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P4 3 Lost In Space

H. K. Devenport, R. A. Bakrania, C. J. R. Hanna, O. W. B. Malkin

Department of Physics and Astronomy, University of Leicester, Leicester, LE1 7RH

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Abstract

We explore the journey to Alpha Centauri using 2 different spaceships, as in Netflix's series "Lost in Space". We find the Resolute has an average speed of 100c, while the Jupiter is much slower and has a journey time of 5.87 years. As a result of the high speed travel, the Jupiter experiences a time dilation of 3 years, a length contraction of 11.9 m, and is Doppler shifted into the ultraviolet spectrum.

Introduction

The Netflix series "Lost in Space" follows the Robinson family, alongside the rest of the 24th colonist group, on their journey to Alpha Centauri to start a new life following the ever increasing inhabitability of Earth after a meteorite destroyed the surface. The journey to the new planet takes place on 2 spaceships, "The Resolute"- the larger spacecraft capable of faster-than-light travel thanks to their stolen alien engine [1], and the "Jupiter"- where they are sadly limited to following the laws of physics as we know, and so only have light speed capabilities [2]. We discuss the differences between the two spacecraft, and the relativistic effects experienced due to the high speed of travel.

The Resolute

In the show, we discover the 24th Colony starts their journey to Alpha Centauri, which is 4.40 light years away [3]. Their journey begins at the end of 2046, approximately 2 years after the first colony made their journey to the new planet following a catastrophic meteorite that destroyed Earth as we know it on Christmas eve 2044.

Assuming the 24th colonist group leave exactly 2 years (24 months) after the first colony, we are able to determine that each of the previous 23 return trips lasted 31.7 days. Using this, we are able to calculate the average duration of each journey to Alpha Centauri, and the average speed at which the Resolute travels. Using basic speed-distance-time relations, we found that the Resolute makes its return journey to Alpha Centauri at $3.01\text{x}10^{10}$ ms^{-1}, or 100c.
Since this breaks one of the most fundamental laws of special relativity- that nothing with mass can travel faster than the speed of light- without the alien engine, this faster-than-light travel would not be possible on the smaller Jupiter when disconnected from the main Resolute spacecraft.

The Jupiter

While the maximum speed of the Jupiter was never directly mentioned within the Netflix series, it was mentioned in the original 1965 show with the same title [2]. So for the purpose of this paper, it was assumed both ships have the same light speed capabilities, and in all calculations,

the average speed of the Jupiter was taken as 0.75c, to account for acceleration and deceleration, as the light speed travel was not used all of the time. Again using basic speed-distance-time relations, the one-way journey to Alpha Centauri from the perspective of the Jupiter was found to take 5.87 years.

Since the Jupiter is travelling at such high speeds, from the perspective of the inhabitants already on Alpha Centauri, the spacecraft will appear to undergo time dilation, as given by

$$\Delta t = \gamma \Delta t' \tag{1}$$

where Δt is the time taken from the frame of reference on Alpha Centauri, $\Delta t'$ is the time taken from the frame of reference onboard the Jupiter, and γ is the Lorentz factor as given by

$$\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{2}$$

from this, we are able to calculate a value for γ of 1.512, and therefore a journey time of 8.87 years, a duration 3 years longer than the journey appears to take from the perspective of those on board the Jupiter.

Due to the high speed of the spacecraft, it will also undergo length contraction, since the faster an object moves, the shorter it becomes. The contracted length of the Jupiter due to the high velocity of travel is given by

$$\Delta x = \frac{\Delta x'}{\gamma} \tag{3}$$

where Δx is the length of the Jupiter from the reference frame of the observer on Alpha Centauri, $\Delta x'$ is the length of the Jupiter from the reference frame of those on board- 35.1 m [4], and γ is the Lorentz factor as previously calculated. Using these values, we calculated the length of the Jupiter within the reference frame of Alpha Centauri to be 23.1 m, meaning it is 11.9 m shorter than it is from the perspective of those on board.

Due to the spacecraft being in motion, it will experience a doppler shift, which at relativistic speeds for an approaching source is given by

$$\frac{\lambda}{\lambda_0} = \sqrt{\frac{1 - \frac{v}{c}}{1 + \frac{v}{c}}} \tag{4}$$

where λ is the observed wavelength from the frame of reference of Alpha Centauri, λ_0 is the observed wavelength from the frame of reference of the Jupiter. Using the already stated value for v, and taking the wavelength to be that of orange, the main colour of the ship, 600 nm [5], a doppler shifted wavelength of 227 nm is calculated, and so the spaceship has been blue-shifted out of the visible spectrum and into the ultraviolet range.

Conclusion

While the journey would be much faster making use of the Resolute's faster-than-light travel, the Jupiter's almost light speed journey would still be much more enjoyable (and quicker!) than a journey on any real-life spaceships.

References

[1] https://lostinspace.fandom.com/wiki/Resolute [Accessed 19 October 2023]

[2] https://www.nytimes.com/2018/04/11/watching/lost-in-space-netflix-original-guide.html [Accessed 19 October 2023]

[3] https://www.space.com/18090-alpha-centauri-nearest-star-system.html [Accessed 19 October 2023]

[4] https://www.vfxvoice.com/lost-in-space-2018-undergoes-a-radical-transformation/#:~:text=a%20breathtaking%20world.-,(Image%20%C2%A9%202018%20Netflix%20and%20Legendary%20Television),ship%20is%20a%20massive%20undertaking.%E2%80%A6 [Accessed 20 October 2023]

[5] https://www.britannica.com/science/color/The-visible-spectrum [Accessed 20 October 2023]