# A Marble and a Photon: Single Speed Hypothesis

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This study explores the concept of velocity within the framework of the physical interpretation of acceleration and deceleration for moving objects in space. A thought experiment involving a marble and a photon is employed to introduce the hypothesis that all objects in space inherently travel at the speed of light when in motion. Through a series of systematically structured thought experiments, this hypothesis and related conclusions are examined and substantiated. Newton's first law of motion serves as the foundation for these scenarios, allowing for logical conclusions to be derived. The methodology prioritizes logical reasoning over detailed mathematical formulations to provide a more accessible presentation.

Consider two entities: a photon and a marble. Both the marble and the photon are set to travel 100 meters in a straight line within the same dimension in a vacuum. Since a photon travels at the speed of light, it takes approximately 0.0000003336 seconds for the photon to complete the distance. Assuming the marble is initially traveling at a speed of 40 meters per second for this thought experiment, it takes 2.5 seconds for the marble to complete the 100 meters. A question arises: The photon completed the distance in 0.0000003336 seconds, while the marble took 2.5 seconds. In other words, the marble took approximately 2.4999996664 additional seconds to complete the distance compared to the photon. What accounts for this additional time taken by the marble?

Consider the following analogy: Mrs. Bob has two sons, Eric and Smith, with Eric being the older child in the household. Mrs. Bob usually sends Eric to buy groceries from the supermarket a few blocks away from her house. Eric always takes about 20 minutes to purchase the groceries and return. Unfortunately, he was unavailable the other day; thus, Mrs. Bob sent her younger child, Smith, instead. Smith left the house with a list of groceries, just as Eric would. However, unlike Eric, he returned with the groceries after 45 minutes. Mrs. Bob noticed this significant difference in timing between the two and asked Smith the question: "Why did you take so long? Eric would return in 20 minutes." If Smith were to answer that question, he might say: "I couldn't find some of the items, so I had to go to another supermarket, which is farther away," "There was a long line at the checkout counter," "It took me a while to locate some of the items on the list inside the supermarket," "The supermarket was closed, so I had to wait for 15 minutes until it opened," "I ran into a friend on the way, and we chatted for some time," and more. Smith can provide multiple answers to account for his delay. However, all the possible reasons he could present to his mother would distill down to one or both of two terms: "Stop" and "Extra-Action." Assuming that Eric's timing is the ideal and acceptable one from Mrs. Bob's perspective, the reason Smith took the extra 25 minutes is because he either stopped one or more times during the journey or performed additional actions that added more time, or both. For instance, reasons such as a long line at the checkout, the supermarket being closed, or running into a friend fall under the stop category because Smith would need to stop executing his main task while time passed from his mother's perspective. The other reasons, such as walking to another supermarket or taking a while to locate the items, result in extra activity or action.

The case of Eric and Smith can be applied to the photon and marble, posing the same question to the marble. As shown in Fig. 1, the marble could not have performed any extra activities since both the photon and the marble traveled the same line in the vacuum of space, thus ruling out the extra-action reason. The remaining explanation for the extra time is a "Stop." This implies that during the 2.5 seconds the marble is observed moving, it was stationary for approximately 99.9999866574 percent of the time. Based on this basic observation, in this study, it will be shown that the marble took an extra 2.4999996664 seconds because it stopped, followed by subsequent conclusions derived from this argument.

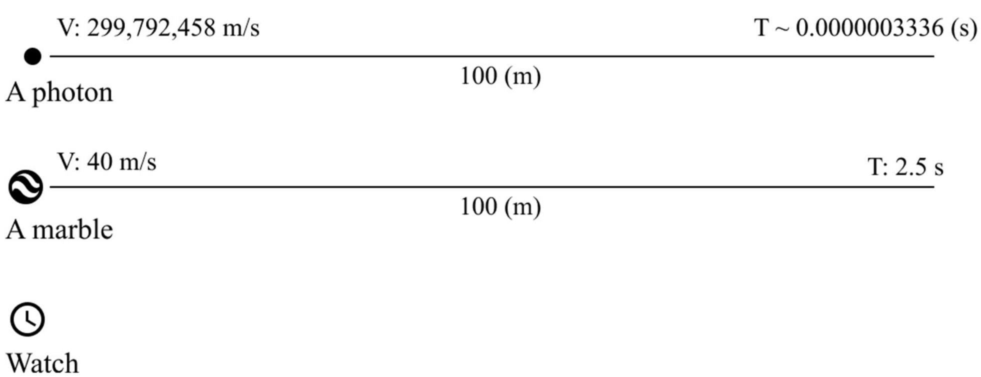


FIG. 1. Representation of the thought experiment in which a photon and a marble are set to travel 100 meters at a specific velocity in the vacuum of space.

