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P2 3 Universally Screwed?

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Abstract

If the Universal production logo appeared above the Earth and was modelled to be a single, solid, geostationary, silver sphere, a person on Earth facing this new moon would feel a gravitational pull of 3.32 ms^{-2} and a pull of 0.51 ms^{-2} on the opposite side of the Earth. With a difference of over 650%, this would cause a permanent tidal bulge on the close side and change the landscape of Earth.

Introduction

The shiny Universal Pictures logo appears orbiting around the Earth and then comes to halt at the start of the production company's film [1]. With one letter alone seemingly covering a continent, we will investigate how big the letters are and what impact they will have on the Earth's surface.

Method

Universal Pictures have not publicly disclosed their model nor any measurements for their logo. So to determine the actual size of the 9 letters, the Universal Pictures intro was analysed [1] and a scale was produced. This scale carries assumptions: The landmasses used in the intro are appropriately based on the actual continents, each letter is equidistant to the Earth's (perfectly spherical) surface and the Universal letters apparent sizes from the observer in space and their actual sizes are the same. By measuring the width of the South American continent [2], the scale comparison was found to be approximately 3 cm : 5190 km, so 1 cm is equivalent to 1730 km. The letter "U" depth was independently estimated by MetaBallStudios to be 2700 km [3]. If we then surmise that each letter has the same depth, each letter's area and volume can be calculated (Table 1).

Another assumption is that the letters are solid and their shiny nature is due to being completely made out of Silver, which has a density of 10,490 kgm^{-3} [4]. To find the masses, we need to convert the letters into metres and use the density equation (1):

$$Density = \frac{Mass}{Volume} \tag{1}$$

The masses of each letter can be found in Table 1. In order to facilitate the mathematics, we assume the letters merge and create a single uniform sphere where the central letter "E" was. In the intro, the letters decelerate to the relative speed of the Earth, so it could be said that this new sphere would be in geostationary orbit. This new "Universal" moon with a total mass of 1.80 x 10^{24} kg would be approximately 30% the mass of Earth (5.97 x 10^{24} kg [5]). We are able to find the tidal force from the Universal moon

	Area (cm^2)	Actual area (km^2)	Actual Volume (1E10 km^3)
U	2.75	8230475	2.22
N	2.96	8858984	2.39
I	1.00	2992900	0.81
V	2.44	7302676	1.97
E	2.60	7781540	2.10
R	3.31	9906499	2.67
S	3.00	8978700	2.42
A	1.90	5686510	1.54
L	1.25	3741125	1.01

Table 1: The physical properties of each letter

when facing the moon [6] by using equation (2):

$$a_{near} = \frac{GM_{moon}}{(R - r_{Earth})^2} - \frac{GM_{moon}}{R^2} \qquad (2)$$

Where G is the gravitational constant at 6.67 x 10^{-11} Nm^2kg^{-2}, R is the distance between the centre of Earth and the centre of the new moon, r_{Earth} is 6371 km [5] and the mass of the moon was found to be 1.80 x 10^{24} kg. To find R, we can assume that the centre of mass of the moon is the same as the letter "E" and the letter's centre of mass is in the middle of its depth. R would be r_{Earth}, plus the distance between Earth's surface and the surface of "E" (4000 km, estimated by the Corridor Crew [7]), plus the half the letter depth (1350 km) which would equal 11721 km.

When at the opposite side of the Universal moon [6],

$$a_{far} = \frac{GM_{moon}}{R^2} - \frac{GM_{moon}}{(R + r_{Earth})^2}, \qquad (3)$$

Results

a_{near} (Equation (2)) results in a gravitational pull of 3.32 ms^{-2}, meaning that when someone is underneath this new moon, they'll feel one third lighter as the gravity of Earth is 9.81 ms^{-2}. a_{far} is calculated to be 0.51 ms^{-2} using equation (3).The Moon's difference is around 5% [6] and the cause of tides. In comparison, the close side tidal forces are over 650% larger compared to the far side.

Conclusion

The relatively huge gravitational pull of the "Universal" moon compared to the current Moon would nullify the impacts of the Moon and a new tidal system would be formed. As the Universal moon is in geostationary orbit, there would be a permanent high tide near the new moon and a permanent low tide on the far side of the Earth. If the letters were kept separate then their individual forces would act on each other and most likely cause a weaker overall gravitational pull on the Earth causing a smaller bulge. Even so, in the very short term, people may enjoy feeling lighter, but soon landscapes would change; beaches would turn into deserts and deserts into oceans. The world would look unrecognisable and resemble a dystopian world and the human race would be Universally screwed.

References

[1] `https://www.youtube.com/watch?v=bNJW113tbKk` [Accessed 14 October 2023]

[2] `https://www.freemaptools.com/measure-distance.htm` [Accessed 15 October 2023]

[3] `https://www.youtube.com/watch?v=Xd5qHyn5Xfw` [Accessed 15 October 2023]

[4] `https://www.bullionbypost.co.uk/index/silver/density-of-silver/` [Accessed 16 October 2023]

[5] `https://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html` [Accessed 17 October 2023]

[6] R.Marciniak(2015), *'Do You Weigh Less When the Moon is Above You?'* [Accessed 17 October 2023]

[7] `https://www.youtube.com/watch?v=xUa2U3Cmawo` [Accessed 17 October 2023]