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Doppler Effect and Special Relativity Theory

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In the introduction to his theory, Einstein wrote: *"... Let us recall, for example, the electrodynamic interaction between a magnet and a conductor. The observable phenomenon depends here only on the relative motion of the conductor and the magnet, while according to the customary conception the two cases, in which, respectively, either the one or the other of the two bodies is the one in motion, are to be strictly differentiated from each other..."*

This misconception shows that Einstein had serious problems with electrodynamics – he ignored completely the fact that the magnetic field needs time to move from the magnet to the conductor, whereas the conductor does not need that time because it moves in the stationary field. Both procedures would be indistinguishable only if the speed of the field be infinite. But it is not the case. All other problems of Einstein's theory are based on this misconception.

Einstein's second postulate reads: *"Every light ray moves in a "stationary" coordinate system at the certain speed c, whether the light ray is emitted by a resting or by a moving body."*

Very interesting. How could a light ray know whether a coordinate system is moving or not to change its velocity to c relative to this particular coordinate system? How can a light ray change its velocity in all possible coordinate systems at the same time? Or how could a coordinate system know that it is moving?

The speed is always defined as relative to a reference point – the speed can never be absolute. If the origin of a coordinate system is chosen as the reference point then the speed must be different in all moving coordinate systems. It is not necessary to use more than one coordinate system to calculate the speed relative to a reference point (object), the speed relative to that reference point must be equal in all coordinate systems independent of the speed of the reference point in any particular coordinate system. For example, the speed of light relative to earth must be equal in all coordinate systems, but it cannot be equal relative to all coordinate systems that are moving at different speeds relative to earth. This is because of the definition of "speed" as physical quantity. Why should a definition be changed to match a theory? The theory must match definitions.

Second postulate also contradicts Einstein's assertion cited above because of asymmetry between source and observer – the motion of the source (magnet) and motion of the observer (conductor) do not lead to equal consequences.

Second postulate is identical with the classical wave theory, when "coordinate system" is replaced by the "medium" in which the wave moves. All Einstein's coordinate systems must contain a stationary medium to maintain constant speed of light. That is indeed the case if we regard sound waves in all closed rooms (for example closed cars) in which the air is stationary.

However, they cannot permeate each other and so Einstein's theory can only be wrong – the theory is disproved by sound in air. Why should light be treated in another way? Because it is faster?

In the moving coordinate system, the Galilei transform must be used to calculate the speed of the wave if the medium moves relative to coordinate system. This is also experimentally verified in case of light at the earth's surface – for example by GPS. The speed of the wave is not constant relative to the source and consequently the Doppler effect for moving source and for moving observer is to be strictly differentiated.

Moving observer

The equation which describes a plane wave that moves along x axis is:

$$y = A \sin 2\pi \left(\frac{x}{\lambda} - \frac{ct}{\lambda}\right)$$

where $\frac{c}{\lambda}$ can be replaced by f.

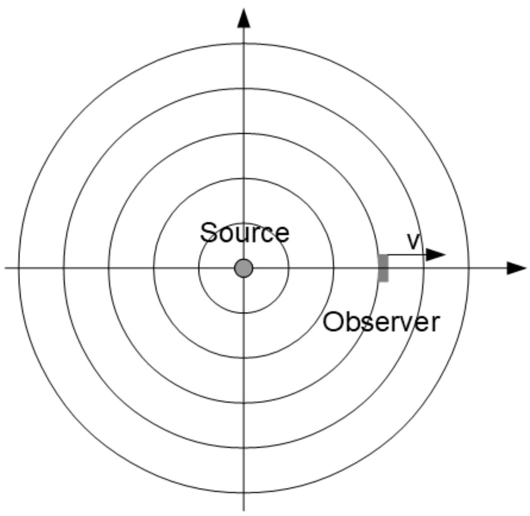

Figure 1. Observer moves relative to medium, the source is at rest. The wavelength does not change but the wave needs more time to cross the detector.

In Fig. 1 the observer is moving relative to medium in the positive direction, so the formula for the moving observer is:

$$y = A \sin 2\pi \left(\frac{x'}{\lambda} - \frac{ct}{\lambda}\right)$$

inserting $x' = x + vt$ gives:

$$y = A \sin 2\pi \left(\frac{x + vt}{\lambda} - \frac{ct}{\lambda}\right) = A \sin 2\pi \left(\frac{x}{\lambda} - \frac{(c - v)t}{\lambda}\right)$$

The speed of light and the frequency in the moving system are $c - v$ and $f' = \frac{(c-v)}{\lambda}$.

$$\frac{f'}{f} = \frac{(c-v)}{c},\ f' = f\left(1 - \frac{v}{c}\right)$$

For $v = c$ the frequency is zero because the light and the observer move at the same speed. This is the case that Einstein was not able to fit to his theory.

