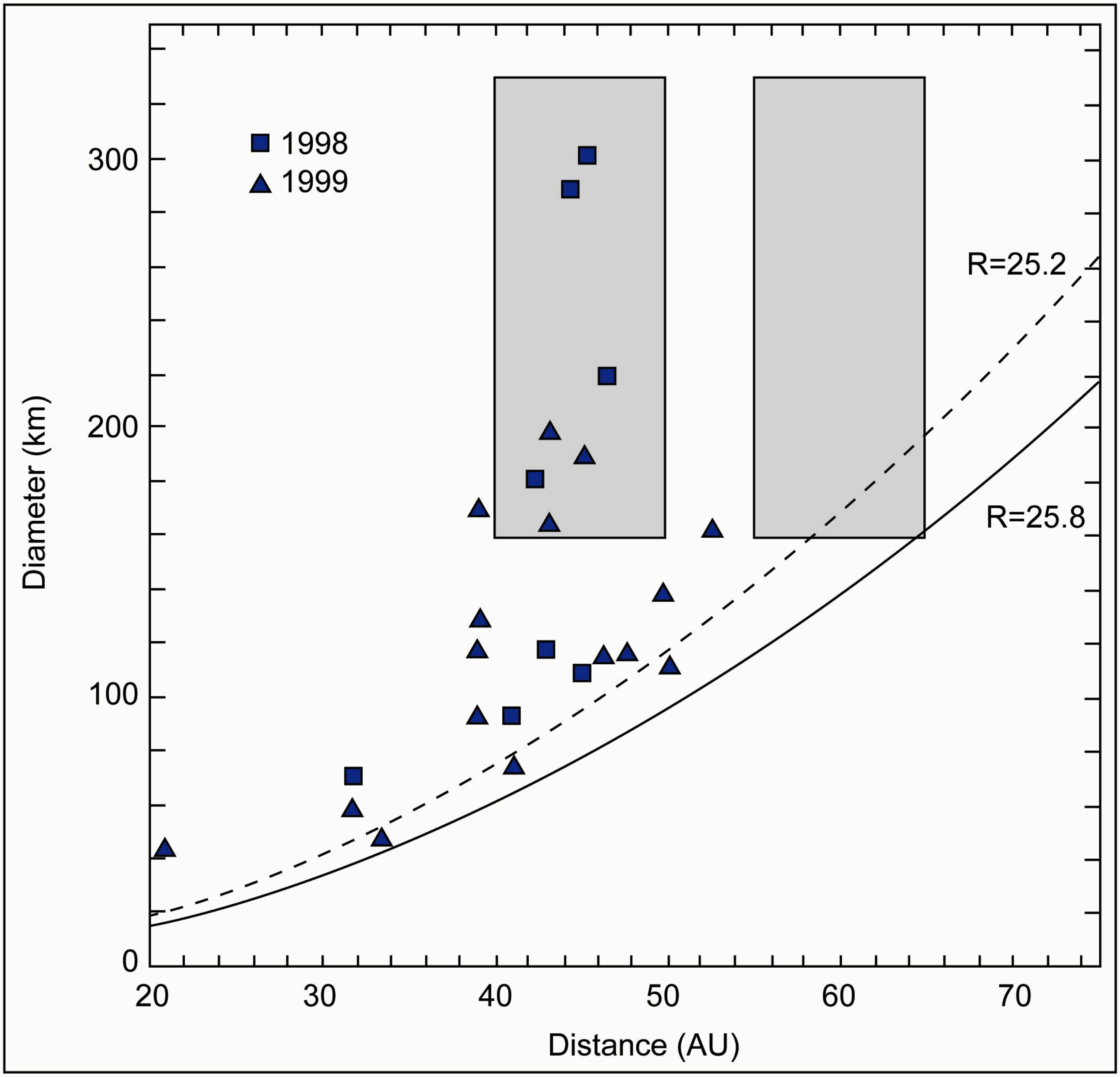

Figure 5 Cruttenden et al., Sheer Edge

Figure 5. *Raw data showing that traceable objects of any size seem to end abruptly at about 53 A.U. (Allen et al, 2001)*

It could be that our Sun's motion around a common center of mass with a companion star would result in some rather neat boundaries to our own solar system. The gravitational effects of a regular sheering, depending on the location of a possible companion would more than likely produce the type of anomaly discovered by R. L. Allen, G. M. Bernstein, and R. Malhotra.

