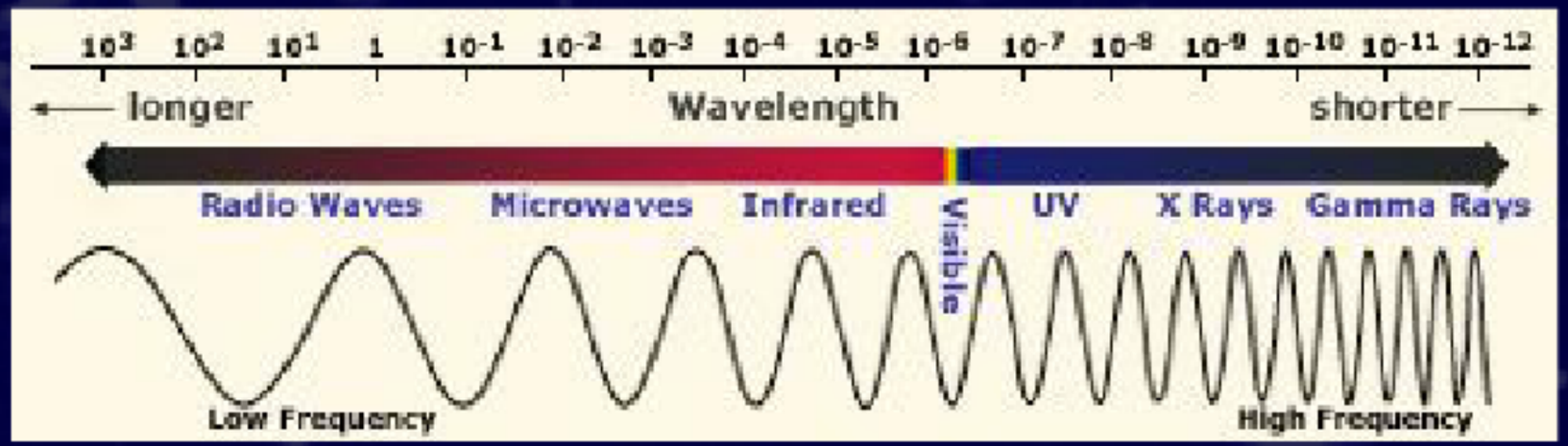
Science Review

The Universe and Big Bang Theory

Telescopes and the Electromagnetic Spectrum

Astronomical objects emit electromagnetic radiation of all wavelengths found on the electromagnetic spectrum. Because Earth's atmosphere absorbs certain wavelengths of electromagnetic radiation, some telescopes need to be launched into orbit above Earth, while others are located on mountain-tops or in airplanes that fly through the stratosphere.



Click on the telescopes below to learn more about them.

Radio
Ground-based

Infrared
Airborne

Infrared
Space-based

Visible Light
Ground-based

Visible Light
Space-based

X-Ray
Space-based

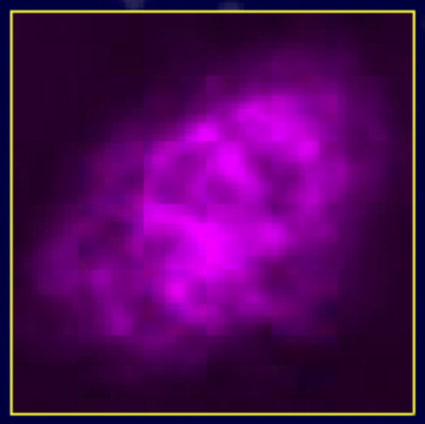
Crab Nebula

The Crab Nebula is a remnant of a supernova explosion that was seen on Earth in 1054 A.D. It is 6,000 light-years from Earth. At the center of the bright nebula is a rapidly spinning neutron star, or pulsar, that emits pulses of radiation 30 times a second.

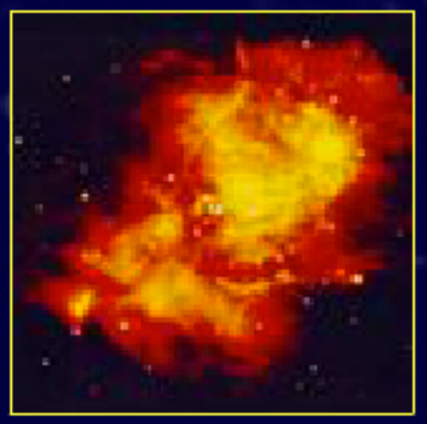
Courtesy of Chandra X-ray Observatory

Click on the images below to enlarge.

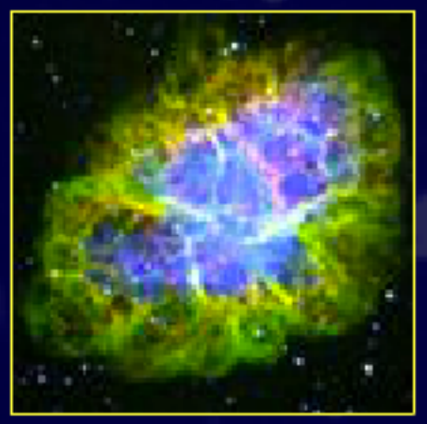
Radio



Infrared



Visible Light



X-Ray

Hubble Space Telescope

Have you ever wondered why stars appear to twinkle? Earth's atmosphere is full of gas and dust that blur and distort visible light. Adaptive optics and other image-processing technologies have greatly minimized the effects of the atmosphere. But by orbiting just above Earth's atmosphere, the Hubble Space Telescope can see the universe more clearly than telescopes on the ground.

