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P1 5 Mom, Phineas and Ferb are Making a Special Topics Paper!

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Abstract

In this paper, we find the speed and energy required to increase the length of Summer vacation from 77 to 104 days from an observers point of view. It would require 1.87×10^{41} J with Earth reaching 67% the speed of light, which we calculate would take 30.9 Myr to absorb from the sun. We also find that the tension felt by a rope holding the Earth at it's normal orbit radius to be 2.17×10^{30} N.

Introduction

In this paper, we discuss Dr. Heinz Doofenshmirtz's diabolical plan, using the Earth-Speedupinator, to increase the Earth's velocity to the point where he views summer vacation as 104 days long as an observer, as per the theme song of Phineas and Ferb [1] and due to the laws of special relativity. We also discuss the energies involved and his efforts to maintain a standard Earth orbital radius, following this speed increase, by using the Lassoinator around the Sun. Note: These are not real events or machines in the show and this does not change the length of an actual summer in the same way.

Theory

A typical American school summer vacation is 77 days long [2], as opposed to 104 days in Phineas and Ferb. Assuming that this is the true length of a summer vacation in the Phineas and Ferb canon and that the antagonist of the show, Doofenshmirtz, has somehow increased the velocity of the Earth's orbit to relativistic speeds using his Earth-Speedupinator, we can calculate

the velocity of Earth using the following [3]:

$$\delta t' = \frac{\delta t}{\sqrt{1 - v^2/c^2}} \quad (1)$$

Where $\delta t' = 104$ days is the time that passes for an observer, which we assume to be Doofenshmirtz in an evil satellite in a solar orbit equal to Earth's original orbit, $\delta t = 77$ days is the time that passes from the Earth's frame of reference, $c \approx 2.998 \times 10^8$ m s⁻¹ is the speed of light, and v is the velocity achieved by Earth, relative to our observer, Doofenshmirtz.

Rearranging for v gives an Earth velocity of $\approx 2.01 \times 10^8$ m s⁻¹ or 67% of the speed of light. The kinetic energy imparted onto the Earth and the final kinetic energy from Doofenshmirtz's frame of reference by the Earth-Speedupinator can be calculated using the following [3]:

$$T = \left(\frac{1}{\sqrt{1 - v^2/c^2}} - 1 \right) m_0 c^2 \quad (2)$$

Where T is the relativistic kinetic energy of Earth and $m_0 = 5.972 \times 10^{24}$ kg [3] is the rest

mass of Earth. We find the relativistic kinetic energy of the Earth to be $T = 1.87 \times 10^{41}$ J.

Unfortunately, the tri-state area, in which Doofenshmirtz resides, would clearly be unable to provide the energy required to power the Earth-Speedupinator and so he must collect the energy from a more powerful source. In season 1, episode 21 of Phineas and Ferb, the titular characters repair a time machine [1] that, in our theoretical scenario, Doofenshmirtz could steal the time machine to go back in time and harvest the Sun's energy.

The sun's luminosity is 3.83×10^{26} W [5], which means that with a perfectly efficient, giant solar panel (the Dyson-Sphereinator), Doofenshmirtz could absorb enough energy to power his Earth-Speedupinator in ≈ 15.5 Myr. Doofenshmirtz, in his infinite wisdom, wishes to keep his plan secret and the inhabitants of Earth alive and so, if he absorbed energy from only the unseen half of the Sun (using the Half-Dyson-Sphereinator), it would take 30.9 Myr.

In normal circumstances, such an increase in velocity would invariably lead to the Earth achieving a hyperbolic trajectory and being ejected from the Solar System. Therefore, Doofenshmirtz could attach a rope of some material to both the Earth and Sun, hereafter referred to as the Lassoinator, to maintain what we assume to be a circular orbit with semi-major axis $r = 1.50 \times 10^8$ km [4] and to keep humanity alive. Ignoring the impossible amount of heat resistance required to lasso the Sun, we can calculate the tension experienced by the Lassoinator by equating it to relativistic centripetal force, which can be rearranged as [3]:

$$F = \frac{m_0}{\sqrt{1 - v^2/c^2}} \frac{v^2}{r} \quad (3)$$

This gives a tension experienced of 2.17×10^{30} N by the Lassoinator if Doofenshmirtz wishes to maintain the orbital radius of Earth.

Discussion

We have made a number of assumptions in this paper, most of which can be accepted as

a combination of what we will call *cartoon logic* and Doofenshmirtz's seemingly unlimited budget for evil inventions; it is of course extremely unlikely that one could use time travel, a Half-Dyson-Sphereinator, Lassoinator, and Earth-Speedupinator to increase the orbital velocity of the Earth. Notably, the Earth-Speedupinator is considered a *black box* that imparts energy with 100% efficiency. Additionally, the calculated values are clearly absurd and we do not take into account how the increased velocity would affect days or seasons.

Conclusion

In conclusion, we find that if Dr. Heinz Doofenshmirtz wished to observe the American summer vacation length accurate to the Phineas and Ferb theme song vacation length, he would have to increase Earth's orbital velocity to 67% the speed of light, requiring 1.87×10^{41} J, and hold the Earth under a tension of 2.17×10^{30} N to maintain a normal Earth radius.

References

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