To demonstrate that the marble was stationary for 99.9999866574 percent of the time it took to cover the distance, another thought experiment will be introduced to substantiate this argument. The primary concept used is a hypothetical space watch. The space watch is analogous to a regular mechanical watch in that a continuous line of space in a vacuum and a photon make up the entire watch, with the photon serving as the sole hand. A photon is set to travel in a straight line in a vacuum at the speed of light, 299,792,458 m/s. The way the space watch works is that as the photon traverses 299,792,458 meters in its line of motion, one second passes. As depicted in Fig. 2, one can consider the end of every 299,792,458 meters from the starting point as a dial marker on the space watch. Each point in space where the space watch operates serves as a unit of time as the photon passes by it.

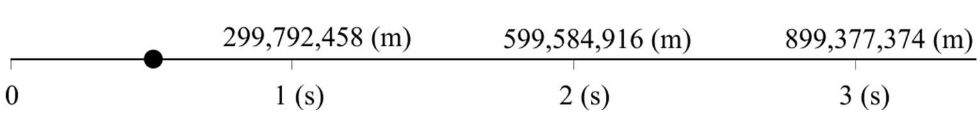

FIG. 2. A depiction of a hypothetical space watch utilizing a photon as its hand, analogous to the hand of a mechanical watch.

The space watch is used to locate the position of the photon and the marble within the 100-meter distance at each point in time they took to complete it. Starting with the photon, Fig. 3 depicts the mapping of its location along the distance at each point in time according to the space watch, within the 0.0000003336 seconds it takes the photon to traverse the distance. Since both the photon in the watch and the photon in the distance travel at the speed of light and are always in motion, each point in time on the space watch within the 0.0000003336-second range corresponds to a unique position of the photon along the 100-meter distance. This indicates that the photon was at a different location at each point in time recorded by the space watch within the 0.0000003336 seconds.

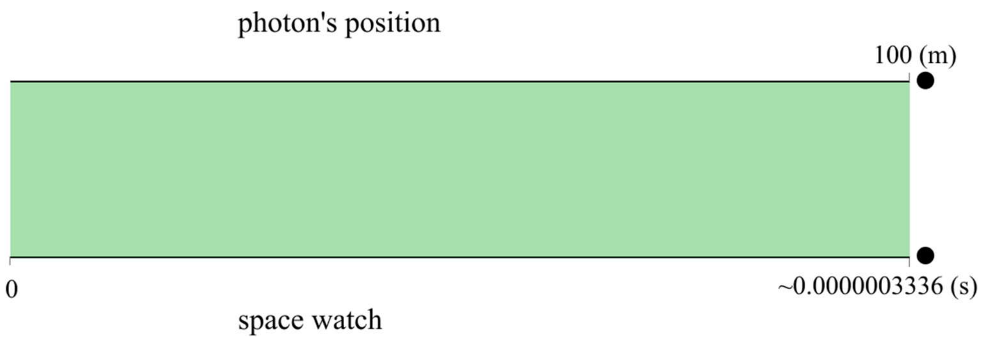


FIG. 3 (color online). The mapping of each point in time within 0.0000003336 seconds on the space watch (bottom axis) to the position of the photon along the 100-meter distance (top axis).

Conversely, when analyzing the location of the marble at each point in time on the space watch during the 2.5 seconds it takes to traverse the distance, it is noticeable that the marble's position remains within the 100-meter distance throughout the entire duration. When mapping each point in time of those seconds on the space watch to the position of the marble over the distance, only a total of 0.0000003336 seconds—equivalent to the time it takes the photon to travel 100 meters—out of the 2.5 seconds corresponds to a unique location of the marble. Within the scope of this study, it is not viable to pinpoint where exactly these 0.0000003336 seconds occur on the space watch, except that all points in time within the defined range that match a unique location of the marble add up to this duration. Similarly, it is not feasible to define the exact location of the marble at each point within those 0.0000003336 seconds. However, it is apparent that the marble was at a different position at each subsequent point in time during those seconds. This is derived from the fact that the photon on the space watch must travel 749,481,145 meters for 2.5

