

# Module 4: Radiation and the Electromagnetic Spectrum

## Topic 4 Content: Calculating the Speed of Stars Notes


### Introduction

### Calculating the Speed of Stars

The Formula    Example: Object 1    Example: Object 2

#### Introduction

Learn the formula that astronomers use to determine how fast an object in space, such as a star, is moving either toward or away from Earth. In this interactivity, click on each folder tab for information. Make sure to view the formula first, and then click on each example to see the equation in action. Click on the magnifying glass below each image to enlarge the information.



Learn the formula that astronomers use to determine how fast an object in space, such as a star, is moving either toward or away from Earth. In this interactivity, click on each folder tab for information. Make sure to view the formula first, and then click on each example to see the equation in action. Click on the magnifying glass below each image to enlarge the information.

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#### The Formula

The screenshot shows a digital interface with a title bar 'Calculating the Speed of Stars' and three tabs: 'The Formula', 'Example: Object 1', and 'Example: Object 2'. The 'The Formula' tab is active, displaying the formula 
$$\frac{V_r}{c} = \frac{\Delta\lambda}{\lambda_0}$$
 and its definitions:  $V_r$  -- the radial velocity of the source of light,  $c$  -- the speed of light,  $\Delta\lambda$  -- the change in wavelength, and  $\lambda_0$  -- the measured wavelength of the element at rest.

$V_r$  -- the radial velocity of the source of light

$c$  -- the speed of light

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#### Example: Object 1

### Calculating the Speed of Stars

The Formula    Example: Object 1    Example: Object 2

#### Example: Object 1

$$\frac{V_r}{c} = \frac{\Delta\lambda}{\lambda_0}$$
$$V_r = \frac{\Delta\lambda * c}{\lambda_0}$$
$$V_r = \frac{(427.6 \text{ nm} - 428.1 \text{ nm}) * (3.0 * 10^8 \text{ m/s})}{428.1 \text{ nm}}$$
$$V_r = -35,030 \text{ m/s}$$

If an object has a measured wavelength of 427.6 nm and a wavelength of 428.1 nm as read by a spectrometer, what would be the speed of the object?

Move the formula around so that  $V_r$  is alone -- this is what you are trying to solve. Radial velocity is the speed of the object.

$V_r = -35,030 \text{ m/s}$

Because the value is negative, we know that the object is approaching. This is how fast it is approaching or blueshifting.

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#### Example: Object 2

### Calculating the Speed of Stars

The Formula    Example: Object 1    Example: Object 2

#### Example: Object 2

$$\frac{V_r}{c} = \frac{\Delta\lambda}{\lambda_0}$$
$$V_r = \frac{\Delta\lambda * c}{\lambda_0}$$
$$V_r = \frac{(678.8 \text{ nm} - 678.2 \text{ nm}) * (3.0 * 10^8 \text{ m/s})}{678.2 \text{ nm}}$$
$$V_r = 265,400 \text{ m/s}$$

If the spectral lines of an object are measured at 678.8 nm and the laboratory measured a wavelength at 678.2 nm, how fast is the object traveling?

Move the formula around so that  $V_r$  is alone -- this is what you are trying to solve. Radial velocity is the speed of the object.

$V_r = 265,400 \text{ m/s}$

Notice that this time the answer is a positive value, meaning that the object is receding or redshifting.

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