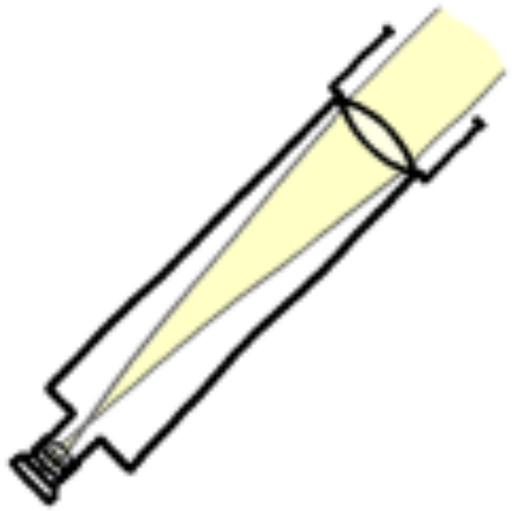
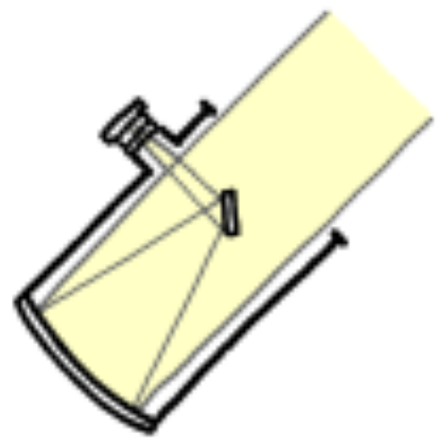
Types of telescopes...

REFRACTOR



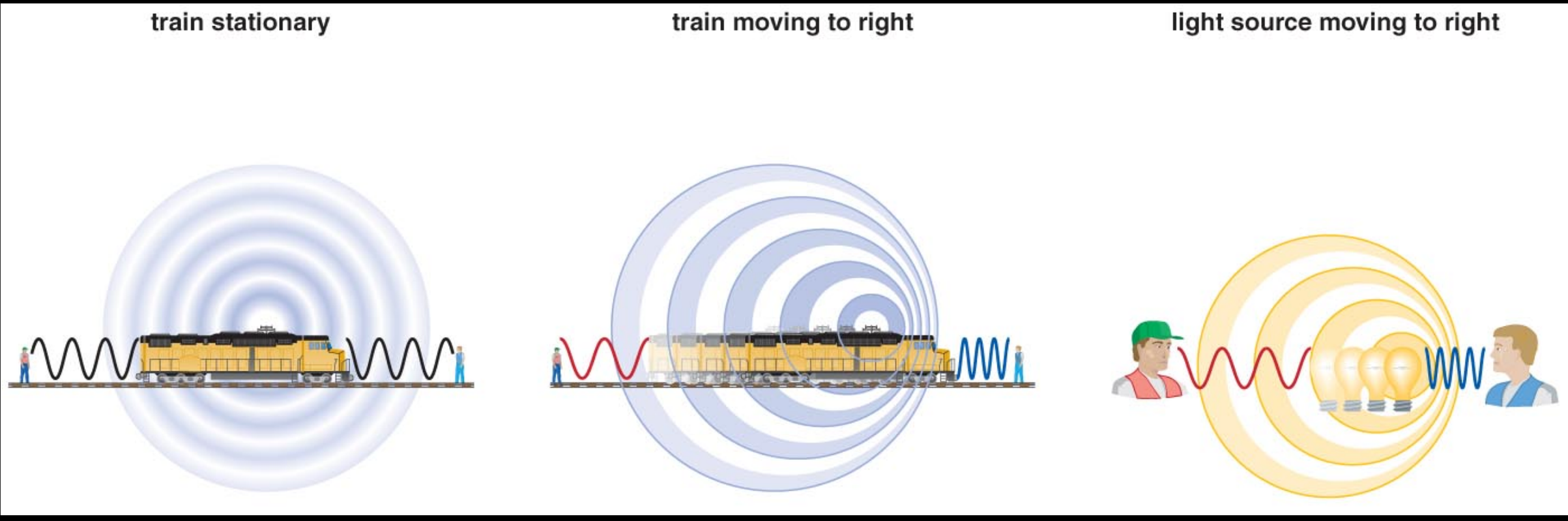
- MORE EXPENSIVE
- LESS COMPACT
- CHROMATIC ABERRATION
- REDUCED LIGHT-GATHERING