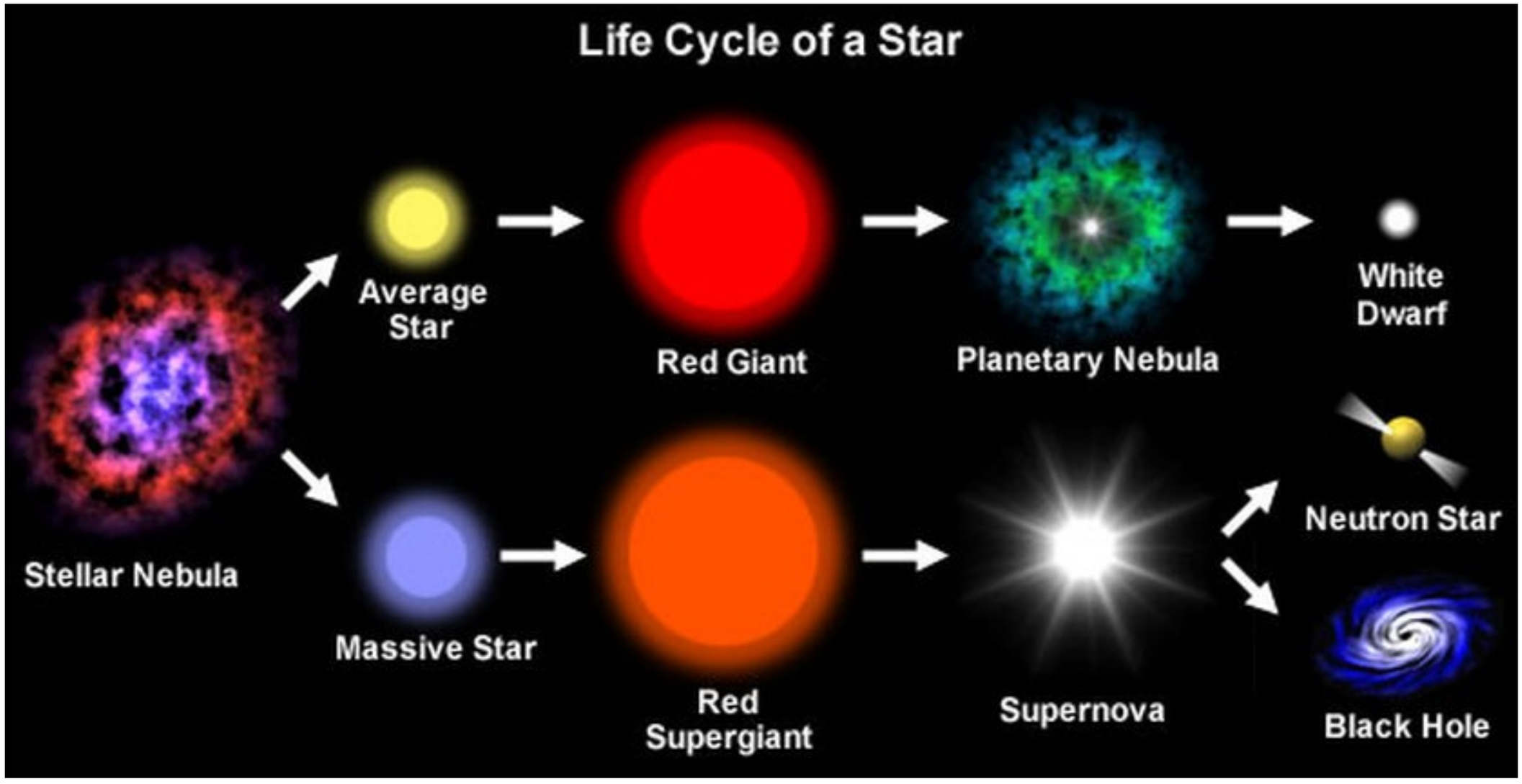
Visible Light — Space-based

Photo: NASA

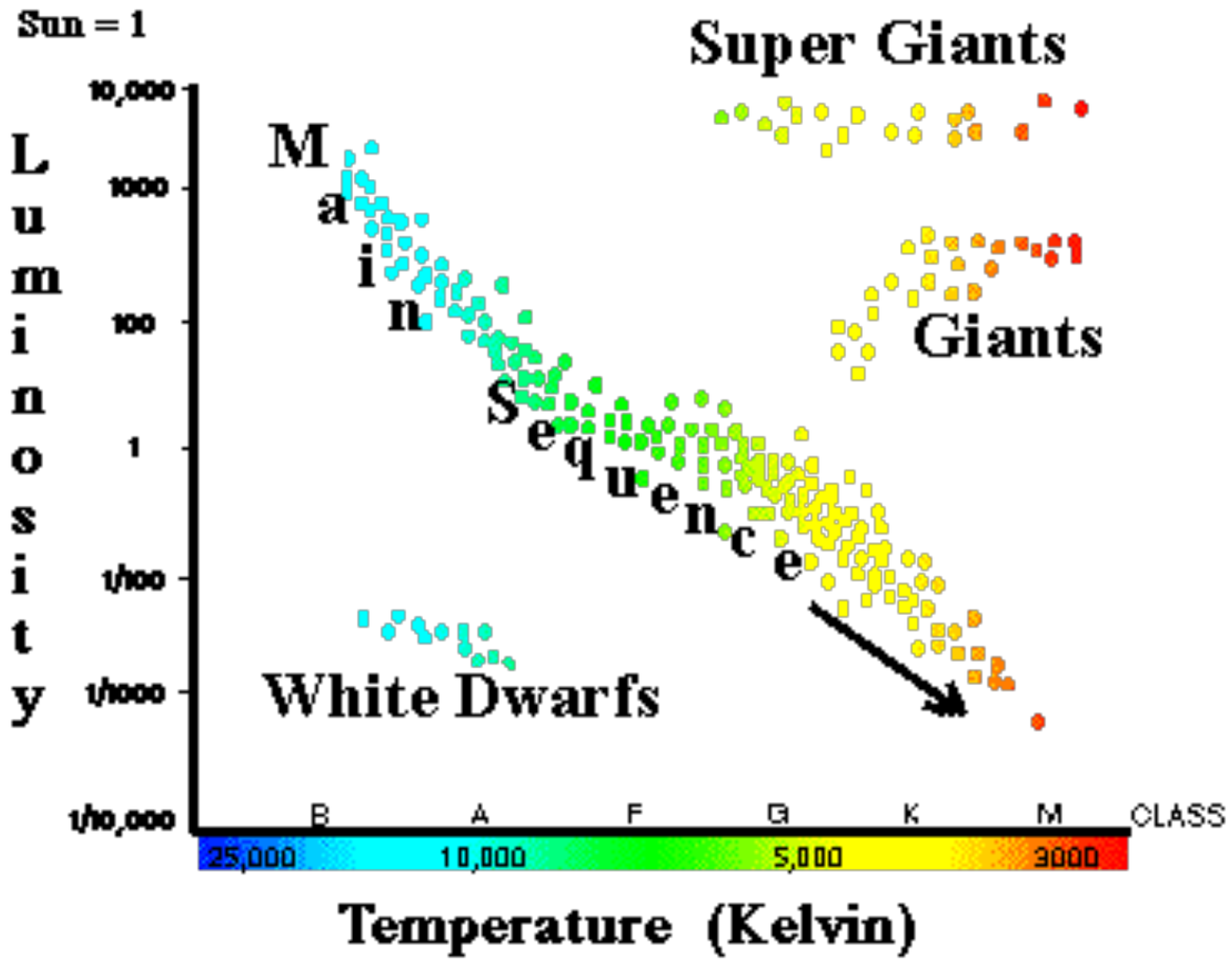
< Telescopes info

Telescopes: 1 | 2 | 3 | 4 | 5 | 6

