

# "The Temporal-Angular Symmetry Hypothesis of Prime Numbers"

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**Time** is a physical dimension used to measure the sequence of events, determine their order of occurrence, and define the intervals between them. It is one of the fundamental quantities in physics and cannot be directly perceived; rather, it is inferred through change and motion. Time is typically measured based on regular periodic phenomena, such as the Earth's rotation on its axis (which causes the alternation of day and night).

The Circular Clock Model, Time, and Trigonometric Functions: A Scientific Analysis  
The traditional circular-shaped clock serves as a simple visual model that reflects profound physical and mathematical concepts, most notably: rotation, time, angles, and the constant  $\pi$ .

Within it, there are indicators denoting seconds, minutes, and hours.

These hands move in a uniform circular motion, resembling the Earth's rotation on its axis, but with absolute consistency and stability.

## Angles in the Clock Represented on the Circle

- A full circle represents 360 degrees.
- Since the circular clock model contains numbers representing hours (as a conceptual visualization)
- Each hour (i.e., the distance between two consecutive numbers) represents a fixed angular interval.
- The minute and second hands:
  - Complete a full rotation =  $360^\circ$  every 60 units (seconds or minutes).
  - The second hand moves faster, completing 360 rotations in one hour.

## The Relationship Between Rotation and Time

- The movement of the clock hands resembles the Earth's rotation on its axis (which causes day and night) thus the clock is used as a representational model for understanding time.
- Just as the Earth's revolution around the Sun forms the basis of the annual calendar, uniform rotation is the key to understanding time.

## The Constant $\pi$ and the Circular Clock

- $\pi \approx 3.14$  is a mathematical constant used in calculating:
  - The circumference of a circle:  $C=2\pi r$
  - The area of a circle:  $A = \pi r^2$
- Since the model under study—the clock—is circular in shape, all time-related and angular calculations inherently depend on  $\pi$ .
- In certain models, this relationship is fundamental.

## The Clock and Trigonometric Functions:

- The unit circle (a circle with radius equal to 1) is used to represent trigonometric functions such as:
  - **Sine**
  - **Cos**
- In this circle
  - Angles are measured from the positive horizontal axis in a counterclockwise direction.
  - Angles are often expressed in radians, such as:  $\pi/6, \pi/4, \pi/2$
- Many of these angle positions approximately coincide with the positions of numbers on the clock, making the circular clock an excellent educational tool for explaining trigonometric concepts.

## Conclusion

The circular clock model embodies the relationship between time, rotation, and angles, while the constant  $\pi$  reflects the mathematical structure underlying everything circular—whether in shape or motion. Thus, the clock serves as a realistic visual example for understanding the connection between time and mathematics.

## Illustrative Explanation

The following concepts are illustrated

- A circular clock
- Key angles ( $0^\circ, 90^\circ, 180^\circ, \dots$ )
- Representation of  $\pi$  in radians ( $\pi/6, \pi/4, \pi/2, \dots$ )
- Positions of the numbers as on a standard clock
- Direction of rotation

## The Mathematical Constant $\pi$ and Its Relationship to Time and Circular Motion

Since this hypothesis focuses on time and circular motion, it is closely connected to the mathematical constant  $\pi$ , which is considered one of the most important constants in mathematics and the natural sciences.

### What is the Constant $\pi$ ?

$\pi$  is a mathematical constant used to express the relationship between the circumference of any circle and its diameter, where:

$$\pi = \frac{\text{Circumference}}{\text{Diameter}}$$

It represents a fixed value that does not change regardless of the size of the circle.

### The Importance of $\pi$ in Science

#### 1. In Geometry:

- It represents the natural constant relationship between the dimensions of any circle.
- It is used to calculate:
  - The circumference of a circle
  - The area of a circle

#### 2. In Advanced Mathematics (Trigonometric Functions and Radians)

- Angles are often measured in radians rather than degrees.
- The fundamental relationship:

$$180^\circ = \pi \text{ radians}$$

#### 3. In Physics and Natural Phenomena:

- $\pi$  appears in many phenomena involving rotational or periodic motion, such as:
  - Waves and vibrations
  - Planetary and lunar orbits
  - Electrical and magnetic phenomena
  - Quantum mechanics and kinematic equations

## The Symbolic Relationship: $\pi$ as a Bridge Between the Straight Line and Circular Motion

$\pi$  serves as a mathematical bridge between:

- The straight line (the diameter)
- And circular motion (the circumference)

In other words,  $\pi$  connects linear and rotational dimensions, making it a cornerstone in understanding time and rotation in physical and mathematical models.

It is impossible to study time and rotation without involving  $\pi$ .

Everything that is periodic or circular in nature follows a mathematical pattern governed  $\pi$ .

From circular shapes to the motion of planets, from sound waves to trigonometric functions,  $\pi$  consistently appears as a unifying mathematical element.

### From This Question and Its Answer, We Can Apply the Hypothesis Time as a Circular Motion

Since time is derived from the Earth's rotation around the Sun, we can simplify the concept by applying it to the traditional analog clock, which possesses the required characteristics, as previously discussed.

Based on the previous elements the circle and the mathematical constant  $\pi$  we begin.

The clock contains three hands (indicators), and there exists a direct relationship between them.

As they rotate, they form new angular positions, and they also establish a proportional relationship with the circumference of the circle  $\pi$ , since they rotate from the center of the circle uniformly along the circumference.

This rotational motion forms the basis for the constant  $\pi$ .

To simplify and explain the model more clearly, we will use a 12-hour clock rotation system.

- **Second hand:** 60 seconds  $\rightarrow$  1 full rotation
- **Minute hand:** 3,600 seconds  $\rightarrow$  60 rotations
- **Hour hand:** 43,200 seconds  $\rightarrow$  12 rotations

These time values inherently contain prime numbers, which result from the rotational cycles of the clock's hands.

They also form measurable angles, which can be studied within this circular time framework.

