# Critique of Reference [3]: Algebraic Error and Uncertainty in Tidal Dissipation Modeling

## 1. Introduction

Reference [3] attempts to justify constraints on the time variation of Newton’s gravitational constant (G) by linking the lunar semi-major axis recession rate (ȧ/a) to Ġ/G. However, we have identified a fundamental algebraic mistake in their derivation, along with substantial uncertainties in the modeling of tidal dissipation. This critique outlines the errors in the paper and highlights the incomplete treatment of planetary perturbations, Earth's moment of inertia variations, and lunar dissipation processes.

## 2. Algebraic Error in Reference [3]

The article assumes the equation:  
  
 ȧ/a = Ġ/G  
  
However, a correct derivation from Newtonian mechanics and conservation of angular momentum shows that:  
  
 ȧ/a = 3 Ġ/G  
  
This missing factor of 3 is a significant mathematical error. The implication of this mistake is that the article underestimates the influence of G variation on the Moon’s recession by a factor of three. Thus, any constraints on Ġ/G derived from this equation are fundamentally flawed.

## 3. Measurement of Lunar Recession vs. Modeling Difficulties

The lunar recession rate (ȧ/a) is measured directly using Lunar Laser Ranging (LLR) and is not subject to significant observational uncertainty. The equation ȧ/a = 3 dr/r is valid and can be used directly. However, what is problematic is the separation of different effects in the model, including:  
- Tidal dissipation uncertainties  
- Planetary perturbations  
- Time-varying moment of inertia of Earth  
- Effects of oceanic expansion due to climate variations  
- Changes in Earth's core and mantle properties  
  
Thus, while the measurement of ȧ/a is possible, the challenge lies in correctly modeling the different contributions to lunar recession, which were not detailed in the article.

## 4. Lack of Detailed Tidal Dissipation Modeling

The Moon is the primary location where tidal dissipation occurs, yet the article does not present a comprehensive model for lunar energy dissipation. It mentions two primary mechanisms:  
  
1. Solid-body dissipation  
2. Viscous dissipation at the liquid-core/solid-mantle interface  
  
However, only the first mechanism was included in the model, while the second was omitted. This omission introduces a significant source of model uncertainty, as different dissipation mechanisms produce different effects on the Moon’s recession.

## 5. Uncertainties in Earth’s Moment of Inertia and Oceanic Expansion

The article incorporates dissipation effects from diurnal and semidiurnal tides but does not provide a detailed discussion of:  
- The time-varying mantle properties of Earth  
- Expansion of Earth’s oceans due to climate change  
- Continental drift and its impact on tidal resonance  
- Changes in Earth's core sliding properties  
  
All of these factors influence the moment of inertia and the rate of energy transfer in tidal locking, but the article does not provide quantitative estimates of their impact on lunar recession.

## 6. Lack of Explicit Modeling of Planetary Influences

The article briefly mentions planetary perturbations but does not describe the ephemerides used to model them. Jupiter and other planets influence the Moon’s orbit, but the document does not specify how these effects were calculated. Without a clear description of their contribution, it is difficult to assess the accuracy of the model.

## 7. HU Prediction and Missing Tidal Dissipation Evidence

The Hypergeometrical Universe (HU) Theory predicts:  
  
 Ġ/G = 7.14 × 10⁻¹¹ per year  
  
This accounts for 71% of the observed lunar recession rate, leaving only 3.9 × 10⁻¹¹ per year to be explained by tidal locking. However, the article does not present independent data to support the assumed tidal dissipation acceleration. Instead, it relies on assumptions without empirical validation. Given the missing dissipation mechanisms and uncertainties in Earth’s moment of inertia, it is unclear whether tidal friction alone can account for the remaining lunar recession.

## 8. Conclusion

Reference [3] contains a fundamental algebraic error, missing a factor of 3 in its derivation of the relationship between the lunar semi-major axis and G variation. This results in an incorrect constraint on Ġ/G. Furthermore, while the measurement of ȧ/a is not problematic, the modeling of tidal dissipation and planetary perturbations is highly uncertain. The Hypergeometrical Universe Theory correctly predicts that 71% of the lunar recession rate is due to G variation, leaving 39% to be explained by tides. However, the article does not provide independent data supporting the assumed tidal dissipation effects. A more rigorous approach is needed to separate tidal effects from gravitational variation and improve constraints on Ġ/G.