Lifecycle of stars

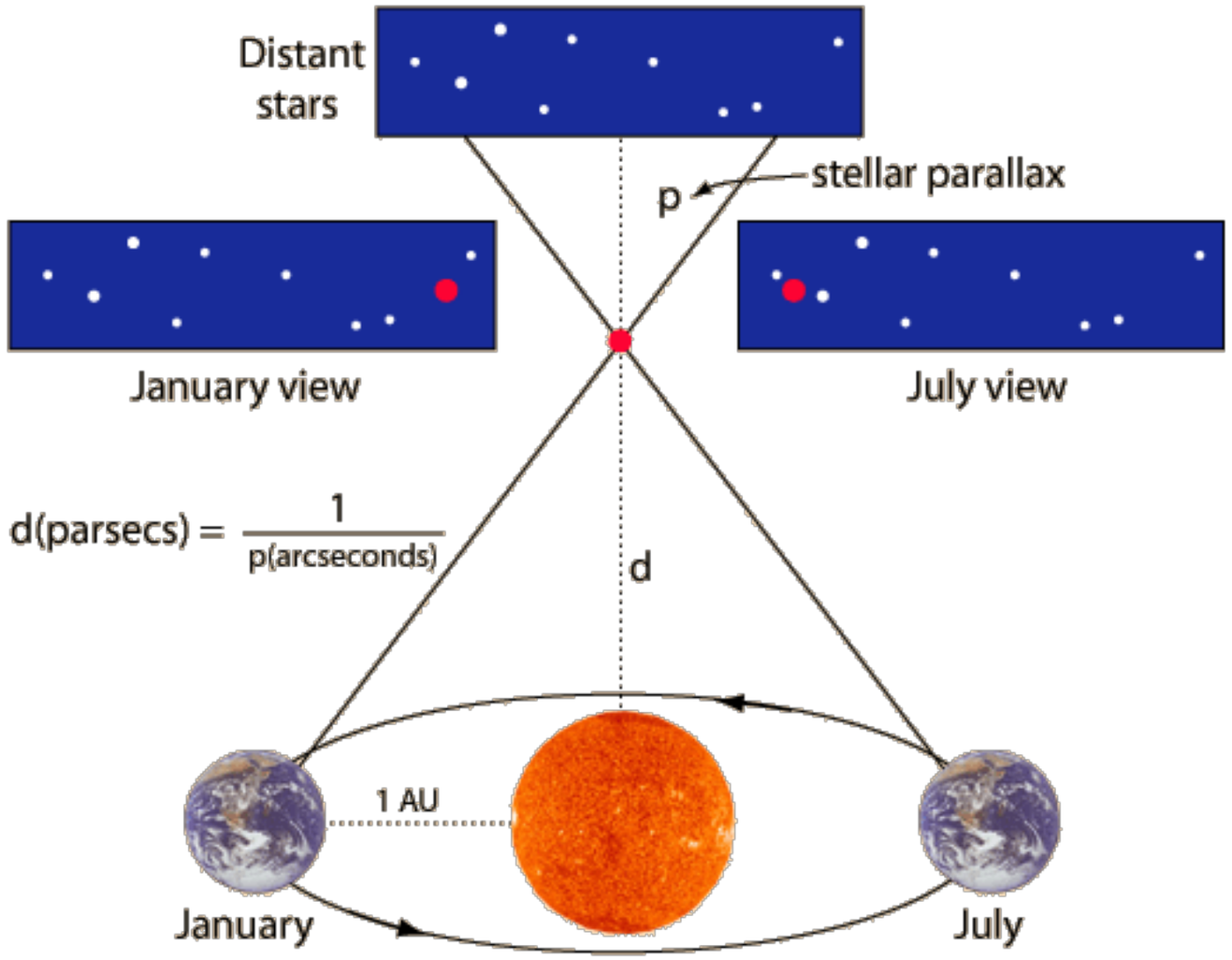


Hertzsprung-Russell



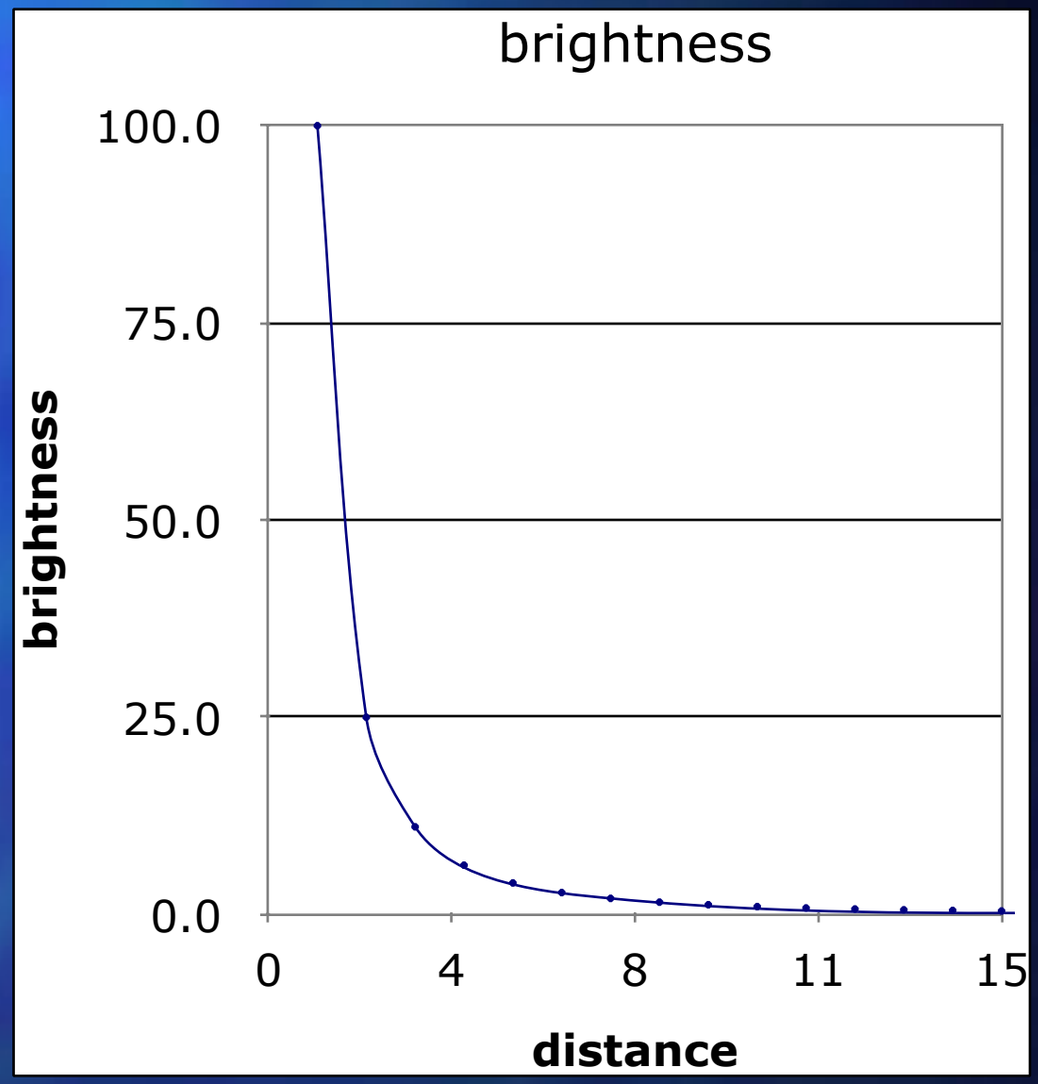
Parallax

- to measure “close” stars



Inverse Square Law

- The brightness of the star changes according to an inverse square law
- When the star is twice as far away, it is 1/4 as bright
- 3 times as far away, it will be 1/9 as bright