From the Perspective That Numbers Are Infinite in the Realm of Arithmetic  
As long as time continues, numbers also continue indefinitely.  
This reflects a direct (proportional) relationship between time and numbers.

By "numbers," we refer to all types, including:

- **Natural numbers**
- **Integers**
- **Prime numbers, etc.**

For natural and integer numbers, their distribution and symmetry are relatively clear and well-defined along the number line.

However, when it comes to prime numbers, their distribution and symmetry are unclear and irregular along the number line.

From This Point, the Central Questions of the Research Arise:

- Can we determine the distribution and symmetry of prime numbers?
- Are they truly infinite, like the natural and integer numbers?

**Question:**

*Is it possible to connect time and circular motion with prime numbers? Why? And why is this connection important?*

**Answer:**

Yes, it is possible to connect time and circular motion with prime numbers, albeit in a nontraditional way, through mathematical and physical concepts such as

- **Repetition**
- **Periodicity**
- **Symmetry**
- **Structured chaos**

This is because prime numbers play a fundamental role in the structure of complex systems, just as time and circular motion do in physical and natural models.

**A. Scientific Perspective on the Answer:**

Yes, the connection is possible, and can be established through the following key aspects:

### 1. Time and Circular Motion as a Periodic System

- Time in our daily life is measured by periodic motion, such as:
  - The rotation of clock hands
  - The rotation of the Earth around its axis (day)
  - The Earth's orbit around the Sun (year)
- The circular clock serves as a simple model:
  - The second hand completes one full rotation ( $360^\circ$ ) every 60 seconds
  - The minute hand completes a rotation every 60 minutes (3,600 seconds)
  - The hour hand completes a rotation every 12 hours (43,200 seconds in the 12-hour system)
- These motions are inherently linked to the mathematical constant  $\pi$ , as the circumference of a circle =  $2\pi r$ , thereby connecting time to circular geometry

### 2. Prime Numbers and Their Distribution

- Prime numbers such as 2, 3, 5, 7, 11... are numbers divisible only by 1 and themselves
- Their distribution along the number line is irregular, but not entirely random
- If we attempt to map prime numbers onto a circular clock using modular systems like mod 12 or mod 60, the distribution is not uniform, but reveals a form of nontrivial symmetry

### 3. Mathematical Connection

- If we think of time as points on a circle, we can imagine that "temporal moments" move in a pattern resembling the jumps between prime numbers
- For example, in a 12-hour clock system (mod 12), the prime numbers are: 2, 3, 5, 7, 11
- If we place them on a circular clock, their positions correspond to angles ( $2 \rightarrow 60^\circ$ ,  $3 \rightarrow 90^\circ$ ,  $5 \rightarrow 150^\circ$ ,  $7 \rightarrow 210^\circ$ ,  $11 \rightarrow 330^\circ$ )
- This uneven distribution resembles quasi-periodic systems in physics, where the motion repeats but not in a perfectly identical pattern

#### 4. Trigonometric Functions and Radians

- Cyclic time is closely linked to trigonometric functions such as sine (sin) and cosine (cos) which express periodicity using angles measured in radians, such as:

$$\pi 6, \pi 4, \pi 2, \dots, \frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{2},$$

- Prime numbers may emerge in the analysis of frequencies or irregular angular divisions, suggesting the possibility of connecting them to nontraditional divisions of the circle.

#### Why This Connection Makes Sense

##### First

##### Time as a Periodic Function

- Time, as measured by clock hands, is a form of circular motion:
  - Every 60 seconds = 1 minute
  - Every 60 minutes = 1 hour
- This cyclic behavior resembles periodic mathematical functions like sin, cos, and frequency-based systems.
- In physics, time, waves, and motion are all modeled using periodic functions or signals.

##### Second:

Circular Motion = Angles = Repetition = Order

- A full circle = 360 degrees
- This number (360) is mathematically rich
  - It has many divisors
  - It can be divided into equal parts using prime numbers such as 2, 3, 5, etc.

However, the distribution of prime numbers along the circle is not uniform and therein lies the mystery.

#### Where Do Prime Numbers Fit In?

## 1. Non-Repetition and Structured Chaos

Prime numbers are often described as lacking an apparent pattern but they are not truly random.

This resembles real physical time as we experience it  
It appears repetitive (day and night, hours, etc.),  
yet it moves forward irreversibly and never returns exactly as it was.

## 2. Cosmic Time vs. Geometric Time

- **Cosmic time = Linear** (a straight line)
- **Geometric time** (like Earth's orbit around the Sun) = Cyclical (a circular motion)

If we attempt to "number" periodic temporal events using jumps based on prime numbers,  
we arrive at a cyclical system that does not repeat identically  
This creates what we can call a non-repeating cycle,  
similar to quasi-periodic systems such as the orbital motions of planets.

## 3. The Clock System and Prime Numbers

What happens if we distribute prime numbers on a circular clock, such as using mod 12 or mod 60?

We observe that prime numbers are distributed non-uniformly around the circle.  
This suggests the possibility of using them to construct a temporal system with non-trivial symmetry,  
known as fractals or quasi-periodic symmetry.

## 4. A Similar Idea Exists in Quantum Physics

In quantum mechanics, concepts like time, energy, angular momentum, and angles are often linked with structures that are not strictly periodic, but instead partially repetitive.

Some models relate to prime frequencies such as resonances occurring at frequencies divisible, only by prime numbers.

Here, we see a direct connection between circular motion and prime numbers.

### Why Is This Connection Important?

Because it leads to a fascinating idea

Is it possible that time does not flow in a "uniform linear" manner, but instead jumps like prime numbers along a circular timeline?

Could time be quantized into "prime-numbered grains"?

## **1. A Deeper Understanding of Time**

If time progresses through "prime jumps" rather than smooth, uniform motion, this could change our understanding of time as either continuous or quantized. This notion aligns with certain physical theories, such as those in quantum mechanics, where time may exhibit discrete, quantized behavior.

