Prime Numbers as the Foundation of the Zodiac: Response to Comments and Questions

By David Cochrane

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The paper that I wrote titled; "***Prime Numbers as the Foundation of the Zodiac***" generated many comments and questions. This article can be found at:

- http://www.astrosoftware.com/primenumbersfoundationofzodiac.pdf

Below I address these comments and questions and in some cases add additional information, clarifications, and adjustments to the information provided in the paper. This paper is presented in question-and-answer format organized into various topics, starting with the most fundamental ideas presented in the paper.

Before proceeding, a small note about terminology: I frequently refer to "the paper", by which I mean the paper "*Prime Numbers as the Foundation of the Zodiac*". This may seem obvious now but as you read through the discussions below it may be less clear.

The Conjecture Regarding Symmetries

There are many symmetries of prime numbers. What is special about the ones that you identify? These are well-known symmetries. What new information you have added to the understanding of the symmetries of prime numbers?

To answer these questions let me stat by giving a more rigorous presentation of the prime number symmetries conjecture which appears as four iterative steps at the beginning of the paper. The conjecture that I present in the paper can be stated as follows:

The strongest symmetries of prime numbers are defined by a center point of the symmetry that is determined by this formula

$$X^n – (X^n / 2)$$

where

X = the result of multiplying the sequence of at least two consecutive prime numbers beginning with 2

and n is any positive integer

> *and "strongest symmetry" is defined as the highest percent of actual prime numbers to possible prime numbers obtained. The percent of actual to possible prime numbers is determined empirically by observing how many prime numbers within some range of the center point have a prime number that is equidistant in the opposite direction. This formula does not identify what the distances from the center point are. It identifies only that these are the center points.*

Note that "strongest symmetries" is a critically important part of this formula. Let us apply the formula to see examples of the results:

> *The first possible value for X is 2x3 = 6 and half of 6 = 3 so the formula is 6n – 3 which produces this series of center points: 3, 9, 15, 21, 27 etc.*

> *The second possible value for X is 2x3x5 = 30 and half of 30 = 15 so the formula is 30n – 15 which produces the series 15, 45, 75, etc.*

> *The third possible value for X is 2x3x5x7 = 210 and half of 210 = 105 so the formula is 210n – 105 which produces the series 105, 315, 525, etc.*

The conjecture being proposed is that these are the strongest symmetric patterns of prime numbers. This can be verified with a simple computer program that selects a prime number as a center point of a symmetric pattern and then determines what percent of other prime numbers are equidistant from these center points. It is anticipated that the prime numbers with the greatest number of equidistant other prime numbers will be the numbers listed above.

One might argue that the conjecture is true but for a trivial reason: we have removed the lowest prime numbers with a sieve so therefore there are fewer numbers left and thus the sequences above certainly are the center points of the strongest symmetries. Also, it is known that prime numbers are often separated by particular numbers such as twin primes (separated by two), sexy primes (separated by six), etc. so consequently it is trivially true that this formula produces center points with strongest symmetries. Therefore, the term "*conjecture*" may be regarded as a misnomer because the formula that I am using is true for almost trivial reasons. Although perhaps true for trivial reasons, the formula is nevertheless important for identifying the center points of symmetric patterns and I have rarely seen this formula given, although perhaps it is much more common than I am aware of.

Although some may regard these symmetries as mathematically trivial, it appears to me that there is still one mysterious element to these symmetries: they are much stronger than one might intuitively expect. As one looks at the distribution of prime numbers in Table 1, Table 2, and Table 3 in the paper, the percent of "hits", i.e. accurate predictions of a prime number existing at a point equidistant from the center point in the opposite direction, is impressive. Personally, I find it awe-inspiring. The ever-increasing rings of prime number symmetries forming infinite sets of prime numbers is fascinating. Some readers of the paper commented that they could not see anything awesome or inspiring in this and certainly different people may feel inspired by

different things.

Regarding what new information is presented by this formula, there perhaps may be no new information, as I suspect this simple formula has been identified before and most likely is well-established. Many years ago when I was studying prime numbers in detail I may have come across it and forgotten about it. As stated above, it is almost mathematically trivial. Although very simple, this specific formula or the equivalent iterative procedures given in the paper are rarely cited. Several readers of the paper directed me to websites that they claimed give this formula but all of these websites only give the 6n – 3 formula and/or the 30n -15 formula, do not mention that both of these formulas are expressions of an underlying formula and that the underlying formula also determines center points for other prime number symmetric patterns.

