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Methods to find Absolute Velocity of any object moving in space

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Abstract— Absolute Velocity is the velocity of a body measured with reference to the absolute space. Absolute velocity of a body in space has become an essential parameter for modern space application. By fixing an absolute direction and velocity frame will simplify the motions in absolute space. Constancy of speed of light in vacuum and its directionality is can be used to find absolute velocity of anybody moving in space.

Index Terms— absolute space, absolute velocity, laser, Light, observer, relative velocity, source, space, speed of light, synchronize, universal speed limit, velocity

1 Introduction

VELOCITY of an object is defined as the time rate of change of its position with respect to the frame of refrence. Relative velocity of an object only measured with our present knowledge and technology.

Absolute velocity of an object can be defined as the time rate of change of its position with respect to absolute spatial co-ordinates. Absolute velocity is independent of any frame of reference.

Absolute velocity of an object can be measured by following ways:

1. An observer moving along with the object and observe its change of position with respect to time.

2. A stationary observer sitting in the spatial co-ordinate and observe the change of position of object with respect to time.

3. Absolute velocity of an object can be measured as the vector sum of velocities of references (any one of the reference should be with absolute space) frames and velocity of the object with respect to the velocity reference.

1st method can be easily applied when the absolute frame of reference is known. Studies are ongoing to find the absolute spatial co-ordinates. When it is known the relative velocity will be overwritten by absolute velocity.

2nd method is the inverse procedure of first method. For this procedure two conditions must satisfied:

a) Observer should be fixed on absolute space.
b) Observer should be in the line of direction of motion where the object moves away or towards the observer. Here the observer should know the absolute space co-ordinate and direction of motion of the object.

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3rd method can be easily implemented in practical problems or experiments where the reference plane has linear uniform velocity along any of its co-ordinates.

This method can be applied in practical problems, where the reference frame is split into multiple frames of references and there vector sum can be used to determine the net velocity or other parameters with respect to space. Any one of the reference frame should be with absolute space.

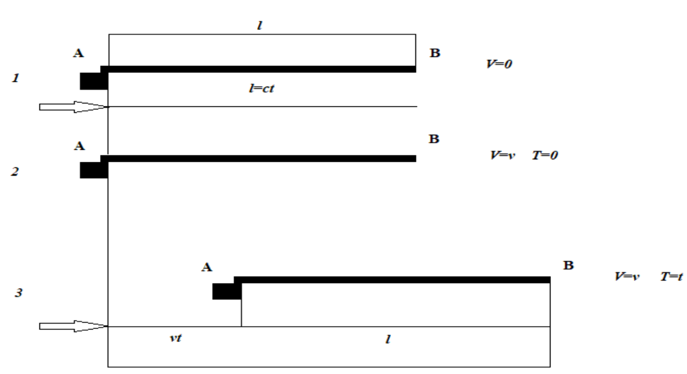
2 Mathematical Model

2.1 Model 1

Consider a 1-dimensional arbitrary body AB of length l with a monochromatic and coherent laser source fixed at A. The laser emits unidirectional light rays in positive x-direction from A. When the absolute velocity of the body is zero, time taken for light reach point B can be determined by

$$t = l / c$$

Where c is the speed of light in vacuum.



When the body has an absolute uniform velocity in positive x-direction, the light will have to travel more distance to reach B from A.

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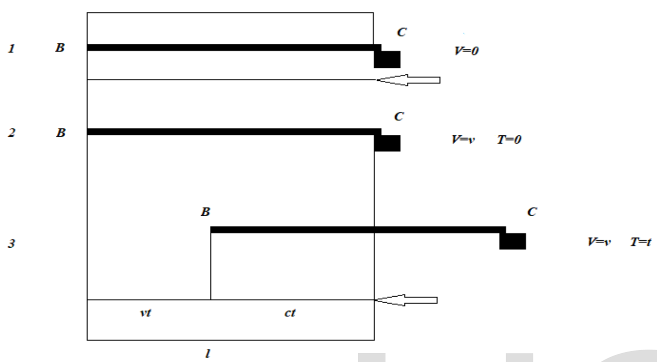
As speed of light is irrespective of frame of reference[1],total distance travelled by light is equal to the sum of length of AB and distance travelled by the body(here point B) at time t_a .

$$vt + l = ct_a \qquad (1)$$

Time taken for light to reach B can be determined by

$$t_a = l\,/\,(c-v) \qquad (2)$$

2.1 Model 2



and light source at C emits light in negative x-direction i.e. C to B. when the body is in absolute rest the time taken for light ray to reach B can be determined by

$$t_c = l\,/\,c$$

When the body has an absolute uniform velocity in positive x-direction, the light will have to travel shorter distance to reach B from C.