### **Mathematical Applications:**

Distributing prime numbers on a circle may aid in solving complex mathematical problems, such as the Riemann Hypothesis, which connects the distribution of primes to periodic functions (such as the zeta function).

### **Modeling Natural Phenomena:**

In cosmological physics, this connection might help explain quasi-periodic cycles (like the motion of planets or variable stars), where prime numbers could represent "pulses" or unexpected turning points in dynamic systems.

### **Philosophical Suggestion or Initial Hypothesis:**

"Time may be a series of angular pulses moving along a conceptual circle, where each moment does not pass through the same angle, but instead jumps between angles linked to prime numbers.

This may explain our perception of irregularity and infinity in the experience of time."

## **Let Us Formulate a Testable Hypothesis**

### **Hypothesis:**

*"Time can be modeled as points along a conceptual circle, where the temporal distances between events follow a distribution similar to that of prime numbers."*

### **How to Test the Hypothesis:**

1. Use a clock system (12-hour or 24-hour) and plot the prime numbers as points on the circular dial.
2. Calculate the angular distances between these points (in degrees or radians).
3. Compare this distribution with natural temporal events (such as astronomical cycles or quantum pulses).
4. Apply Fourier Analysis to detect periodic patterns potentially linked to the distribution of prime numbers.

### **Practical Example:**

- In the mod 12 system: the prime numbers are 2, 3, 5, 7, 11.
- Corresponding angles:  $60^\circ$ ,  $90^\circ$ ,  $150^\circ$ ,  $210^\circ$ ,  $330^\circ$ .
- Differences between angles:  $30^\circ$ ,  $60^\circ$ ,  $60^\circ$ ,  $120^\circ$ .

### **○ Conclusion:**

These unequal angular gaps reflect the irregular distribution of prime numbers. A similar pattern may be observed in complex temporal phenomena, indicating an underlying non-uniform structure of time.

## **Experimental Components**

### **Explanation**

- **Circular Clock:** A circle divided into 12 equal sections, each representing  $30^\circ$ .
- **Numbers:** The values 1, 2, 3, ..., 12 are placed in their usual clock positions.
- **Angles:** Identify the main angles:
  - $0^\circ$  at 12 o'clock,
  - $90^\circ$  at 3 o'clock,
  - $180^\circ$  at 6 o'clock,
  - $270^\circ$  at 9 o'clock.
- **Radians:** Add corresponding radian values such as
  - $\pi/6$  ( $30^\circ$ ),  $\pi/4$  ( $45^\circ$ ),  $\pi/2$  ( $90^\circ$ ) next to the angles.
- **Prime Numbers:** Mark prime numbers (2, 3, 5, 7, 11) with distinct symbols (e.g., stars) on their respective positions.

- **Direction of Rotation:** Draw arrows in a counterclockwise direction to illustrate the movement of the clock hands.
- **Objective:** To visualize how prime numbers are irregularly distributed on the circular clock compared to the clock's regular division.

### **Conclusion:**

- **Can a connection be made?**  
Yes ,through periodicity, angles, and irregular distribution.
- **Why?**  
Because time and circular motion share with prime numbers a pattern of complex symmetry and hidden order.

### **Why is this important?**

Because it may uncover a deeper structure of time, potentially linking mathematics and physics in new and meaningful ways.

This connection opens the door to future questions:

- *Is time itself "prime" in nature?*
- *Can we measure time using a new pattern based on prime numbers rather than regular divisions?*

### **Practical Study on Prime Symmetry and the Distribution of Prime Numbers Within Circular Time**

In this study, we apply the following methodology:

- We use a 24-hour clock system, representing a full day cycle.
- The observed duration for the distribution of hourly values on the circular time model is 4 weeks, equivalent to 672 hours.
- We draw a circular diagram to represent time.
- Numbers from 1 to 24 are placed along the circle, just as on a traditional 24-hour clock.
- The distribution direction of the numbers follows the clockwise rotation.
- We begin assigning the numbers sequentially around the circle.
- Then, we identify the prime numbers within this system.

- We study:
  - Where the prime numbers are located on the circle.
  - How they are distributed.
  - The density of prime occurrences.
  - And which zones are void of prime numbers.

### 1. Distribution of Prime Numbers on the Clock Face

We observe that prime numbers are distributed across 10 out of the 24 positions on the circular time clock:

[1, 2, 3, 5, 7, 11, 13, 17, 19, 23]

These are the only positions (or “hours”) that receive prime numbers during the study period.

The remaining positions show no prime number occurrences:

[4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24]

- Notably, there are no large angular gaps between these non-prime positions. For example:
  - Between 9 and 10 → just 1 degree apart
  - Between 4 and 6 → just 2 degrees apart

### 2. Unique Appearance of Primes on Positions 2 and 3

We observe that only two positions [2] and [3] exhibit prime numbers just once during the entire 4-week cycle.

- These appear only during the first cycle (i.e., metaphorically, the first day),
- After that, they no longer receive any prime numbers.

### 3. Sequential and Intermittent Distribution of Primes

Other positions, such as [1, 5, 7, 11, 13, 17, 19, 23], receive multiple prime numbers, sometimes in sequence, and sometimes intermittently.

#### **Example: Prime Distribution on Position 5**

On the clock position [5], prime numbers are distributed as follows:

- **Week 1:**  
5,29,53,77,101,125,149, 29, 53, 77, 101, 125, 149  
*(Note: 77 and 125 are not primes)*
- **Week 2:**  
173,197,221,245,269,293,317, 197, 221, 245, 269, 293, 317  
*(Note: 221 and 245 are not primes)*
- **Week 3:**  
341,365,389,413,437,461,485, 365, 389, 413, 437, 461, 485  
*(Note: 365, 413, 437, and 485 are not primes)*
- **Week 4:**  
509,533,557,581,605,629,653, 533, 557, 581, 605, 629, 653  
*(Note: 533, 581, 605, and 629 are not primes)*

This shows a non-uniform distribution of prime numbers on hour 5.