Stars of equal brightness

- The brightness of stars varies both because of the luminosity and distance
- Luminosity is a way of measuring the light emitted by a star, the more luminous the star, the more light it emits

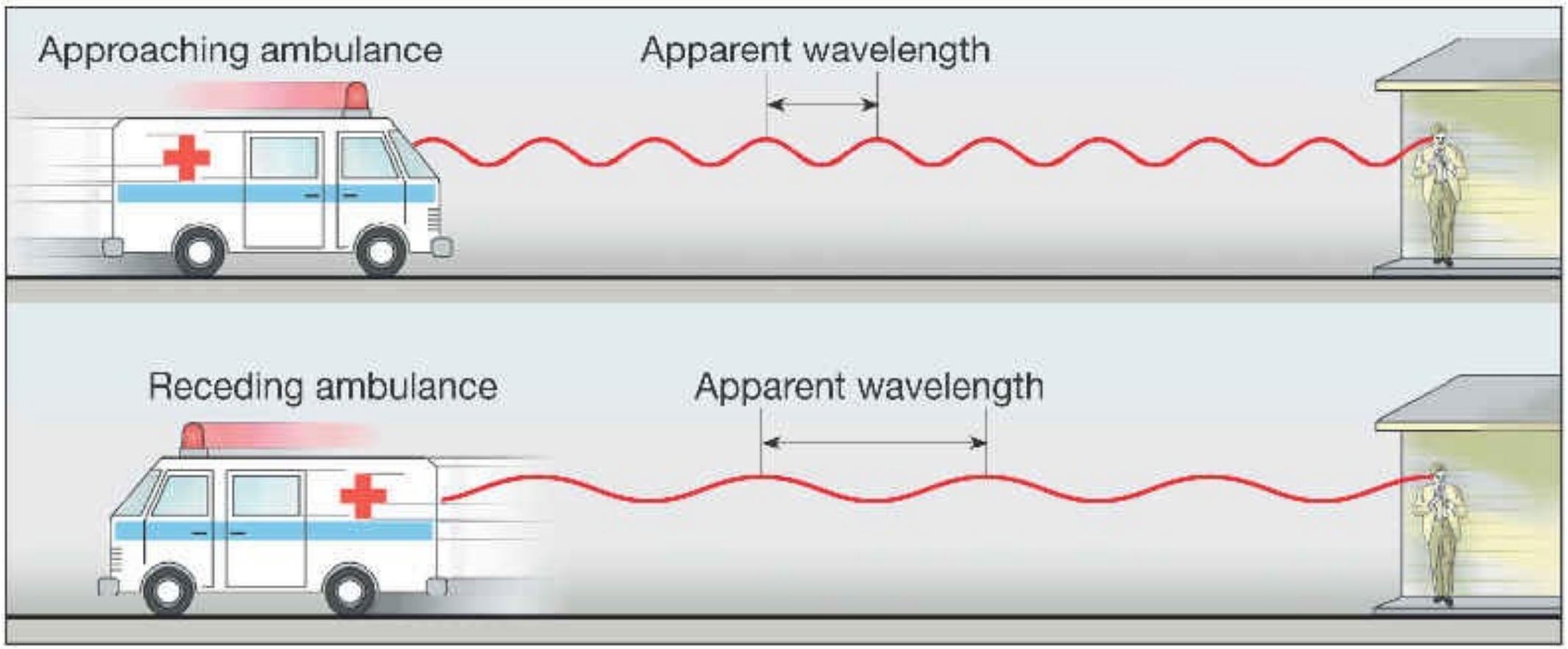
Are the three bright stars equally distant - we cannot tell from the photo unless we know that they are equally luminous