From the constancy of speed of light total distance travelled by light is equal to the difference between the length BC and the distance travelled the body (here point B) at time *t*.

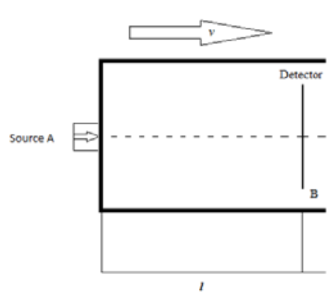
$$l - vt_c = ct_c \qquad (3)$$

Time taken for light to reach B can be determined by

$$t_c = l\,/\,(c+v) \qquad (4)$$

3 Experimental Setup

3.1 Experimental Setup A



This experimental setup is similar to Model 1. Synchronize clock A, clock B which are placed at source A, detector B respectively.

Switch on the light source at A and measure the time from clock A placed at end A.

Now measure the time at clock B, when Light reaches the detector at end B.

The time taken by the light to reach end B

$$t_a = t_B - t_A$$

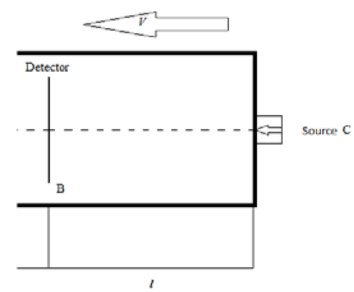
From equation 2

$$t_A - t_B = l\,/\,(c-v)$$

or

$$v = c - l/(t_B - t_A) \qquad (5)$$

3.2 Experimental Setup B



This experimental setup is similar to Model 2. Synchronize clock C, clock B which are placed at source C, detector B respectively.

Switch on the light source at C and measure the time from clock C placed at end C.

Now measure the time at clock B, when Light reaches the detector at end B.

The time taken by the light to reach end B

$$t_b = t_B - t_C$$

From equation 4

$$T_B - t_C = l\,/\,(c+v)$$

or

$$v = l/(t_B - t_C) - c$$

The Experimental Procedure for Setup A and B are similar.

Main challenge faced in these set up is the synchronization of clocks while taking clock readings. According to Special Relativity proposed by Albert Einstein both clocks will not be synchronized with the observer because an observer may get readings at different positions of his location. For example if the observer is standing near clock A reads both clocks would find that time shown in clock A is lesser than time shown in clock B. Similarly the observer at different locations will find that both clocks are not synchronized even though they are synchronized .If an observer need to obtain synchronized time he should be present at A when the source start emission and he should be at B when the light reaches the detector i.e. the observer has to travel greater than the speed of light which is not possible due to universal speed limit. Thus we cannot find the time difference needed in the above equations.

The observer can obtain a location at which both clocks are

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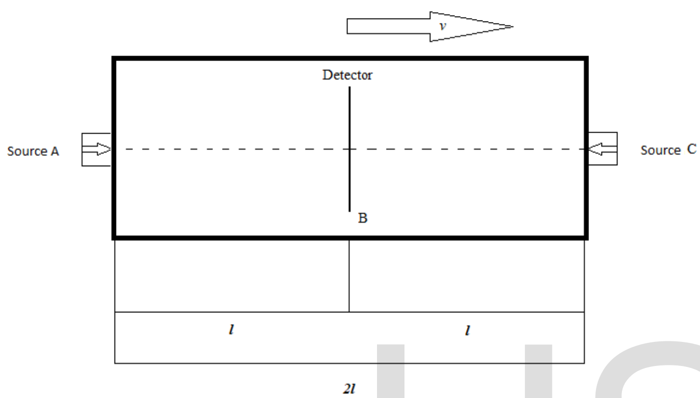
synchronized, when the light the both clocks reaches the observer at same time. This location is not known as the velocity of the body is not known.

Computer algorithms can be used to get synchronized time at both locations in such a way that the clock A notes the time of emission of light and clock B notes the time when the light reaches the detector. Form this ,the time difference can be obtained to calculate absolute velocity.

Length l should be greater value to get better approximation.

3.3 Experimental Setup C



This method is a combination of Model 1 and Model 2. Two light sources are placed at A and C. Source A produces light in positive x-direction from A where Source C produces light rays in negative x-direction from C.

Synchronize 3 clocks, clock A, clock B, clock C which are placed at source A, detector B and source C respectively. Even though the clocks are synchronized, an observer from different locations feels as they are synchronized. Thus here the observer will be placed near each clock before take readings.

Switch on the light source at A and measure the time t_A from clock A by an observer at A.