#### 4. Total Prime Occurrences on Position 5

- **Week 1:** 5 prime numbers
- **Week 2:** 5 prime numbers
- **Week 3:** 2 prime numbers
- **Week 4:** 3 prime numbers
- **Total:** 15 prime numbers on position 5 during the study period of 672 hours (4 weeks)

#### 5. Other Positions with Prime Numbers

We also observe that other positions receiving primes exhibit either:

- Sequential patterns,
- Or intermittent (irregular) patterns.

#### Practical Study II: Modified Directional Time Distribution

We conducted a second practical study under the same temporal and structural conditions as the first, with one key modification:

The distribution of days was alternated one day clockwise, followed by one day counterclockwise over a span of four weeks. The cycle started with the first day moving in the clockwise direction.

After redrawing the circular time chart and adjusting the numerical placements according to this new directional pattern, the following observations emerged:

**1. Prime Number Distribution on 10 out of 24 Time Positions:**

Prime numbers were found to appear at only 10 positions on the clock:

(1, 2, 3, 5, 7, 11, 13, 17, 19, 23)

No prime numbers were distributed over the other positions:

(4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24)

Notably, these non-prime positions are often separated by small angular distances—e.g., between 9 and 10 (1 degree), or between 4 and 6 (2 degrees).

**2. Transient Appearance of Some Primes:**

Among the prime-bearing positions, two specific numbers 2 and 3 hosted prime numbers only once, during the first cycle (first day), and never again in the full study period.

**3. Detailed Example: Prime Distribution on Time Marker 5**

The number 5 exhibited a consistent pattern of both sequential and scattered prime number placements.

Breakdown by week:

- **Week 1:** [5, 43, 53, 91, 101, 139, 149] → *(Note: 91 is not prime)*
- **Week 2:** [187, 197, 235, 245, 283, 293, 331] → *(187, 235, 245 are not prime)*
- **Week 3:** [341, 379, 389, 427, 437, 475, 485] → *(341, 427, 437, 475, 485 are not prime)*
- **Week 4:** [523, 533, 571, 581, 619, 629, 667] → *(533, 581, 629, 667 are not prime)*

**4. Asymmetry in Prime Frequency on Marker 5**

The number of prime numbers appearing at hour-marker 5 across the four weeks varied:

- Week 1: 6 primes
  - Week 2: 4 primes
  - Week 3: 2 primes
  - Week 4: 3 primes
- Total: 15 prime numbers appeared on marker 5 over the full 672-hour study duration.

**5. Irregular Distributions on Other Prime-Bearing Markers:**

Other time markers with primes also exhibited non-uniform distributions, sometimes sequential, other times scattered.

## 6. Important Note:

Across both studies (clockwise and alternating directions), the total number of prime numbers associated with hour-marker 5 remained constant.

### We Conclude That

**"Prime numbers may form a temporally regular numerical pattern on the time circle, resembling circular motion but not following a simple periodic distribution."**

### Explanation of the Conclusion:

Let us precisely clarify the difference between *random distribution* and *non-random pattern* in the context of the temporal-numeric distribution of prime numbers within the circular time model, from two perspectives:

#### First: Time-Based Numeric Distribution

This refers to the linear passage of time through natural numbers one by one, as if we are progressing along a temporal axis from 1 to infinity, and observing the positions of prime numbers along this axis.

#### In the Case of Random Distribution:

- If prime numbers were randomly distributed, we would not expect any structure or pattern in the spacing between one prime and the next.
- The differences between consecutive primes

$$P_{n+1} - P_n$$

would be irregular, showing no apparent repetition or symmetry.

#### In the Case of Non-Random Distribution:

- When prime numbers are projected onto a modular circular system such as

$$\text{mod } 6, \text{ mod } 12, \text{ mod } 24 \setminus \text{mod } 6, \setminus \text{mod } 12, \setminus \text{mod } 24$$

we observe that they do not appear at all possible residues, but instead fall only on specific, restricted residues.

- Illustrative Example:  $\forall p > 3, p \in P \Rightarrow p \setminus \text{mod } 6 \in \{1,5\}$

- Within the system:

$$\text{mod } 6 \Rightarrow \text{Possible residues: } 0,1,2,3,4,5 \setminus \text{mod } 6 \Rightarrow \text{Possible residues: } 0,1,2,3,4,5$$

All prime numbers greater than 3 fall only on the residues:

$$p \equiv 1 \pmod{6} \text{ or } p \equiv 5 \pmod{6} \text{ or } p \equiv 1 \pmod{6} \text{ or } p \equiv 5 \pmod{6}$$

- In the system:

$\pmod{12} \Rightarrow$  Possible residues: 0 – 11  $\pmod{12} \Rightarrow$  Possible residues: 0 – 11

*Prime numbers typically fall on residues*

1,5,7,11

- In the system

$\pmod{24}$

which represents your circular time model primes tend to cluster only at specific angular positions, and these positions repeat with the flow of time, indicating the existence of a hidden angular-temporal structure, rather than a random scattering.

**This implies that prime numbers appear in a specific time-based numeric pattern approximately every 6 time units, and they fall into recurring positions.**

### Angular Temporal Distribution

#### • Simplified Scientific Study Using Modulo 12 System

Using the list of prime numbers from 1 to 100 (total: 25 prime numbers)

**Step 1: Applying the first layer of analysis to determine which residue classes the primes fall into**

#### Modulo 12 residue Prime Numbers Falling into This Class

|    |                        |
|----|------------------------|
| 1  | 13, 37, 61, 73, 97     |
| 2  | 2                      |
| 3  | 3                      |
| 5  | 5, 17, 29, 41, 53, 89  |
| 7  | 7, 19, 31, 43, 67, 79  |
| 11 | 11, 23, 47, 59, 71, 83 |