LO: Understand what is meant by the Doppler Effect and how it affects light

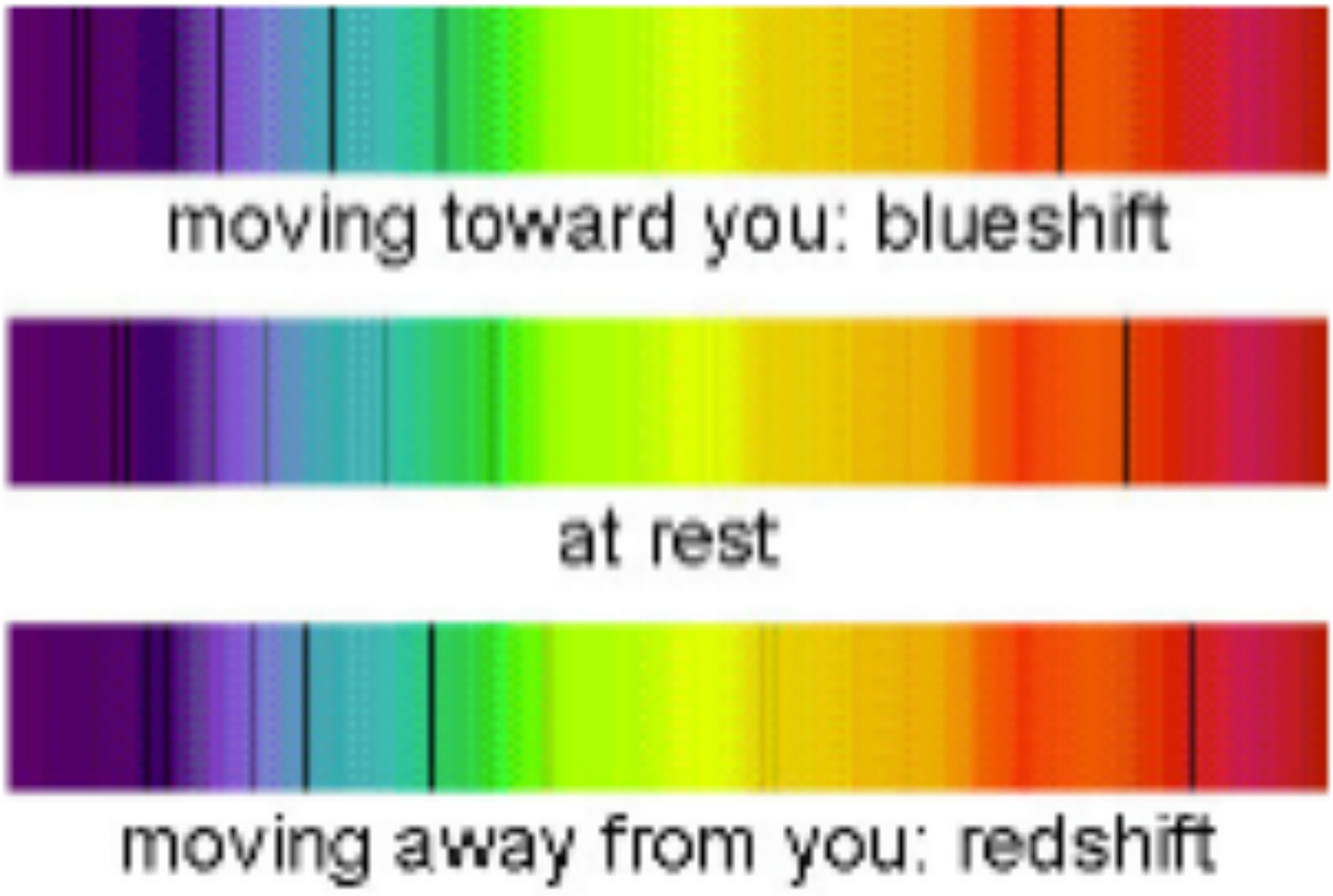
Explanation

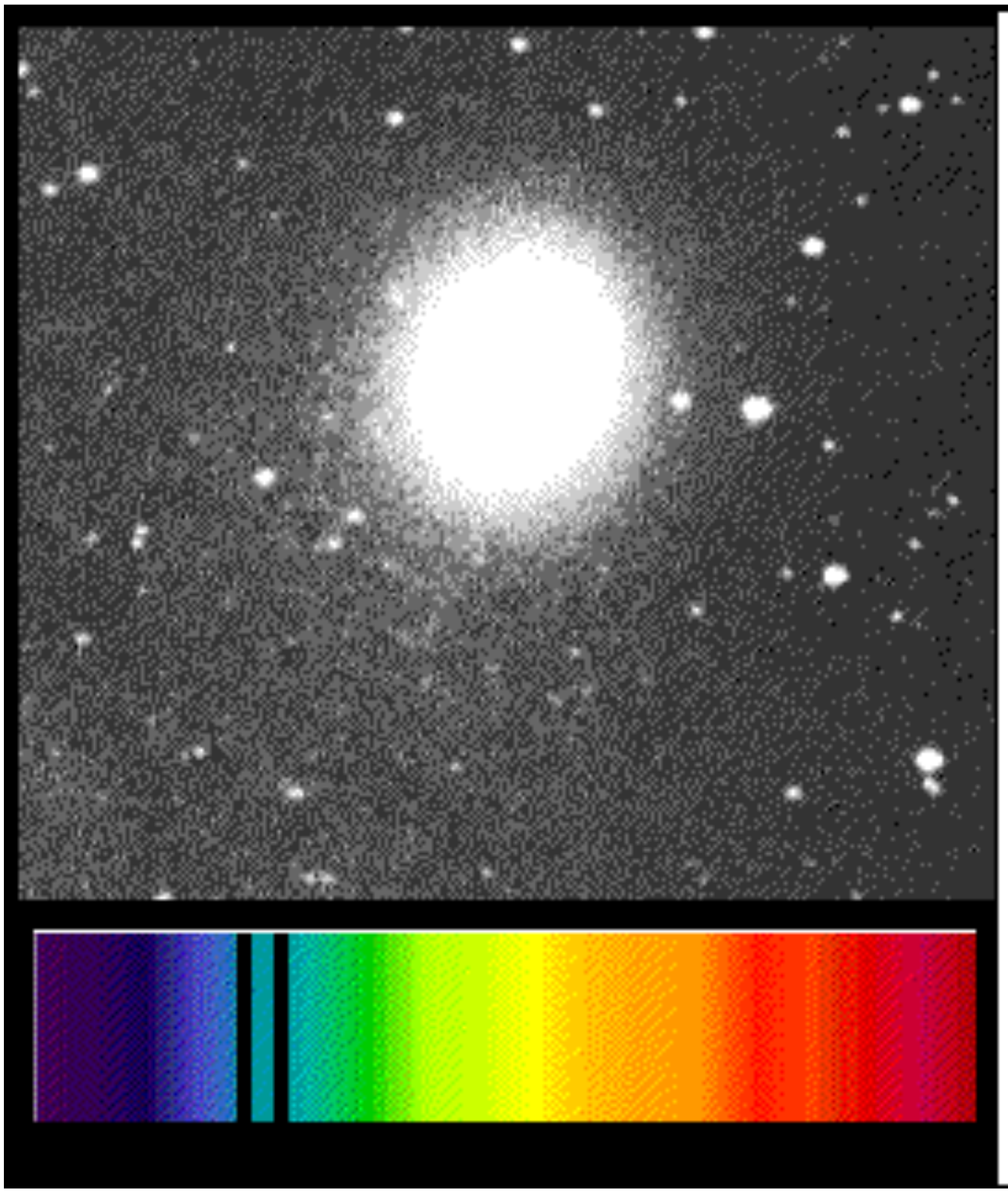
When the car is moving towards you, the sound you hear is of a higher pitch. This is because the sound waves in front of the car become squashed together and the wavelength decreases and the frequency increases.