> *To repeat: my point is simply that the non-professional mathematician is not likely to find in the mathematical literature that the formula $X^n – (X^n / 2)$ is an underlying formula that generates symmetries of prime numbers in sequences with a length of 6, 30, 210, etc.*

In short, most important is that the formula is often overlooked! One important point of the paper is that the formula is important because it identifies the strongest symmetries of prime numbers. Thus, the main points regarding this conjecture are *(a) to bring attention to a simple, useful, and often overlooked property of prime numbers*, and *(b) to present the formula because the results of the formula are used later in the paper*. For those interested in prime numbers, shining a light on this often ignored simple formula may be interesting and helpful.

Also often ignored is that the formula **6n +- 1**, which is frequently cited as producing symmetric prime numbers, is equivalent to **6n – 3** when applied iteratively. The formula 6n – 3 is, in a sense, the more consistent and proper or original notation as it is a direct expression of the universal formula $X^n – (X^n / 2)$ that identifies the strongest symmetries of prime numbers.

A great many papers on prime numbers mention the symmetry produced by the formula 6n – 3 (actually usually expressed as 6n +- 1) and the symmetries around the set {15, 45, 75, 105, etc.} multiples of the number 15, but very rarely is it mentioned that these two formulas are expressions of one underlying formula. The underlying formula produces the next set of strong center points of symmetrical patterns, {105, 315, 535 . . . } and an infinite number of other sets of center points of symmetrical patterns.

As additional prime numbers are added to the formula, a subset of the previous set of symmetries is found and this new subset has stronger symmetry than most other neighboring numbers in the set.

> For example, let's begin with the first set of center points: {3, 9, 15, 21, 27, 33 . . . }. Table 1 in the paper shows the result of placing prime numbers in a modulus 6 order and the symmetry is evident. The numbers in the next series of prime numbers are a subset of this set and are {15, 45, 75, 105, 135 . . .}. An example of these symmetric patterns is shown in Table 2 in the paper.

> The numbers in the next series of prime numbers are again a subset of this set and are {105, 315, 535 . . . }. An example of these symmetric patterns is shown in Table 3 of the paper. Each subset contains prime number center points that have especially strong symmetries within the set of prime number center points. This conjecture seems obvious but may not be true and can be confirmed with a computer program to confirm it. The computer program would also identify what the actual to predicted prime number ratio is and how large of an improvement each new level of sets of prime numbers improves upon the ratio of actual to predicted primes is in the previous set. The computer program would also identify the distance of the prime numbers from the center points which at this point is determined empirically rather than analytically.

In short, the paper throws a spotlight on a largely ignored simple formula for determining the strongest symmetries of prime numbers. This simple formula can get completely ignored in the pursuit of sophisticated analyses like the Reimann zeta function, but nevertheless the conjecture exists that it is important and at some point simple computer programs will be developed to determine to what extent the symmetries produced by these center points are distinguished from other random symmetries.

In the paper you refer to "my conjecture" but the conjecture is not completely new so why do you refer to it as "my conjecture"?

I used the term "my conjecture" in the sense that I thought of it. Perhaps I had read this formula years ago when reading works by Marcus du Sautoy and others and have forgotten but it surfaced as I was playing with prime number sequences.

Again, the formula is not mathematically sophisticated and the fundamentals of it are already well-known. Rather than conjecture, perhaps the formula can be called a trivially true formula! I cannot take credit for some great new discovery in understanding symmetry of prime numbers. Rather I am highlighting the elegant simplicity of these symmetries and suggesting that the properties of the symmetries produced by this formula can be further investigated to determine how well this formula identifies symmetries as compare to other randomly selected prime numbers as center points. My conjecture is that the formula produces clear and unambiguously the strongest symmetric patterns.

Some individuals have sent me comments that the symmetries defined by these center points are imperfect and just some center points among a great many. Yes, of course, the symmetries are imperfect but my conjecture is that the strongest symmetries of prime numbers are produced by this formula. This can be confirmed with a simple computer program that calculates the ratio of actual prime numbers to predicted prime number pairs based on the expectation that every prime number will have a corresponding prime number equidistant from the center point in the opposite direction.

Another comment that I received is that if the formula was so good, it would be used to identify prime numbers. This comment results from a misunderstanding of the formula. The formula does not predict prime numbers. It predicts the center points of symmetric points. Why would we

want to know where center points of symmetric patterns are without knowing precisely which numbers are prime? Because symmetry is important in its own right and, for example, there is evidence that these symmetries influenced the development of astrological thought, as described in the paper, in the comments, and will be discussed further in another paper that I will write soon on a possible prime number basis to an astrological concepts known as the bounds of a zodiac sign.

