The Time of Perihelion Passage and the Longitude of Perihelion of Nemesis

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Abstract

If Nemesis, a hypothetical solar companion star, periodically passes through the asteroid belt, it should have perturbed the orbits of the planets substantially, especially near times of perihelion passage. Yet almost no such perturbations have been detected. This can be explained if Nemesis is comprised of two stars with complementary orbits such that their perturbing accelerations tend to cancel at the Sun. If these orbits are also inclined by 90° to the ecliptic plane, the planet orbit perturbations could have been minimal even if acceleration cancellation was not perfect. This would be especially true for planets that were all on the opposite side of the Sun from Nemesis during the passage.

With this in mind, a search was made for significant planet alignments. On July 5, 2079 Mercury, Earth, Mars+180°, and Jupiter will align with each other at a mean polar longitude of 102.161°±0.206°. Nemesis A, a brown dwarf star, is expected to approach from the south and arrive 180° away at a perihelion longitude of 282.161°±0.206° and at a perihelion distance of 3.971 AU, the 3/2 resonance with Jupiter at that time. On July 13, 2079 Saturn, Uranus, and Neptune+180° will align at a mean polar longitude of 299.155°±0.008°. Nemesis B, a white dwarf star, is expected to approach from the north and arrive at that same longitude and at a perihelion distance of 67.25 AU, outside the Kuiper Belt. The mass of Nemesis A is estimated to be 2.545 Jupiter masses, and the mass of Nemesis B is estimated to be 0.4325 solar mass.

The Sun's orbit about this ternary system's center of mass, not the presumed Newtonian lunisolar torque, may be the primary cause of the precession of the equinoxes. This ternary system itself is apparently a member of a globular cluster of cold dark stars, a hypothetical object not recognized by conventional astronomers. I suggest that dark globular clusters have been misidentified as cosmic voids. The ecliptic longitude of the center of this cluster is about 258°, but its latitude has not yet been determined. In fact, there is a huge cosmic void located at that very longitude and about +24° latitude, which is very near the equatorial plane. The temperature of these cold dark stars may be 2.7°K. If so, they may be the source of the cosmic microwave background (CMB). The CMB anisotropy dipole can be explained by the Sun's motion relative to these cold, dark stars. If the orbital elements for the three ternary system members and for the ternary system itself about the dark cluster barycenter can be found, it may be possible to compute the observed CMB anisotropy dipole. This hypothesis would be proved if two faint stars in opposite hemispheres with extremely high annual parallaxes were found near their predicted positions in the sky.

1. Nemesis's Invisibility

Nemesis is the name given to a hypothetical solar companion star by Richard Muller[1][1] that is credited with having bombarded the solar system with asteroids and/or comets in the distant past. In addition to the evidence from impact craters and mass extinctions, there are ancient legends referring to historic apparitions of such a star. Walter Cruttenden writes:

> The Arabic, Sumerian, Mithraic and Vedic traditions all made reference to another star that influenced our Sun and "drove precession." That other star has been called by many names: Nibiru, Indra, Mithras, etc. but has been little understood or acknowledged in modern times. …
>
> The Sumerians, one of the oldest cultures in the world, made reference to *other Suns* in stone tablets found scattered in the ruins of Sumer. …
>
> One well-known Sumerian celestial object is called Nibiru, made famous by Zecharia Sitchin in his book, *The 12th Planet*. …

Sitchin has done a great job of recognizing and describing many of the astounding accomplishments of the ancient Sumerian people, and noticing that this civilization was once at a very high state of development. For this he should be commended. However, his astronomical theory does not fit with basic physical astronomy, and his interpretation of some celestial words and symbols has been challenged by well-regarded scholars.

One scholar of note, Michael Heiser (with degrees in ancient history and lost languages, as well as a Ph.D. in the Hebrew Bible and Ancient Semitic

Languages), has examined the same data as Sitchin and come to the conclusion that the Nibiru symbol is always that of a "star", and does not represent a "planet." His work is thorough and compelling. [2][2]

The best arguments against the Nemesis hypothesis are the facts that it has not been observed either visually or gravitationally (because it is not perturbing planet orbits). The nearest known stars are too far away to be gravitationally bound to the Sun.

The failure to observe Nemesis visually can be explained in several ways, some of which are more plausible than others.

The most straightforward explanation for our failure to observe Nemesis visually is that our telescopes have seen it, but we just don't recognize it because it has such a very small proper motion since it is headed directly towards the Sun. It should also have a very high radial velocity, but there has been no systematic survey of faint stars having high radial velocities.

The problem with this explanation is that while the proper motion of Nemesis should be quite small, its annual parallax should be much larger than any known stellar parallax. Hipparcos, a European mission, systematically cataloged the precise astrometric positions, proper motions, and annual parallaxes of 118,000 stars. This includes almost every star brighter than 9th magnitude. This explanation might succeed if Nemesis is fainter than 9th magnitude, and that is a distinct possibility. If Nemesis is brighter than 9th magnitude, it could be hiding as a foreground star in the Milky Way star clouds or in one of the many globular clusters or galactic clusters because the Hipparcos telescope did not have enough resolution to resolve individual stars in dense clusters.

Another reason why the annual parallax of Nemesis has not yet been discovered is that it may be so large that observers may have classified it as being a trans-Neptunian object. The problem with this excuse is that Nemesis is probably much brighter than any trans-Neptunian object.

A more speculative explanation for failing to observe Nemesis involves gravitational lensing by the Sun. I discussed this idea in two previous papers.[3][3] [4][4] If the Sun is at the center of a gravitational lens and Nemesis is outside that lens but inside its focal distance, it would not be visible. A gravitational lens is defined as a spherical volume of space in which the speed of light is slower inside than outside. No object outside the lens and inside its focal distance (the invisibility zone) can be imaged inside the lens with an optical system that is focused at infinity as all telescopes are focused. If this explanation is correct, then Nemesis would simply suddenly appear in the night sky when it passes inside the Sun's gravitational lens. If so, astronomers might think it was a nova at first, until they measured its radial velocity. If Nemesis suddenly appears in this way, that would be strong support for the solar gravitational lens hypothesis.

Astronomers normally associate gravitational lensing with Einstein rings.[5][5] These are optical distortions of a background galaxy caused by the gravitational lens of a foreground galaxy along the same line of sight. But if we could move our point of view much closer to the lensing galaxy, we would not see the Einstein ring. Instead, we would see a minified image of the background galaxy (see Section 2).

Gravitational lenses are ubiquitous in the universe. There is no question that the Sun is at the center of a gravitational lens since stellar light ray bending has been observed many times during solar eclipses, and radio galaxy signals are also bent by the Sun. The only question is whether this lens has a continuous refraction index gradient that approaches one asymptotically along solar radials or whether there is a discrete spherical boundary outside the Kuiper Belt where the speed of light makes a sudden step up along a radial. Such a boundary would be a spherical lens surface.

I suggest that Earth is at the center of a gravitational lens, and its effect is called atmospheric refraction of starlight. The Sun is at the center of a gravitational lens, and its effect in the day sky is the bending of starlight and radio galaxy signals. Its effect in the night sky may be confused with stellar parallax.

Another conceivable explanation, that Nemesis itself is a cold dark star, may be ruled out if it is a survivor of a stellar collision (see Section 2) because the collision would certainly have heated it up to incandescence.

The only plausible explanation for the lack of planetary perturbations requires special conditions. Two stars that are poles apart in the sky could conceivably have masses and distances such that their gravitational forces at the Sun would cancel out over long periods of time. This arrangement of two stars having synchronous and opposing orbits relative to the Sun may sound fantastic until you consider they may have been the progenitors of solar system formation. Perturbations in the x-y (ecliptic) plane would be minimized if the inclination of the orbit plane of Nemesis relative to the ecliptic plane were nearly 90°. I made a case for a high-inclination orbit in my 2006 paper[3].