When the car is moving away from you, the sound you hear is of a lower pitch. This is because the sound waves behind the ball become stretched and the wavelength increases and frequency decreases.



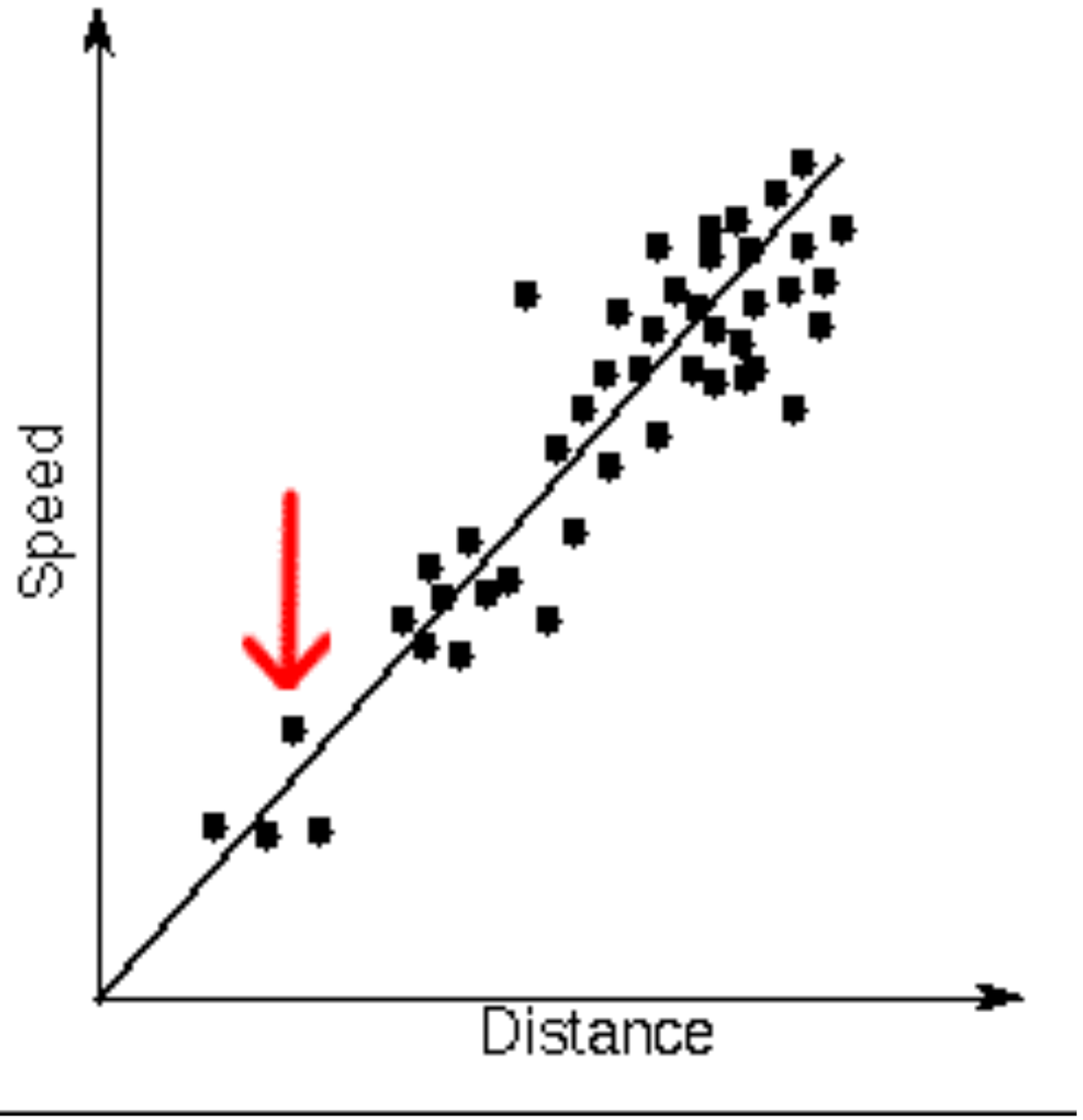
We observe this light from stars in other galaxies like this—
we can tell if the galaxy is moving toward us or away from us,
And in fact we can also measure the SPEED of these galaxies.

