

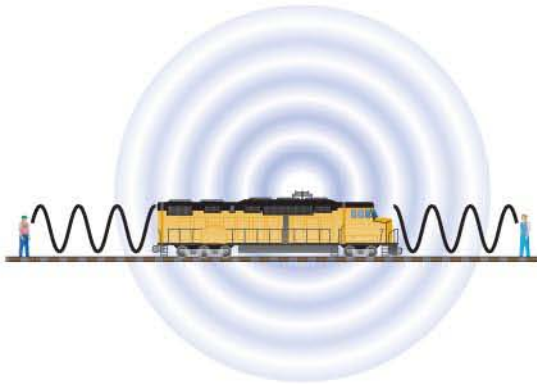
# 5.5 The Doppler Effect

Our goals for learning:

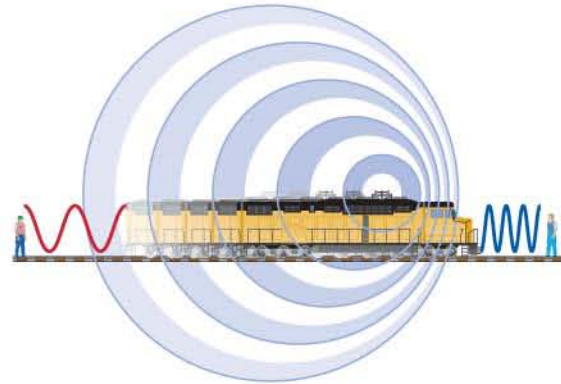
- How does light tell us the speed of a distant object?
- How does light tell us the rotation rate of an object?