REFLECTOR

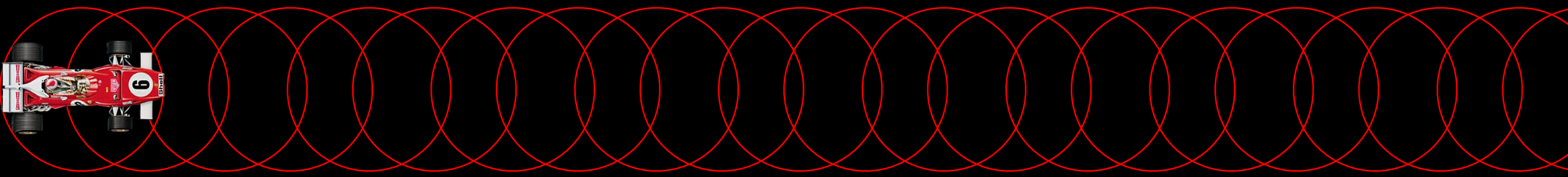


- CAN'T SEE SPACE VAMPIRES

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

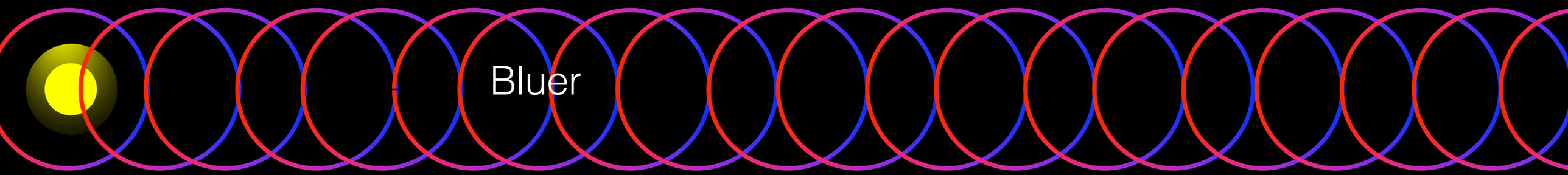


The Doppler Effect



Compared to the speed of sound,
the racecar is slow

The Doppler Effect

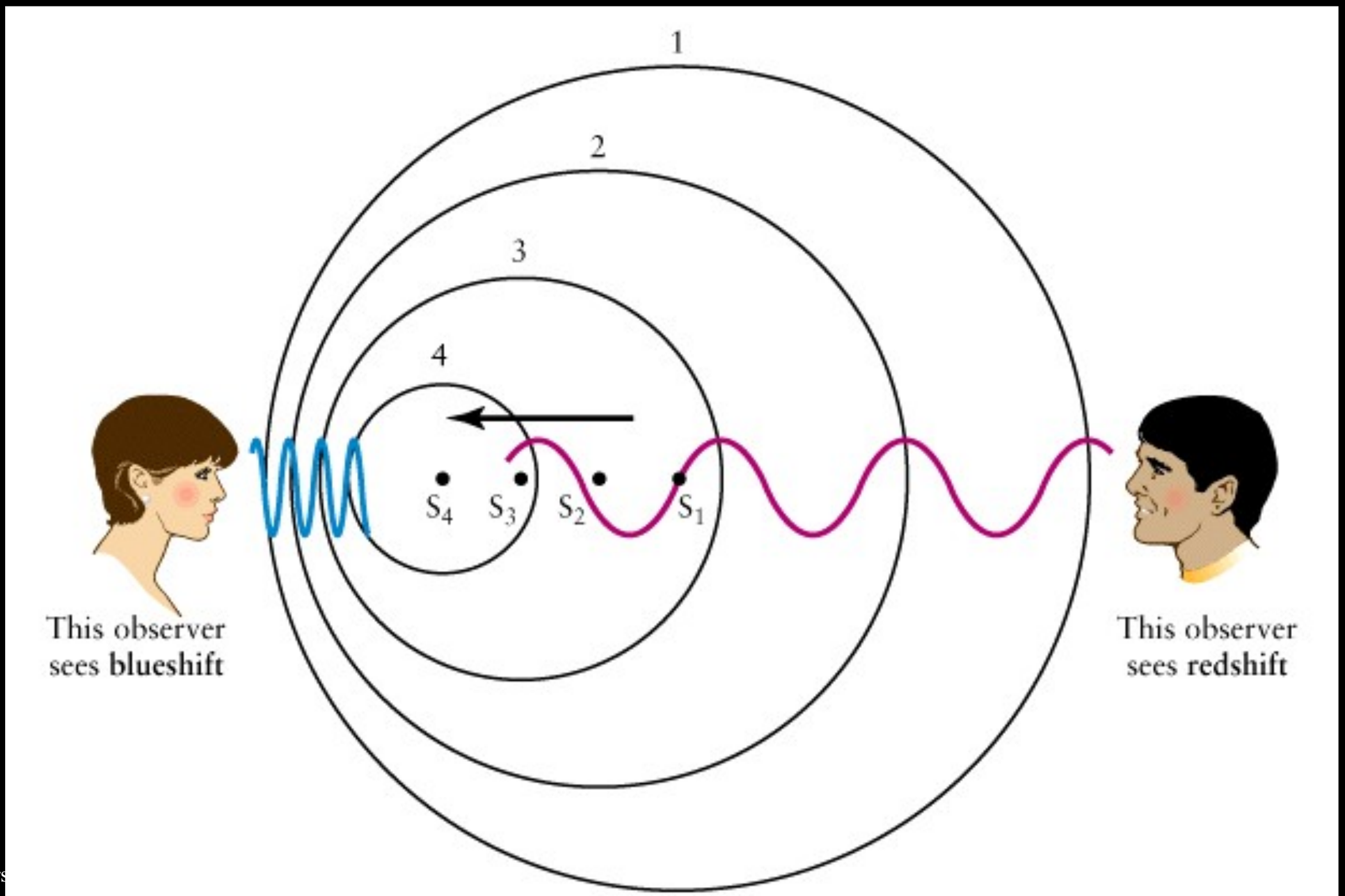


Light is also a wave, and we can measure the Doppler shift of light (redder or bluer) extremely precisely.

The Doppler Effect

- Definition: "The change in wavelength of radiation (light) due to the relative motion between the source and the observer along the line of sight."

Astronomers use the Doppler Effect to learn about the *radial* (along the line of sight) motions of stars, and other astronomical objects.



Real Life Examples of Doppler Effect

- Doppler Radar (for weather)
- Airplane radar system
- Submarine radar system
  - Ok, anything with radar