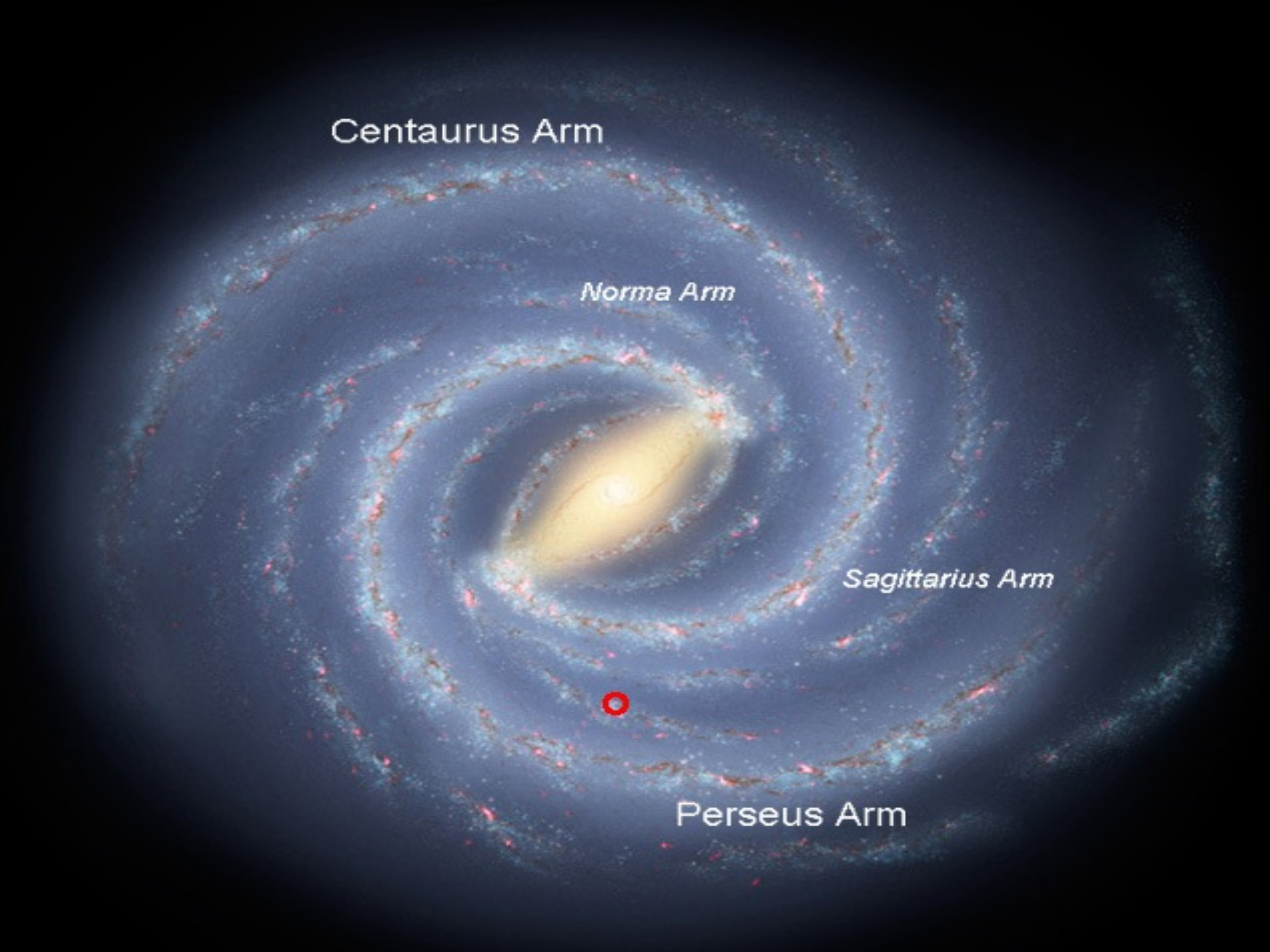




Hubble Law

recession speed = $H_0 \times$ distance




Centaurus Arm
Norma Arm
Sagittarius Arm
Perseus Arm