2. The Case for a Ternary System

Suppose the solar system as we know it formed from the debris of a stellar collision. My hypotheses is that a binary system similar to Sirius A and B originally had such an eccentric orbit that their periapsis distance was on the order of one AU but their period was a few tens of thousands of years. Suppose that the main-sequence star evolved into a red giant while its white-dwarf companion was far away at its apoapsis. Let's call the red giant Nemesis A and the white dwarf Nemesis B.

Suppose that the radius of Nemesis A became greater as it expanded into a red giant than the periapsis distance of the binary system. If so, then when Nemesis B returned to its periapsis, it would have plowed through Nemesis A, completely disrupting it and blasting perhaps 99.75% of it into space and leaving behind only a brown dwarf core of perhaps 0.0025 solar mass (2.6 Jupiter masses) as the survivor. Actually, that is approximately the present estimated mass for this brown dwarf star. But if it has transferred substantial mass onto the Sun at each perihelion passage, then it would have been substantially more massive than 0.0025 solar mass immediately following the collision.

This devastation would have occurred because the surface gravity and the density of white dwarf stars are extremely large, and Nemesis B would have survived the collision virtually intact.

Some of the collision debris would have been captured by each star in accretion disks, but the bulk of it, about one solar mass, could have formed the proto-solar nebula that could have collapsed under its own gravity to form the Sun at what was originally the barycenter of the binary system, but has since evolved into the gravitational equilibrium point of the newly-formed ternary system.

I suggest that Nemesis A's accretion disk, rich in heavy elements, furnished the material that eventually formed the inner rocky planets while Nemesis B's accretion disk, rich in hydrogen, furnished the material that eventually formed the gas giant planets of the solar system.

I suggest that the original binary system (and consequently the present ternary system) has always been and continues to be a maverick member (maverick because its members are hot and bright) of a globular cluster of a few hundred thousand cold, dark stars. Such stars are unknown in conventional astrophysics because the only acknowledged process for cooling a star is radiation. In my theory there is a much more powerful cooling mechanism, namely reverse beta decay of hydrogen atoms: the transformation of hydrogen atoms into neutrons. Each reverse beta decay event would absorb as much thermal energy as the ordinary beta decay that a free neutron releases, about 0.782 MeV per neutron. I suggest that the average temperature of a cold, dark star is about 2.7°K. The uniformity of the cosmic microwave background (CMB) over the sky can be explained if the Sun and its companions are surrounded by hundreds of thousands of cold, dark stars that form a globular cluster. The anisotropy dipole in the CMB can be explained by the Sun's motion relative to these cold, dark stars.

Confirmation of the Cold Dark Globular Cluster (CDGC) hypothesis would come if the resolution of a subsequent CMB observatory, perhaps ESA's Planck Mission with an angular resolution of about 5 arcminutes, is high enough to resolve the CMB into hundreds of thousands of point sources. Support for this hypothesis could come if the Sun's motion relative to the CMB, the combination of the Sun's orbital velocity with respect to the ternary system center of mass (CM) and the orbital velocity of that CM with respect to the center of the CDGR, agrees with the "absolute" solar motion observed by the COBE and WMAP spacecraft. This issue will be studied after the orbital elements of Nemesis A and B and of the ternary system have been determined.

I suggest that the few dozen known so-called cosmic voids (circular areas in the sky that have galaxy abundances much below average and those few galaxies that are present are quite small and distant) are in fact globular clusters of cold dark stars. I suggest that the faint galaxies that we see in these "voids" are background galaxies that are minified by the optical properties of the CDGC acting like a spherical lens. Hold a glass ball at arms length and look through it to see what I mean.

3. Ternary System Accelerations

The information in this section is somewhat out of order in the sense that it uses the longitudes of the perihelia of Nemesis A and B and their dates of perihelion passage that are developed in Section 4. But this section immediately applies to the CDGC hypothesis proposed in Section 2 in the sense that it shows how a ternary system can balance or cancel the acceleration that the CDGC would otherwise impose on the solar system.

The ternary system must be in orbit about the CM of this dark cluster. The plane of this orbit is evidently either the ecliptic plane or the equatorial plane. Which plane it is will be determined later. The orbit planes of Nemesis A and B are approximately perpendicular to this plane. These stars are well outside the ecliptic plane, either above it or below it except when they actually pass through the plane. As we will see later, these passage times are eight days apart, with Nemesis A passing through the asteroid belt on July 5, 2079 moving northward, and Nemesis B passing just outside the Kuiper Belt on July 13, 2079 moving southward.

Fig. 1 illustrates the accelerations on the Sun from its two companions and the central attractor of the CDGC of which the Sun and its companions are members on July 5, 2079 when Nemesis A passes by.

The grid unit in Fig. 1 is km/day^2. The plane of the chart is the ecliptic plane, and the $x = 0$ axis is the line of the equinoxes. The CDGC is probably located in the either the ecliptic plane or the equatorial plane. Fig. 1 assumes it is in the ecliptic plane, but a quick survey of cosmic voids shows that there is a huge one with a radius of about 17° in the equatorial plane at that same longitude of 258°. The accelerations cannot cancel exactly except at one point in time. However, since Nemesis A and B are always in opposite celestial hemispheres, it should be possible to adjust their eccentricities to minimize the integrated residual acceleration over their common period, at least from now back to their aphelia, if not from now forward to their perihelia. We have not seen significant planetary perturbations in the past, but who knows what we may observe in the future?

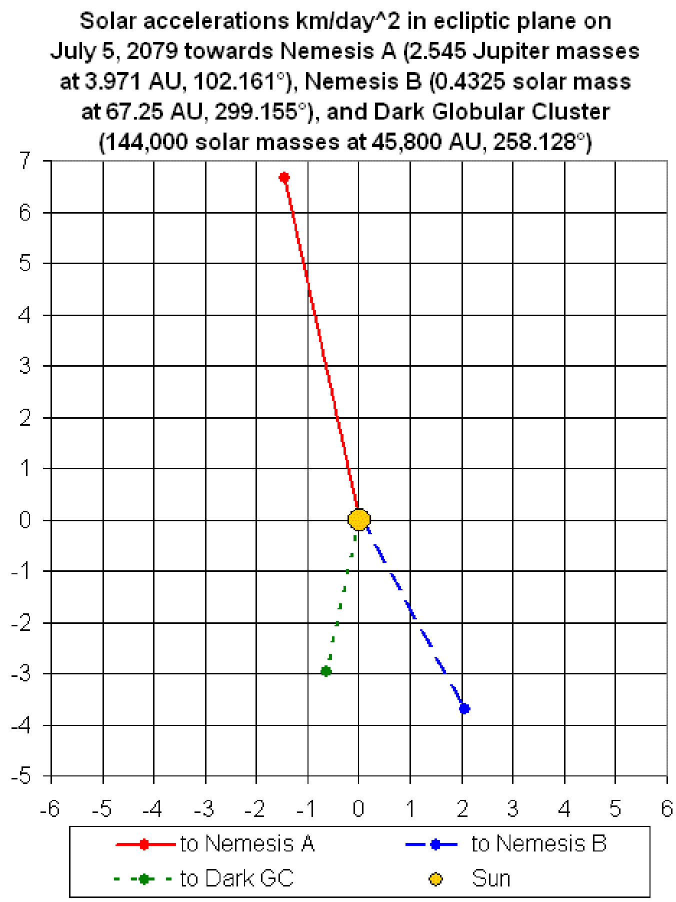

Figure 1. Solar accelerations for a ternary system

The magnitude (only) of the acceleration of the Sun towards the center of the CDGC can be estimated by iteration to be 3.03792 km/day^2 from the known variation in the lunisolar precession rate with time.