Orbital Time Deltas

Most everyone knows that the Earth completes one spin on its axis in about 23 hours and 56 minutes relative to the Stars (a sidereal day) but it takes a full 24 hours for the Earth to complete one spin relative to the Sun, zenith to zenith (a tropical or solar day). The difference of course is due to the Earth's orbital curvature around the Sun. If the Earth did not curve through space, and the Earth and Sun were moving in a parallel track, the length of the two days (sidereal and solar) would be the same 23 hours and 56 minutes. It is solely because the Earth curves through space it takes an extra few minutes of spin time each day, for the same point on Earth to return to its closest point to the Sun. Thus the "delta" between the two days can be attributed to orbital curvature. The result is there are 365.2422 solar days every year but exactly one more "sidereal" day, or 36<u>6</u>.2422, each solar year.

Likewise the Moon goes around the Earth once every 27.3 days but we only see a new moon (or full moon) every 29.5 days. The reason for this 2.2 day delta between the Moon's revolution period and the Moon's phases, a.k.a. synodic cycle, is because the Moon curves around the Earth while the Earth curves around the Sun. Like the example above, if the Earth did not curve around the Sun, but the Moon still went around the Earth, then there would be no difference in the time period between the Moon's revolution period and the Moon's phases we see. In other words we would see the Moon make one orbit around the Earth (say marked by its passage between the Sun and the Earth) and the new Moon cycle would be in exact synch with that time period. There would be no delta between the two events. So you can see the time "delta" between the Moons revolution period and the synodic period are due to the Earth's orbital curvature around the Sun, just as the delta between a solar day and sidereal day are due to orbital curvature.

Another time "delta" to consider is that between the solar year (a.k.a. the tropical year or equinoctial year) and the sidereal year. The solar year is the time it takes the Earth to complete one rotation on its axis equinox to equinox (the equinox is when the Earth's axis reaches an exact 90 degree angle relative to a line drawn from the center of the Sun to the center of the Earth a.k.a. the first day of Spring or Fall). The sidereal year, 365.2563 spins, is the period of time it takes the Earth to realign with a fixed star or point in inertial space each year. The solar year is 365.2422 spins of the Earth or 31,556,926 seconds, whereas the sidereal year is slightly longer at 365.2563 spins of the Earth or 31,558,150 seconds. The delta is 1224 seconds or about 20 minutes.

Here is the point: the time delta between the Earth days (tropical and sidereal) and the Moon periods (synodic, etc.) is due to orbital curvature, whereas the time delta between the two years (tropical and sidereal) is attributed to an entirely different phenomenon under the lunisolar precession theory. This theory, which says the Earth is wobbled by local forces, tells us the reason for the time difference between the two years is because the Earth wobbled enough to cause the equinox to occur twenty minutes earlier (in its orbit path) relative to a fixed point in inertial space. So in the case of the days and the lunar cycles the time deltas are due to “orbital curvature” whereas in the case of the time delta between the two “years” the lunisolar theory requires different physics to explain the same time difference phenomenon. But the binary theory does not have this problem. In the binary model the difference between the two years is also due to the same physics which cause the daily and “moonthly” time deltas; orbital curvature. As the solar system, which carries the Earth, curves through space, it causes a slow reorientation in the Earth’s axis[12]. The lunisolar forces do not need to completely twist the Earth around on its axis in the binary model, [they just need enough force to hold it and the binary motion does the rest]. Consequently the binary model allows the same physics of “orbital curvature” to be the causative factor behind daily, monthly and yearly time deltas.