seconds to pass while the marble remains within the 100 meters. The remaining 2.4999996664 seconds on the space watch correspond to duplicate positions of the marble within the 100 meters, since the marble was still within the distance during those seconds as well. All the duplicate mappings suggest a stop by the marble, as previously argued. In Fig. 4, the stops represented by the gray bands are shown consistently distributed across the path of the marble, assuming that the marble appears to be moving at a uniform velocity. The light-green bands indicate unique position mappings of the marble over the 100 meters, while the gray bands represent duplicate position mappings. From this thought experiment, one can deduce that the marble was stationary for 99.9999866574 percent of the time it took to complete the distance.

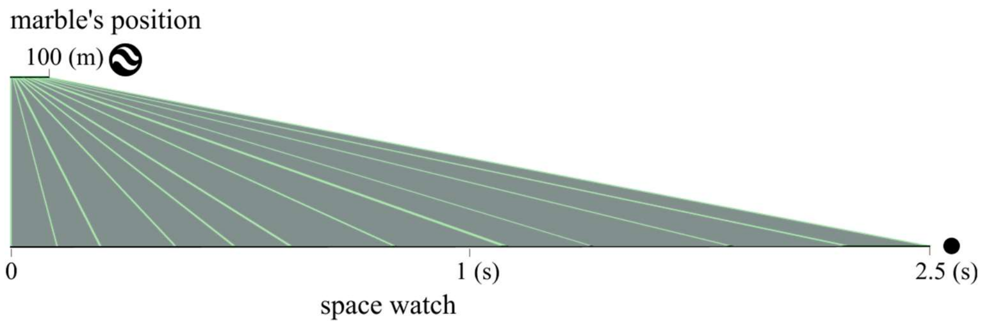


FIG. 4 (Color Online). The exemplary mapping of the marble's position along the 100-meter distance (top axis) relative to each point in time over the 2.5-second duration on the space watch (bottom axis).

It is possible to replace the photon in the space watch with the marble to deduce a similar conclusion. To illustrate, the hand in the space watch will be substituted with the marble running at the same 40 m/s velocity in a vacuum of space. Similar to the photon in the space watch, as the marble travels 40 meters, a second passes. Therefore, each point in the space watch serves as a unit of time as the marble passes by it. When locating the position of the photon along the 100-meter distance with respect to each point in the time the photon took to cover it, each point in that time, on the space watch, will map to a unique position of the photon along the distance. In other words, when the photon completes the 100 meters, approximately 0.0000003336 seconds will have passed on the space watch. Mapping the position of the photon at each point in time within those 0.0000003336 seconds on the space watch, each point will correspond to a unique position of the photon along the 100 meters since the photon is always in motion. At 0.0000003336 seconds on the space watch, the marble on the watch has traversed approximately 0.0000133426 meters, while the photon has completed the 100 meters. This signifies that only a total of 0.0000133426 meters of the photon's positions along the 100-meter distance has been matched by each point in time on the space watch in 0.0000003336 seconds. However, the remaining 99.9999866574 meters of the photon's positions lack a corresponding unique point in time on the space watch. Nevertheless, when the photon occupied those positions along the distance, the marble was also within the 0.0000003336 seconds on the space watch. As shown in Fig. 5, if one maps those positions of the photon against points in time on the space watch, they will correspond to duplicate points in time, although this study does not specify which points in time each position maps to. These duplicate points in time will sum up to the total stops made by the marble while running on the space watch. If both the marble and the photon are allowed to run until 2.5 seconds have passed on the space watch, the total stops made by the marble will add up to 2.4999996664 seconds. The above basic thought experiments demonstrate that the marble was motionless 99.9999866574 percent of the time it took to complete the 100 meters, without specifying where it stopped within the distance.