# How does light tell us the speed of a distant object?

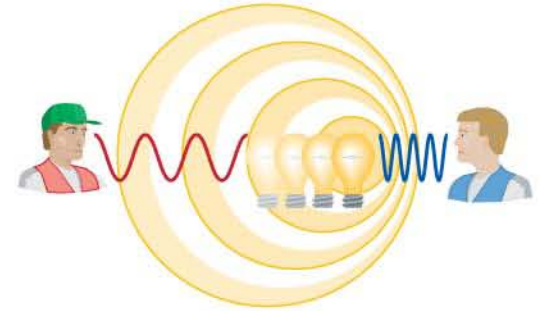
train stationary



train moving to right

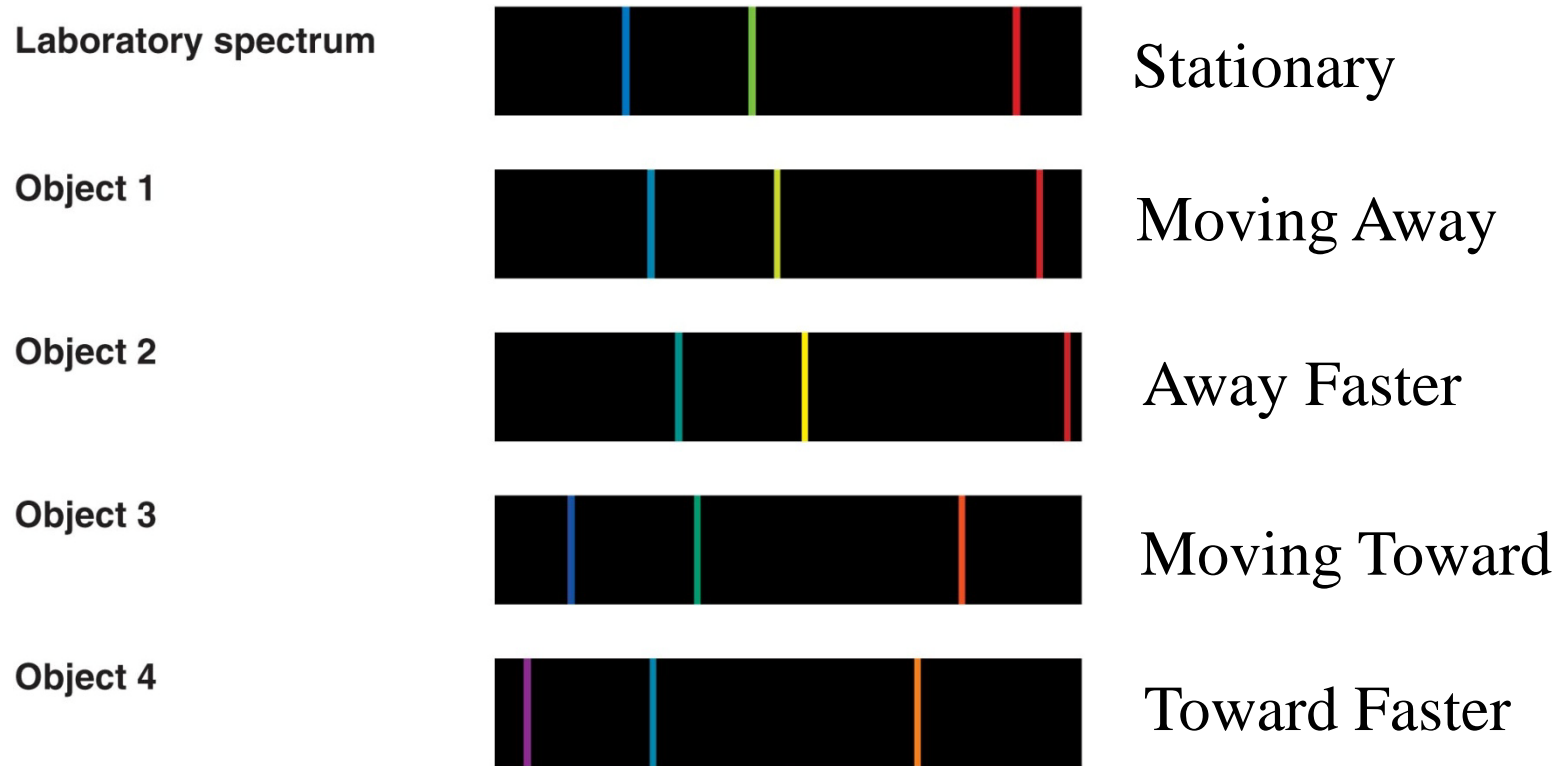


light source moving to right



The Doppler Effect

# Measuring the Shift

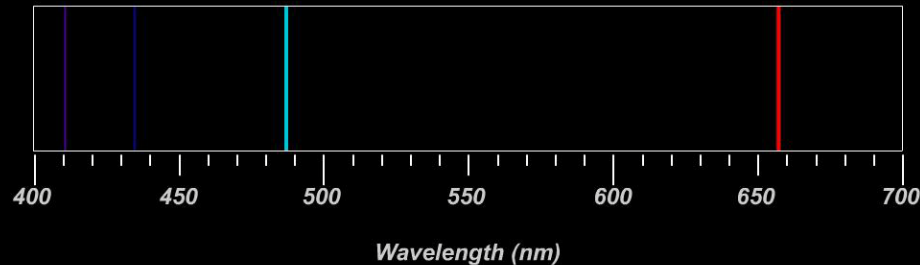


- We generally measure the Doppler Effect from shifts in the wavelengths of spectral lines

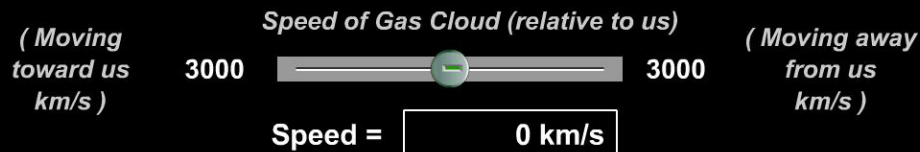
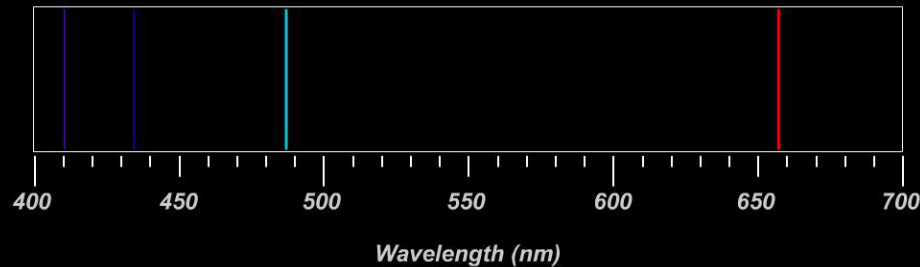
## The Doppler Shift of an Emission-Line Spectrum

Range 2

Spectrum of Stationary Hydrogen Gas (*Laboratory*)