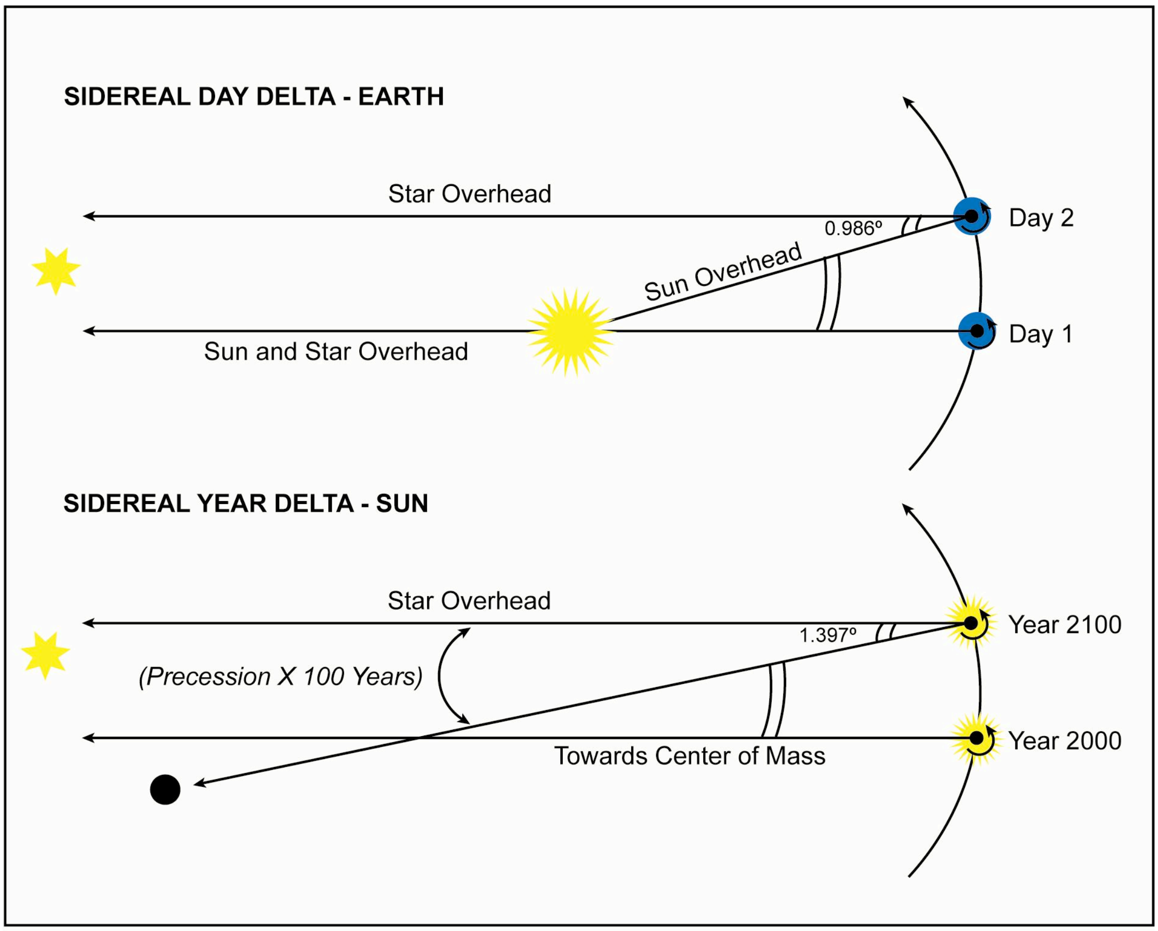

Figure 6 Cruttenden et al., Sidereal Delta

[12] Remember this axis of the oblate Earth is subject to the same physics of the Earth as in the lunisolar model albeit the forces in the binary model only need to produce enough torque to hold the Earth in a synchronous position (just as the major moons in the solar system are held in a synchronous position relative to their home planets).

