Why Light is an ordinary wave

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Abstract:

Light is treated as a different sort of wave than other types of waves, sound waves or water waves for example. This is indicated by the fact that Doppler frequency shift equations used for sound or water waves do not hold for light waves. However, light waves can be treated as *normal* waves (normal refers to a wave being a disturbance propagating through a medium, rather than a wave existing unsupported in space without a medium) if one takes the Doppler shift equation for light and split it into two component parts.

(1) The usual Doppler shift attributed to other types of waves.
(2) A relativistic frequency shift of the emitted light at its source.

Introduction:

If the frequency of the emitted light is frequency corrected due to the source's motion prior to applying the normal Doppler shift equation, then the resulting frequency shift is the same as that given by the equation normally used for calculating the Doppler shift for light.

Doppler Shift equation for *normal* waves:

$$f' = f \times \frac{c}{c+v} \tag{1}$$

Doppler Shift equation for light:

$$f' = f \times \sqrt{\frac{1-\frac{v}{c}}{1+\frac{v}{c}}} \tag{2}$$

Where: c is the transmission speed of the wave.
v is the recession speed of the source.

For a light source moving at speed v, Relativity states that the frequency of the emitted light will be:

$$f_{emitted} = f \times \sqrt{1-\frac{v^2}{c^2}} \tag{3}$$

So, treating light as a *normal* wave, the total Doppler shift should be :

$$f' = f_{emitted} \times \frac{c}{c+v} \tag{4}$$

$$f' = f \times \sqrt{1-\frac{v^2}{c^2}} \times \frac{c}{c+v} \tag{5}$$

To prove that this treatment is correct, it is necessary to show that (2) and (5) are equivalent. This proof follows:

The Proof:

Using (5) gives:

$$\frac{f'}{f}=\sqrt{1-\frac{v^2}{c^2}}\times\left(\frac{c}{c+v}\right)$$

$$\left(\frac{f'}{f}\right)^2=\left(1-\frac{v^2}{c^2}\right)\times\frac{c^2}{(c+v)^2}$$

$$\left(\frac{f'}{f}\right)^2=\frac{c^2}{(c+v)^2}-\frac{v^2}{(c+v)^2}$$

$$\left(\frac{f'}{f}\right)^2=\frac{c^2-v^2}{(c+v)^2}\quad=\quad\frac{(c+v)(c-v)}{(c+v)^2}$$

$$\left(\frac{f'}{f}\right)^2=\frac{c-v}{c+v}\quad=\quad\frac{1-\frac{v}{c}}{1+\frac{v}{c}}$$

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

$$f'=f\times\sqrt{\frac{1-\frac{v}{c}}{1+\frac{v}{c}}}$$ This is the same as (2)

QED

Conclusion:

The Doppler equation for sound waves can be applied to light waves also if one splits the Doppler equation for light into its two component parts. Thus the same general Doppler equation can be used for all types of waves. Also this finding points to the possibility that light waves travel through space in a medium rather than unsupported in a void.

REFERENCES

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