

The Speed of Light, the Infinitely Repeating Decimal and the “Two God’s Commandments” of Relativistic Physics

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We design the following two thought experiments. In the first one, an immense spaceship with a huge empty and evacuated compartment travels with a speed v relative to the reference frame in rest (usually the Earth) and in a straight line collinear with its length, as shown in Fig. 1a. Let us assume that from the left end of its compartment it is launched a small but superfast drone, D, with a speed u in the direction of the spaceship's motion. This speed is given with respect to the racket, as a reference frame.

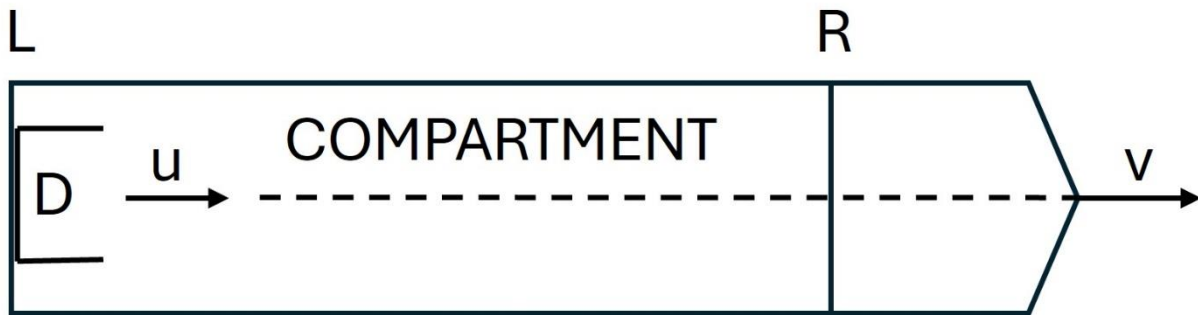


Fig. 1. Schematic representation of the flight of the drone, D, in the rocket compartment. The drone's dimensions are highly exaggerated.

According to elementary physics, the speed of the drone, w , relative to the observer at rest is equal to the sum of the speeds u and v , or $w = u + v$.¹ For example, the speed of the drone in the rocket reference frame, u , can be 95% of the speed of light (or $u = 0.95c$). At the same time, the speed of the rocket, v , relative to the rest reference frame can also be 95% of the speed of light (or $v = 0.95c$). In this case, the speed of the drone, w , relative to this reference frame is 190% of the speed of light c (or $w = 1.90c$). However, Special relativity limits this speed, stating that it cannot be greater than the speed of light c ($\approx 3 \times 10^8 \text{ m sec}^{-1}$) or $w (= u + v) < c$. In other words, in the above example, the speed of light c will be the limiting factor for the drone's speed, u , in the rocket's reference frame, or for the rocket's speed, v , in the reference frame at rest. For instance, if the $v = 0.95c$ than

¹ In non-relativistic mechanics, the speeds are simply added and the answer is that the drone is moving with a speed $w = v + u$ relative to the rest frame. Special relativity employs the formula: $w = (v + u)/(1 + uv/c^2)$. If v and u are both small compared to the speed of light c , then the answer is about the same as the non-relativistic theory.

the drone's speed, u , has to be smaller than $u < 0.05c$ and *vice versa*. But mathematically speaking, $u < 0.04999\dots c$ where $0.04999\dots$ is an infinitely repeating decimal that is another way of writing the number 0.05 , or $0.04999\dots$ is not exactly 0.05 . So, Special Relativity shows that $0.04999\dots c$ cannot be equal to $0.05c$ in any case, because then the speed of the above drone or rocket could not reach the speed of light c . So, if we write $u = 0.05c$ or $v = 0.05c$, that is another way of writing $u = 0.04999\dots c$ or $v = 0.04999\dots c$. Physics deals with the real world, so that u and v are real physical quantities and must be rational numbers and not infinitely repeating numbers. The question then arises, what are the rational numbers that express u and v ?

Now, the other two questions arise: how did Special relativity become the one that decides that u or v should be very, very... close to 0.05 (or "rational" $0.04999\dots c$)? And on what basis? Finally, a very intriguing question also arises: Who decides whether a drone or a rocket will move at a speed of "rational" $0.04999\dots c$?

The two postulates of the Special theory of relativity are: (1) the laws of physics are the same for all observers in inertial frames of reference and (2) the speed of light in a vacuum is constant for all observers, regardless of their motion or the motion of the light source. These two postulates are reminiscent of God's Ten Commandments given to Moses, and I wonder if these are "God's two commandments of physics given to Einstein"?