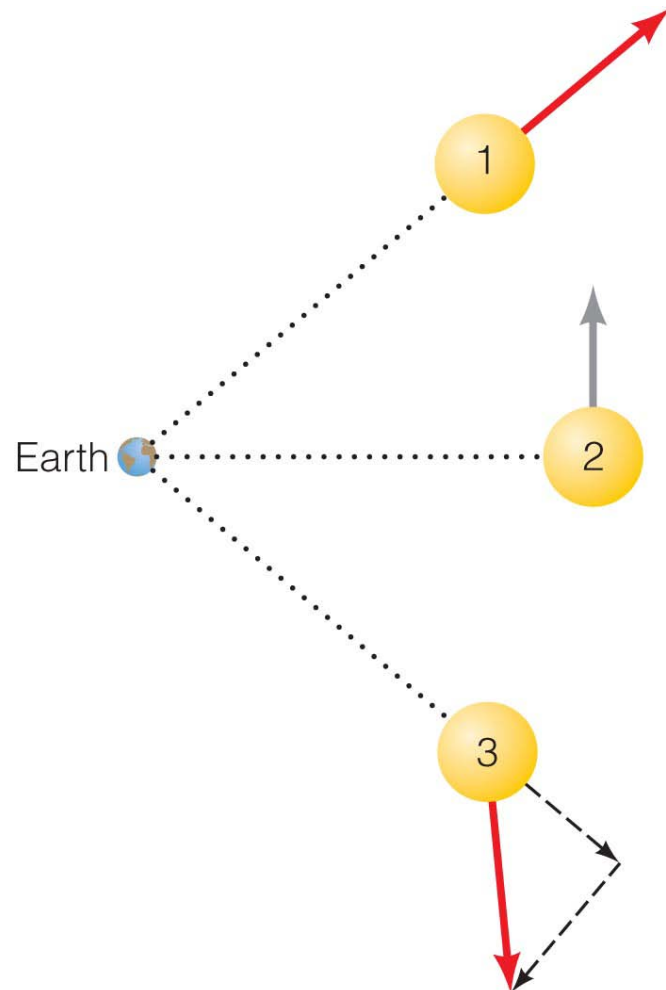


Spectrum of Moving Cloud of Hydrogen Gas



The amount of blue or red shift tells us an object's speed toward or away from us.

Doppler shift tells us **ONLY** about the part of an object's motion toward or away from us:



Interactive Figure 

## Thought Question

I measure a line in the lab at 500.7 nm.

The same line in a star has wavelength 502.8 nm.

What can I say about this star?

- a) It is moving away from me.
- b) It is moving toward me.
- c) It has unusually long spectral lines.