## Step 2: Frequency of Primes in Each Residue Class

| Residue ( $p \bmod 12$ )   | Count of Prime Numbers | Examples               |
|----------------------------|------------------------|------------------------|
| 1                          | 5                      | 13, 37, 61, 73, 97     |
| 2                          | 1                      | 2                      |
| 3                          | 1                      | 3                      |
| 5                          | 5                      | 5, 17, 29, 41, 53, 89  |
| 7                          | 5                      | 7, 19, 31, 43, 67, 79  |
| 11                         | 6                      | 11, 23, 47, 59, 71, 83 |
| Others (0, 4, 6, 8, 9, 10) | 0                      | None                   |

## Step 3: Angular Mapping for Each Residue

Since the clock represents a circle of  $360^\circ$ , and Mod 12 gives us 12 sectors:

- Each sector corresponds to:  $360^\circ \div 12 = 30^\circ$

Thus, the angle corresponding to each modulo class is:

### Modulo Residue Angular Position

|    |             |
|----|-------------|
| 1  | $30^\circ$  |
| 2  | $60^\circ$  |
| 3  | $90^\circ$  |
| 5  | $150^\circ$ |
| 7  | $210^\circ$ |
| 11 | $330^\circ$ |

### Important Observation

Among the 25 prime numbers:

- **5 primes** appear at residue **1** → **angle  $30^\circ$**
- **5 primes** appear at residue **5** → **angle  $150^\circ$**
- **5 primes** appear at residue **7** → **angle  $210^\circ$**
- **6 primes** appear at residue **11** → **angle  $330^\circ$**

- Only one prime appears at each of angles  $60^\circ$  (residue 2) and  $90^\circ$  (residue 3).
- The following angles are completely devoid of primes:  
 **$0^\circ, 120^\circ, 180^\circ, 240^\circ, 270^\circ, 300^\circ$**

### Conclusion:

There is a clear non-random pattern:

Prime numbers from 1 to 100 are concentrated at specific angular positions on the circle (such as  $30^\circ, 150^\circ, 210^\circ, 330^\circ$ ) and completely absent from others. This indicates a true temporal-angular symmetry.

### Secondly: Regarding the Circular Angular Distribution (Mod 12)

Here, we project the prime numbers onto a circular structure (like a clock), where each number falls on a specific angle determined by its residue modulo 12:

$$\theta(n) = \frac{\pi}{6} \cdot (n \bmod 12)$$

#### In the Random Case

- If prime numbers were randomly distributed, their angular positions  $\theta(p)$  would be approximately uniformly distributed around the circle.
- That means there would be no preferred angle, and no specific pattern would emerge in the appearance of primes.

#### In the Non-Random Case

- In reality prime numbers prefer certain angles over others.
- For example, if you calculate the angles for many prime numbers, you'll find they tend to cluster around specific directions:  $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$

They appear symmetrically around the vertical axis (the 12–6 clock line), and are almost absent from angles like  $0^\circ, 120^\circ, 180^\circ, 240^\circ, 270^\circ, 300^\circ$ .

$$\theta = \frac{\pi}{2} \text{ or } \frac{3\pi}{2}$$

#### This Indicates That

- Prime numbers do not appear randomly on the "temporal clock circle".

- Instead, they distribute in a periodic and symmetrical manner.
- This pattern deviates from randomness and reveals a hidden structure in the distribution of prime numbers.

### **Additional Analytical Appendix (if desired)**

If we calculate the angle density (frequency density) for a large set of prime numbers projected onto the circular clock, we find that their distribution is not uniform, but rather exhibits a wave-like or symmetric pattern, which can be analyzed using Fourier Transform.

#### **Applying a Fourier Transform reveals:**

There is a structural temporal repetition

This supports the idea of a non-random temporal-angular distribution.

$$f(\theta) = \sum_{p \leq N} \delta(\theta - \theta(p))$$

### **Linking to a Fundamental Hypothesis in Prime Number Theory**

#### **The Riemann Hypothesis**

However, the Riemann Hypothesis concerns the distribution of prime numbers along the number line, a straight, infinite line.

The non-trivial zeros of the Riemann zeta function suggest a quasi-periodic pattern along this line.

#### **This raises an important question**

#### **Can the straight line be transformed into a circle?**

#### **Answer**

Yes. A straight line can be transformed into a circle through mathematical and physical interpretations using geometric representations and periodic mapping. This transformation is conceptual, not physical, and is widely used in mathematics, physics, and signal processing.

Let's explain how and why this transformation is valid especially within the context of your hypothesis on temporal primes.

### **1. The Basic Concept: Line vs. Circle**

- A straight line represents a linear, unidirectional flow like the timeline of natural numbers or linear time progression.
- A circle represents periodic or cyclic behavior like the hands of a clock or Earth's orbit where positions recur after a full rotation.

The transformation is done using "wrapping" or "mapping" techniques, projecting the linear sequence onto a circular path using modulo operations or periodic functions.

## 2. How to Transform the Line into a Circle

There are several mathematical methods to achieve this transformation:

### Using the Modulo System (mod)

- Numbers along the line (e.g., ..., -2, -1, 0, 1, 2, ...) can be wrapped onto a circle by applying a modulo function.
- For example, using  $\text{mod } 12$  (like a 12-hour clock), the integer 15 would be mapped as:

$$15 \text{ mod } 12 = 3 \quad 315 \text{ mod } 12 = 3$$

→ So, 15 corresponds to the 3 o'clock position on the circular clock.

### Relevance to Your Hypothesis:

In your model, you used a mod 24 system to map prime numbers onto a 24-hour clock circle. This is a clear example of how the linear sequence of time or numbers is folded into a circular domain enabling analysis of symmetry, periodicity, and distribution patterns.

## Transforming the Number Line into a Circle using Modulo System

### Mathematical Representation

Given a natural number  $n \in \mathbb{N}$ , its position on a circle with  $m$  divisions is calculated as:

$$\theta_n = (2\pi/m) \cdot (n \text{ mod } m) \quad \theta_n = \left(\frac{2\pi}{m}\right) \cdot (n \text{ mod } m)$$

### Translation:

We transform the number  $n$  into an angle  $\theta_n$  on a circle divided into  $m$  segments, using modular arithmetic. Each number is projected onto a specific angle on the circumference of the circle.

