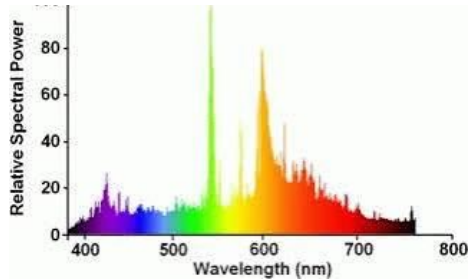


Redshift and Blueshift

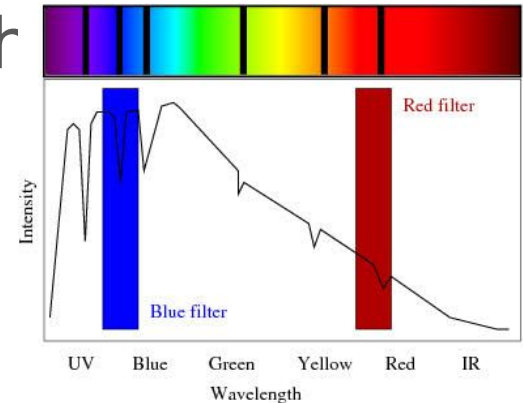
Intro Slides

All matter constantly creates light, either:

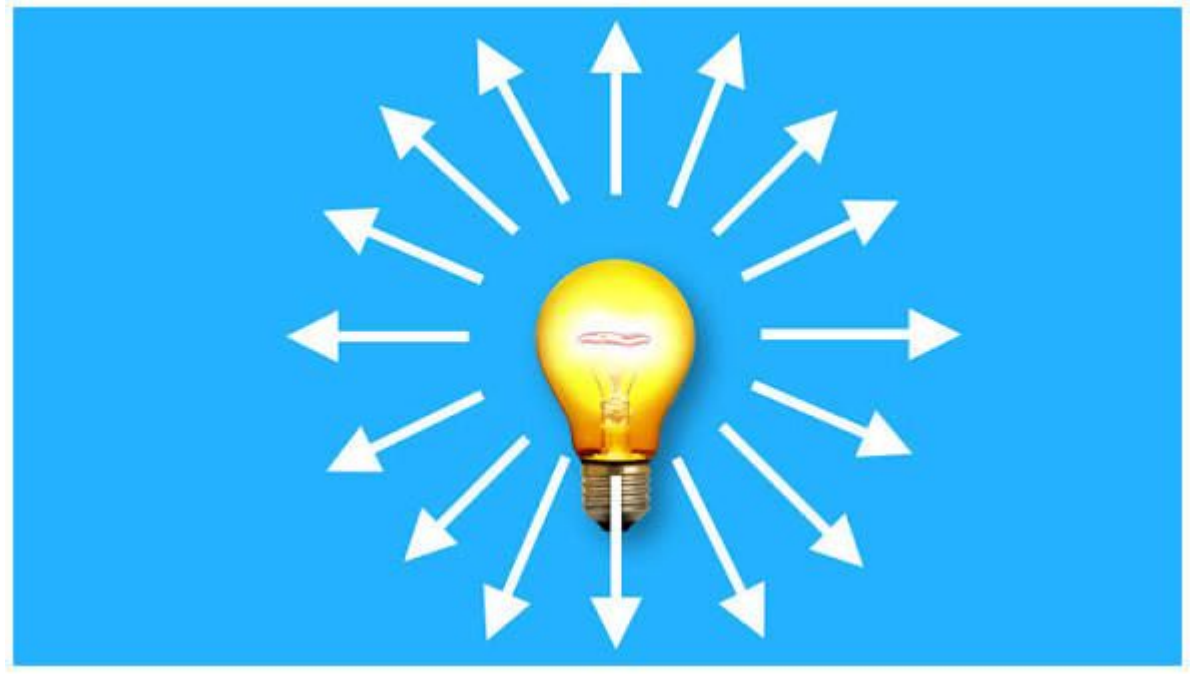
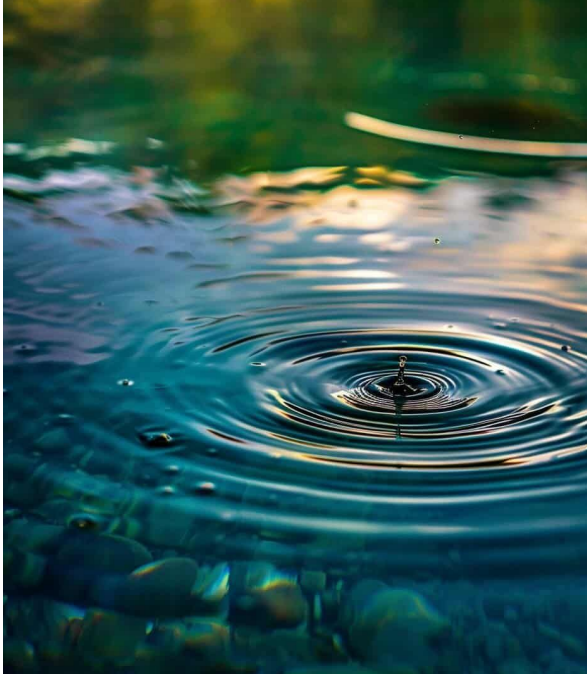
- **Emission Spectra** with Energetic Electrons