Prime Numbers and the Zodiac

There are 360 degrees in a circle for historical reasons. The convergence of the periodicity of strong prime number symmetric patterns as produced by the formula given above to multiples of 30 degrees is an artifact of the arbitrary selection of 360 as the number of degrees in a circle. Why do you find this convergence to multiples of 30 degrees so awe inspiring and why would you think that this convergence implies that there may be a cosmic pattern of twelve zodiac signs of 30 degrees each?

I agree that the number of degrees in a circle developed for historical reasons and practical reasons and most likely is not directly connected to prime numbers. I also agree that the convergence of symmetric pattern periodicities at multiples of 30 degrees does not imply that there is a cosmic design of twelve equally spaced sections of 30 degrees. I also doubt that prime numbers were a primary influence in the development of the zodiac by the people who developed the concept of twelve equally sized zodiac signs. As noted in the paper, if prime numbers were a strong driving force the development of the zodiac we would more likely see the use of prime numbers greater than 13 in early astrological theory and there is virtually no evidence of this.

Rather than being a primary driving force for the making a zodiac of 12 equally sized sections, it is more likely that the relationship of prime numbers to an assumed or hypothesized zodiac of 12 equally sized sections further reinforced the awareness of an elegant and beautiful design which reinforces one's belief in the model. In other words, if we obtain new information that fits beautifully within the model, enhancing the elegance and beauty of the model, we are naturally inclined to suspect that the model is correct.

The time period of around 600 BC to 300 BC was a time of sophisticated mathematics and little empiricism and there was a philosophical emphasis on trusting the pure Platonic realities more than the impressions of our senses, whereas in the modern world a much greater emphasis is placed on empiricism, careful measurement, controlled studies, etc.

Some of the earliest extant astrological works from around 100 AD give interpretations for each degree of the zodiac. These interpretations indicate that astrologers already were committed to the idea that the circle is divided into 360 distinct compartments and each compartment has its own unique astrological significance. These 360 distinct compartments form groups of 10 degrees (decans), 30 degrees (zodiac signs), and other groups. The 360 degrees form a kind of basic cellular structure upon which astrology was based. This development of thought probably

took place independently of an awareness of prime numbers. We can guess this by the fact there is little reference to prime numbers.

However, given an assumption or belief that there are 360 degrees in a circle and that these 360 degrees have some real basis in a cosmic design rather than being an arbitrary number that was chosen (as clearly astrologers believed then and still do believe based on the tradition of belief in degree meanings which goes back to at least the time of 100 AD and probably much earlier), finding that prime numbers fit within this assume design very neatly must have been inspiring. With the great work of Euclid and others, an educated person could hardly be unaware of the concepts in geometry, number theory, etc. at the time. That prime numbers are symmetric within each zodiac sign would like have been noticed by someone in ancient times.

There is new evidence from an observation that I made that this is true. There is a division of zodiac signs in the early Hellenistic astrology known as bounds and in later medieval astrology known as terms. There are five bounds within each sign and the bounds have different sizes and planets assigned to them in an apparently somewhat but not completely random order. The distribution of prime numbers in each zodiac sign appears to determine why one of the two malefic planets is sometimes the planet of the first bound within a sign. This will be described in a separate paper soon.

Also, the formula given above identifies the number 105 as a very strong point of symmetry. Therefore within a circle of 360 degrees the most powerful center points of symmetry are the set {15, 45, 75, 105, 135 . . . } with the number 105 being an especially strong point of symmetry. This can be verified empirically by calculating the number of prime numbers between 1 and 360 that are equidistant from the 105 and 285 axis.

> *In other words, any two prime numbers that are equidistant from 105 are also by definition equidistant from 285 when placed around a circle. At a future time someone will take the time to verify this symmetry (I will do this when I find time to do it if nobody else does). Assuming that it is a very strong point of symmetry then astrologers might have also noticed this and based some ideas symmetric around 105 degrees, which is 15 degrees of the zodiac sign Cancer. In fact, they did if we regard the ruling planets of zodiac signs as a function of a planetary association at the beginning of each zodiac sign, as described below.*

Let's take the beginning of each zodiac sign equidistant from 15 degrees Cancer. The beginning of the signs Cancer and Leo are 15 degrees from this point, the beginning of the signs Gemini and Virgo are 45 degrees from this point and continuing around the circle we have these pairs: Cancer-Leo, Gemini-Virgo, Taurus-Libra, Aries-Scorpio, Pisces-Sagittarius, and Aquarius-Capricorn. Placing the planets around this circle in order from fastest to slowest but with "the lights" (Sun and Moon) as a pair first, we have the rulers of the zodiac signs of each pair. How it was decided that Cancer would be associated with the Moon and Leo with the Sun is not known but otherwise the pattern of planet rulers placed at the beginning of the zodiac sign that they rule are symmetrically distribute around the strong prime number symmetry point of 15 degrees Cancer.