### Example: Mapping Numbers to Angles Using mod 24

$$\begin{aligned}\theta_n &= (360 \div 24) \cdot (n \bmod 24) = 15 \cdot (n \bmod 24) \\ \theta_n &= \left(\frac{360^\circ}{24}\right) \cdot (n \bmod 24) \\ &= 15^\circ \cdot (n \bmod 24)\end{aligned}$$

#### Translation:

In the 24-hour circular system (mod 24), each number  $n$  maps to an angle  $\theta_n$  where every step corresponds to  $15^\circ$ . For example:

- $n=0 \rightarrow 0^\circ$
- $n=1 \rightarrow 15^\circ$
- $n=5 \rightarrow 75^\circ$
- $n=24 \rightarrow 0^\circ$  (Full circle)

### Angular Frequency Density Function

To calculate the angular density function for prime numbers

$$f(\theta) = \sum_{p \in P} \delta(\theta - \theta_p) \quad \hat{f}(k) = \sum_{p \in P} \delta(\theta - \theta_p)$$

Where:

- $P$ : Set of prime numbers
- $\delta$ : Dirac delta function
- $\theta_p$ : The angle corresponding to the prime  $p$

#### Translation

This function accumulates the number of prime numbers located at each angle  $\theta$ , producing a density function that represents the distribution of primes along the circle.

### Fourier Transform for Temporal Symmetry Detection

$$f^{(k)} = \int_0^{2\pi} f(\theta) \cdot e^{-ik\theta} d\theta \quad \hat{f}(k) = \int_0^{2\pi} f(\theta) \cdot e^{-ik\theta} d\theta$$

#### Translation

We apply the Fourier transform to the angular density function  $f(\theta)$  to analyze frequency patterns or symmetry in the angular-time distribution of prime numbers.

## Relationship to the Riemann Hypothesis

The Riemann Hypothesis states that all non-trivial zeros of the zeta function lie on the line:

$$\operatorname{Re}(s) = \frac{1}{2}$$

Where the Riemann zeta function is defined as

$$\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s} \quad \text{and} \quad \zeta(s) = \prod_{p \in P} \left(1 - \frac{1}{p^s}\right)^{-1}$$

## Translation

Connecting prime number distribution with the zeta function reveals a hidden structure or periodicity in the primes. Our angular-temporal model attempts to capture and analyze this structure through circular representations and mathematical transformations.

## Summary of Geometric Transformation

### From Linear Time to Circular Time

$$\mathbb{R} \rightarrow \text{mod } m \mathbb{S}^1$$

## Translation

We transform the linear number line  $\mathbb{R}$  (representing time or number sequence) into the unit circle  $\mathbb{S}^1$  using the modulo system. This forms the basis of our "circular time" model.

## Trigonometric Functions (Sin and Cos)

- A straight line can be transformed into a circle using trigonometric functions (sine and cosine), which map linear points to points on the unit circle (a circle with radius 1).

*For example, if  $t$  represents a point on a straight line (such as time), it can be mapped onto*

$$x = \cos(t) \quad , \quad y = \sin(t)$$

*Here,  $t$  is the angle in radians, and  $(x, y)$  are the coordinates of a point on the unit circle.*

- **Relation to the Hypothesis**

Trigonometric functions appear naturally in the context of the circular clock model, where angles such as  $\pi/6$  or  $\pi/4$  represent the positions of the clock hands. This reflects the transformation of linear time (seconds or minutes) into circular motion on the clock.

### Geometric Wrapping Function

- One can visualize a straight line being wrapped around a circle. For example, if we have a straight line containing integer values, we can wrap this line around a circle of radius  $r$ , and each point on the line is mapped to an angle on the circle using:

$$\theta = xr \bmod 2\pi = \frac{x}{r} \bmod 2$$

Where  $x$  is a point on the line, and  $\theta$  is the corresponding angular position on the circle.

- **Relation to the Hypothesis:**

In your model, linear time (e.g., 672 hours over 4 weeks) is "wrapped" onto a 24-hour circular clock, where each 24-hour cycle completes a full rotation. This wrapping allows for the angular analysis of prime numbers in time.

### Transformation from Linear Time to Circular Time

- In physics and astronomy, linear time (e.g., the chronological sequence of events) is often converted into circular time when studying periodic phenomena such as the Earth's rotation (day) or its orbit around the Sun (year).
- Relation to the Hypothesis  
You pointed out that time is typically measured using cyclical phenomena like Earth's rotation. The circular clock model is a direct transformation of linear time (in seconds or hours) into angular time (positions of the clock hands on a circle).

### 3. Why Can a Straight Line Be Converted into a Circle?

This transformation is possible for the following reasons

1. **Periodicity:**

A straight line can represent an unbounded sequence (such as integers or linear time), but when studying periodic phenomena, this sequence is "wrapped" into a circle using modulo systems or periodic functions.

## 2. **Geometric Symmetry:**

The circle is inherently a periodic shape and can be used to represent any linear sequence that repeats after a certain interval.

## 3. **The Constant $\pi$ :**

As you mentioned in your hypothesis, the constant  $\pi$  links linear dimensions (like the diameter) with circular motion (like the circumference). This constant enables the mathematical transformation from a line to a circle.

## 4. **Practical Applications:**

In physics (such as waves and oscillations) and signal analysis, linear signals (like time) are transformed into periodic signals using Fourier analysis, which relies on trigonometric functions.

## 4. **Connection to the Prime Time Hypothesis**

In the context of your hypothesis, converting a straight line into a circle is the core of the model you developed:

- **Linear Time:**

It represents a continuous chronological sequence (such as 672 hours across 4 weeks the study you conducted).

## 5. **Why Is the Transformation Important in the Context of My Hypothesis?**

The conversion from a straight line to a circle is crucial for the following reasons:

### 1. **Visualization of Prime Numbers:**

Transforming the sequence of prime numbers from a straight line into a circle allows their distribution to be studied visually, as you did in your studies (e.g., the distribution of 2, 3, 5, ... on the clock circle).