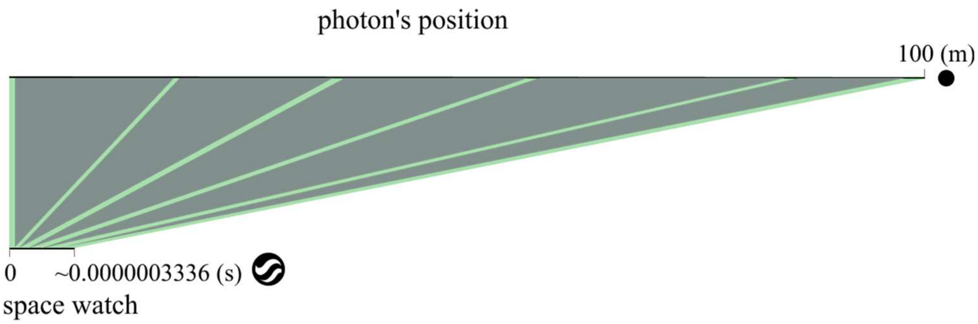


FIG. 5 (color online). Exemplary illustration depicting the mapping of the photon's position along the 100-meter distance (top axis) relative to each point in time within 0.0000003336 seconds on the space watch (bottom axis), operated by a marble moving at 40 m/s.

When analyzing the motion of the marble over the 100-meter distance, it is evident that the marble has stopped more than once during its travel. Otherwise, one would observe a single stop of 2.4999996664 seconds along the distance. However, for an observer monitoring the motion of the marble in a vacuum of space, it appears to be moving continuously throughout the 100 meters. According to Newton's first law of motion (Newton, 1687), every body perseveres in its state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by forces impressed upon it. The marble was in motion at the very moment it started the journey, then stopped somewhere along the distance, and moved again after a certain passage of time. This cycle is inferred to occur multiple times, suggesting the marble’s apparent consistent velocity. Thus, this observation leads to the introduction of the presence of an external force acting upon the marble to stop and then resume its motion. The marble must be experiencing a series of external influences throughout its course to account for its consistent velocity. This inference, in general, suggests the existence of an obscure force that acts on moving bodies in a vacuum, which appears to be devoid of external forces.

If all the stops that the marble is forced upon are due to external forces, one could speculate what would happen if all those external forces were eliminated from the path of the marble. This would imply that the marble would not experience any stops, thus not adding the aforementioned approximate 2.4999996664 seconds of extra time to the marble's record. Applying Newton's first law of motion once again, the marble will complete the 100 meters without any interruption from the point it started moving. This leads to the conclusion that whenever the marble was in motion, it was traveling at the same speed as the photon, which is the speed of light. The marble was either traveling at the speed of light or at a standstill throughout the course of 100 meters, allowing the decomposition of the marble's travel into a series of light-speed-runs and stops over the total time it took. This principle applies to all objects in space, such that all bodies travel at the speed of light when they are in motion, leaving the speed of light as the velocity of every moving body.

As the initial force applied to the marble to initiate its motion increases, it launches with a higher regular velocity, resulting in a decrease in the time it takes for the marble to complete the 100-meter distance. Based on the arguments presented in this study, as the initial force increases, some of the stops that the marble experiences are reduced, leading to a lower record of time. The energy imparted to the marble can be perceived as serving the purpose of overcoming the stops it encounters; as the force increases, more stops are overcome. This perspective redefines acceleration for a moving body as the reduction of the frequency of stops in space along the direction of motion. While considering the effect of the initial force on the marble, one can contemplate the force required to make the marble travel at the speed of light in a vacuum devoid of external forces. Since the marble won't experience any additional time due to stops, it will travel at the speed of light in the absence of external forces, regardless of the initial force applied to trigger its motion. An object maintains the same speed, the speed of light, irrespective of the amount of force applied in its direction of motion in a space devoid of external forces acting against it. This leads to the realization that energy transferred to a moving object serves no purpose in terms of velocity when there are no external forces opposing the motion of the object.

In summary, this analysis delves into the motion of objects in the vacuum of space through thought experiments involving a marble and a photon, aiming to scrutinize the physical interpretation of velocity. It concludes that every body moves at the speed of light when in motion. The speed discrepancy observed in practical cases arises from stops incurred on moving bodies due to external forces. The study highlights the presence of an obscure force acting on moving bodies in an apparently force-free vacuum of space. Furthermore, it argues that the energy carried by a moving object does not contribute to its velocity in the absence of external forces impeding its motion. The arguments presented are mainly based on Newton's first law of motion, assuming its applicability to all scenarios involving moving physical phenomena or bodies. To challenge the conclusions proposed herein, one needs to concurrently question the validity of Newton's first law of motion.

[1] I. Newton, *Philosophiæ Naturalis Principia Mathematica* (Royal Society, London, England, 1687).