## Thought Question

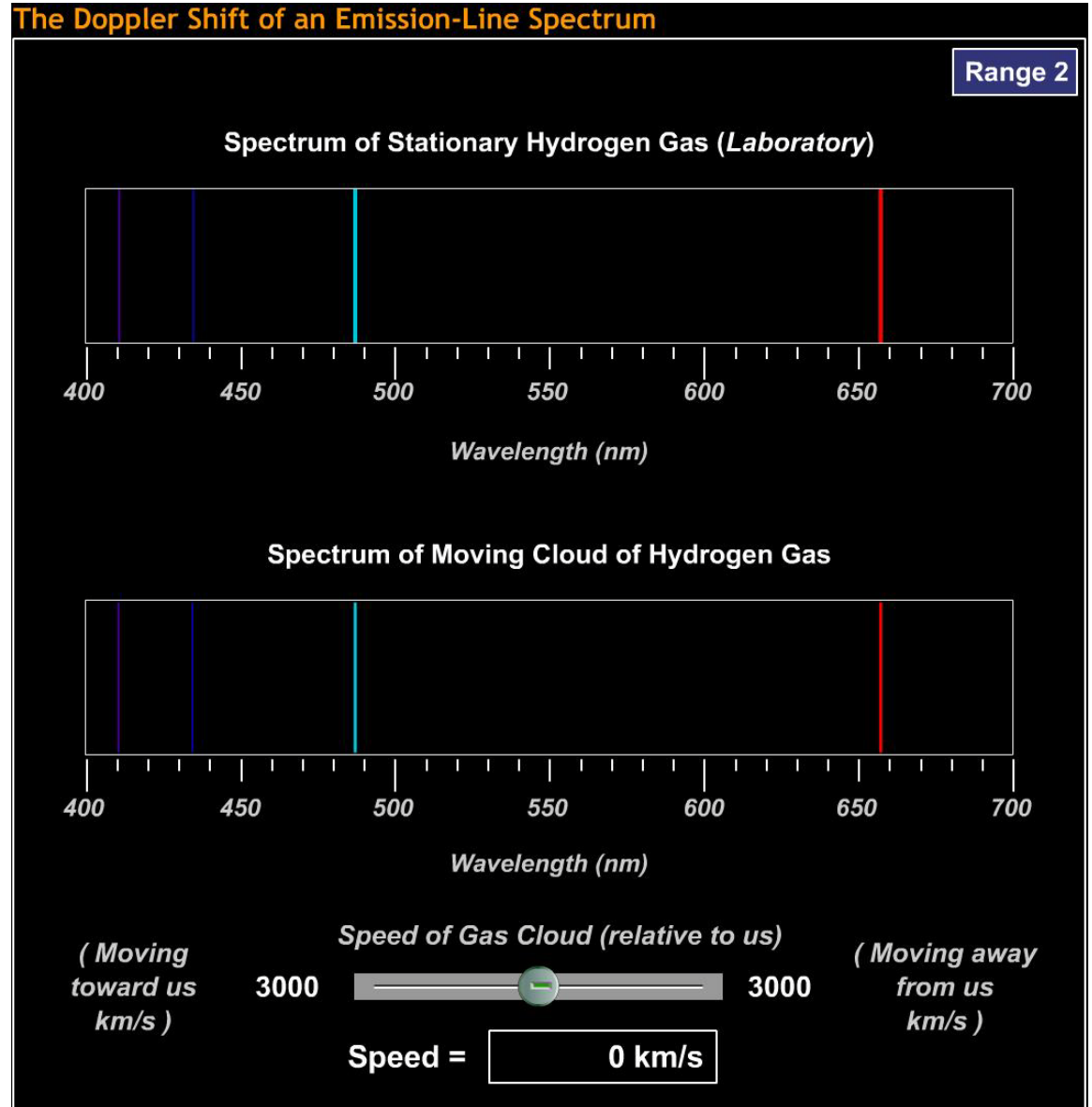
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The same line in a star has wavelength 502.8 nm.

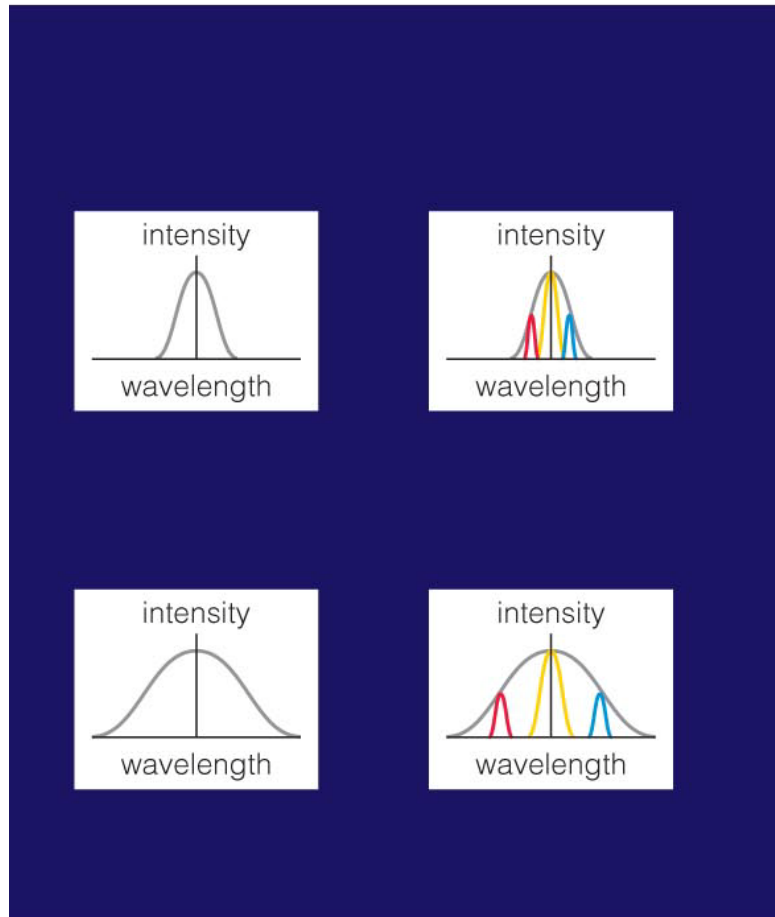
What can I say about this star?