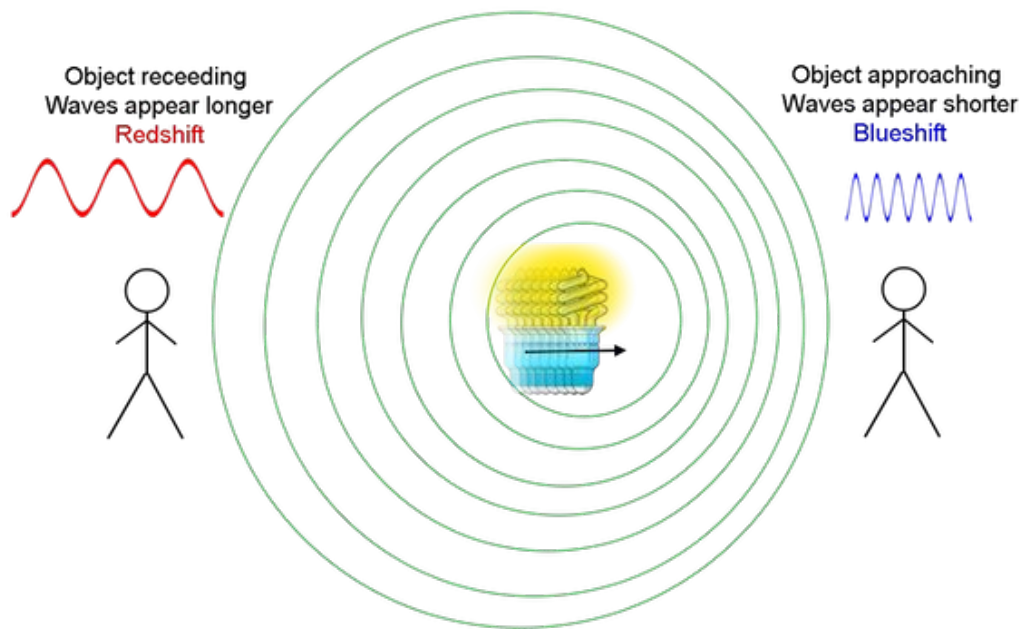
- or **Black Body Radiation** through Temperature-based Vibrations



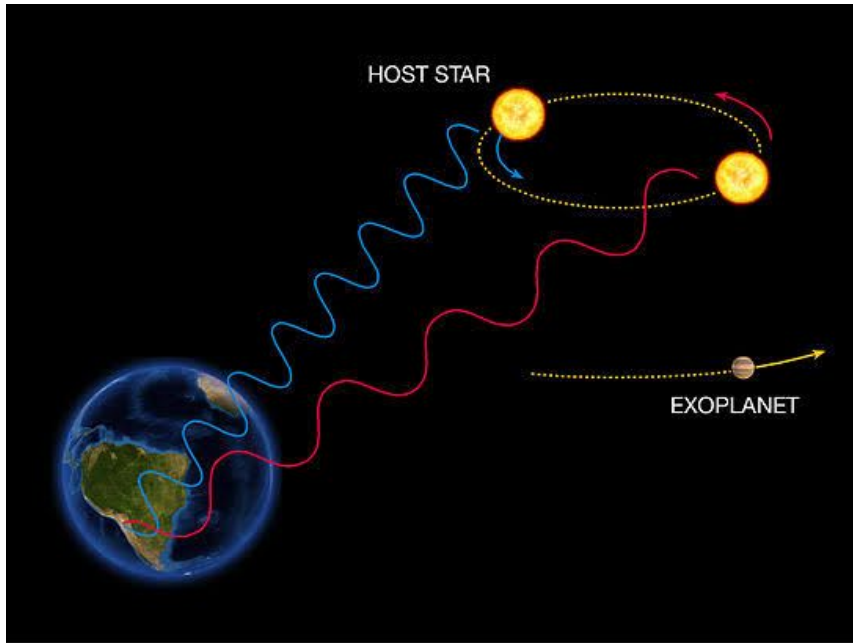
Light waves progress out from the source in all directions