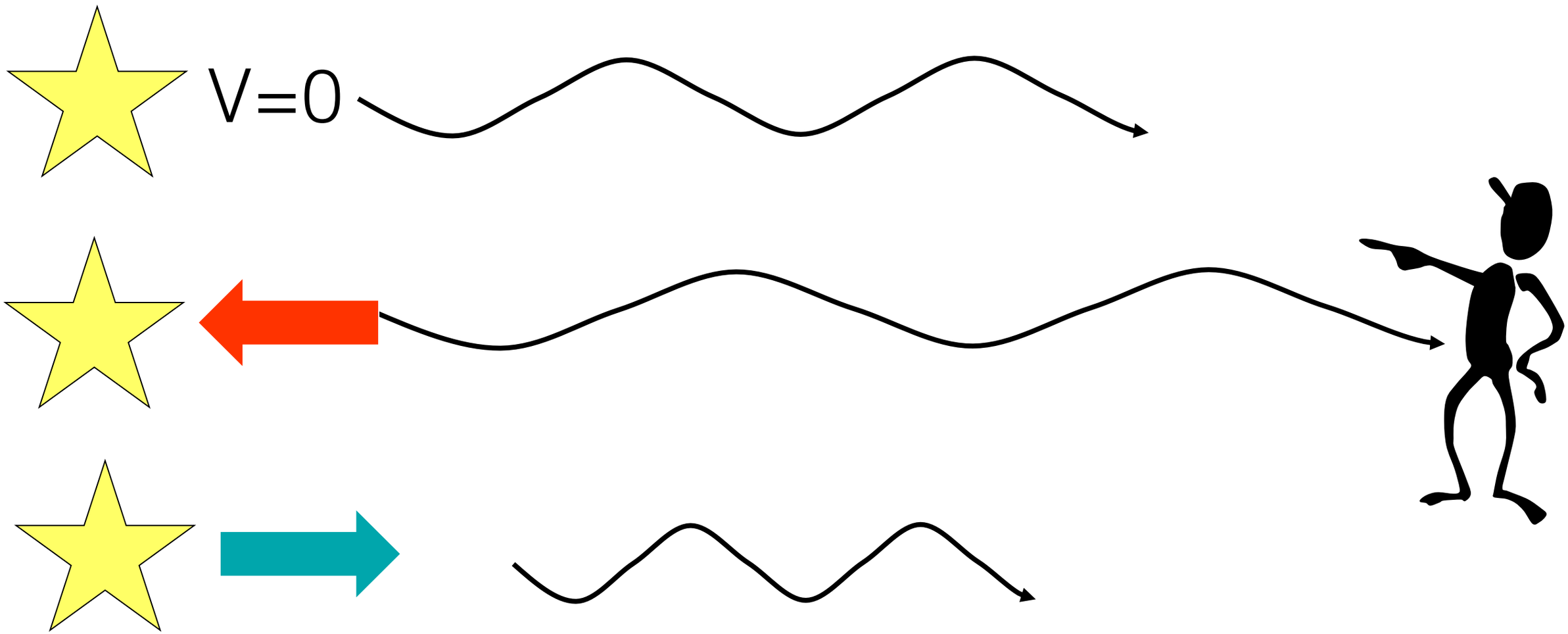
- Radar gun, used by Law Enforcement Officers…

The Doppler Effect

- Definition: "**The change in wavelength of radiation (light) due to the relative motion between the source and the observer** along the line of sight."

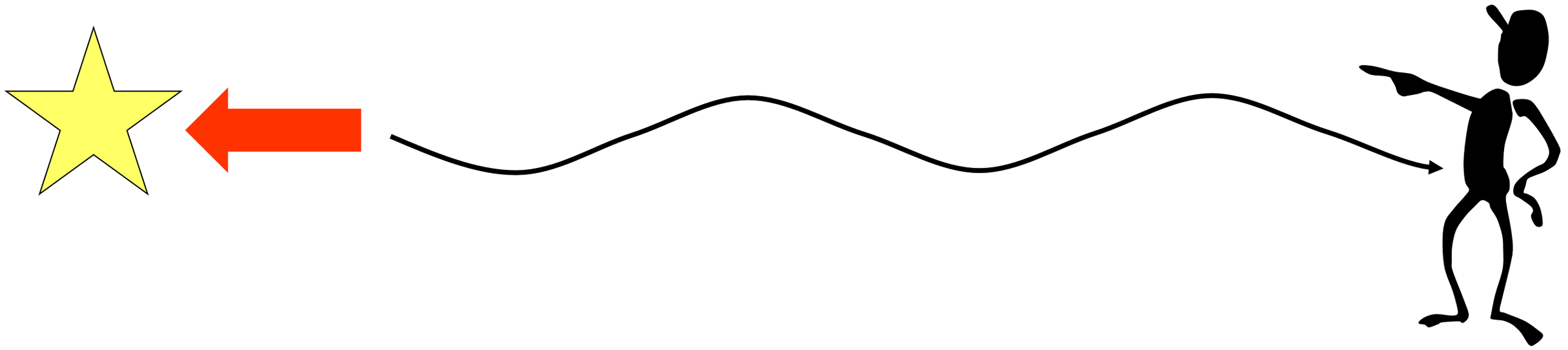
Doppler Effect

- When something which is giving off light moves towards or away from you, the wavelength of the emitted light is changed or shifted



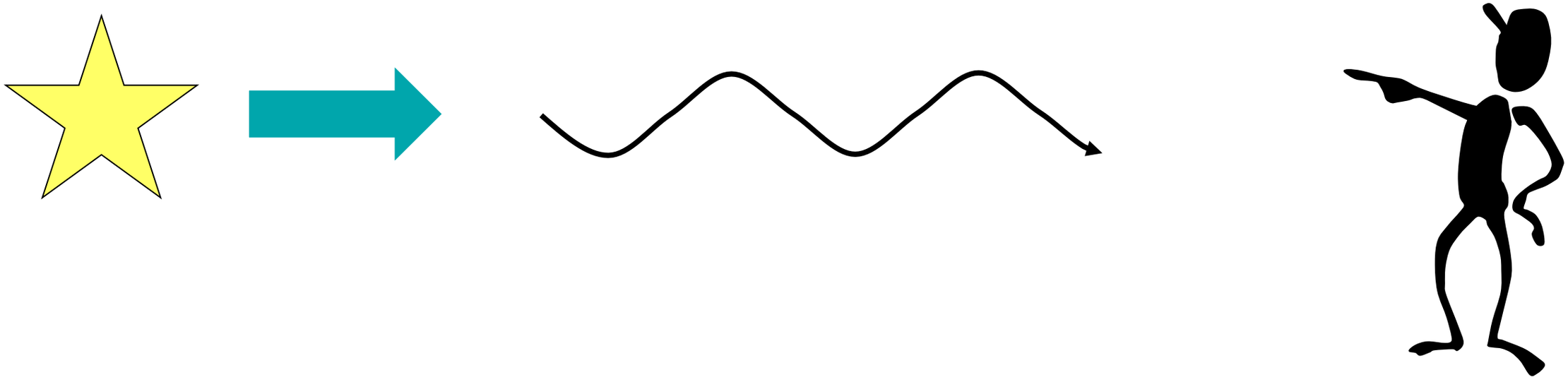
Doppler Effect

- When the source of light is moving away from the observer the wavelength of the emitted light will appear to increase. We call this a "redshift".



