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Speed of Light is Relative and Not Absolute

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Abstract : Here I have tried to prove that the speed of light is **not** absolute **nor** the cosmic speed limit , as shown by theory of relativity. I have the doppler effect and the aberration of starlight to prove the same.

Introduction:

Before we delve deep into the relativity of light, lets consider the doppler effect first.

Doppler Effect

Consider the following situations

A tennis ball putter is throwing balls on a glove at the rate of 1 ball every 1 sec. Consider the 1st scenario where both the putter and the glove are not moving at all.

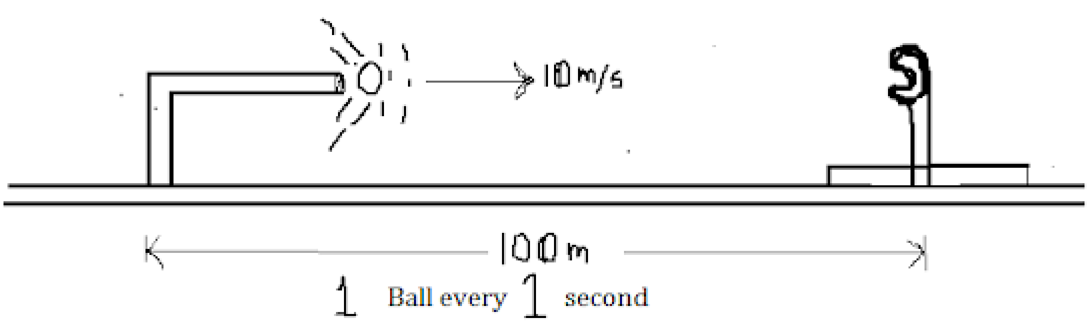


Fig 2

Here no matter the speed of the ball , the glove on the other hand will receive the balls at the rate of 1ball/sec. Or the frequency would be 1 ball/ sec.

Lets call it Fo , or fundamental frequency.

Fo = 1 ball/sec.

In the same way we can consider the fundamental wavelength as Yo. It will be calculated as the distance between 2 consecutive balls. As the first ball is moving at 10m/s , it will travel a distance of 10 m. At the same at , since the frequency of the putter throwing the ball is 1 ball/ sec, the second ball will emerge out of the putter. In that duration the first ball has moved 10 m , Hence the distance between the first and second ball will be 10.

Speed of the ball can be shown in terms of its frequency leaving the putter or its frequency hitting the glove.

b = Fo * λo

= 1 ball/sec * 10m

= 10 m /sec

Now consider the scenario when the glove starts moving towards the putter at the speed of 2 m/s.

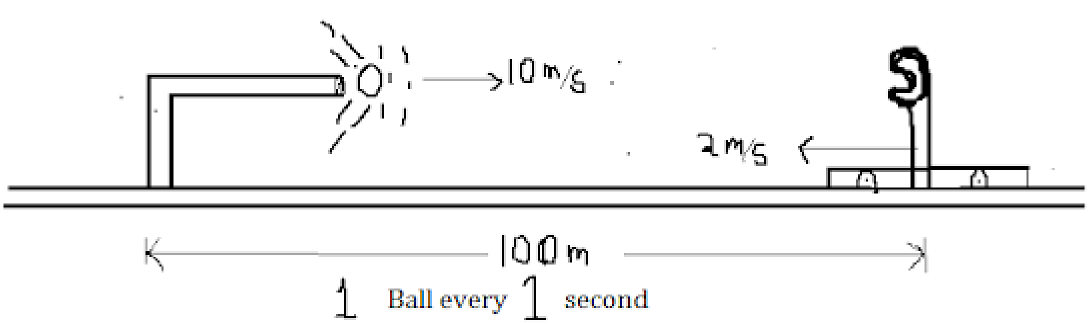
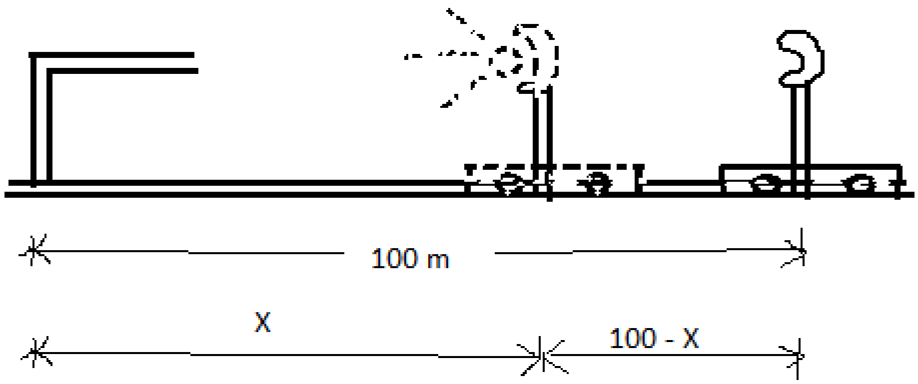


Fig 3

Here though the putter is throwing balls at 1ball/sec, the glove will not receive the balls at 1 ball/sec. This happens because as soon as the 1st ball leaves the putter, glove has already moved ahead by 2 m, hence the 1st ball will have to travel less distance , so less time will be required to hit the glove.

