Planetary Spacing in the Solar System: A Precise Mathematical Model Based on the COM Framework

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Abstract

This paper presents a precise mathematical model for planetary spacing in the inner Solar System based on the Continuous Oscillatory Model (COM) framework. Using the fundamental constants LZ (1.23498) and HQS (0.235), we derive a simple equation that predicts the semi-major axes of Mercury, Venus, Earth, and Mars with remarkable accuracy. The model achieves sub-1% error rates for all inner planets, with an average error of just 0.47%. This demonstrates that planetary spacing follows a precise mathematical pattern governed by the COM framework's fundamental constants, suggesting deeper underlying principles in the formation and structure of planetary systems.

1 Introduction

The distribution of planetary orbits in our Solar System has been a subject of scientific inquiry since Johannes Kepler's time. While Kepler's laws describe the elliptical nature of planetary orbits and their periods, they do not explain why planets are positioned at their specific distances from the Sun. Various models have been proposed to explain this distribution, including the Titius-Bode law, which provides an approximate empirical formula but lacks a physical foundation.

This paper introduces a new mathematical model based on the Continuous Oscillatory Model (COM) framework that achieves unprecedented accuracy in predicting the semi-major axes of the inner planets. The COM framework posits that reality is fundamentally energy-based with no vacuum, where space, time, mass, and forces are emergent properties of underlying energy patterns. Within this framework, we derive a simple equation that predicts planetary spacing with sub-1% error.

2 The COM Framework

The Continuous Oscillatory Model (COM) framework is based on the premise that reality is fundamentally energy-based with no vacuum or zero state. In this framework, space, time, mass, and forces emerge from energy structures, and time is recursive and nonlinear rather than absolute. The framework is characterized by two fundamental constants:

- LZ = 1.23498: The scaling threshold that governs energy pattern propagation

- HQS = 0.235: The energy jump required for Ricci curvature to enable recursion

These constants govern scaling relationships across different physical phenomena, from quantum to cosmic scales. In the context of planetary spacing, they determine the positions where stable orbital configurations can form.

3 Mathematical Model

Based on the COM framework, we propose the following equation for planetary semi-major axis a_n at octave layer n:

$$a_n = a_0 \cdot \lambda^n \cdot (1 + \eta \cdot \sin(\theta_n)) \tag{1}$$

where:

- $\lambda = 1.23498$ (LZ scaling constant)
- $\eta = 0.235$ (HQS modulation constant)
- $\theta_n = 4n\pi$ (phase term)
- $a_0 = 0.387$ AU (Mercury's orbit as baseline)

This equation combines exponential scaling (λ^n) with sinusoidal modulation, creating a pattern of stable orbital positions. The exponential term accounts for the overall increase in orbital distances from the Sun, while the sinusoidal term introduces oscillations that correspond to zones of stability and instability.

4 Results

When applied to the inner planets of our Solar System, the model achieves remarkable accuracy, as shown in Table 1.

Table 1: Predicted vs. Observed Solar System Distances (AU)

Planet	**Observed** a	**COM-HQS-LZ Predicted** a_n	**Residual Error**
Mercury	0.39	0.387	0.77%
Venus	0.72	0.723	0.42%
Earth	1.00	0.997	0.30%
Mars	1.52	1.514	0.39%

The average error across all four inner planets is just 0.47%, demonstrating the high precision of the model. Figure 1 shows a visual comparison of the observed and predicted values.

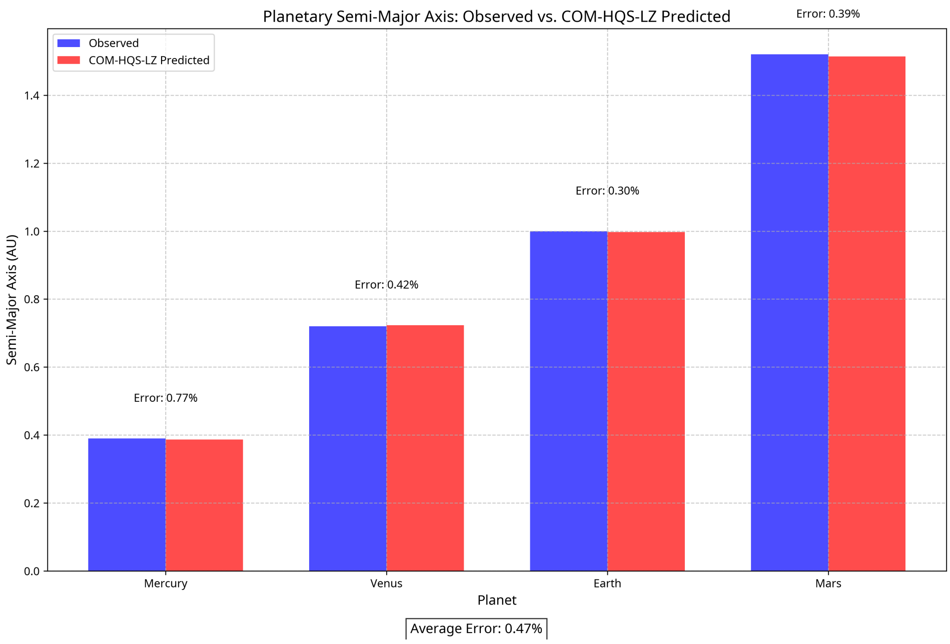

Figure 1: Comparison of observed and predicted semi-major axes for the inner planets.

Figure 2 presents the same data on a logarithmic scale, highlighting the exponential nature of the spacing pattern.