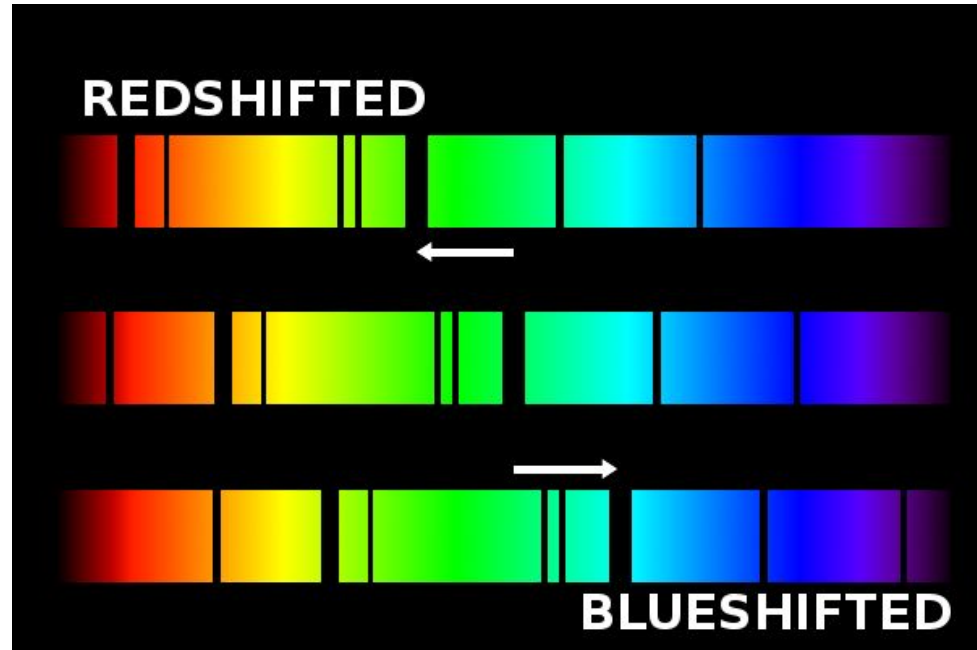
When the light source is moving though, it slightly catches up to or moves away from it's own waves. This shrinks or stretches the wavelengths. These wavelength changes are called **Redshift / Blueshift** or the **Doppler Effect** in general.



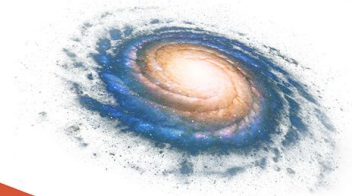
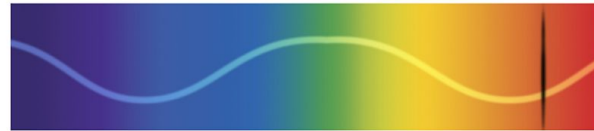
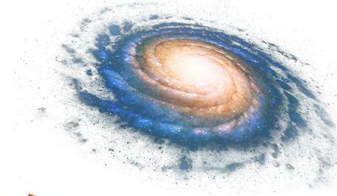
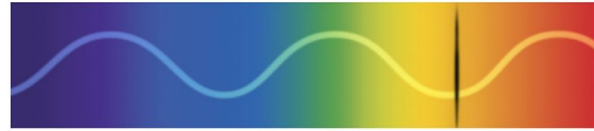
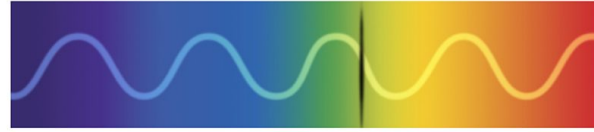
The motion of stars can cause their light to redshift and blueshift.