Doppler Effect

- When the source of light is moving towards the observer the wavelength of the emitted light will appear to decrease. We call this a "blueshift".

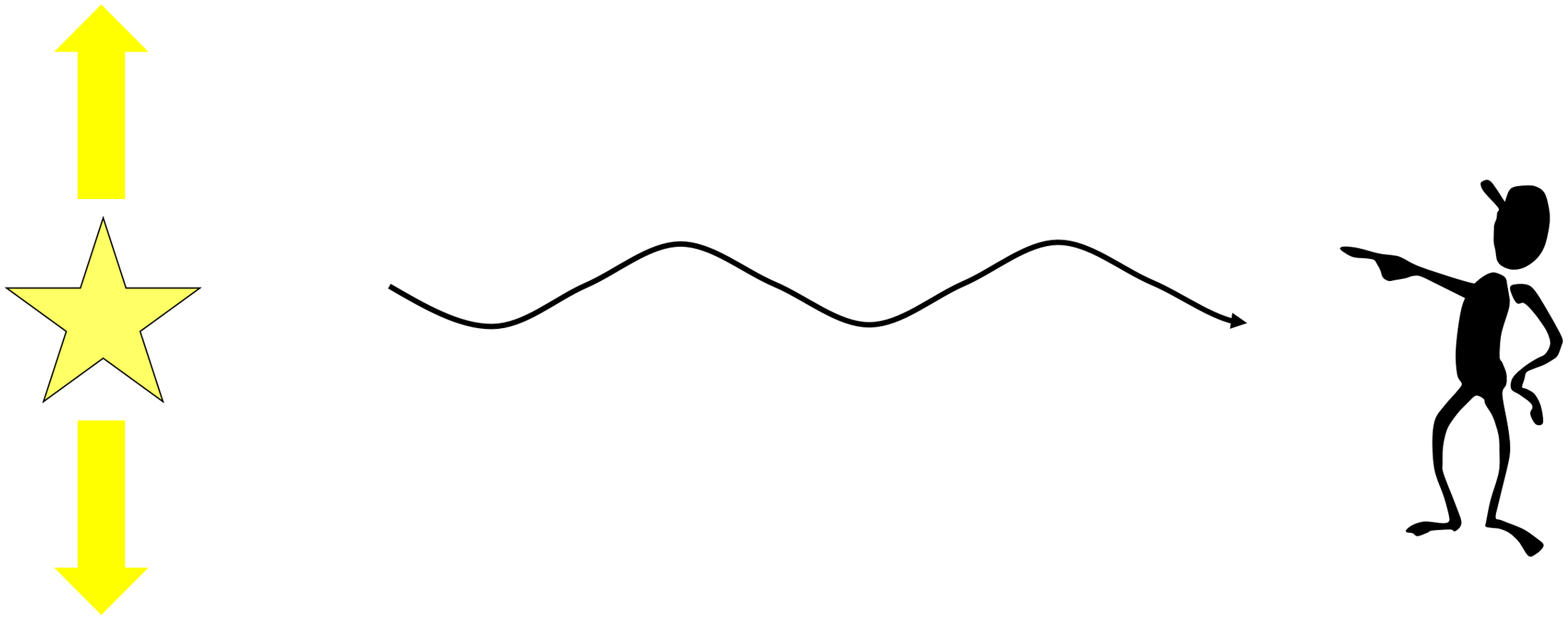


The Doppler Effect

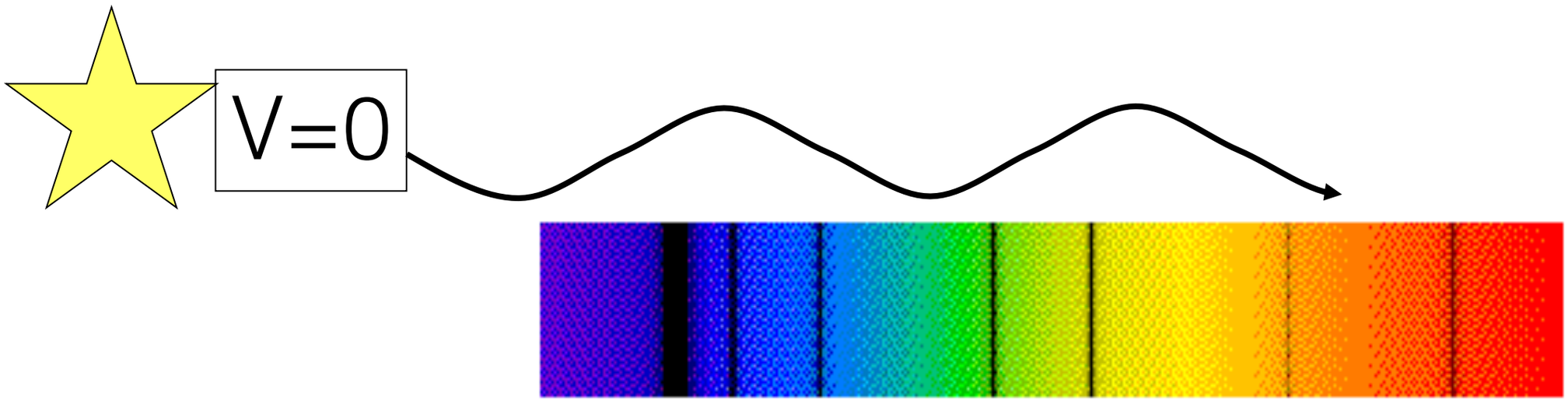
- Definition: "**The change in wavelength of radiation (light) due to the relative motion between the source and the observer** along the line of sight."