### 2. **Connecting Time with Periodicity:**

Linear time (like a sequence of hours) becomes more analytically tractable when converted into circular time, where it can be linked to periodic functions and frequencies, as in Fourier analysis.

### 3. **Relation to the Riemann Hypothesis:**

The Riemann Hypothesis studies the distribution of prime numbers on the real number line, but the non-trivial zeros represent periodic frequencies. Your model's transformation of the line into a circle mirrors those frequencies, enabling a possible connection to the Riemann Hypothesis.

### 4. **Fractal Symmetry:**

The non-uniform distribution of prime numbers on the circle (as you observed)

reflects a type of fractal symmetry, which resembles the quasi-periodic patterns indicated by the non-trivial zeros.

## **7. (Due to the lack of necessary resources, I will describe the illustration verbally)**

### **Diagram Elements**

#### **1. The Straight Line**

- Draw a horizontal line representing linear time or the sequence of numbers (e.g., 1, 2, 3, ..., 672 for the four weeks).
- Mark the prime numbers (such as 5, 29, 53, ...) as distinctive points (e.g., red circles).

#### **2. The Circle**

- Draw a circle divided into 24 sections (each section being  $15^\circ$  or  $\pi/12$  radians).
- Place the numbers from 1 to 24 in their respective positions (e.g., 1 at  $15^\circ$ , 2 at  $30^\circ$ , ...).
- Highlight the prime numbers among them (1, 2, 3, 5, 7, 11, 13, 17, 19, 23) using special markers (e.g., stars).

#### **3. The Transformation**

- Draw arrows from the points on the straight line (e.g., 29, 53, ...) to their corresponding points on the circle.
- Add labels for the angles in degrees ( $15^\circ$ ,  $30^\circ$ ,  $45^\circ$ , ...) and in radians ( $\pi/12$ ,  $\pi/6$ , ...).

#### **4. Direction of Rotation**

- Indicate the direction of rotation
  - In the first study: Clockwise.
  - In the second study: One day clockwise, one day counterclockwise.
- Use different colors for each of the four weeks to show the distribution of prime numbers.

#### **5. Angular Differences**

- Add lines connecting prime numbers on the circle to show angular differences (e.g.,  $15^\circ$  between 2 and 3,  $30^\circ$  between 3 and 5).

## **8. Conclusion:**

Yes, it is possible to transform a straight line into a circle using mathematical methods such as the modulo system, trigonometric functions, or Fourier analysis.

In the context of the Prime Time Hypothesis, you have transformed linear time (a sequence of hours) into circular time (a 24-hour clock circle) and distributed prime numbers across this circle. This transformation reflects the quasi-periodic pattern of prime numbers, which is analogous to the pattern determined by the non-trivial zeros in the Riemann Hypothesis.

The transformation is important because it enables a visual representation of the distribution of prime numbers, linking time, mathematics, and physics in novel and meaningful ways.

**Now, you can pose a specific scientific question such as.**

**Does the distribution of prime numbers on the temporal circle exhibit a periodic frequency pattern that mimics the frequencies observed in the analysis of the Riemann zeta function  $\zeta(s)$  in the complex plane?**

### **Next Steps in the Study**

At this stage of the research, we have yet to determine whether prime numbers exhibit a uniform angular-temporal distribution around the 24-hour circular model of time. In other words, it is still unknown whether prime occurrences are evenly spread across the temporal circle, or if they cluster at certain angular positions more than others.

The next essential step is to:

1. Analyze the angular distribution of primes across the full 24-hour cycle (or  $360^\circ$ ).
2. Quantify the presence or absence of symmetry, periodicity, or clustering.
3. Formulate a mathematical hypothesis regarding the angular-temporal distribution of prime numbers.

If a full or partial symmetry is detected particularly if prime numbers display consistent angular gaps or periodic structures this could provide strong evidence supporting the Riemann Hypothesis.

**In essence, we propose that:**

**The Riemann Hypothesis is valid as long as time is continuous and the angular distribution of prime numbers remains symmetric on the temporal circle.**

This approach provides a geometric and temporal reinterpretation of prime number distribution and could potentially serve as a novel route toward understanding or even proving the Riemann Hypothesis, based on the visual and angular behavior of primes in a cyclic temporal model.

**Mathematical Hypothesis: The Angular-Temporal Distribution of Prime Numbers**

**Definition: Temporal Angular Mapping (TAM)**

Let every natural number  $n \in \mathbb{N}$  be mapped onto a unit circle (like a clock), such that its angular position is

$$\theta(n) = 2\pi \cdot (n \bmod T) / T$$

- $\theta(n) \in [0, 2\pi)$  is the angular coordinate of number  $n$ ,
- $T$  is the modular base (e.g.,  $T = 24$  for a 24-hour temporal circle).

**Observation: Prime Clustering**

Let  $P \subset \mathbb{N}$

denote the set of prime numbers. Let us define the angular image of the primes:

$\Theta_P = \{\theta(p) \mid p \in P\}$  Empirical analysis suggests that

- The values in  $\Theta_P$  do not appear uniformly across the unit circle.
- Certain angular sectors (e.g., around  $\theta = \pi/6, 5\pi/6, 7\pi/6, 11\pi/6$ ) tend to **accumulate** prime occurrences.
- Other sectors (e.g.,  $\theta = 0, \pi$ ) show **sparse or zero** prime appearances.

**Hypothesis (H<sub>1</sub>): Angular-Temporal Symmetry of Primes**

The distribution of  $\Theta_P$  on the circle is not uniform, but instead exhibits a symmetric and periodic pattern, such that

$$\theta(p) \approx \theta(p') \text{ if } |p - p'| = k \cdot T \text{ for some integer } k$$

Meaning: primes separated by full periods ( $T$ ) tend to land on same or symmetric angular positions.

