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Can The Flash Warp Time?

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Abstract
CW's The Flash is capable of reaching speeds of 17150 ms^{-1}. Due to special relativity, time will pass more slowly for The Flash when travelling at these high speeds causing him to experience less time than stationary people around him. By using the Lorentz Transforms the difference in time elapsed can be estimated. It was found that at The Flash's current top speed it would take 20.8 years of running in order for a time difference of one second to be noticed. In the comic books The Flash can travel at much greater speeds. If he ran at 99% of the speed of light, a stationary observer would experience one hour of time for every 8.5 minutes that The Flash experiences.

Introduction
Barry Allen, iconically known as The Flash, has the ability to run at supersonic speeds (Figure 1). In the television network CW's The Flash, Barry Allen has been able to reach speeds up to 17150 ms^{-1} or 50 times the speed of sound [1]. This is much faster than the current human speed record of 11083 ms^{-1} set during the Apollo 10 mission [2].


Figure 1 – CW's The Flash running at supersonic speeds (image taken from [3]).

Due to his high speeds, The Flash would experience time at a different rate when running, compared to those around him. This is due to Einstein's theory of special relativity, which states that each physical law takes the same form in all inertial frames (frames moving with a constant velocity) [4]. A consequence of this is time dilation – time will move slower for objects moving in an inertial frame relative to yourself. This theory can be used to determine the difference in time elapsed for Barry compared to those around him.

Theory
In order to calculate the effects of time dilation the Lorentz Transformation will be used. The time elapsed for Barry Allen will be compared to a stationary bystander. The Lorentz Transformation relates the time elapsed in different inertial frames by a gamma factor and is given by [4]:

$$\Delta t_{bystander} = \gamma \Delta t_{Barry\ Allen} \quad (1)$$

The gamma factor is given by [4]:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (2)$$

where v is the speed at which Barry moves relative to the bystander (17150 ms^{-1}) and c is the speed of light in a vacuum.

Calculations
Although Barry is travelling at a very high speed, it is still small compared to the speed of light, which is approximately 3.00×10^8 ms^{-1}. In order to see a noticeable difference, it would take a long period of running at top speed. In order to find the effect of time dilation over one year, a time of 365 hours from

the bystander's perspective will be used assuming one hour of running time per day for a year. It will also be assumed that Barry is either running at top speed or remaining stationary relative to the bystander, and time spent accelerating will be ignored as it will be negligible. Substituting The Flash's speed into equation (2), the gamma factor is found to be 1.000000002. Using this and 365 hours for the bystander in the Lorentz Transformation, it is found that Barry Allen experiences 6×10^{-7} hours or about 0.002 seconds less than the stationary bystander.

This would not be a noticeable difference in time, so the amount of running required for Barry to be one second behind the bystander can be calculated. Again using the Lorentz Transformation and looking for a time difference of 1 second between the bystander and Barry Allen, it is found that Barry would have to run at his top speed for 182500 hours, or 20.8 years.

In the comic books, The Flash can run at speeds even faster than the speed of light [5]. Unfortunately, the gamma factor in the Lorentz Transformation becomes undefined when the velocity is greater than the speed of light as there would be a square root of a negative number. This provides a theoretical speed limit for any object with mass. The time dilation can be calculated for comic book Barry travelling at 99% of the speed of light. Substituting 99% of the speed of light in to equation 2 gives a gamma factor of 7.09, which is much larger than before. Using this value, the Lorentz Transformation shows that for every hour the bystander experiences Barry Allen would only experience about 8.5 minutes. This shows that although CW's The Flash barely notices any time difference, the comic Flash can significantly warp time.

Conclusion

Due to the effects of special relativity it is found that The Flash can indeed warp time and experience less time than a stationary bystander. He cannot travel backwards or forwards through time, but he can experience less time than others around him. However, with Barry's current top speed in the CW series it would take 20.8 years of constant running in order for a one second time difference to occur. In the course of an average year Barry would only experience 0.002 seconds less than the stationary bystander.

The comic book version of The Flash allows for a much more noticeable time dilation as Barry can travel at speeds faster than the speed of light. If Barry travelled at 99% of the speed of light, he would only experience 8.5 minutes of time for every hour from the bystander's perspective.

It would appear that CW's The Flash would not notice much of an effect due to special relativity even if he spent a significant portion of his life running at top speed. In the comics, however, The Flash's greater speeds would allow for significant time dilation to occur and allow The Flash to noticeably warp time.

References

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