Calculation of anomaly in lunar orbital evolution

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Abstract. Studies of the Moon, with thanks to Johnson Space Center, have quantified a large anomaly in lunar orbital evolution. The Moon has long been known to be slowly drifting farther away due to tidal forces transferring angular momentum from Earth's rotation. Our Lunar Laser Ranging Experiment has reported the Moon's semimajor axis increasing at *3.82 ± .07 cm/yr*[1], anomalously high. If the Moon were today gaining angular momentum at this rate, it would have coincided with Earth less than 1.5 Gyr ago. Our studies of lunar samples show that the Moon is over 4.5 Gyr old.

Studies of tidal rhythmites can also measure lunar orbital evolution. Thicknesses of sedimentary layers vary with the height of lunar tides. Fossilized rhythmites can be used to determine lunar distance over many millions of years. The Mansfield sediment of Indiana places the Moon *375,300 ± 1,900 km* away *310 Myr* ago, a recession rate of only *2.9 ± 0.6 cm/yr.* Independent studies of the older Elatina and Reynella tidal rhythmites also indicate a significantly lower rate than LLRE[2].

Corroborating data may have come from historical astronomers. If the narrow track of a total eclipse is recorded over an observatory, it provides an accurate measure of Earth's slowing rotation rate. As Earth and Moon form a closed system, this tells us how much angular momentum has been transferred. A rate of *3.82 ± 0.7 cm/yr* corresponds to change in Earth's length of day of *2.30 msec/cyr.* Observations spanning 2700 yr show change in LOD of *1.70 ± .05 msec/cyr*[3], indicating a lunar recession of *2.82 ± 0.08 cm/yr.* Though eclipse records corroborate tidal data, LLRE's laser light differs by over 10σ.

Anomalies in observed orbits of Mercury and the moons of Jupiter are today known to result from Relativity and the speed of light. A cosmology where speed of light c is related to age of Universe t by $GM=tc^3$ has been suggested to predict the redshifts of distant Type Ia supernovae, and a *4.507034%* proportion of baryonic matter[4]. If c were changing at the rate predicted, lunar orbital distance would appear to increase by an additional *0.935 cm/yr.* A 10σ anomaly may be precisely accounted for, shedding light on puzzles of "dark energy." In Planck units this may be summarized as $M = R = t$.

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