Einstein: *"If I pursue a beam of light with the velocity c (velocity of light in a vacuum), I should observe such a beam of light as an electromagnetic field at rest though spatially oscillating... From the very beginning it appeared to me intuitively clear that, judged from the standpoint of such an observer, everything would have to happen according to the same laws as for an observer who, relative to the earth, was at rest. For how should the first observer know or be able to determine, that he is in a state of fast uniform motion?"*

Einstein made many mistakes at this point. Today, in many accelerators the charged particles ride on the electromagnetic wave at the same speed as the wave. It is the Doppler effect that makes it possible to determine whether an observer is moving relative to a beam of light (or to a beam of sound) or not.

Moving source

The formula for the moving source is the same as for moving observer:

$$y = A \sin 2\pi \left(\frac{x}{\lambda} - \frac{ct}{\lambda}\right)$$

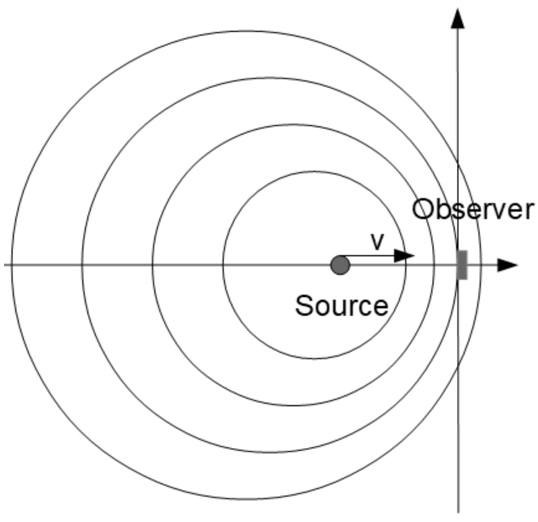

Figure 2. Source moves relative to medium, the observer is at rest. The illustration is compatible with the "second postulate" and with the classical theory.

When source of a wave moves relative to the medium the wavelength is no longer constant. This is consistent with Einstein's second postulate, because, according to postulate, the speed of light is independent of the motion of the source. When the source and the wave move in the same direction, the wave is shortened by vT (T: period of oscillation) because the source "chases" the wave.

$\lambda' = \lambda\left(1 - \frac{v}{c}\right)$

If source emits waves at the specified frequency, the Doppler effect for sound and light must be equal because both waves move at the constant speed relative to observer. The distance relative to observer is for both the same function of time and speed. Only if source changes its frequency due to motion, there would be a difference, but the pure Doppler effect is the same. The relativistic Doppler effect is herewith disproved. The formula must be separated into two parts, the part that describes the change of the emitted resonance frequency due to motion of the source and the ordinary doppler part. This view is confirmed by Ives-Stillwell experiment [1] and especially in [2] where is unwittingly demonstrated that the motion of the source and the motion of the receiver has to be strictly differentiated. Only motions with respect to the preferred reference frame (laboratory) affect the resonance frequency of emission or absorption. This is a straightforward disproof of special relativity although the mainstream always attempts to misinterpret the results in favour of relativity theory. In this case a misinterpretation is not possible.

$$y = A\sin 2\pi\left(\frac{x}{\lambda\left(1-\frac{v}{c}\right)} - \frac{ct}{\lambda\left(1-\frac{v}{c}\right)}\right)$$

The stationary observer measures:

$$f' = \frac{c}{\lambda'} = f\frac{1}{1-\frac{v}{c}}$$

When the observer moves relative to medium, in the same direction and at the same speed as source, the change of the frequency cancels but the change of the wavelength remains.

$$y = A\sin 2\pi\left(\frac{x'}{\lambda\left(1-\frac{v}{c}\right)} - \frac{ct}{\lambda\left(1-\frac{v}{c}\right)}\right) = A\sin 2\pi\left(\frac{x+vt}{\lambda\left(1-\frac{v}{c}\right)} - \frac{ct}{\lambda\left(1-\frac{v}{c}\right)}\right)$$
$$= A\sin 2\pi\left(\frac{x}{\lambda\left(1-\frac{v}{c}\right)} - \frac{(c-v)t}{\lambda\left(1-\frac{v}{c}\right)}\right) = A\sin 2\pi\left(\frac{x}{\lambda\left(1-\frac{v}{c}\right)} - \frac{ct}{\lambda}\right)$$

The wavelength depends only on the motion of the source relative to medium. If the observer moves at any speed w the formula changes to:

$$y = A\sin 2\pi\left(\frac{x}{\lambda\left(1-\frac{v}{c}\right)} - \frac{(c-w)t}{\lambda\left(1-\frac{v}{c}\right)}\right) = A\sin 2\pi\left(\frac{x}{\lambda\left(1-\frac{v}{c}\right)} - \frac{c(c-w)t}{\lambda(c-v)}\right)$$

This article only examines the case where the source or observer move directly toward or away from each other.

References

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