A standing wave can be formed in a microwave resonator if the length of the resonator is equal to one half of the wavelength multiplied by an integer. Two observers moving at the same speed will observe the resonator of the same length. They will also observe the same wavelength as the wavelength is proportional to the length of the resonator. If one observer moves in the opposite direction, they will observe an identical wavelength but two different frequencies due to the Doppler effect. Therefore, the apparent speed of the microwave appears to be different for these two observers.

I. INTRODUCTION

A standing wave can be formed between the wave transmitter and the reflector if one half of the wavelength multiplied by an integer is equal to the distance between the transmitter and the reflector. The standing wave exhibits the first harmonic if the distance is equal to one half of the wavelength. The standing wave exhibits the second harmonic if the distance is equal to the wavelength.

\[ n\lambda_2 = d \]

n is a positive integer.

B. Length Contraction

The laws of physics are conserved in all inertial frames of reference. Let another reference frame \( F_2 \) moves at a constant velocity of \((-v,0)\) relative to \( F_0 \). The standing wave in \( F_2 \) is represented by

\[ n\lambda_2 = d_2 \]

Let another reference frame \( F_2 \) moves at a constant velocity of \((-v,0)\) relative to \( F_0 \). The standing wave in \( F_2 \) is represented by

\[ n\lambda_2 = d_2 \]
According to Lorentz transformation, length contraction is independent of the direction of the relative motion.

\[ d_1 = d_2 \]  

(4)

From equations (2,3,4),

\[ \lambda_1 = \lambda_2 \]  

(5)

The wavelength is conserved in both \( F_1 \) and \( F_2 \).

C. Doppler Effect

To a stationary observer in \( F_1 \), the transmitter is moving away while emitting the microwave at an apparent frequency \( f_1 \). To a stationary observer in \( F_2 \), the transmitter is moving closer while emitting the microwave at an apparent frequency \( f_2 \).

According to the Doppler effect,

\[ f_1 < f_2 \]  

(6)

The apparent frequency of the microwave decreases in \( F_1 \) but increases in \( F_2 \).

D. Speed of Microwave

The speed of microwave in \( F_1 \) is \( C_1 \).

\[ C_1 = f_1 \times \lambda_1 \]  

(7)

The speed of microwave in \( F_2 \) is \( C_2 \).

\[ C_2 = f_2 \times \lambda_2 \]  

(8)

From equations (5,6,7,8),

\[ C_1 < C_2 \]  

(9)

The apparent speed of the microwave decreases in \( F_1 \) but increases in \( F_2 \).

III. CONCLUSION

The apparent speed of microwave is different in a different reference frame. The speed of microwave in the rest frame of the observer depends on the relative motion between the observer and the transmitter.

A stationary standing wave shows that the wavelength of its microwave is conserved for two observers moving at the same speed but in the opposite direction. These observers detect an identical wavelength but two different frequencies. Therefore, they observe two different speeds from the same microwave.

Lorentz transformation is based on the assumption that the speed of light is identical in all inertial reference frames. This is proved to be incorrect by the standing wave from a microwave resonance. Lorentz transformation has contradicted itself with its assumption of length contraction.

Therefore, Lorentz transformation fails to describe physics properly. It is an impractical mathematical description not for the real world. It is not suitable for physics. All theories that are based on Lorentz transformation are proved to be unsuitable for physics.