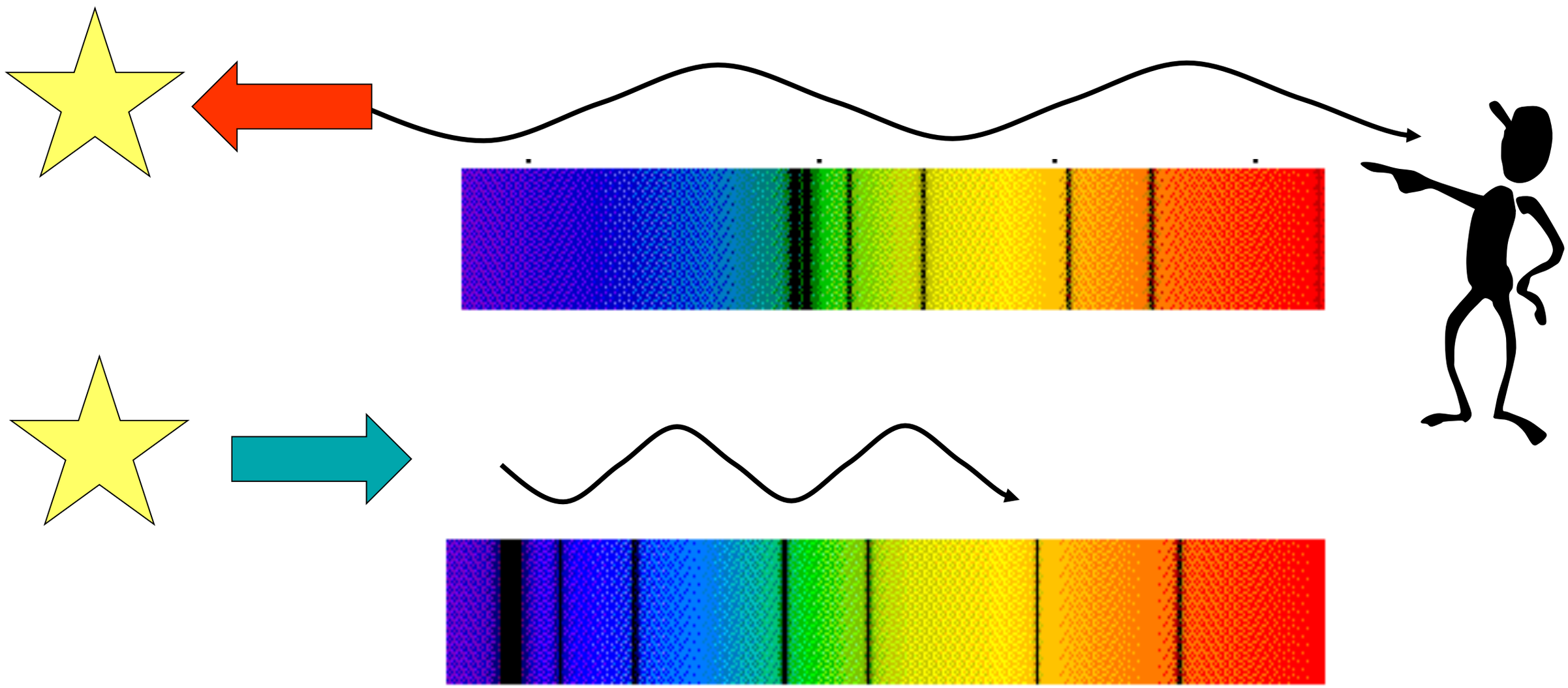
Doppler Effect

- "Along the line of sight" means the Doppler Effect happens only if the object which is emitting light is ***moving towards you or away from you***.
  - An object moving "**side to side**" or **perpendicular**, relative to your line of sight, will ***not*** experience a Doppler Effect.