I assumed that the perihelion distance of Nemesis A is 3.971 AU, which is the location of the Kirkwood 3/2 resonance with Jupiter. An asteroid at that distance from the Sun goes around the Sun three times while Jupiter goes around it twice. Kepler's third law states that the period of a planet in years is equal to its semi-major axis in AU raised to the 3/2 power. Since the semi-major axis of Jupiter's orbit is 5.203 AU, the semi-major axis of the 3/2 resonance Kirkwood Gap is given by $[(2/3)(5.203^{(3/2)})]^{(2/3)} = 3.9706$ AU.

This band is the nearest Kirkwood "gap" that still contains asteroids, contrary to the standard theory, which says that all of the Kirkwood gaps should have no asteroids at all. These various resonances (2:1, 3:1, 7:3, 5:2, etc.) are called Kirkwood gaps after the astronomer who discovered that there are no asteroids orbiting at those distances from the Sun. Astronomers proposed a theory to explain why asteroids are depleted in these resonance bands. Their models showed how any asteroid in one of these gaps would be repeatedly retarded by Jupiter or advanced by Jupiter over time so that they would drift to higher or lower distances from the Sun, avoiding the resonant distance. There is nothing wrong with their theory. But their assumptions are faulty because these asteroids need at least 100,000 years to drift away from these resonant bands under Jupiter's influence, and according to my theory Nemesis A passes through the asteroid belt every 24,000 years and stirs up all the existing asteroids.

According to my theory these inner Kirkwood gaps are depleted in asteroids because Nemesis A perturbed them all into higher or lower orbits in past perihelion passages. The asteroids themselves may be the debris from an exploded planet[6][6] caused by an even earlier passage of Nemesis A.

There are two remaining Kirkwood "gaps" that are still populated with asteroids. The nearest one to the Sun is the 3:2 resonance at 3.971 AU, which is why I chose it for the perihelion distance of Nemesis A. Allow me to quote Stuart Ross Taylor [7][7]:

> Strong depletions of asteroids occur at the 2/1 (3.28 AU) and 3/1 (2.50 AU) resonance with Jupiter. Other gaps occur at the 7/3, 5/2, and 4/1 ratios of jovian/asteroid orbital periods (Fig. 5.11.1). The ultimate explanation for the Kirkwood Gaps is understood in terms of chaotic behavior. Asteroids occupying orbits that are simple ratios of the jovian orbit may remain in regular orbits for periods of 100,000 years before suddenly jumping into a chaotic state, with large increases in orbital eccentricity. The resulting orbits may well become Mars- or Earth-crossing, they providing the terrestrial meteorite flux [146].
>
> The 2/1 and 3/1 Kirkwood Gaps contain few asteroids and contrast sharply with the 3/2 resonance (3.97 AU), which is populated by the Hilda Group, including 153 Hilda and 190 Ismene (80 x 100 km

> diameter). These differences have always been puzzling in terms of classical dynamics, but are probably due to underlying dynamical differences: "Where the phase space is chaotic there are no asteroids, and where it is quasiperiodic, asteroids are found" [146].
>
> The 4/3 resonance at about 4.2 AU contains 279 Thule, while 1/1 resonances are occupied by the Trojans at the Lagrangian points ahead of and following the orbit of Jupiter.

So this 3/2 Kirkwood Gap theory allows us to define another of the many variables.

I also suggest that we can plausibly assume that the ratio of the mass of Nemesis B to that of Nemesis A is equal to 178. In the present version of my hypothesis, the original perihelion of Nemesis A relative to the Sun was 0.39 AU, the semi-major axis of Mercury's orbit, and the original perihelion of Nemesis B was 5.2 AU, the semi-major axis of Jupiter's orbit. These perihelia have expanded at each passage because the stars have transferred some of their own mass onto the Sun or the solar system at each passage. As a first approximation, since we expect their gravity forces to cancel out, we can say that the mass ratio of these stars should be equal to the square of their semi-major axis ratio by using Newton's universal gravitation law. So at the time of the first perihelion, the mass ratio of Nemesis B to Nemesis A was:

$$\frac{m_B}{m_A} = \left(\frac{a_{Jupiter}}{a_{Mercury}}\right)^2 = \left(\frac{5.2}{0.39}\right)^2 = 178$$

Even if this initial mass ratio is correct it may have changed over time if Nemesis A gained more mass from the Sun or lost more mass to the Sun during previous passages than Nemesis B. Nevertheless it is a reasonable start. This mass ratio of 178 allows us to define another variable.

The remaining undefined variables are the perihelion of Nemesis B and the mass of either Nemesis A or B. I varied those two variables using Microsoft Excel's Solver to minimize the error between (1) the magnitude of the acceleration of the Sun towards the Dark Globular Cluster to cancel its accelerations toward Nemesis A and B, and (2) the magnitude of the acceleration of the Sun towards the CDGC needed to match the known variation of the lunisolar precession rate with time over a couple of millennia. This had been determined earlier to be 3.03792 km/day^2 based on the calculated eccentricity and period (see Section 7). The solutions obtained from Solver were that the perihelion distance for Nemesis B is 67.2547 AU, and masses for Nemesis A and B are 2.545 Jupiter masses and 0.43253 solar masses, respectively. The perihelion distance for Nemesis B is comfortably outside the 50-AU outer edge of the Kuiper Belt of trans-Neptunian asteroids.[8][8]

These masses for Nemesis A and B fit within the limits for a brown dwarf and a white dwarf star. I have estimated that Nemesis A has the mass of 2.545 Jupiters, which is 0.00243 solar masses, which is just a little greater than the conventional minimum of 0.002 solar masses for a brown dwarf star. Also Nemesis B has a mass of 0.4325 solar masses, which is well under the Chandrasekhar limit of 1.4 solar masses.

4. Future Planetary Alignments

I know of no physical reason why planet alignments should have anything to do with the times of perihelion passages of Nemesis A or B. Perhaps these stars impose some sort of resonance constraints on planet orbit periods. If so, then the planets are certainly not controlling the stars. The stars must be controlling the planets. Not knowing any better, I prefer to imagine that these orbits were designed by an intelligent designer because the results seem to be more perfect than one could hope for by chance. Whether my idea concerning an intelligent designer is true or not does not matter. What matters is that it is proving to be useful.

Planetary lineups are generally unremarkable because they happen so frequently. Richard W. Noone wrote a book entitled *5/5/2000 Ice: The Ultimate Disaster* (I omit this book from my list of References), and the latest edition was published in 1995. It claimed that the six-planet (Mercury, Venus, Earth, Mars, Jupiter, Saturn) lineup that occurred on that date would actually “cause” a global disaster. Noone is not an astronomer. He is a new-age researcher. He got his information from an astronomer. In fact, May 5, 2000 yields a “good” 6-planet lineup only if you omit Venus and Mars. On that date, Earth is one side of the Sun and the other five planets are on the other side. The mean longitude on May 5.5, 2000 (noon UT) for six planets (Earth+180°) is 46.47°±9.87°. If you omit Venus and Mars, the mean longitude for four planets is 46.41°±1.89°. Compare that with my eight-planet alignment of 291.4°±5.7° mean longitude on July 11, 2079 and my four-planet alignment of 282.161°±0.206° mean longitude on July 5, 2079.

No disaster could ever be caused by a planetary lineup because such lineups have no such power. But the quality of my lineups (the small size of their probable errors) shown in Fig. 4 and Fig. 5 does seem to be especially remarkable. I suggest that the power of my lineups is in the information they give us: longitudes and dates. By themselves, these bits of information prove nothing. But I intend to use them as if they convey the meaning I ascribe to them in order to compute orbital elements for Nemesis A and B relative to the Sun and of the Sun relative to the center of mass of the ternary system. I claim that this solar orbit about the ternary system barycenter is the major (but not the only) cause of the precession of the equinoxes. It ought to be possible to eventually determine at least some of the orbital elements of the ternary system itself relative to the CDGC. That orbit may have a period of millions of years. Then I will look for objective predictions that might be gleaned from these mathematical models.