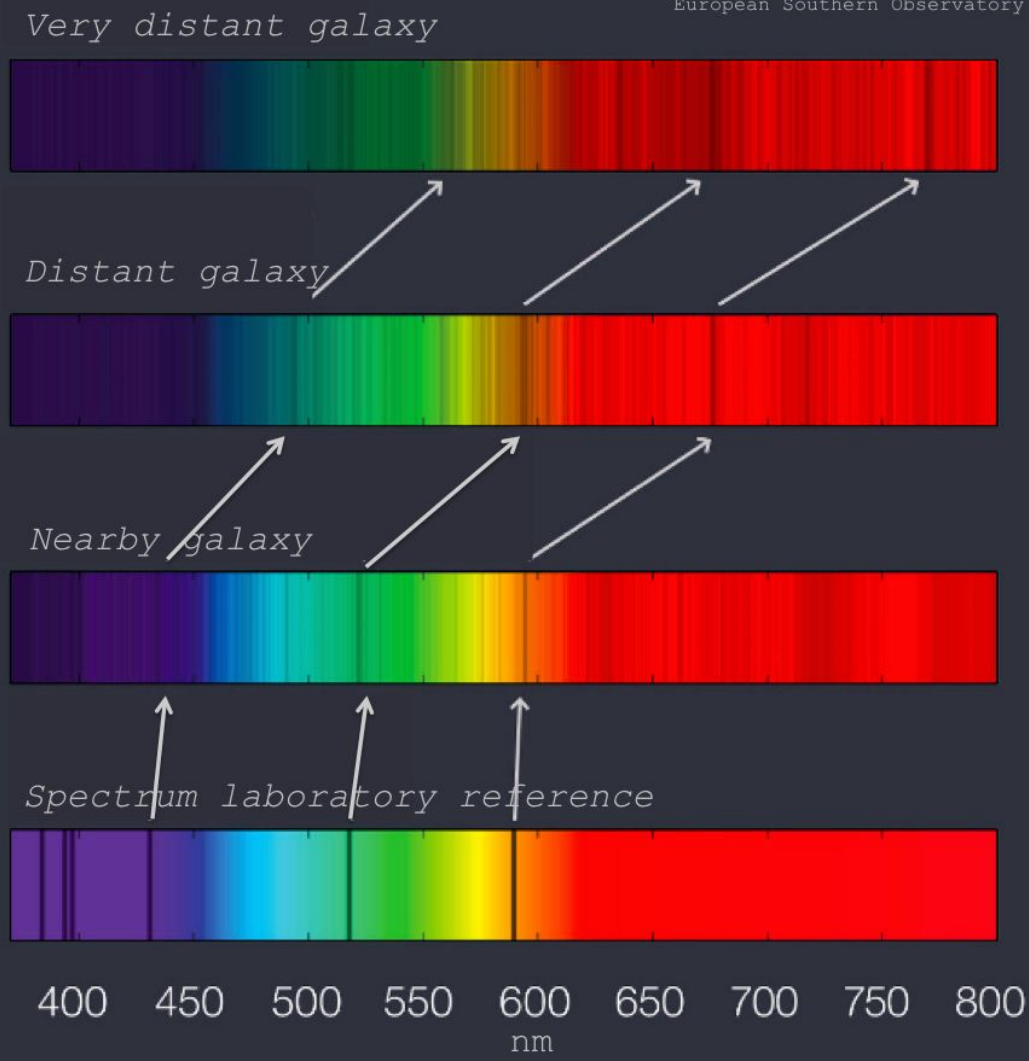


The Radial Velocity Method



Galaxies are more distant, but their motion also creates redshifting of their light





We see a pattern involving galaxy redshift and distance from Earth.

Some galaxies are close, but we can see many that are very far from us too.

We use spectra to identify patterns in their light and estimate their speed.

As galaxies get farther away from Earth they tend to be very **redshifted**.