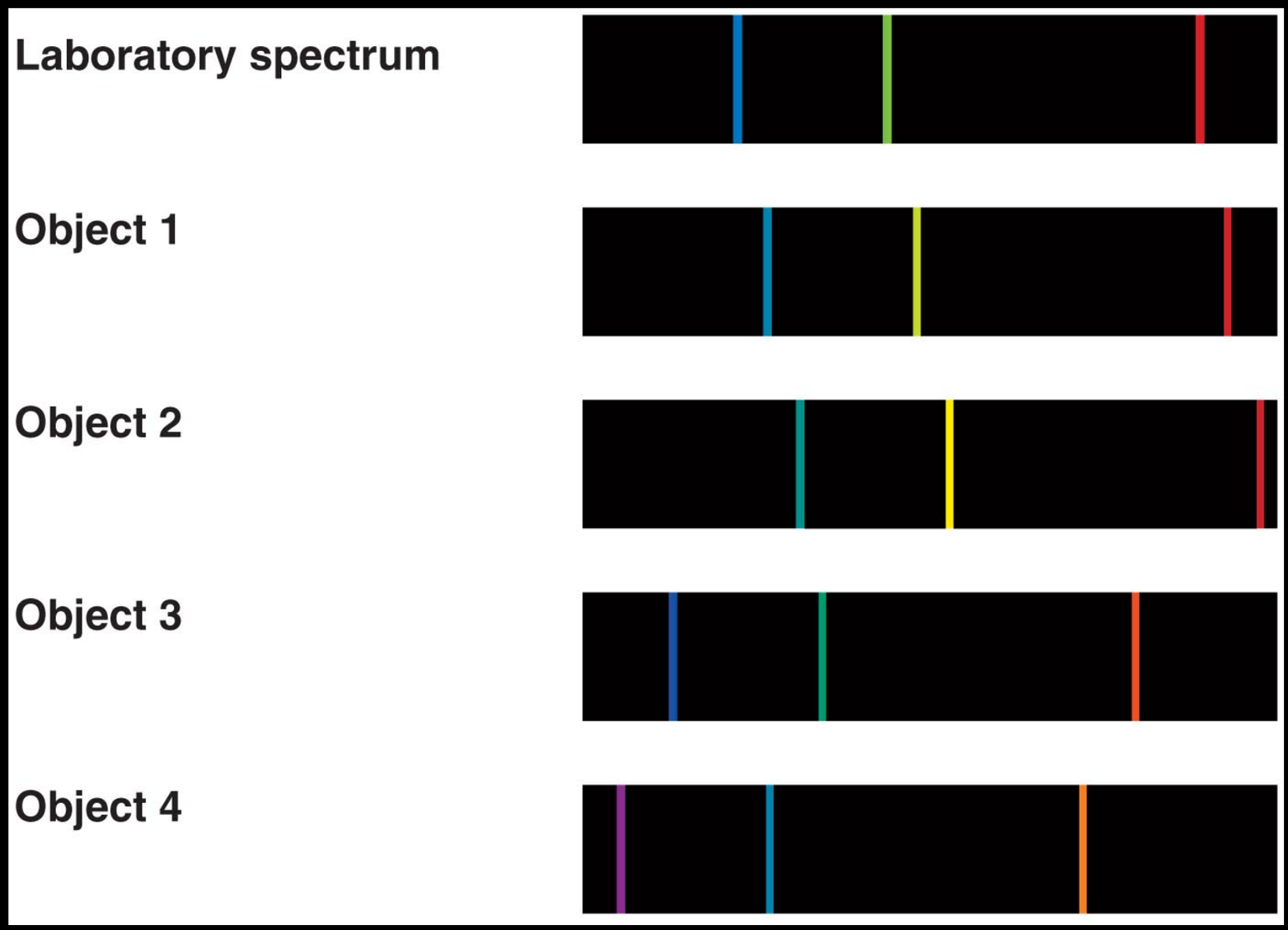


Astronomy Application





Measuring the Shift



We generally measure the Doppler effect from shifts in the wavelengths of spectral lines.

The Doppler Effect causes light from a source moving away to:

A. be shifted to shorter wavelengths.
B. be shifted to longer wavelengths.
C. change in velocity.
D. Both a and c above
E. Both b and c above

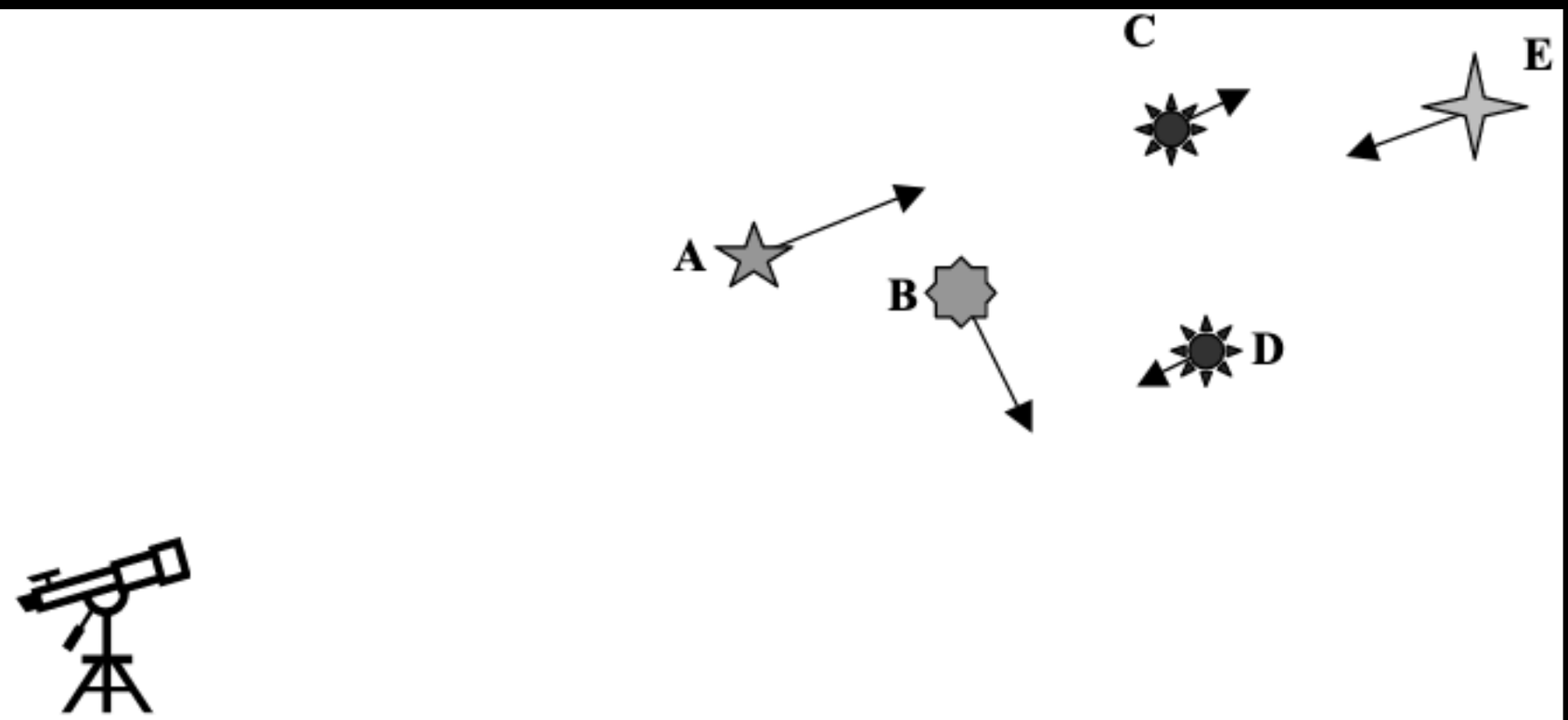
You observe two spectra (shown below) that are redshifted relative to that of a stationary source of light. Which of the following statements best describes how the sources of light that produced the two spectra were moving?