Figure 6. Sidereal day delta compared to sidereal year delta. Note that both deltas account for orbits.

> Just because there is no known orbit, which need be compensated for by an annual delta between a sidereal year and a solar year, does not mean the 20-minute delta must be caused by something other than an orbit.
>
> The binary theory unifies the cause behind all time deltas and once again eliminates the need for a special explanation to explain a solar system phenomenon. The burden of proof lies with those who support the current lunisolar precession theory, which requires a different explanation for the two deltas as well as so many other solar system "anomalies".

Earth Orbit Geometry and Reference Frames

As mentioned, the geometry of the Earth's orbit measured in the period from equinox to equinox (one tropical or solar year) or measured in the period from same star to same star (a sidereal year) differs in the two models of precession. In the lunisolar model the Earth is thought to travel around the Sun 50 arc seconds less than a complete 360 degree orbit in the solar year because that is what you see if you look back at inertial space after one solar year; the Earth comes up 50 arc seconds short of a 360 degree orbit at the time of equinox. It is assumed that the Earth's spin axis was sufficiently wobbled by local forces to cause the change in Earth orientation, even though it maintains its 90-degree position at the time of the equinox. This lunisolar model only recognizes the longer sidereal year as representing a complete 360-degree orbit of the Earth around the Sun. Moreover, the lunisolar model does not recognize any binary motion and therefore uses one less reference frame (in relating to inertial space) than the binary model.

The binary model on the other hand says that the Earth goes around the Sun a full 360 degrees equinox to equinox, that the equinox does not move relative to the Sun, and only appears to come up 50 arc seconds short (relative to inertial space) because the solar system itself (which contains the Earth, Moon, Sun system) is curving through space (due to the binary motion). Likewise the Earth in a binary model goes around the Sun 50 arc seconds more than 360 degrees in a sidereal year. So the two models are quite different.

In summary, one says precession is caused by local forces wobbling the Earth (and moving the equinox) so the equinox always occurs before the Earth has completed a 360 degree motion around the Sun, and the other says the equinox is fixed and the Earth has completed a 360 degree motion at the time of equinox but just appears to come up short because the solar system itself is a moving reference frame.

Fortunately, there are enough things happening within the moving reference frame of the solar system, to determine which model is true. For example: solar eclipses and planetary conjunctions are calculated based on the tropical year. Here is a quote for the Sirius Research Group website:

"…there seems to be no doubt that the occurrence of solar eclipses and planetary conjunctions, for example, are calculated based on the time interval of the fundamental tropical year (a). These observed celestial phenomena are, in fact, not derived from a roughly twenty minutes longer orbital period of our Earth around its Sun.

Conforming to the laws of geometry, there can only be one 360-degree orbit period of the Earth around the Sun - either the tropical year or the so-called sidereal year.

It is argued that each of these years or orbit periods are defined with respect to two different frames of reference: a moving and a non-moving origin. Astronomers, therefore, consider the reference frame of the fixed stars as the non-moving origin and the equinoctial points as the moving origin.

The regression of the stars is an observed phenomenon, yet astronomers who apparently make no assumptions about its cause assert that our Sun (speak solar system) does not move in space.

What they fail to recognize is the simple fact that the so-called moving origin (the equinox) is actually a fixed frame of reference within a moving system, while the fixed stars represent a fixed point outside the moving reference frame of our solar system.

Precise mathematical equations that describe the observed phenomena occurring within our solar system (eclipse cycles, planetary conjunctions, etc.) do not rely on an outside frame of reference. Since the 360-degree equinoctial cycle of our Earth reflects physical reality, it is not a matter of finding out if our solar systems moves or curves through space but what causes it to move.