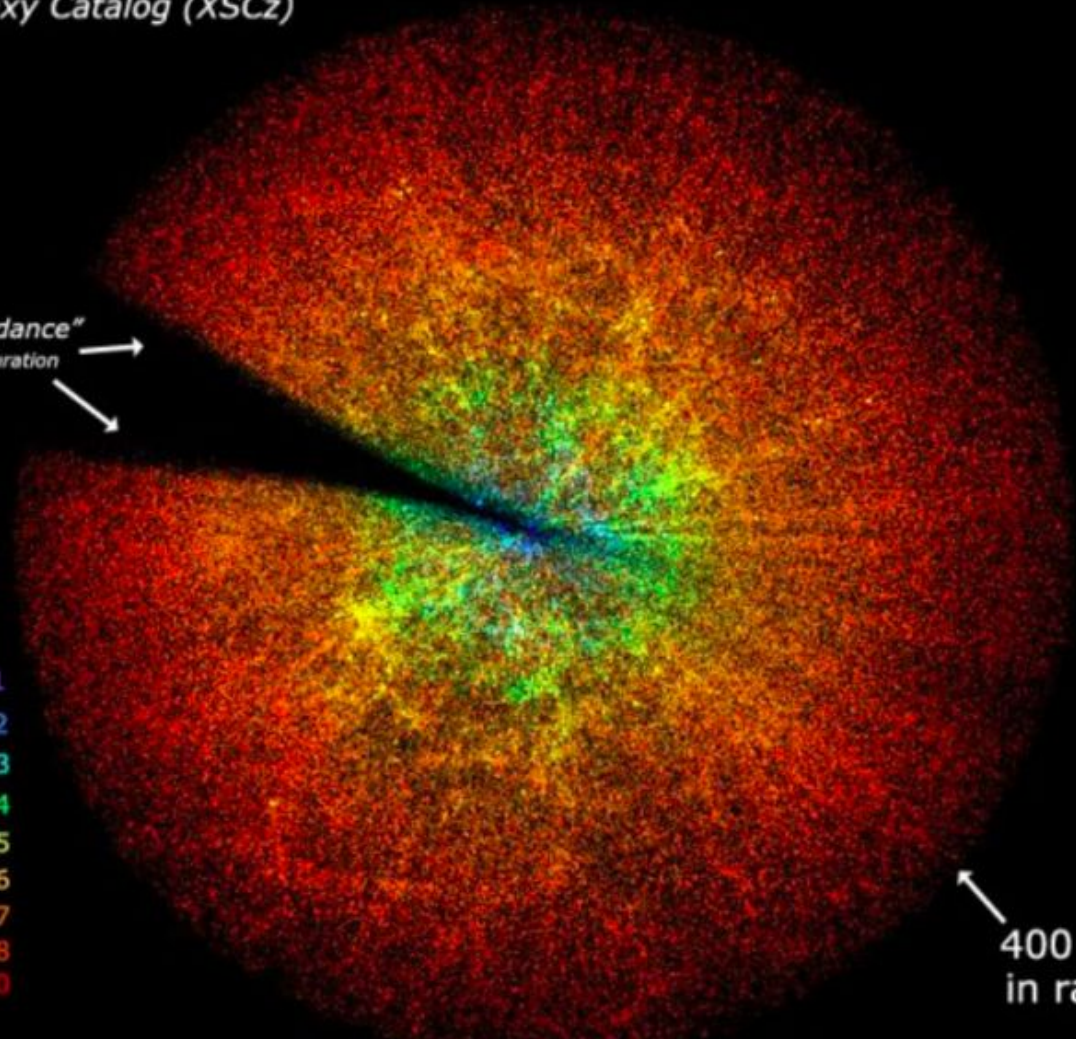
2MASS Galaxy Catalog (XSCz)

"Zone of Avoidance"
Milky Way obscuration

Redshift Key:

$0 < z < 0.01$
 $0.01 < z < 0.02$
 $0.02 < z < 0.03$
 $0.03 < z < 0.04$
 $0.04 < z < 0.05$
 $0.05 < z < 0.06$
 $0.06 < z < 0.07$
 $0.07 < z < 0.08$
 $0.08 < z < 0.10$