### Hypothesis (H<sub>2</sub>): Harmonic Structure in Prime Distribution

The set  $\Theta_p$  exhibits dominant angular frequencies when analyzed via Fourier Transform on the angular density function  $f(\theta)$  where:

$$f(\theta) = \sum_{p \leq N} \delta(\theta - \theta(p)) \quad f(\theta) = \sum_{p \leq N} \delta(\theta - \theta(p))$$

Then the Fourier coefficients

$$f^{(n)} = \int_0^{2\pi} f(\theta) \cdot e^{-in\theta} d\theta \quad \hat{f}(n) = \int_0^{2\pi} f(\theta) \cdot e^{-in\theta} d\theta$$

are non-negligible for certain  $n \in \mathbb{Z}$  revealing the hidden periodicity of primes on the angular-temporal domain.

### Hypothesis (H<sub>3</sub>): Angular-Temporal Link to the Riemann Hypothesis

If the angular-temporal distribution of primes is symmetrical and periodic, this suggests the zeros of the Riemann zeta function  $\zeta(s)$  are located on the critical line  $Re(s) = \frac{1}{2}$ , since:

$$\zeta(s) \leftrightarrow \text{Distribution of primes} \leftrightarrow f(\theta) \zeta(s) \leftrightarrow \text{Distribution of primes} \leftrightarrow f(\theta)$$

That is, a symmetric angular prime distribution implies a harmonic (oscillatory) structure compatible with the known oscillations in the complex plane of  $\zeta(s)$ , supporting the validity of the Riemann Hypothesis.

### Hypothesis 1: Temporal-Angular Symmetry of Prime Numbers

Let  $P = \{p_1, p_2, p_3, \dots\}$  be the set of all prime numbers.

Define a temporal-angular mapping on a 24-hour circular clock as

$$\theta(p) = 2\pi(p \bmod 24) / 24 \quad \theta(p) = \frac{2\pi(p \bmod 24)}{24}$$

This maps each prime number  $p$  to an angular position on the unit circle corresponding to a time of day coordinate.

We define the prime angular distribution function as:

$$f(\theta) = \sum_{p \in P} \delta(\theta - 2\pi(p \bmod 24)/24) f(\theta) = \sum_{p \in P} \delta\left(\theta - \frac{2\pi(p \bmod 24)}{24}\right)$$

**Hypothesis:** If the angular distribution  $f(\theta)$  exhibits detectable patterns of symmetry or periodicity, this indicates that prime numbers are not randomly scattered across the temporal circle, but follow a latent angular structure.

## Hypothesis 2: Connection Between Angular Prime Distribution and the Riemann Hypothesis

Let  $\zeta(s)$  be the Riemann zeta function.

**Hypothesis:** If the temporal-angular distribution  $f(\theta)$  shows symmetrical or harmonic structures possibly revealed through Fourier analysis then such periodicities may correspond to the imaginary components of the non-trivial zeros of  $\zeta(s)$  supporting the Riemann Hypothesis:

$$\text{Re}(s) = \frac{1}{2}$$

### In other words:

The angular symmetry of primes on a circular time model may reflect the harmonic nature of the Riemann zeta function's zeros, offering geometric insight into its validity.

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## Mathematical Formulation of the Hypotheses

### 1. Temporal-Angular Distribution Hypothesis of Prime Numbers

Let  $p \in P$

$\in P$  be a prime number, and let us define its temporal angular position on a circular clock of period  $T = 24T = 24$  hours as:

$$\theta_p = 2\pi(p \bmod T)/T \theta_p = \frac{2\pi(p \bmod T)}{T}$$

### Hypothesis:

$\exists$  non-random patterns in  $\theta_p$  such that  $\theta_p$

$\sim \mathcal{U}(0, 2\pi) \exists$  non-random patterns in  $\theta_p$  such that  $\theta_p / \sim \mathcal{U}(0, 2\pi)$

### 2. Symmetry Hypothesis of Prime Angular Positions

Define the set of angular differences:

$$\Delta\theta = \theta_{p_i} + 1 - \theta_{p_{i+1}} \pmod{2\pi} \Delta\theta = \{\theta_{p_{i+1}} - \theta_{p_i} \pmod{2\pi}\}$$

**Hypothesis:**

$\Delta\theta$  shows periodic or symmetric structures around certain axes such as  $\theta = \pi$  or  $\theta = \pi/2$  or  $\theta = 3\pi/2$  shows periodic or symmetric structures around certain axes such as  $\theta = \pi$  or  $\theta = \pi/2$

**3. Zeta Function Correspondence Hypothesis**

Let  $\zeta(s)$  be the Riemann zeta function, and let its non-trivial zeros be defined as:

$$\rho_n = \sigma_n + i\gamma_n \text{ where } \zeta(\rho_n) = 0 \text{ or } \rho_n = \frac{1}{2} + i\gamma_n \text{ where } \zeta(\rho_n) = 0$$

Define the angular frequency of primes in time as:

$$f_p = \frac{1}{\Delta t_p} \text{ or } \omega_p = 2\pi \Delta t_p f_p = \frac{1}{\Delta t_p} \text{ or } \omega_p = \frac{2\pi}{\Delta t_p}$$

**Hypothesis:**

$$\omega_p \approx \gamma_n \text{ for some sequence of } \gamma_n \in \text{Im}(\rho_n)$$

**4. Riemann Validity from Temporal Continuity**

Assume that time is continuous:  $t \in \mathbb{R}^+$ , and define prime time points projected on the circle as:

$$\theta(t) = 2\pi \cdot t \pmod{T} \text{ or } \theta(t) = 2\pi \cdot \frac{t \pmod{T}}{T}$$

If prime angles  $\theta_p$  show full circular symmetry, then:

*This symmetry implies a structure aligned with  $t$*

*the critical strip of  $\zeta(s)$ , supporting the Riemann Hypothesis. This symmetry implies a structure aligned with the critical strip of  $\zeta(s)$ , supporting the Riemann Hypothesis.*

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