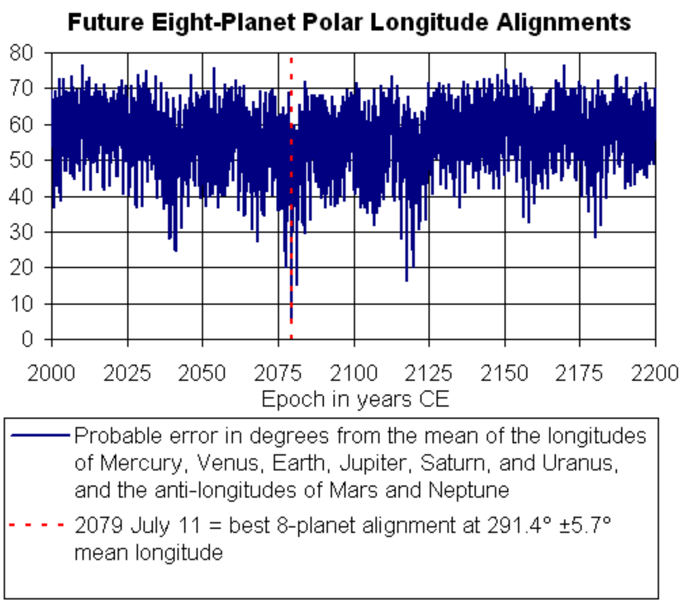

Figure 2. Future 8-planet polar longitude alignments

Fig. 2 plots the probable error from the mean of the polar longitudes of Mercury, Venus, Earth, Jupiter, Saturn, and Uranus, and the anti-longitudes (longitudes + 180°) of Mars and Neptune over the 200-year interval from 2000 to 2200 CE. Since Mercury moves so fast (88-day period), 0.05-year (18.2625-day) steps were taken to find all the minima.

The polar longitude of a planet is defined as its true anomaly plus the longitude of its perihelion. It is arctan(y/x), where the radius vector to the planet from the Sun is specified in a Cartesian coordinate system as $\{x,y,z\}$, the x-y plane is the ecliptic plane, and the x axis is the line of the equinoxes. The mean longitude is determined by averaging the x and y components of unit vectors in each longitude direction.

At each discrete minimum in the table, the epoch for that line in the table was continuously fine-tuned to locate the true minimum. The epoch of July 11, 2079 was the best alignment by a wide margin with a mean longitude of 291.4°±5.7°. The second best alignment had a probable error of ±15.2° on June 14, 2081. These alignments are for the case where the longitudes of Mars and Neptune are reversed. But the original search did not reverse any planet longitudes. I only reversed Mars and Neptune after I found the optimum epoch because it was obvious that should be done since their unreversed longitude errors for these two planets were near 180°.

As I was fine-tuning the epoch for the eight-planet alignment, it became obvious that the inner planets came to a sharper alignment on July 5, 2079, while the outer planets came to a sharper alignment on July 13, 2079 as shown in Fig. 3.

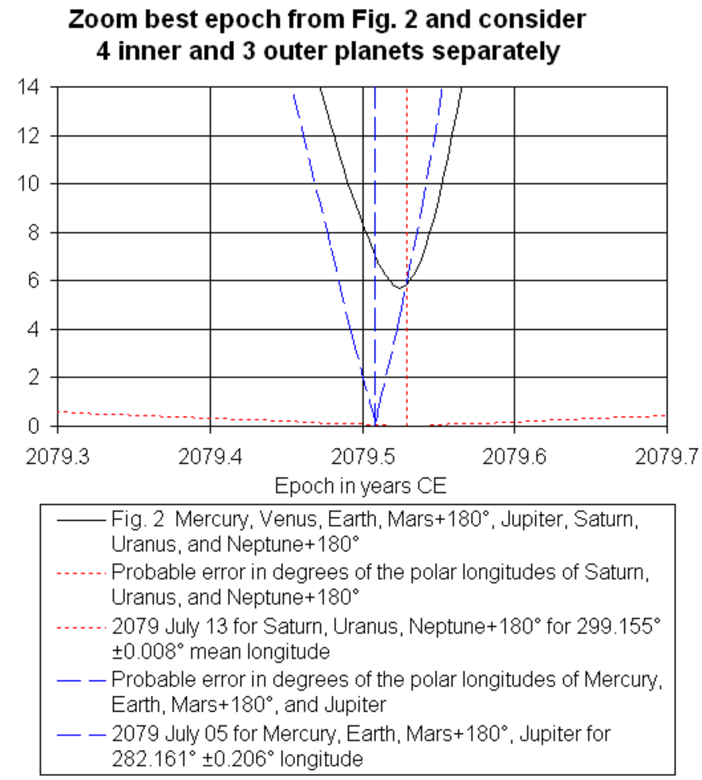

Figure 3. Zoom Fig. 2; separate 4 inner from 5 outer

Fig. 3 shows how the epoch was fine-tuned to find the best alignment. The solid curve is a zoomed version of Fig. 2. Fig. 2 covers an interval of 200 years. Fig. 3 covers an interval of 146 days. The short-dashed curve in Fig. 3 plots the probable error for Saturn, Uranus, and Neptune+180°. This outer-planet error reached an astonishing minimum of ±0.008° on July 13, 2079. The inner-planet plot revealed that Venus had a longitude error from the mean of 13.863° on July 5, 2079 when Mercury, Earth, Mars+180°, and Jupiter reached a minimum probable error of ±0.206° (long-dashed curve). So, Venus was dropped from the group. It must be a special case.

The orbital elements of the planets as functions of time that are used in this paper were obtained from J.L. Simon, et al.[9][9] The authors give fifth-order polynomials for the mean elements of the planets. Those alone are not adequate for computing ephemerides for the planets, especially the outer planets which have large perturbations. So they also give 8th-order trigonometric terms to account for perturbations over the interval 1800-2050 and 10th-order trigonometric terms to account for perturbations over the interval 1000-3000.