If the development of zodiac sign rulership was based on an awareness that 15 degrees Cancer is a strong symmetry center point of prime numbers, then the question arises as to how this observation was made. One possibility is that the symmetry of prime numbers within each zodiac was noticed by somebody. This would not be difficult to notice. The paper which I will write soon on the placement of malefic planets in the bounds suggests that some astrologers had made this observation.

Even without the evidence based on the analysis of the bounds the symmetric pattern of prime numbers within each zodiac sign is so strong that someone over a few hundred years between perhaps 600 BC and 300 BC would likely have noticed this. One then might look for other symmetry points just by going around the zodiac to see if the prime numbers tended to align equally distant. Of the twelve midpoints of each zodiac sign, the midpoint of Cancer most likely is strongest (based on the conjecture provided above but which I have not as yet taken the time to confirm) and would therefore be seen as a particularly powerful point of symmetry upon which to build a symmetrical pattern of planet rulers of zodiac signs. Another possibility is that someone was aware of the formula given above identifying prime number symmetry points.

History of the Zodiac

You incorrectly state that the zodiac with 12 equally sized sections of 30 degrees was developed in the first millennium BC. The zodiac with equal divisions of 30 degrees was used at least as far back as somewhere in the range of 2000 – 1500 BC.

This comment from an astrologer revealed some extraordinary new information that I was not aware of. The time period of 1000 BC to 500 BC is widely quoted. For example, in the wikipedia article on the zodiac at http://en.wikipedia.org/wiki/Zodiac#Early_history it is stated that "*The division of the ecliptic into the zodiacal signs originates in Babylonian ("Chaldean") astronomy during the first half of the 1st millennium BC, likely during Median/"Neo-Babylonian" times (7th century BC)*" .

David Pingree is one of the greatest authorities on the early history of astronomy and he, as well as other historians of astronomy give this as the date of the earliest indications of a zodiac of 12 equally sized zodiac signs.

However, this question about the history of the zodiac motivated me to verify this information and I discovered the very well –research work of David Frawley which suggests that a division of a 360 degree circle into various divisions such as 12 divisions and 720 divisions was in place somewhere between 2000 BC and 1500 BC and is described in the Rig Veda (http://archaeologyonline.net/artifacts/origins-zodiac). The dating of these verses in the Rig Veda are difficult to determine and controversial. I have not yet researched the evidence for the dating of these sections of the Rig Veda. One of the most convincing of the verses in the Rig Veda which David Frawley quotes on this website page is "*The wheel of law with twelve spokes does not decay as it revolves around heaven. Oh Fire, here your 720 sons abide.*" This sentence is consistent with the symbolic language used throughout this section of the Rig Veda and in the

context of the rest of the Rig Veda, it appears very clear that the wheel of life referred to is the path of the planets through the sky. This sentence does not state that the twelve spokes are equally spaced but spokes of a wheel are normally evenly spaced and we can reasonably assume this would have always been the case. Perhaps the image of "spokes" should not be taken to literally indicate a radiating line from the center of the wheel that divides the sky into 12 equal pieces. Because of the symbolic nature of the language, perhaps the indications that a zodiac is being symbolized is still debatable. Also, the text does not seem to necessarily refer to the 12 sections as being qualitatively different. We are given only some symbolic statements and we need to interpret them.

This verse is also interesting: "*Revolving on this five-spoked wheel all beings stand. Though it carries a heavy load, its axle does not over heat. From of old it does not break its ancient laws.*" This sentence appears to suggest that a zodiac of 5 signs was also used.

Experts in the Rig Veda can decipher these symbolic verses far better than I can. As discussed in my response to the next question, the issue of the age of the zodiac is not critically important or relevant to the main concepts and ideas presented in the paper.

If there was a zodiac of 12 signs 1,500 years or more earlier than Pingree and others suggest, does this affect the overall concepts and conclusions in my paper?

No. If David Pingree is incorrect and David Frawley is correct that there was a zodiac of 12 signs over a millennium earlier, then the zodiac that was revived around 700 BC was part of a revival of ideas that had not been in circulation in the area of Babylonia, Greece, and Egypt for a very long time.