- a) **It is moving away from me.**
- b) It is moving toward me.
- c) It has unusually long spectral lines.

# Measuring Redshift

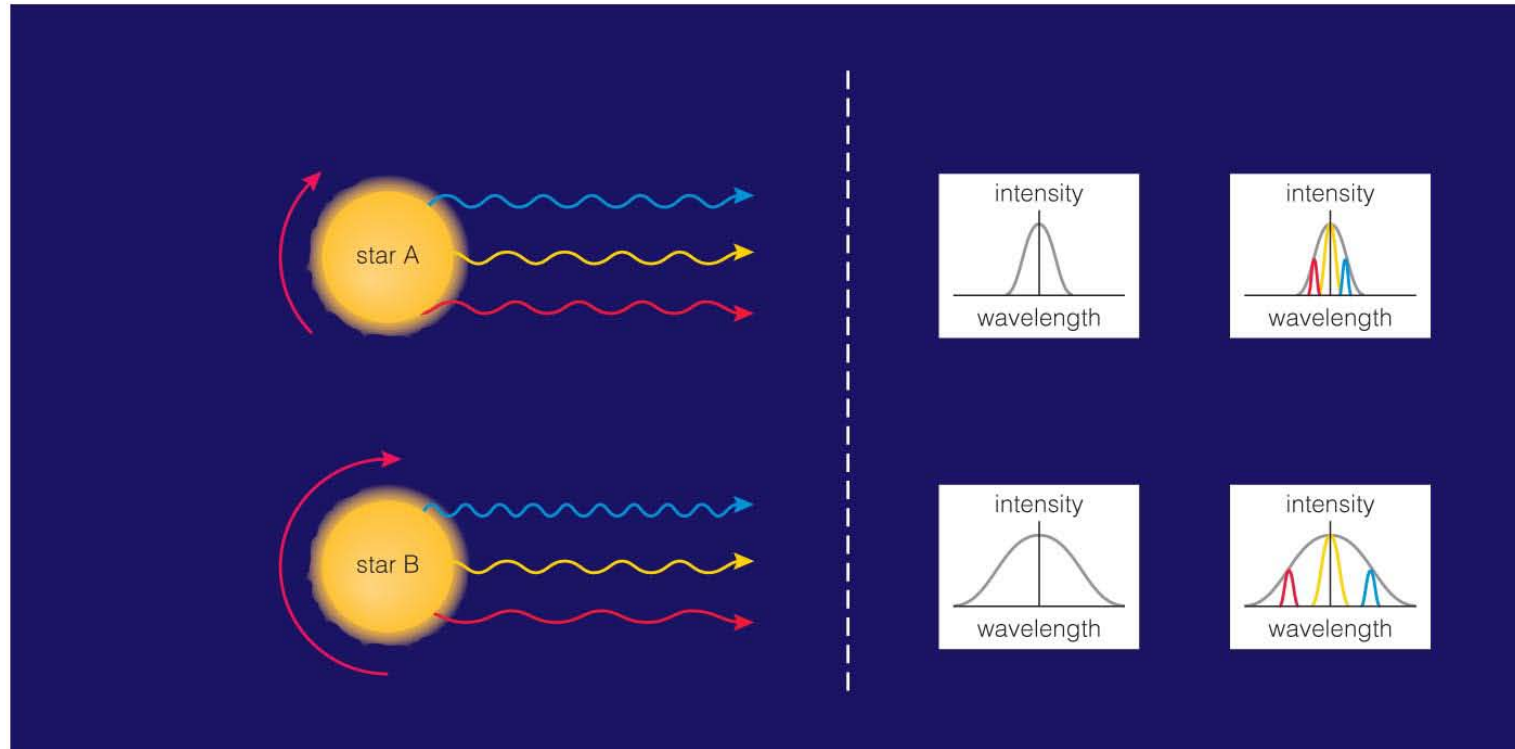


# How does light tell us the rotation rate of an object?



- Different Doppler shifts from different sides of a rotating object spread out its spectral lines

# Spectrum of a Rotating Object



- Spectral lines are wider when an object rotates faster

# What have we learned?

- How does light tell us the speed of a distant object?
  - The Doppler effect tells us how fast an object is moving toward or away from us.
    - **Blueshift**: objects moving toward us
    - **Redshift**: objects moving away from us
- How does light tell us the rotation rate of an object?
  - The width of an object's spectral lines can tell us how fast it is rotating