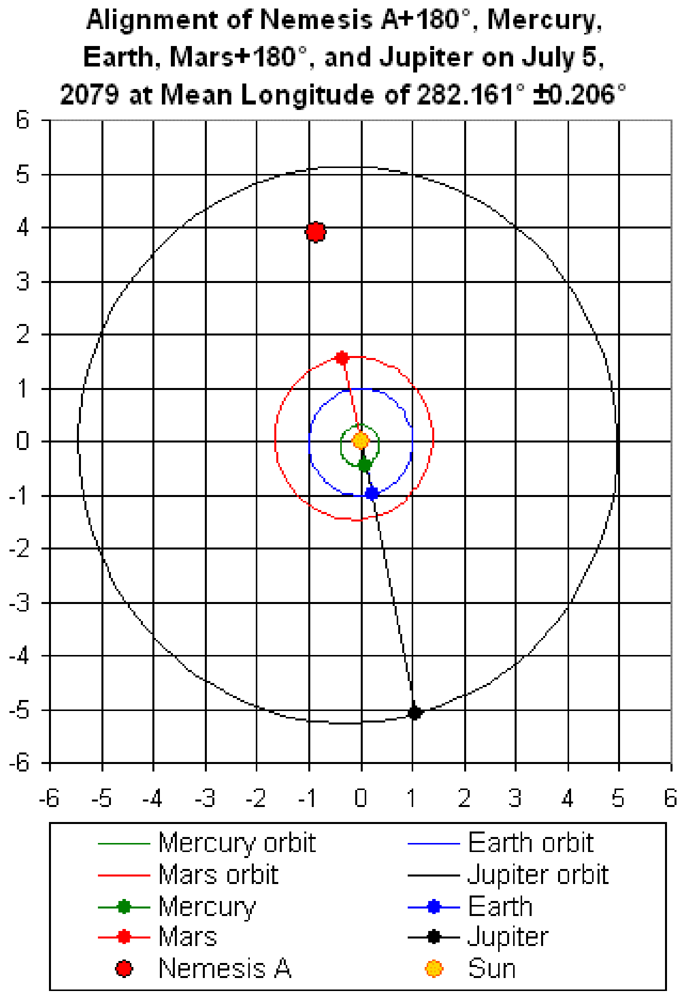

Figure 4. Alignment of Nemesis A and inner planets

Nemesis A is expected to pass through its perihelion of 3.971 AU at 102.161°±0.206° ecliptic longitude (J2000) moving northward along a path that is perpendicular to the ecliptic plane on July 5, 2079 as shown in Fig. 4. Its perihelion distance was chosen to be at the Kirkwood 3/2 resonance with Jupiter in the heart of the asteroid belt as I explained in Section 3. The grid units are astronomical units. The plane of the chart is the J2000 ecliptic plane, and the $x = 0$ axis is the line of the equinoxes.

Fig. 4 shows the alignment of Nemesis A and four of the five inner planets. Venus is missing from this grouping because it spoils the near perfection of the alignment. There is probably a reason for Venus being excluded from this alignment that we may discover later. Mars is included in the group even though it is on the same side of the Sun as Nemesis A while the others are on the opposite side because this explains how the southern hemisphere of Mars came to be covered with impact craters while its northern hemisphere is smooth. Nemesis A and its retinue of comets and meteors always fly towards Mars from the south at every apparition.

Nemesis B is expected to pass through its perihelion of 67.25 AU at 299.155°±0.008° eight days later moving southward on July 13, 2079 as shown in Fig. 5. Its perihelion distance and its mass were the two variables that were adjusted to balance the accelerations in Fig. 1. The mass ratio of Nemesis B to Nemesis A was assumed to be 178 for the reason given in Section 3.

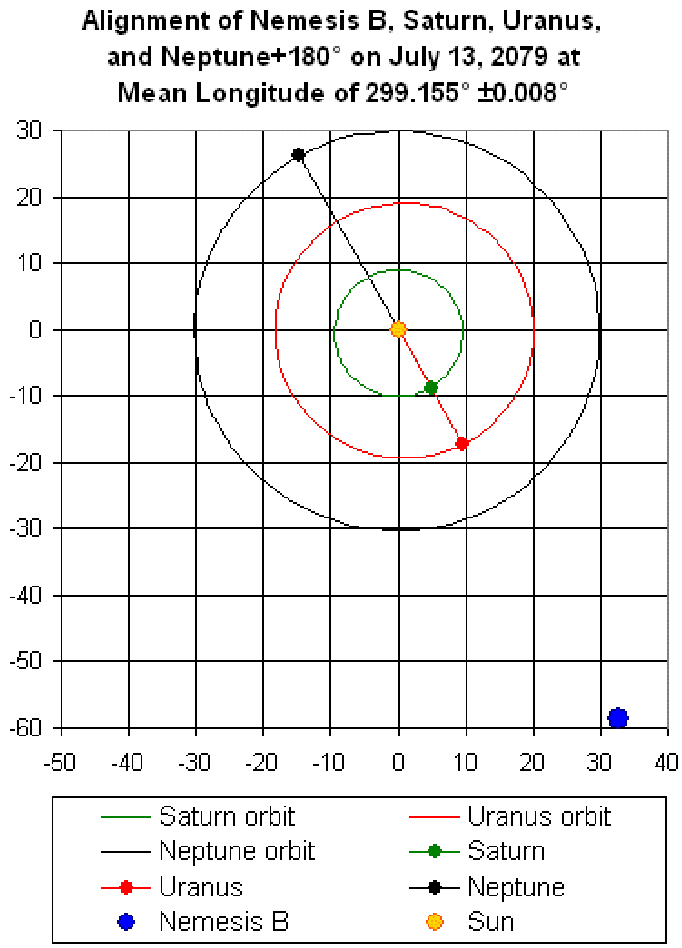

Figure 5. Alignment of Nemesis B and outer planets

5. Past Planetary Alignments

Simon, et al. did not intend their approximate ephemerides of the planets to be used earlier than 1000 CE, although in a private communication Simon said that Mercury's ephemerides were useful as far back as 4000 BCE. In this section I use all the Simon ephemerides back to 24000 BCE. So we cannot place much faith in the results of this section. Not only because we are using Simon's approximate ephemerides much earlier than they were intended, but also because the Jet Propulsion Laboratory's definitive numerical integrations[10][10] upon which Simon and his colleagues have based their formulas did not take Nemesis A and B into account. How could they? Their very existence has not even been established. We have no confirming observations.

If planetary alignments can be used to identify the times and longitudes of perihelia of Nemesis A and B in the near future, how would we find them in the ancient past at the previous apparition? It's one thing to examine 200 years into the future in 0.05-year steps. That's just 4,000 steps. It's quite another thing to search 25,000 years into the past at the same step size. Outer planet alignments could be found that way in principle using 0.25-year steps because Jupiter's period is 11.86 years, and one step would be 7.6 degrees. But 25,000 years would still mean 100,000 steps. That would be tolerable if it just meant computer time, but since I do all my calculations in Microsoft Excel, it means a spreadsheet with 100,000 lines to me. However, there is a short cut if we assume that the Sun either gains or loses mass whenever Nemesis A and B pass through the solar system.

The key to finding past planetary alignments over a 25,000-year interval may be to see if there is an epoch in the past when the semi-major axes of the planets lined up with each other. These would include the longitudes of the perihelia and/or the aphelia of all planets. The reason for such a key has to do with the assumption that during each passage, Nemesis A and/or B participate in a matter-transfer episode with the Sun. Either one or the other or both stars transfer matter onto the Sun, or the Sun transfers matter onto one or both of them.

The Sun continually loses mass in the form of protons and electrons that are transported by the solar wind. It might be possible for Nemesis B, the white dwarf star, to be a strong attractor for the solar wind and cause the Sun to transfer a considerable amount of mass onto Nemesis B while it is nearby.

Nemesis A might have a substantial tail like a giant comet. The variable star Mira was recently found to have an extremely long tail that is visible in ultraviolet light.[11][11] If Nemesis A has a tail, it might transfer matter onto the Sun while it is nearby.

Suppose for the sake of argument that the planet orbits were all circular before a sudden and permanent mass change in the Sun occurred.

If the Sun suddenly and permanently gained mass at some epoch, the planets would find that their velocities were too slow for circular orbits around the suddenly more massive Sun. The result would be that their previously circular orbits would suddenly become eccentric, and the polar longitudes of all the planets at that epoch would suddenly become their longitudes of aphelia.

Conversely, if the Sun suddenly and permanently lost mass at some epoch, the planets would find that their velocities were too fast for circular orbits around the suddenly less massive Sun. The result would be that their previously circular orbits would suddenly become eccentric, and the polar longitudes of all the planets at that epoch would suddenly become their longitudes of perihelia. This concept is illustrated in Fig. 6.