BLUE RED

Spectrum A

Spectrum B

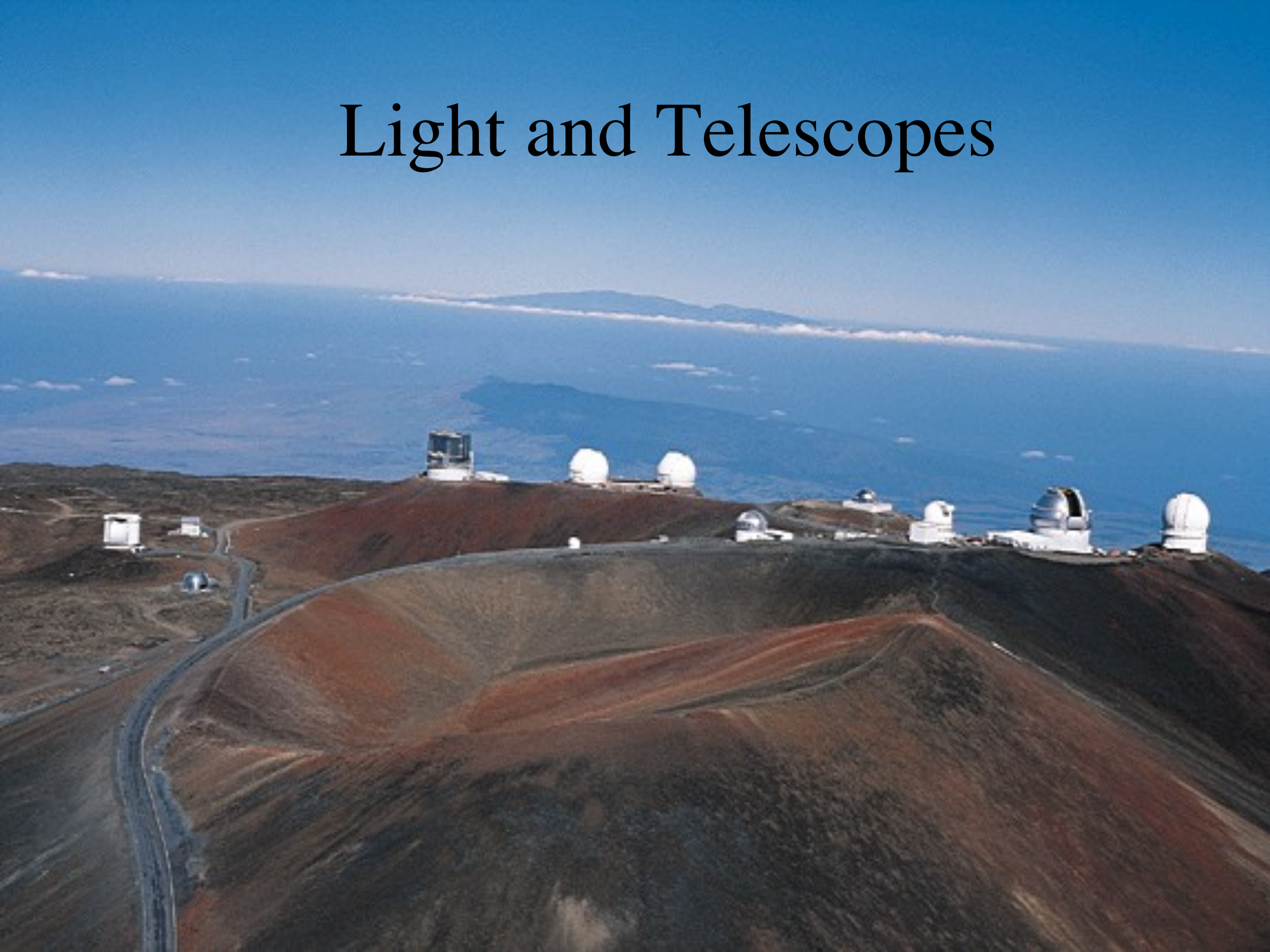
A) Source A is moving faster than source B.
B) Source B is moving faster than source A.
C) Both sources are moving with the same speed.
D) It is impossible to tell from looking at these spectra.



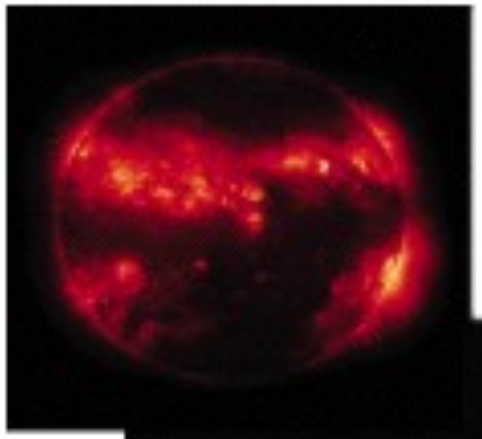
Rank the Doppler shift observed from each star (A-E) from greatest blueshift to no shift to greatest redshift:

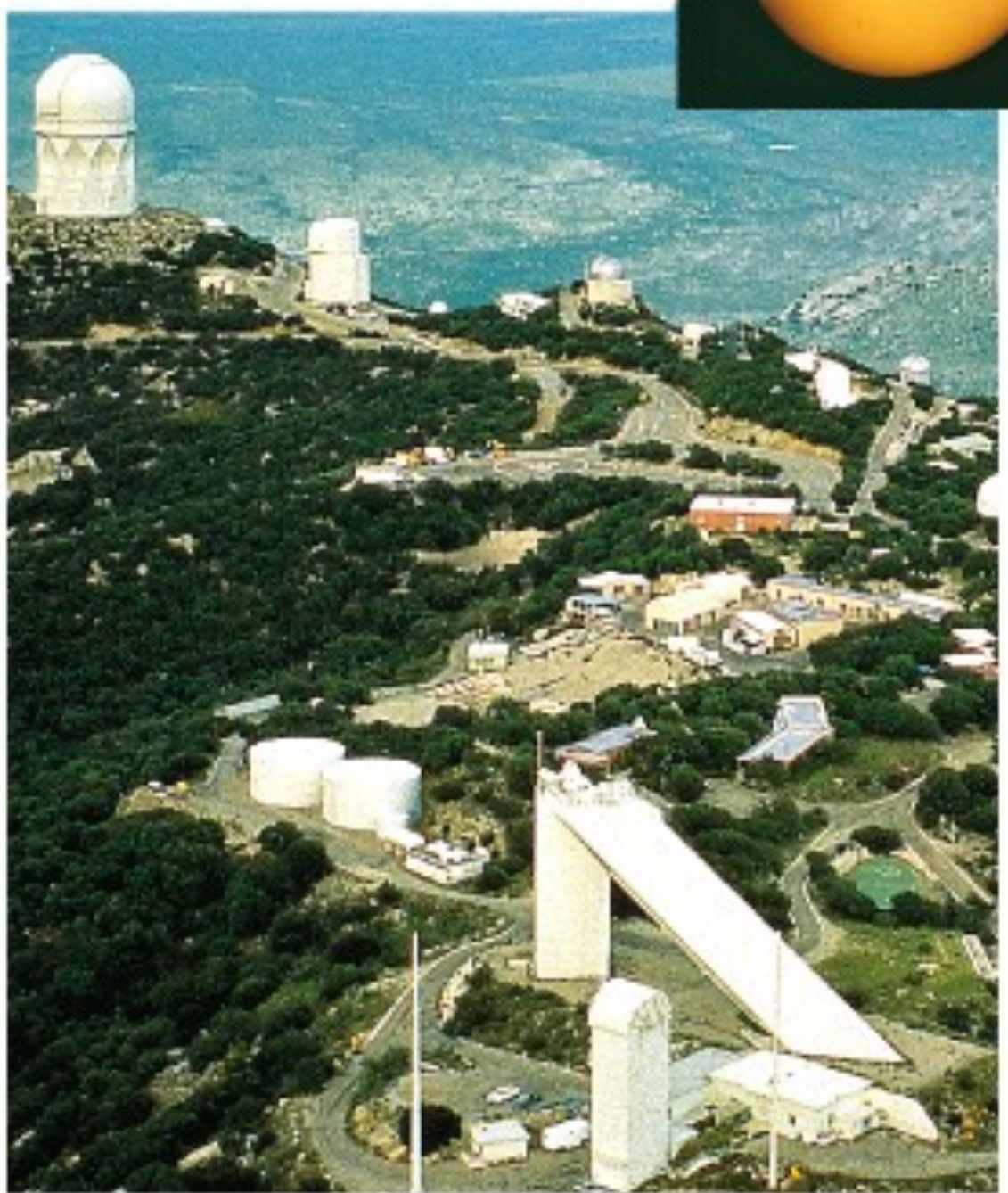
Greatest blueshift 1_____2_____3_____ 4 _____5 ____ redshift

Light and Telescopes



A Telescopes is a tool used to gather light from objects in the universe





Three main functions of a telescope

Most important!!

- **Gather More Light** – (bigger Is better) *making objects appear brighter*

followed by

- to see fine detail
  (called resolution)

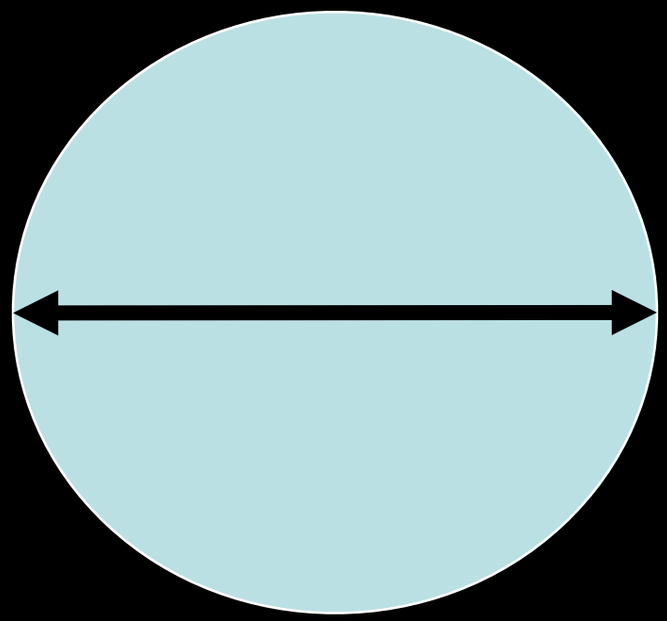
and least important,

- magnify

  magnification = (objective lens focal length / eyepiece lens focal length)

Light-gathering power refers to the ability of a telescope to collect light.

- Catching light in a telescope is like catching rain in a bucket—the bigger the bucket, the more rain it catches.
- The light-gathering power is proportional to the *area* of the primary mirror—that is, proportional to the square of the primary's mirror diameter.



A larger lens/mirror provides a brighter (*not bigger*) image

Which telescope has the greatest light gathering power?

A) A 5 meter diameter optical telescope
B) A 10 meter diameter optical telescope
C) A 20 meter radius optical telescope
D) A 30 meter diameter optical telescope
E) B and C