Measure the time t_{B1} at clock B when light reaches the detector.

After some arbitrary time t_C (if needed i.e. to move observer from A to C) switch on the light source at C and measure the time from clock C. Clock A and Clock C are synchronized due to linear motion of the body and position of observer while taking measurement.

Measure the time t_{B2} at clock B when the light from source C reaches the detector.

Now we know time

$$t_x = t_C - t_A$$

that we obtained from clock A and clock B.

The clock C gives two time values, i.e. the time at which the light reaches from source A and source C.

Now we have time difference

$$t_P = t_{B2} - t_{B1}$$

As both time is measured by clock B the question of synchronization does not occur.

$$t_x - t_P = t_C - t_A - t_{B2} + t_{B1}$$

$$t_x - t_P = (t_{B1} - t_A) + (t_C - t_{B2})$$

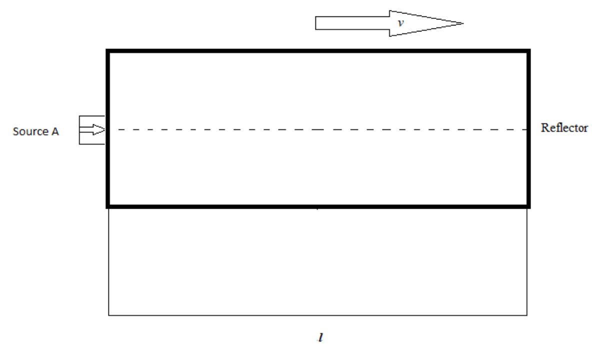
$$t_x - t_p = t_a + t_c$$

$$t_x - t_p = l/(c-v) + l/(c+v)$$

$$v^2 = c^2 - 2cl/(t_X - t_P)$$

$$v = (c^2 - 2cl/(t_X - t_P))^{0.5}$$

3.4 Experimental Setup D



Single clock is used to avoid errors due to synchronization between different clocks at different locations. A laser source and a clock are placed at A similar to above methods. A perfect reflector is placed perpendicular to the direction of motion which helps to return the light ray.

Even though the positions of source and reflectors are altered the time period is not varied.

Total time taken for the light to return to its source is the sum of time taken for light to reach the reflector, time hold at the reflector t_r and time taken for light to return from the reflector.

This method is also a combination of Model A and Model B

$$t = t_a + t_b + t_r$$

Comparing with (2) and (4) gives

$$t - t_r = l/(c-v) + l/(c+v)$$

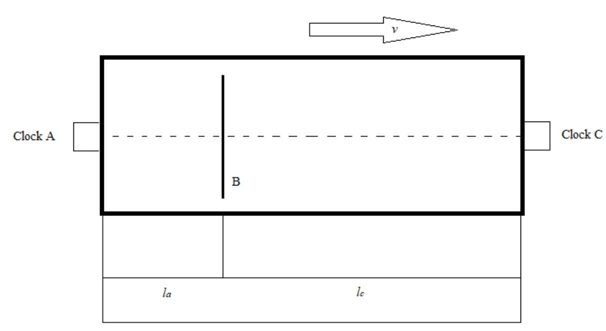
$$v^2 = c^2 - 2lc/(t-t_r)$$

$$v = (c^2 - 2lc/(t-t_r))^{0.5}$$

For perfect reflectors $t_r=0$

$$v = (c^2 - 2lc/t)^{0.5}$$

3.5 Experimental Setup E1



An observer is placed in between A and C in such a way that both clocks at A and C synchronize each other for the observer, i.e. time taken by the light ray from A to reach the observer is equal to the time taken by the ray from C to reach the observer.

$$t_a = t_c$$

Comparing with (2) and (4)

$$l_a/(v+c) = l_c/(v-c)$$

$$l_b/l_c = (c-v)/(c+v)$$

Or

$$v = c\,((l_c-l_b)\,/\,(l_c+l_b))$$

3.6 Experimental Setup E2

Now replace the light source with digital clock.

4 Result

Different methods for finding the absolute velocity of the body moving in space have been introduced by applying different properties of light. These methods may be practically verified. All methods have their own advantages and limitations.

5 Conclusion

Methods for finding Absolute velocity have been developed. These can be applied in space applications where the relative reference frame is absent. High speed space vehicles with velocity above 30% speed of light can be used efficiently. Methods may be chosen according to the application and instruments available.

Acknowledgment

I would like to thank my parents and friends, whose love and guidance are with me in whatever I persue.

References

[1] Albert Einstein, On the Electrodynamics of Moving Bodies,June30 ,1905,German Translation ,Zur Elektrodynamik bewegter K¨orper,