Suppose, by analogy, that we were to discover that the jazz music that started in United States in the early to mid 20th century was passed on from a few people who had sustained a musical tradition that was well developed 1,000 years ago. This fact would not significantly affect the way in which jazz music arose as a fresh and new sound, the reactions of different people to it, and the development and evolution of this music.

If equal divisions of a circle of 360 degrees was an ancient idea that was revived between 1000 BC and 500 BC that might explain how the complex astrological rules and details of the system were developed so rapidly. Also, if a sophisticated understanding of celestial measurement had been developed over a millennium earlier, it is also possible that interest in prime numbers and other related areas of mathematics and the sciences were much better developed than we believe.

We can take this line of thought even further with the belief in ancient civilizations like Atlantis and Lemuria or the existence of ancient civilizations as indicated by Gobleki Tepe, the ancient underwater city off the coast of India (see, for example, http://news.bbc.co.uk/2/hi/south_asia/1768109.stm) perhaps could have had well developed systems of astrology. Whether they did or not, it would not have a significant impact on the points made in the paper.

Whether the birth of astrology and zodiac signs was really more of a rebirth than a first birth does not alter the fact that this revival occurred at the time when Platonic thinking and Euclidian mathematics were very strong and there was likely some influence of Platonic thinking on the revival of astrology. Relationships and connections between mathematics and astrology, and a fascination with elegant models as a priority over empirically evaluating the models is very likely.

Conclusions from This Analysis

Why are you certain that prime numbers are a basis of the zodiac?

I am not certain of this and the paper makes it clear that there is not certainty regarding this. I have simply presented information about the history of astrology, the distribution of prime numbers and possible relationships. From this information I have proposed various possible reasonable conclusions. We are building models and testing the models. The model of zodiac signs as being understood in terms of prime numbers is gaining increasing support from the symmetry of rulerships around the strongest symmetry point in the circle and the distribution of malefics in the subdivision of zodiac signs known as bounds (to be discussed in more detail in a future paper).

The convergence of prime number periodicities at multiples of 30 degrees and the consistent symmetry of ruling planets of zodiac signs shown in Table 5 of the paper is an awesome consistent reinforcement that the equally spaced sign rulership from 105 degrees and the choice of 30 as the length of zodiac signs is the correct one. As often happens in mathematics, there is an elegant and beautiful model in which different ways of analyzing the data repeatedly concludes that the multiplication of the first 3 prime numbers (2, 3, and 5) produces a fundamental number that repeatedly gets emphasized from different mathematical perspectives.

Note that there may be multiple elegant systems. Just as the elegance of Euclidean geometry eventually gave way to a multiplicity of elegant non-Euclidean geometries, there may be other elegant numerical systems that are not based on the 360-division of the circle. We can see, however, how as one digs deeper and deeper into the mysteries of the zodiac, one continues to find an extraordinarily consistent model of the geometry of the heavens. The zodiac is an enduring concept in human history. It seems to not go away. It decorates cathedrals and palaces. It captures the imagination of people from all walks of life. The geometry which supports the concept may have at some historical points in time helped sustain interest in the zodiac.

Do you think that the mathematics behind the zodiac implies that there is a zodiac?

Personally, I do not, but this is a rather subjective and personal assessment rather than a completely logical or scientific assessment. My reasoning is that there are many possible elegant mathematical systems and while all truth may be elegant and beautiful, not all elegant and beautiful models describe some physical reality.

My opinion at the moment is that prime numbers have influenced the development of astrological theory, such as ruling planets of signs and the bounds of signs, but we have only some evidence to support this at this time. Apart from the topic of the distribution of prime numbers and the zodiac, I do believe that harmonic astrology will continue to evolve, develop and improve and other systems of astrology may also continue to evolve, develop, and improve but this opinion is based on other work in the field of astrology not directly related to the ideas presented in the original paper and these responses to questions and comments about the paper.

Do you think that the mathematics behind the zodiac strengthens the argument that there is a zodiac?

The convergence of symmetric prime number periodicities at multiples of 30 degrees, combined with the fact that the center points of the 30 degree areas of the zodiac signs, are center points of a symmetric pattern of prime numbers in each zodiac sign suggests that this geometric structure is wonderfully elegant and coherent. This suggests to me that the pattern of points are important and likely to be important in astrological aspects between planets but it does not as clearly suggest that each of the 12 sections of 30 degree areas are qualitatively different from each other. As stated in the Rig Veda, these points are like eternal spokes in a wheel but the spokes appear to me to identify critically important points rather than necessarily the starting points of phases.

For those who already believe in a zodiac, however, the patterns can reinforce this belief because they provide a convergence of prime numbers synchronizes with the starting and ending points of the zodiac signs.

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