Let the distance when the ball and the glove collide be x, as shown in the diagram



Then we can write.

T = X/10 = (100-X)/2

2X = 100*10 – 10X

12X = 100*10

X = 100*10/12 and T = X/10 = 100/12 ----------------------1

Similarly the 2nd ball will hit the glove when the new distance is

(100 *10/12) – Xnew from the glove.

Tnew = Xnew/10 = (100*10/12 – Xnew) /2

Xnew = (100 * 10 * 10)/ (12 * 12) and Tnew = X/10 = 100*10/12*12 ----------2

If we subtract the two X and Xnew, also we substract T and Tnew, we get the distance between two balls which have left the putter and the time period between two successive hits. Let us call them as ‘x’ and ‘t’ respectively.

x = X - Xnew
= 100 * 10/12 - (100 * 10 * 10)/ (12 * 12) = 100*10/12(1 – 10/12)
= (2 * 10 * 100)/ (12* 12)

t = T - Tnew
= 100/12 – 100 *10/12*12
= 2 *100/(12*12)

These can be equated to wavelength and time period of the ball-wave pattern hitting the glove.

So if we calculate the velocity of ball as

B = f * λ
= 1/t * x
= (12 * 12)/ (2*100) * (2*10 *100)/ (12*12)
B = 10 m/s

So velocity of ball comes exactly as the original speed of ball i.e 10 m/s. This can also be proven if we consider the doppler effect.

B = f * λ
= fo (b + g) /b * λo (b / (b + g))
= fo * λo = 10 m/s

Where,

b = Velocity of the ball

g = Velocity of the glove

So what ever the relative velocity between ball and the glove , the speed of the ball always seems the same.

a) Based on the above fact I have considered a simple scenario as described below.

Like the above example of glove and the putter , consider a lake and a boat(with the observer). Consider that a stone is thrown into the lake and the boat is moving directly perpendicular to the creation of wavefront towards the place of impact of the stone. Now as the boat moves forward towards the wavefront it will feel more number of ripples colliding with it hence the frequency increases and because of its own velocity it will feel that the distance between alternate ripples is also decreasing. This will correspond to an increase in frequency and a decrease in wavelength of the ripple, and the velocity of the ripple wavefront will feel to be exactly the same to the boat(Observer) . But if you see the far end of the ripple and compare it with your own speed of the boat, then it will definitely add up.

Basically any periodic and harmonic motion will create the same apparent speed whether it be ripple, sound or light.

b) Consider the phenomena of "Aberration of Starlight"

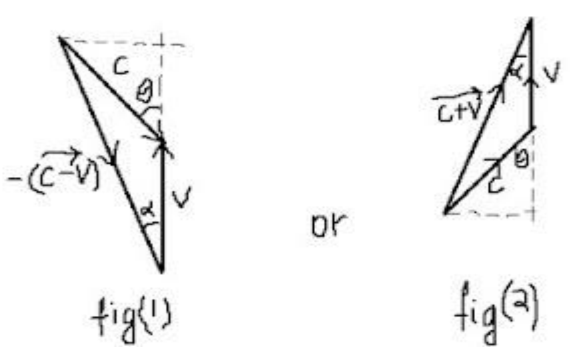


Fig 10

It is a phenomena wherein the star light appears deflected or shifted inwards, whenever an observer on earth is moving towards the star tangentially.
So when a ray of light from a star is propagated towards an observer and because of the observers own motion , the position of the star appears shifted from a bigger angle to a lower angle..

So in the above figure 1 above, starlight is traveling towards you at speed c, you are moving at v because of motion of earth. but you observe the aberrated starlight (c-v), so your angle of observation of the star changes from θ to α.

This can be given as a simple vector subtraction as in fig(1), as vector subtraction is a little bit confusing we will consider the fig(2) i.e vector addition, here the body is receding away from the starlight and looking backwards it finds the star shifted from θ to α.

We will consider relativistic vector addition as opposite of standard vector addition namely,
$R = (c + v)^{bar} = \sqrt{c^2 + v^2 - 2cv\cos\theta}$

When the ray of light is following the body we have θ= 0 then the above equation becomes,

$R = \sqrt{c^2 + v^2 - 2cv}$

$= \sqrt{(c-v)^2}$
$= c - v$
Naturally when 'c' is following 'v' the relative velocity would be c-v.

If θ= 180 i.e the light is coming from the opposite direction then the above equation becomes.

$R = \sqrt{c^2 + v^2 + 2cv}$
$= \sqrt{(c + v)^2}$
$= c + v$

This is again obvious as the starlight is coming from the other side and adds to the velocity of the body.

These two cases show that speed of light follows the concept of vector addition and subtraction, implying that it is relative. Since there is no fixed frame of reference in the universe it also follows that speed of light is not the cosmic speed limit.

Conclusion : From the doppler example we can see that the speed of light apparently comes out as c. But from a third persons perspective it does add up to the velocity of the observer. From the aberration of starlight it can be concluded that speed of light follows vector addition hence it is not absolute. Also Since there are no fixed frames of reference in this universe the speed of light is not the cosmic speed limit.