# Critique of the Tidal Dissipation Model in LLR-Based Constraints on \( \dot{G}/G \)

## 1. Introduction

Lunar Laser Ranging (LLR) studies claim to constrain the variation of Newton’s gravitational constant (\( \dot{G}/G \)) by attributing the observed lunar recession entirely to tidal dissipation effects. However, these studies fail to provide a direct, quantitative prediction of how much \( dr/r \) should change per year due to tidal effects alone. Additionally, the tidal dissipation model used is idiosyncratic, Earth-based, and has not been independently validated for the Moon. This document critically evaluates these issues and concludes that the LLR-based tidal model is not a sufficient basis to rule out \( \dot{G}/G \) variation.

## 2. No Explicit Prediction for \( dr/r \) from Tidal Locking

The fundamental requirement for validating the LLR tidal dissipation model is an explicit prediction for the annual change in the Moon’s orbit (\( dr/r \)) due to tidal locking alone. However, the LLR papers do not provide this calculation. Instead, they assume tidal dissipation accounts for the observed lunar recession and use this assumption to reject \( \dot{G}/G \). Without an explicit tidal prediction for \( dr/r \), this argument lacks empirical justification.

## 3. Uncertainty Without a Reference Value is Meaningless

The LLR studies claim that the tidal dissipation model has an uncertainty of ~2%. However, this uncertainty is meaningless without a baseline value to which it applies. If the expected tidal contribution to \( dr/r \) is unknown or unstated, then a 2% uncertainty provides no useful information. The lack of a stated reference value undermines the credibility of the tidal model’s accuracy.

## 4. Tidal Model is Highly Idiosyncratic and Not Universally Applicable

The parameters used in the LLR tidal dissipation model have only been applied to Earth and have not been independently verified for the Moon. The dissipation mechanisms in the lunar interior are significantly different from Earth's, making direct parameter transplantation from Earth to the Moon unjustified. Additionally, the model has not been validated in other planetary systems, such as exoplanets with tidal locking or moons in other star systems. Without independent verification, the model remains highly idiosyncratic and questionable in its applicability to the Moon.

## 5. No Independent Cross-Verification of the Tidal Model

A robust physical model should be verifiable across multiple planetary systems. If the tidal dissipation model used in LLR studies were correct, it should be applicable to other celestial bodies experiencing tidal locking. However, the LLR papers do not provide any cross-verification of this model. There is no attempt to compare it to tidal dissipation effects in exoplanets, Jupiter’s moons, or binary systems, making the model entirely Earth-centric.

## 6. Circular Reasoning in the Paper’s Argument

The LLR studies assume tidal dissipation accounts for the observed \( dr/r \) and then use this assumption to dismiss \( \dot{G}/G \). Instead, they should have first calculated \( dr/r \) from tidal effects independently and then compared it to the observed value. Since no independent baseline calculation of \( dr/r \) is provided, the model’s correctness is assumed rather than demonstrated. This circular reasoning undermines the validity of their conclusions.

## 7. Conclusion

The LLR studies fail to justify their constraint on \( \dot{G}/G \) due to multiple critical issues:

- No explicit tidal prediction for \( dr/r \) per year is provided.  
- The claim of 2% model uncertainty is meaningless without a baseline value.  
- The tidal model is based on Earth-centric assumptions and is not validated for the Moon.  
- The model lacks independent cross-verification in other planetary systems.  
- The rejection of \( \dot{G}/G \) is based on circular reasoning rather than empirical validation.  
  
Given these flaws, the tidal dissipation model used in LLR studies is not a sufficient basis to rule out \( \dot{G}/G \) variation. A proper scientific approach would require an explicit tidal prediction for \( dr/r \), independent verification in other planetary systems, and a rigorous separation of tidal effects from \( \dot{G}/G \) effects before making definitive claims.