

Doppler effect · supported focus

Supported focus · HL

Supported scope

- Supported HL focus. First assessment 2025; full Physics guide acquired (84 PDF pages). Remaining guide, assessment and practical requirements retain their recorded holds.
- State model conditions and distinguish fictional data from measurements.

Light Doppler · 1.1

Reasoning

A recognizable spectral line appears at a longer wavelength in a distant source. Its shift can provide evidence of recession along the line of sight. Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

Light Doppler · 2.1

Reasoning

Relative source-observer motion changes observed frequency or wavelength. For light at a relative speed much smaller than c , the magnitude of the fractional wavelength shift is approximately v/c . Recession corresponds to longer wavelength, and approach to shorter wavelength.

redshift	: Shift of an identified line toward longer
wavelength; rest wavelength	: Wavelength of the line measured with no
relative source motion.	

Light Doppler · 3.1

Reasoning

Compare a identified line with its laboratory rest wavelength. Use $z = (\text{observed} - \text{rest}) / \text{rest}$, then v approximately cz in the stated low-speed model. Do not apply this approximation without checking the regime or treating a cosmological redshift as a simple exact velocity. Use attributed spectra with calibration and line identification. Compare several lines for a consistent shift. State uncertainty and distinguish relative line-of-sight motion from an unmeasured transverse component.

Light Doppler · 4.1

Reasoning

State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution. Known: a 500 nm rest line is observed at 501 nm. $z = (501 - 500)/500 = 0.002$. With $c = 3.0 \times 10^8$ m/s, v approximately 6.0×10^5 m/s away. The sound-source denominator formula is not the required SL light approximation.

Light Doppler · 4.2

Reasoning

A 600 nm rest line is observed at 601.2 nm. Find $z = (\text{observed} - \text{rest}) / \text{rest}$. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

Light Doppler · 5.1

Reasoning

The approximate shift relation does not show that light travels faster from an approaching source. A single unidentified line cannot safely establish a redshift. Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Light Doppler · 5.2

Reasoning

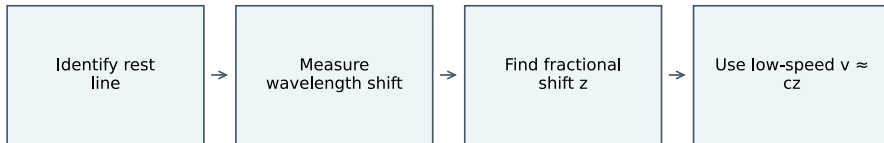
An observed redshift means light speed increased. This claim is false: The approximate shift relation does not show that light travels faster from an approaching source. A single unidentified line cannot safely establish a redshift.

Light Doppler · 5.3

Reasoning

Spectral shifts: a low-speed astronomical estimate: Compare a identified line with its laboratory rest wavelength. Use $z = (\text{observed} - \text{rest}) / \text{rest}$, then v approximately cz in the stated low-speed model. Do not apply this approximation without checking the regime or treating a cosmological redshift as a simple exact velocity.

Light Doppler · diagram



- Original teaching diagram: Spectral shifts: a low-speed astronomical estimate
- Use the labels and the stated model together.

Light Doppler · original transfer

Your turn

A 500 nm rest line is observed at 499 nm. Find z and low-speed radial velocity using $c=3\times 10^8$ m/s. Explain sign and limit.

Light Doppler · transfer reasoning

Method and interpretation

$z = -0.002$; $v \approx cz = -6 \times 10^5$ m/s, approaching under the positive-away convention. This small- $|z|$ kinematic approximation does not cover every origin of redshift.

Doppler · 1.1

Reasoning

An approaching sound source is heard at a higher pitch even when the source produces a constant frequency. Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

Doppler · 2.1

Reasoning

Doppler shift arises from relative source-observer motion. A moving source compresses wavefront spacing ahead and increases it behind. For sound in a stationary medium, the wave speed relative to that medium need not change.

Doppler shift: Change of observed frequency due to relative motion; wavefront: A surface joining points with the same wave phase.

Doppler · 3.1

Reasoning

For a source approaching a stationary observer along the line of sight, $f_{\text{observed}} = f_{\text{source}} \times v / (v - v_{\text{source}})$. Recession uses $v + v_{\text{source}}$ in the denominator. These are sound-wave models; light requires its appropriate relation. Use a simulation or recorded data with stated source and observer directions. Draw wavefronts before choosing signs. Avoid demonstrations near moving traffic or unsafe high-volume sources.

Doppler · 4.1

Reasoning

State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution. Known: source frequency 500 Hz, sound speed 340 m/s, source approaches at 20 m/s. Observed frequency = $500 \times 340 / (340 - 20) = 531.25$ Hz. The increase is 31.25 Hz; it is not the source frequency changing.

Doppler · 4.2

Reasoning

A 600 Hz source approaches a stationary observer at 20 m/s. Use $v = 340$ m/s. Find observed frequency. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

Doppler · 5.1

Reasoning

A stationary source and moving observer require the observer-motion relation. Do not use the same denominator formula for every arrangement or import a sound formula into relativity. Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Doppler · 5.2

Reasoning

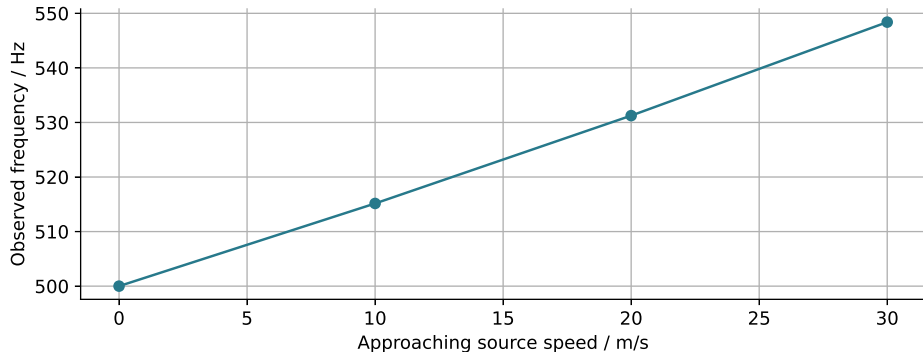
The Doppler effect always means the wave speed in the medium changed. This claim is false: A stationary source and moving observer require the observer-motion relation. Do not use the same denominator formula for every arrangement or import a sound formula into relativity.

Doppler · 5.3

Reasoning

Doppler effect: separate source motion from wave speed: For a source approaching a stationary observer along the line of sight, $f_{\text{observed}} = f_{\text{source}} \times v/(v - v_{\text{source}})$. Recession uses $v + v_{\text{source}}$ in the denominator. These are sound-wave models; light requires its appropriate relation.

Doppler · diagram



- Original teaching diagram: Doppler effect: separate source motion from wave speed
- Use the labels and the stated model together.

Doppler · original transfer

Your turn

A 600 Hz sound source recedes at 20 m/s from a stationary observer; sound speed is 340 m/s. Find frequency and compare approach. Why is this not the light Doppler law?

Doppler · transfer reasoning

Method and interpretation

Recession gives $600 \times 340 / (340 + 20) = 566.7$ Hz; approach gives 637.5 Hz. Source direction is relative to a material medium; light requires its appropriate relativistic relation.

Check yourself

- Explain redshift using the stated model.
- Explain rest wavelength using the stated model.
- Change one value in the original transfer; explain which assumption still matters.