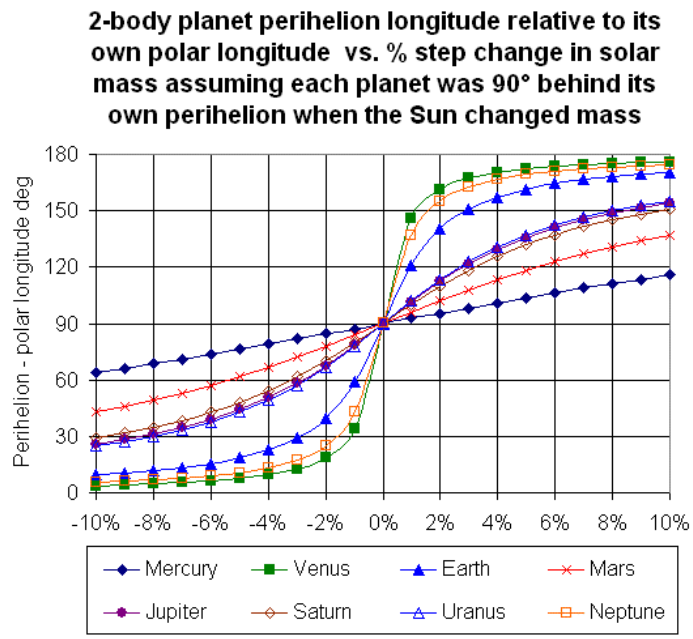

Figure 6. Solar mass changes affect planet orbits

Fig. 6 plots the behavior of the perihelion longitudes of the eight planets if the Sun should suddenly and permanently change its mass by a given percentage. The planets are viewed individually as two-body Keplerian orbits, assuming that each planet is lagging its own perihelion longitude by 90° when the Sun changes mass. This assumption is made to normalize the problem so that all eight planets can be shown in the same chart. At 0% change, the differences between each planet's longitude of perihelion and its own polar longitude are 90° because of that assumption. That's why all the curves cross each other at the center of the chart.

Notice that when the Sun loses mass, the difference between the perihelion longitude and the planet's own polar longitude approaches zero. This means the perihelion longitude moves near to the planet's own polar longitude. Conversely, when the sun gains mass, the difference between the perihelion longitude and the planet's own polar longitude approaches 180°. This means the aphelion longitude moves near to the planet's own polar longitude.

Notice that the steepest slopes at the center are for planets having the lowest eccentricity (most nearly circular), namely Venus and Neptune. Conversely the planets having the shallowest slopes at the center are for planets having the highest eccentricity, namely Mars and Mercury.

If all orbits had been exactly circular before the mass change, all the curves in Fig. 6 would be step functions with vertical transitions from 0° to 180° at 0%. That would mean that whatever polar longitude the planet had when the Sun changed mass would become the planet's new longitude of perihelion if the Sun lost even a small amount of mass, or it would become the planet's new aphelion longitude if the Sun gained even a small amount of mass.

With this understanding of the effect of a solar mass increase on a planet's aphelion longitude, we are justified in looking back in time for a possible alignment of planet aphelion longitudes assuming that they are proxies for the planets' polar longitudes at the time the Sun increased its mass. It is worth pointing out that this technique only works when looking back in time, since any shift in a planet's perihelion/aphelion longitude necessarily follows the Sun's mass change.

Fig. 7 shows the probable error from the mean of the longitudes of (1) aphelia of Mercury and Earth and the perihelion of Mars and (2) the aphelia of Jupiter, Saturn, and Uranus vs. time. Venus and Neptune are omitted because they do not fit the alignments of the other planets. I chose the planet aphelion longitudes (for all but Mars) to be aligned with each other because I believe that the Sun received a matter transfer from Nemesis A at the past passage. If the planets' orbits had been circular before the passage, and the Sun gained mass, then the planet aphelion longitudes would coincide with their polar longitudes after the mass increase. If the planets (except Mars) are to be on the opposite side of the Sun from Nemesis, then the longitude of the perihelion of Nemesis should be aligned with the planets' perihelion longitudes.

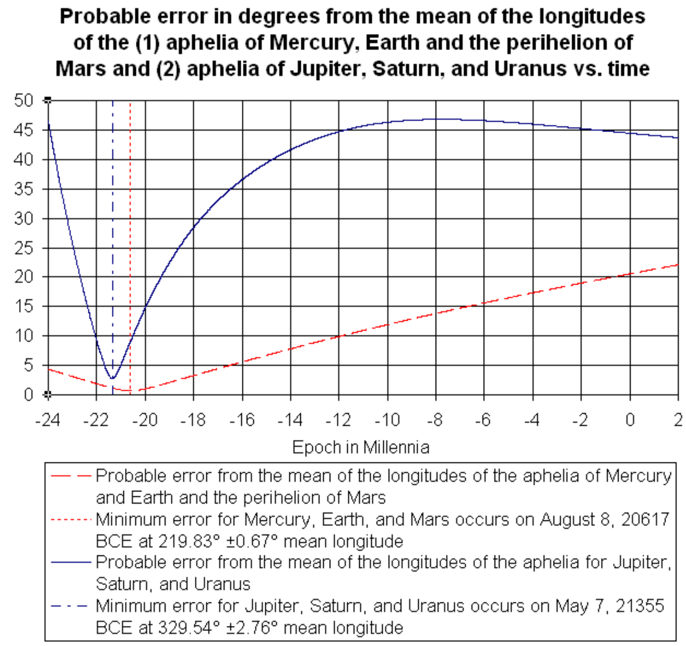

Figure 7. Past alignments of aphelion longitudes

Since Mars is expected to be on the same side of the Sun as Nemesis A as it is in Fig. 4, it follows that the perihelion of Mars should align with the aphelia of Mercury and Earth. By this reasoning, the longitude of the perihelion of Nemesis A on August, 8, 20617 BCE should be at 219.83° − 180° = 39.83° according to Fig. 7. Likewise, the longitude of the perihelion of Nemesis B on May 7, 21355 BCE should be at 329.54° − 180° = 149.54°. However, these minima in the probable errors are really too broad over time to be precise indicators for the times and the longitudes of the perihelia of Nemesis A and B. But they nevertheless serve to indicate roughly where in the broad time interval of all of pre-history to look for the alignment of planet polar longitudes using a narrower time interval. This is easier to do with the outer planets than it is with the inner planets because their periods are much longer.

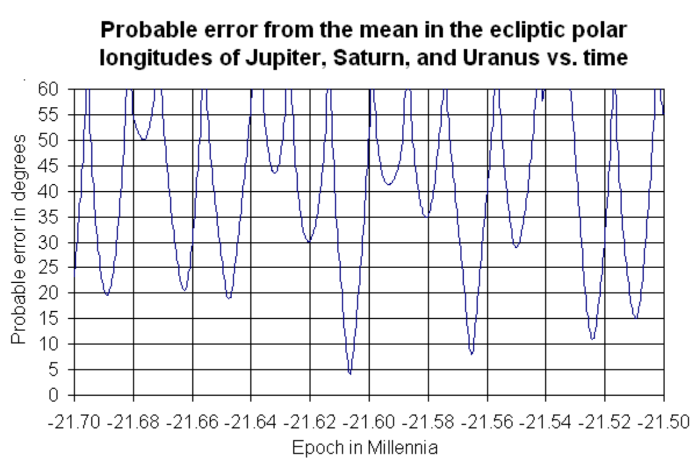

Figure 8. Past alignment of Jupiter, Saturn, & Uranus

Fig. 8 shows the probable error from the mean in the polar longitudes of Jupiter, Saturn, and Uranus over the 200-year interval centered on 21600 BCE. This shows when these three planets align with each other, but it does not show which mean polar longitudes align with the mean aphelion longitude. The way to find that out is to plot the probable error from the mean using six longitudes: three polar longitudes for the planets and their three aphelion longitudes as shown in Fig. 9. Although we won't use them, I also plotted the probable error from the mean for the three polar longitudes with their three perihelion longitudes.

