

Ask an Astronomer

Question: "What is a redshift?"

segment number: 2006-001

Tom Jarrett:

Astronomers often use the term "redshift" to describe how far away a distant object is.

To understand what a cosmic redshift is, think about sound.

Sound travels in a wave. You hear the engine of an airplane because the waves travel through the air to your ear.

If the airplane is moving, the sound waves in front of it are compressed, creating a higher-frequency sound. The sound waves behind it stretch out, creating a lower-frequency sound. As the airplane passes you, you will hear the familiar Doppler Shift.

(doppler shift)

Light also travels in waves, and a similar thing happens to these waves. Light waves are able to compress and stretch, thereby changing their frequency, or color. Blue light has shorter wavelengths than red light.

When an object in space moves towards us, its light waves are compressed into higher frequencies, or shorter wavelengths, and hence we say that the light is blueshifted.

When an object moves away from us, its light waves are stretched into lower frequencies or longer wavelengths, and we say that the light is redshifted.

So how does redshift define distance?

Well, the light from most objects in the Universe is redshifted as seen from the Earth because the universe is expanding.

It turns out that the farther away a galaxy is, the faster it's moving. And the faster a galaxy moves, the more its light is redshifted. So measuring the amount of redshift is a good measure of the distance of the galaxy.

Using this cosmic redshift, astronomers have measured the distance of galaxies as far away as 12 billion light-years. And we're always pushing that cosmic limit farther back.

For "Ask an Astronomer," I'm Dr. Tom Jarrett at NASA's Infrared Processing and Analysis Center.