We invite the reader to investigate the current methods of calculating Saros cycles, eclipses, planetary conjunctions, and other mathematically testable celestial relationships within the solar system. You will find that although precession is said to be caused by a local wobbling of the Earth, it need not be compensated for within the solar system. Why? Because it is not due to any wobbling of the axis by local forces. It only comes into play when looking outside the solar system towards the fixed stars, as it is only then that the true cause of precession, a moving solar system, has any bearing on positional calculations.

All arguments lead to a unified solution

Although the weight of the above arguments cast great doubt on the feasibility of lunisolar precession theory they do not necessarily "prove" we are in a binary system. But where current solar system theories require different dynamics to explain all the unusual phenomenon: a rogue planet to explain the sheer edge or non-random comet phenomenon, disappearing matter to explain the loss of angular momentum, different physics to explain the time deltas between sidereal and solar days, lunar periods and sidereal and solar years, etc., the binary theory is simple because it offers a single solution which makes sense out of all of the current solar system formation theory problems. Moreover, current theory sometimes has no explanation for certain phenomena, such as for the accelerating trend in precession rates or why lunar rotation equations do not show the Earth traveling less than 360 degrees relative to the Sun in an equinoctial year as required by lunisolar theory. But again the binary theory makes sense of all these pieces, which are not only easily explained but actually expected in a binary system. To recap:

Likely Binary System	**Accepted Single Sun System**
most star systems are binary[13]	minority of star systems
curved path of Sun through space simply explains the Earth's changing orientation to inertial space, is expected phenomena	no significant curvature in Sun's path, requires Earth's changing orientation to inertial space to be explained by complex theories that are still unproven;
sidereal and solar year time deltas are natural result of binary orbit	sidereal and solar year delta explanation conflicts with sidereal and solar day explanations – requires different physics
angular momentum balances with dual star	peculiar distribution of angular momentum among planets still not explainable
sheer edge of solar system is explained and expected,	observed sheer edge of solar system is unexplained and unexpected
precession accelerates past apoapsis	lunisolar precession should be constant (unless gravity of Sun and Moon are steadily increasing) but in fact precession calculations are continually altered
precession conforms to elliptical equation model – Kepler's laws	precession should be relatively constant but it is not
Precession is only seen relative to objects outside the solar system	Lack of precession relative to objects within the solar system is inexplicable

[13] A. Richichi and C. Leinert 2000, and NASA's Chandra X-Ray Observatory website

some long cycle comet paths should be channeled by dual mass	comet paths should be random, but they are not [14]
recognition of binary reference frame provides single solution to solar system anomalies	lack of recognition of binary reference frame makes observables seem like anomalies and requires disparate theories to explain: wobble, time deltas, angular momentum, etc. Occam's razor applies.

Conclusions

The majority of stars form in multiple system relationships. It is likely that our Sun is also in a binary or multiple system relationship and conforms to the majority.

The angular momentum distribution of our solar system is a problem that has frustrated attempts at developing a reasonable theory of how the solar system developed. This problem disappears using a binary relationship model. (Fig. 5)

The gravitational effect of a binary companion could easily cause a non-random distribution of long-range comets.

In a single sun system, an abrupt edge like the one just beyond our Kuiper Belt would not be expected. In a binary system a sheer edge would be normal and expected.

The current model of precession (spinning top speeding up) would mean a very different value of precession 100,000 years ago. In a binary relationship model, there is a reason for periodicity and precession 100,000 years ago would be about the same as today – because it would be cyclical. This is in keeping with the accepted Milankovitch (Precession) Cycle. (A. L. Berger 1977)

Unlike lunisolar theory, the new model does not require concurrent slippage of the equinoctial point in order make precession work:

- An equinoctial year, tropical year and solar year all, once again, represent a 360 degree motion of the Earth around the Sun.

- The equinox occurs at the same place in the Earth's orbit path each year (relative to the Sun). The ecliptic plane and celestial equator are fixed at the point of the equinox and all lunar rotation and eclipse data makes sense.