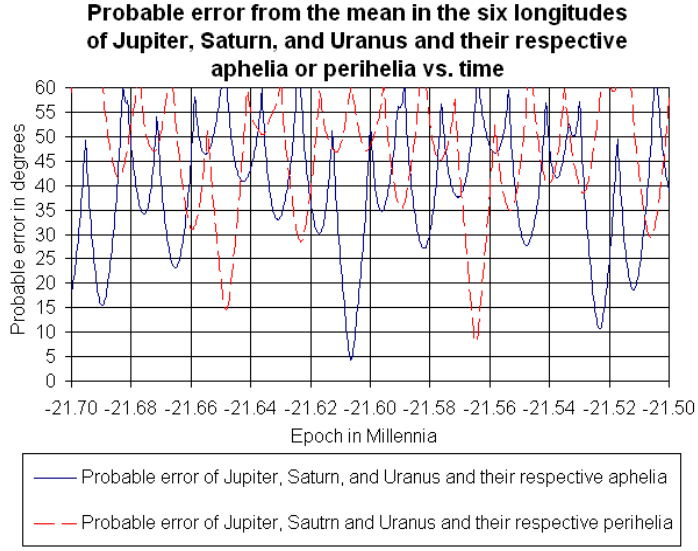

Figure 9. Alignment of JSU polar longitudes with aphelia

The solid curve in Fig. 9 is the one we are interested in since it includes the aphelion longitudes. The dashed curve includes the perihelion longitudes. It is good to see that the best alignment occurs with the aphelion alignment, not the perihelion alignment. The best alignment is zoomed in Fig. 10 over a 3-year interval.

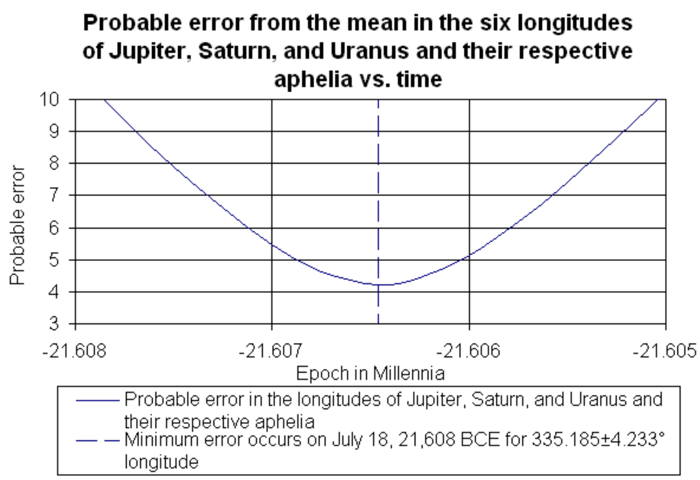

Figure 10. Zoomed view of Fig. 9

6. Hollow Earth Hypothesis

The line of the equinoxes is the intersection of the ecliptic plane with the equatorial plane. The precession of the equinoxes over a cycle of approximately 26,000 years has been well known since antiquity. Newton suggested that this precession is caused by a precession of Earth's equator caused by lunar and solar gravity forces on an oblate Earth that is filled with matter. Astronomers now call this the lunisolar precession, and the observed general precession is that lunisolar precession plus a much smaller planetary precession that is caused by perturbations on the Earth by the other planets.

But if the Earth were perfectly spherical, the same precession of the equinoxes could occur if the Sun had a 26,000-year orbit as a member of a binary or ternary system. The analogy is the Earth's orbit around the Sun, which causes the celestial sphere to advance an extra 360° every year, so the summer stars are different than the winter stars.

I suggest that since the Sun does have such an orbit, the observed "lunisolar" precession of the equinoxes must necessarily result from the combined precessions of the ecliptic and the equator. The ecliptic precession would be caused by the Sun's ternary orbit, and the equatorial precession must be much less than the Newtonian value. This would only be possible if the Earth is hollow, because although Earth is oblate, its shell would have a uniform thickness. That would mean that Earth's mass distribution would be much more spherically symmetrical that it would be if Earth were filled with matter.

If the Earth is a hollow shell having a uniform thickness, then its equatorial bulge would have an approximately uniform mass distribution with respect to geographic latitude, at least to the first order. There would be very little torque on the hollow Earth due to the Moon's and Sun's gravity forces, although there probably is enough to measure. Newton's lunisolar torques probably cause a small fraction of what we call lunisolar precession (general precession minus planetary precession). This means that the period of the Sun's orbit will be different than the precession cycle period. If the Newtonian precession rate is in such a direction as to aid the solar orbit angular velocity, then the solar orbit will have a longer period than the precession cycle. On the other hand, if the Newtonian precession rate is in such a direction as to oppose the solar orbit angular velocity, then the solar orbit will have a shorter period than the precession cycle. Surprisingly, this latter result seems to be the case. Section 7 shows that the lunisolar precession cycle appears to have a period of 29,700 years. The period of Nemesis B can be estimated from Fig. 3 and

Fig. 10 to be 2,070 + 21,607 = 23,686 years. This is presumably also pretty close to the period of Nemesis A and the Sun's orbit about the ternary barycenter.

Most scientists regard any hollow Earth hypothesis as being absurd because geophysicists tell us that the Earth is not hollow. According to them seismology has demonstrated that the Earth is not only not hollow, but it has given us a detailed mapping of its interior. But such details are all based on fitting seismic observations to a theoretical model of the solid/liquid Earth's interior.

In fact transverse seismic waves are reflected at the boundary between the lower mantle and the outer core. The standard model says that's because the outer core is liquid, and a liquid cannot support transverse waves. But neither can a gas or a vacuum. If that boundary is the ceiling of an empty cavity, it would also reflect transverse waves.

Longitudinal waves, however, appear to travel through the core, casting doubt on the hollow-Earth model. I suggest that longitudinal waves convert to transverse spherical surface waves at the ceiling of the cavity, and they propagate around the hemispherical surface of the ceiling and converge to a focus at the antipode on the opposite side of the dome where they convert back to longitudinal waves and continue their path upward through the material shell on the other side.

The longitudinal wave velocity suddenly drops from about 13.7 km/s to about 8 km/s at the interface going from the mantle to the outer core.[12][12] This apparent reduction in wave velocity in the core could be the result of the path around the hemispheric ceiling of the dome enclosing the cavity being longer than the direct path across the diameter through the "core". Such waves traveling along the ceiling of the dome would travel $\pi/2 = 1.57$ times farther around the semi-circle than they would have going straight across the diameter of the presumed matter-filled outer and inner core in the standard model. The observed velocity ratio for longitudinal waves in the mantle to that in the core is 13.7/8 = 1.71. This is only 9% more than $\pi/2$.

According to Fowler there is a "dirty little secret" hiding in the standard model of the Earth's interior.

> Although such a self-compression density model for the earth satisfies the seismic velocity data from which it was derived, it does not satisfy data on the rotation of the earth. In particular, the earth's moment of inertia, which is sensitive to the distribution of mass in the earth, is significantly greater than the moment of inertia for the self-compression model. There must be more mass in the mantle than the self-compression model allows.[13][13]

Given a value for lunisolar precession computed by astronomers from observations of general precession adjusted for nutation and planetary precession, people who believe that precession is caused solely by lunar and solar torques on an oblate spinning and tilted Earth that is filled with matter (not hollow) can compute the principal moments of inertia of the Earth using Hamiltonian mechanics and the precessing spinning toy top model. When they do that, the resulting moment of inertia about the Earth's spin axis is considerably greater than what geophysicists compute from their self-compression model of the Earth's interior. This caused geophysicists to invent ad-hoc theories about state changes in the Earth's interior to attempt to explain the discrepancy. But a simpler solution is to relocate the mass from the core into the mantle and let the core be hollow.