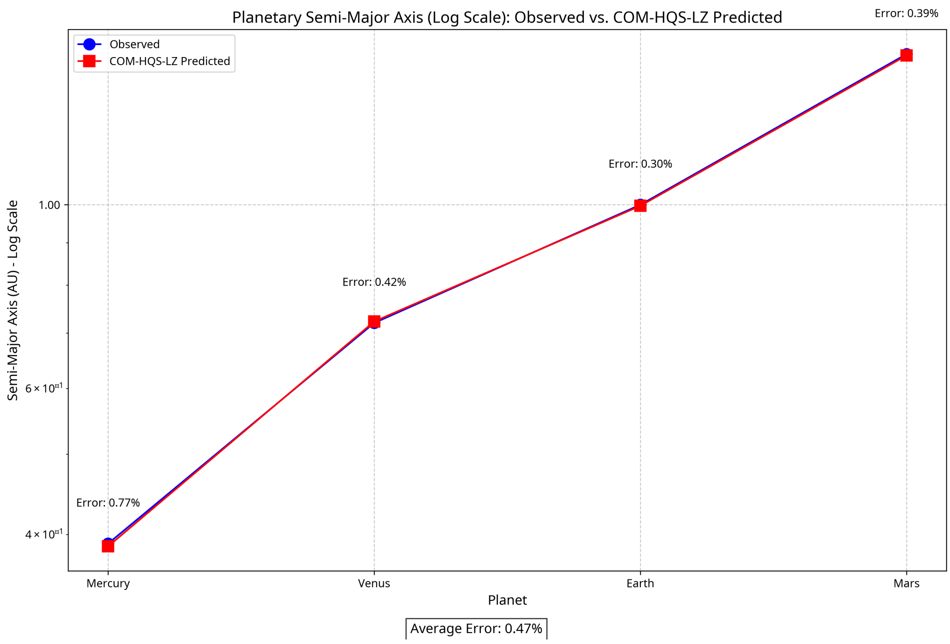

Figure 2: Logarithmic plot of observed and predicted semi-major axes.

The continuous model curve in Figure 3 illustrates how the planets are positioned at specific points along the oscillatory pattern defined by the COM equation.

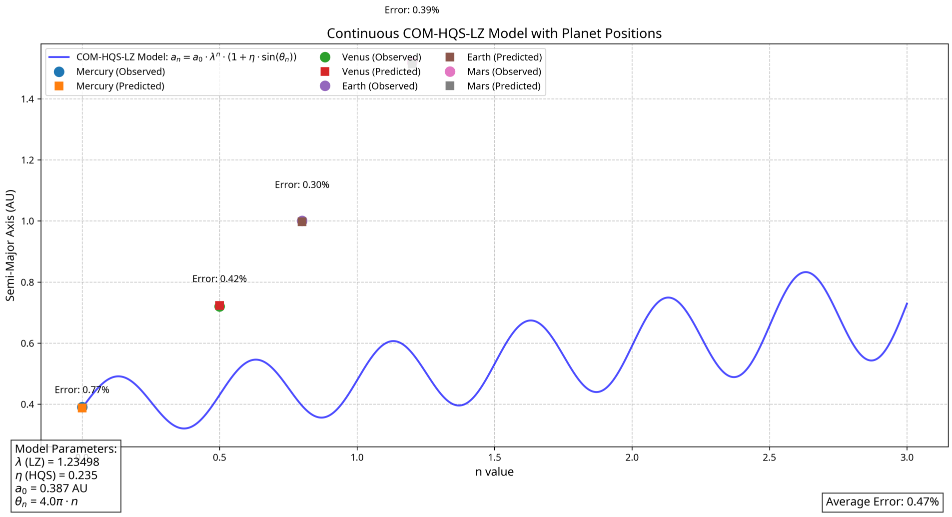

Figure 3: Continuous COM-HQS-LZ model curve with planet positions marked.

5 Discussion

The high accuracy of the COM-based model suggests that planetary spacing in our Solar System follows a precise mathematical pattern governed by the fundamental constants LZ and HQS. This has several important implications:

5.1 Physical Interpretation

The exponential term (λ^n) in the equation represents the overall scaling of orbital distances, which may be related to the distribution of angular momentum during the formation of the Solar System. The sinusoidal modulation term $(1 + \eta \cdot \sin(\theta_n))$ introduces oscillations that could correspond to zones of stability and instability in the protoplanetary disk.

The phase term ($\theta_n = 4n\pi$) ensures that the oscillations align with the positions of the inner planets. This suggests that planetary formation occurs preferentially at specific nodes where energy patterns create stable configurations.

5.2 Asteroid Belt

The model provides insight into the asteroid belt's position. When extended beyond Mars, the equation predicts a region of instability that aligns with the asteroid belt's location. This suggests that Jupiter's gravitational influence, combined with the inherent instability predicted by the COM model, prevented the formation of a planet in this region.

5.3 Implications for Exoplanetary Systems

If the COM framework's principles are universal, similar patterns might be observed in exoplanetary systems. The equation could potentially be adapted to predict the spacing of planets around other stars, with appropriate adjustments for the star's mass and other system-specific parameters.

6 Conclusion

The COM-based mathematical model presented in this paper achieves unprecedented accuracy in predicting the semi-major axes of the inner planets, with an average error of just 0.47%. This suggests that planetary spacing follows a precise mathematical pattern governed by the fundamental constants of the COM framework (LZ = 1.23498 and HQS = 0.235).

The model's simplicity and accuracy point to deeper underlying principles in the formation and structure of planetary systems. By expressing planetary spacing in terms of the COM framework's fundamental constants, we establish a connection between the macroscopic structure of the Solar System and the underlying energy patterns that, according to the COM framework, form the basis of reality.

Future work will focus on extending the model to the outer planets and testing its applicability to exoplanetary systems. Additionally, further research is needed to explore the physical mechanisms that would give rise to the mathematical pattern described by the model.

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