- The average calendar year represents a complete orbit of the Earth around the Sun. (Except for the differential between 365.25 (average days in a year) and

[14] J. B. Murray 1999, and D. P. Whitmire, J. J. Matese and P. G. Whitman, 1999

365.2422 (actual rotations in a year) that exists because mans calendar is made of whole days).

Also, the new model does not require extremely complex equations to predict precession. Nor do the new equations suffer a high degree of degradation over time:

- The Earth's changing orientation to inertial space is only minimally affected by the planets, tides, geo-physical movements, asteroids, etc. The principal source of movement is caused by the binary motion and the Sun curving through space, slowly changing the Earth's orientation.

- Precession can be more accurately, and easily predicted by plotting the angular velocity of the Sun in its binary orbit, and using this as the main input in precession calculations.

- The Sun's angular momentum is now proportional to its mass, along with the other planets.

- Precession's annual increase is attributed primarily to the increasing angular velocity (curved motion) of the Sun's "elliptical" orbit around it's binary.

- Precession waxes and wanes with the elliptical orbit of our Sun around its binary center of mass. In this model precession is cyclical and the current accelerating precession trend, expected in elliptical orbit, is now understandable.

- Precession was never so small as to not exist and it will never become so large that we all wobble off the Earth. Minimum precession is about one degree every 72 years when the Sun is at apoapsis, and maximum precession is about one degree every 60 years when the Sun is near periapsis. The Earth will average about one degree of precession per 66.6 years over the 24,000-year cycle.

The new model does not require one cause to be given to explain the difference between a solar and sidereal "day" (orbital curvature) and another completely different principal to be given to explain the difference between a solar and sidereal "year":

- The sidereal year is 360 degrees plus precession due to the Sun's motion

- The sidereal year realigns with the same stars of a year ago, 20 minutes later than an equinoctial year (50.29 arc seconds), only because the solar system has curved through space by about 50 arc seconds, along it's binary orbit.

- Just like the delta between a sidereal day and a solar day, the delta between a sidereal year and solar year is also due to curvature of an orbit. The "day" delta is due to curvature of the Earth around the Sun. The "year" delta is due to curvature of the Sun around its binary center of mass.

The binary model is a simpler, more logical model for explaining the mechanics of our solar system and the motions of the Earth.

References

Allen, R. L., G. M. Bernstein, and R. Malhotra 2001. The Edge of the Solar System. *The AstroPhysical Journal* , **549,** 1241-1244**.**

Berger, A. L. 1977, Support for the Astronomical Theory of Climatic Change, *Nature,* **269,** 44-45.

Carroll, B. W., and D. A. Ostlie 1998. Pluto, Solar System Debris, and Formation. In *An Introduction to Modern Astrophysics* (J. Berrisford, J. Albanese, Eds.) pp. 890-900. Addison-Wesley Publishing Company, New York

Matese, J. J., P. G. Whitman, and D. P. Whitmire 1999. Cometary Evidence of a Massive Body in the Outer Oort Cloud*.* *Icarus*, **141**, 354-356.

Murray, J. B. 1999. Arguments for the Presence of a Distant Large Undiscovered Solar System Planet. Monthly Notices of the Royal Astronomical Society 309, 31-34.

Richichi, A. and C. Leinert 2000, Binary Stars and the VLTI Research Prospects, Proc. SPIE 4006, 289-298.

Santagata, C., 2002, On Newton's Paradoxes. Gruppo di Ricera Matematica Applicata (G.RI.M.A)

Sirius Research Group, 2000, Comments on the Saros and Sidereal Periods, www.SiriusResearchGroup.com

Svitil, K. A. 2001. One of Our Planets Is Missing. Discover Magazine, October 2001

U.S. Naval Observatory 1900 to 2002. The American Ephemeris and Nautical Almanac (1900 to 1980), Astronomical Almanac (1981 to 2002), U. S. Government Printing Office, Washington.