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S5_4 The Lion King: An Adventure in Time and Space

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Abstract

We hypothesised that Disney's *The Lion King* took place on a supermassive planet, which was why the main character - Simba - appears to grow up very fast; as a result of time dilation. We found that for this to occur, the hypothetical planet would have to have a mass of 4.30×10^{33}kg.

Introduction

In Disney's *The Lion King*, the main character - called Simba - is shown to be growing up incredibly quickly. This is generally accepted to be Disney skipping ahead in the story and only showing moments of Simba maturing, but what if it actually was real time? What if Simba seems to grow so fast as a result of time dilation, due to the observer being close to a massive object? We hypothesise that *The Lion King* takes place on a planet with the same radius of Earth, and aim in this paper to estimate how heavy the planet would have to be if this were the case.

Theory

Time passes differently for different observers, depending on the strength of the gravitational field they are experiencing, and the speed at which they are travelling. This is known as time dilation. Given that no relativistic travel occurs in *The Lion King*, the only consideration for time dilation to be taken into account will be gravitational distortions. The difference in time passed for an observer outside the influence of the gravitational field and an event occurring with the effect is given by:

$$T_{obs} = \sqrt{1 - \frac{2GM}{Rc^2}} T_{event}, \tag{1}$$

where T_{event} and T_{obs} are the times passed for the event and the observer, respectively, G is the gravitational constant, 6.67×10^{-11} m^3 kg^{-1} s^{-2}, M is the mass of the body distorting time, R is the distance from the centre of the mass, and c is the speed of light [1].

We have assumed in this scenario that the film takes place on a planet with the same radius as Earth, but with a greater mass, and that the camera remains on the ground, while the log scene during which Simba matures is at a sufficient altitude that time dilation can occur, which is why this is the only point in the film that time dilation occurs, as the rest of the time, the observer and the events were in the same gravitational potential. Therefore, $R = 6,371$km.

As our aim was to calculate the mass of *The Lion King*'s planet, we required M to be the subject of Eq. (1), giving:

$$M = \frac{Rc^2}{2G}[1 - (\frac{T_{obs}}{T_{event}})^2]. \tag{2}$$

We found our T_{obs} value to be 9 seconds, the time for which Simba is shown maturing while

walking across a log [2]. Lions enter maturity at about 3 years of age, and Simba is 1 year old, or less [3], at the start of the log scene, so the real time that passed, T_{event}, was 2 years, or 6.3×10^7s. We therefore found the planet's mass to be 4.30×10^{33}kg, or 7.1×10^8 times the mass of the Earth.

Discussion

There are no known planets with a mass of this magnitude; the largest known planet has a mass of 5.41×10^{28}kg [4], and even stars often do not reach this mass; most of them have masses below 150 times the mass of our Sun [5], whereas this hypothetical planet is 2000 times as massive. Additonally, the gravitational acceleration on that planet, given by:

$$g = \frac{GM}{R^2}, \tag{3}$$

would be over 10^{14} times as strong as on Earth, at a value of 7.07×10^{15}, compared to Earth's 9.81. It is highly unlikely that any life would be able to evolve, let alone survive.

Conclusion

We found that the mass of the hypothetical planet Disney's *The Lion King* would have to be 4.30×10^{33}kg, making the planet more massive than most astronomical bodies, excluding black holes, and rendering it uninhabitable to any life as recognised on Earth.

References

[1] `http://www.awitness.org/unifiedm/introgrtd.html` [Accessed 22 November 2017]

[2] `https://www.youtube.com/watch?v=3syhVQivOvU` [Accessed 22 November 2017]

[3] `livingwithlions.org/mara/how-to/age-lions` [Accessed 22 November 2017]

[4] `https://goo.gl/o2nZQ2` [Accessed 23 November 2017]

[5] `https://www.universetoday.com/25328/mass-of-stars/` [Accessed 23 November 2017]