400 Mpc
in radius

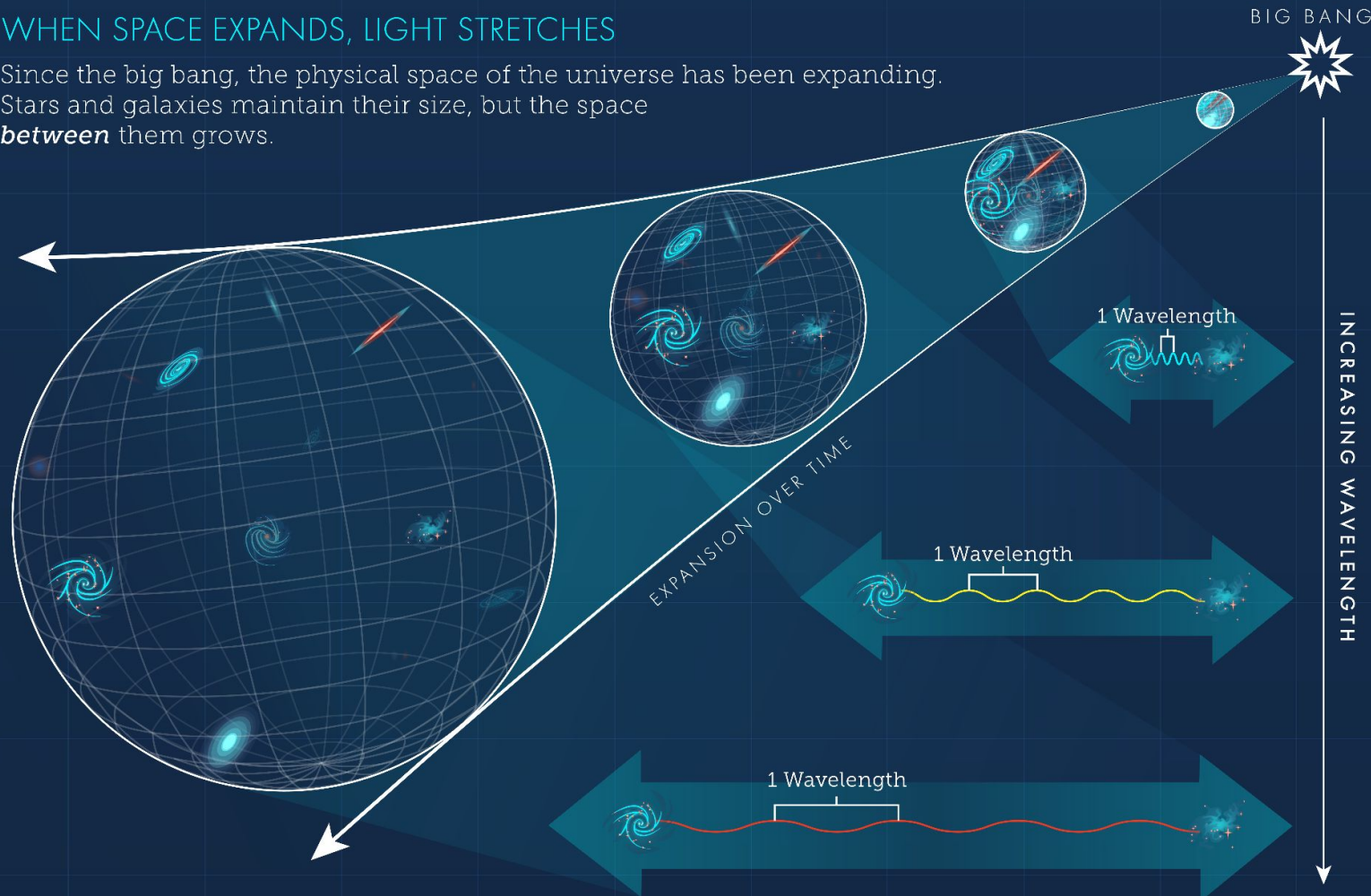


There are two main causes of Galaxy Redshift:

- **Motion Redshift** - As the faster an object is moving **away** from Earth, the more its light will redshift.
- **Expansion Redshift** - The more the universe stretches and expands, the more an object's light will redshift.

WHEN SPACE EXPANDS, LIGHT STRETCHES

Since the big bang, the physical space of the universe has been expanding. Stars and galaxies maintain their size, but the space *between* them grows.



As light travels through expanding space, it is stretched to longer wavelengths.