7. Lunisolar Precession Rate

Walter Cruttenden, in his book already cited, correctly states that the lunisolar precession of the equinoxes is the effect produced by the Sun's orbit in space. I claim that the conventional theoretical cause of lunisolar precession given by Newton of gravitational torques from the Moon and Sun on an oblate tilted and spinning Earth is not wrong; it is simply not the whole story as we discussed in Section 6. That's because if Nemesis A and B exist, the Sun will have its own orbit about the ternary system barycenter, and if so it will cause the celestial sphere to appear to rotate about the ecliptic pole just as precession does. From the periods I will disclose in the present Section 7, it seems that solar orbit effect dominates the Newtonian lunisolar torque effect. This is possible if the Earth is hollow as we discussed in Section 6.

We should distinguish between lunisolar precession and general precession, which adds planetary precession to the lunisolar precession. General precession is complicated because planetary precession is complicated. Lunisolar precession, on the other hand, is simple by comparison, and it is by far the larger component anyway. At the epoch 2000 the lunisolar precession is 50.3851 arcseconds per year, according to J.H. Lieske, et al[14][14], and the general precession is 50.290966 arcseconds per year, according to any Astronomical Almanac. This means that the planetary precession is −0.0941 arcseconds per year. That planetary precession is negative should not be surprising because it is CCW (west to east) in the same direction as planetary motion, and the equinoxes precess in the CW (east to west) direction.

Lieske, et al say in no uncertain terms that lunisolar precession has ***not*** been determined from first principles (taking into account geodetic parameters such as Earth's density variation as a function of its radius). Instead it has to be inferred from the observations of the general precession. Astronomers observe the general precession using VLBI radio astrometry of quasars, which have no parallax or proper motion, and they back out nutation using two decades of lunar laser ranges[15][15]. Then they compute planetary precession by integrating planet orbits on a computer using Newtonian mechanics. Finally, they subtract the planetary precession from the general precession to get the lunisolar precession. Lieske, et al write the following on page 10 of their paper[14]:

> Newcomb's "Precessional Constant" P is a function of the moments of inertia of the earth and also of the elements of the earth's orbit (de Sitter and Brouwer, 1938). **Because it has been impossible, so far, to calculate P from its theoretical dependence upon geodetic parameters, P has to be inferred from observationally determined values of the general precession *p*.** [Emphasis mine.] Hence P is replaced by the general precession *p* in the list of astronomical constants. There is a slight dependence of P upon time ($P = P_0 + P_1 t$), the variation being approximately P_1 = -0.00369 per century, which is due mainly to changes in the eccentricity of the earth's orbit. From the work of de Sitter and Brouwer (1938) it can be shown that the centennial variation is
>
> $$P_1 = -0.00001'' - 7.313\times10^{-7}p - 2.5\times10^{-3}\cdot\nu$$
> (Lieske's 15)
>
> Where *p* is the general precession (units: arc seconds per century) and where ν is defined by the mass of the moon relative to the earth (μ),
>
> $$M/E = \mu = 0.0123000383 = 0.0123(1+\nu)$$

From this we get ν = 0.00000311382 for the modern ratio of Moon to Earth mass shown above, and that makes the last term of Lieske's equation (15) equal to -7.78455×10^{-9}. That equation is updated to the current Moon/Earth mass ratio as follows:

$$P_1 = -0.00001000778455''/\text{cy} - 7.313\times10^{-7}p$$

The general precession *p* is part of every astronomer's toolkit. I use the formulas given by Jean Meeus[16][16]. The updated lunisolar precession rate in arcseconds per century according to Lieske can be expressed as:

$$P = P_0 + P_1(T - 2000.0)/100,$$

where $P_0 = 5038.51''$/cy and T is the epoch of interest in years.

We assume that the lunisolar precession rate P is the angular velocity of the Sun's true anomaly with respect to the ternary system barycenter plus (algebraically) the (possibly negative) precession rate cause by the less important Newtonian lunisolar torque on the oblate hollow Earth. Since *p* is a complicated function of time, P_1 and P are also complicated, and therefore to find the Sun's true anomaly at any epoch, we must integrate the lunisolar precession rate numerically. Integrating this formula for P from 50.385075″/year at epoch 2080 back to 50.385811″/year at epoch 0 (an arbitrary interval over which I have confidence in the computation of *p*), I found that the total angular displacement in the true anomaly of the Sun's ternary orbit over 2080 years was 29.111595°.

The average annual rate for this orbit is 29.111595°×(3600″/°)/2080yr = 50.385452″/yr. This is very close to the circular rate of 50.3851″/yr given by Lieske. I conclude from this that the Sun's orbit is very nearly circular. If I had assumed a constant lunisolar precession rate over 2080 years equal to Lieske's epoch 2000 value of 50.3851″/yr, the total change in the Sun's true anomaly would have been 29.111391 degrees (not much different).

This constant precession rate would result in an equivalent circular orbit (having an eccentricity of 0) and a period of 25,722 years. I say equivalent orbit because lunisolar precession rate is a combination of the solar orbit and the Newtonian torque-induced precession. The line of the equinoxes is not a celestial body that has an orbit. But if its lunisolar precession rate were constant, it would take the autumnal equinox 25,722 years to return to its starting point.

Taking the variability of the precession rate into account, and assuming that the periapsis of this equivalent orbit occurs in 2080, I found by iteration that the equivalent orbit for lunisolar precession of the equinoxes has an eccentricity of 0.073344, and a period of 29,700 years.

8. Conclusion

This paper is merely an initial progress report on a line of research that could continue for years. The important tentative discoveries made, so far, of the times of the near-future perihelion passages and the perihelion longitudes for Nemesis A and B are shown in Fig. 4 and Fig. 5.

The pre-historic perihelion passage and longitude of Nemesis A has not yet been determined. The pre-historic Nemesis B values can be estimated from the outer planet data of Fig. 10. However these pre-historic values in Section 5 are all questionable because the approximate ephemerides given by Simon, et al. [9] are not reliable that far back in time.

The next major goal should be to discover the orbital elements for the orbits of Nemesis A and B with respect to the Sun. Once that is done, the acceleration balance shown schematically in Fig. 1 should be redone in three dimensions over a wide interval of time allowing the ecliptic latitude of the center of the CDGC to be a free parameter. The intent should be to adjust the free parameters to minimize the integrated net vectorial acceleration on the Sun over as wide a time interval as possible but at least over the last few hundred years. If the optimum latitude and longitude of the center of the CDGC should happen to coincide with the known position of the huge cosmic void in Ophiuchus, that would be important support for the CDGC hypothesis.

After that, Fig. 7 should be redone using the approximate initial positions and velocities for Nemesis A and B at their future apparitions in 2079. Then the state vectors for all the planets and these two companion stars should be numerically integrated back to the previous perihelia dates for Nemesis A and B. Third, use those integrations to look for past planetary alignments to obtain more refined dates and longitudes of their past perihelia. Fourth, using those revisions, compute revised orbital elements and ephemerides for Nemesis A and B. This work will take time. We are now at the first step.

Strong support for this hypothesis should come from an independent calculation of the CMB anisotropy dipole velocity that was observed by COBE. I'm saying that the cold dark stars that comprise the globular cluster are point sources of this microwave radiation. The COBE mission measured this "absolute" solar velocity, and my goal is to come to that number independently. This anisotropy dipole velocity should be the Sun's velocity with respect to the CDGC, which would be its velocity with respect to the ternary system barycenter plus that barycenter's velocity with respect to the cold dark globular cluster (CDGC).

Proof of this hypothesis might come if the model predicts a secular variation in the CMB anisotropy dipole velocity that is subsequently confirmed by ESA's Planck mission.

But the best proof would be to find two faint stars in opposite hemispheres with extremely high annual parallaxes near their predicted positions in the sky. It would be nice if the northern star were a white dwarf and the southern star were a brown dwarf.

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