Doppler Effect

The Doppler Effect (sometimes referred to as Doppler Shift) is the change in frequency and wavelength of a wave for an observer moving relative to the source of the waves. The Doppler Effect was named after Austrian physicist Christian Doppler, who was the one to first propose the idea in 1842. It is commonly heard when a vehicle sounding a siren approaches, passes, and recedes from an observer.

The Doppler Shift for electromagnetic waves (such as light from distant stars) is of great use in astronomy and results in either a so-called redshift of blueshift. Redshift occurs when electromagnetic radiation (usually this is visible light) emitted or reflected by an object is shifted towards the less energetic red end of the electromagnetic spectrum due to the Doppler effect. The light from distant galaxies (these are all galaxies that aren't in our Local Group) are in Redshift (the wavelengths of spectral lines are longer than those measured on Earth). This means that those galaxies are moving away from us.

Blueshift, on the other hand, is the shortening of a transmitted wavelength, and/or an increase in its frequency, due to the Doppler effect. This indicates that an object is moving towards an observer. Both redshift and blueshift depend on our knowledge that the spectra of stars are not continuous.

In 1912 Vesto Slipher measured the first Doppler shift of a spiral galaxy and shortly thereafter found out that almost all similar galaxies were receding from Earth. 10 years later Alexander Friedmann derived the Friedmann equations from Einstein's equations of general relativity. With these equations he was able to show that the universe might be expanding in contrast to the static model advocated by Einstein. Then in 1927 Georges Lemaitre used the Friedmann equations to predict that the galaxies were receding due to the expansion of the universe. In 1931 he further suggested that the evident expansion in forward time required that the universe contracted backwards in time, and would continue to do so until it could contract no further, bringing all the mass of the universe into a single point, a "primeval atom", at a point in time before which time and space existed. At this point, the very fabric of time and space had not yet come into existence.

Current Technologies

In just the past 5 years 340 new planets have been identified. NASA launched the Kepler telescope just 4 days before I started this project (the launch was March 6th). This telescope uses a new technique that can pick out planets through the blinding light of the stars that they orbit. It is hoped that it will find many more plants including Earth-like ones, but the very technique makes it more likely that it will just find gas giants like Jupiter instead. It will focus on a section of space with 100,000 relatively close stars. 10 years ago we didn't know that most stars had planets orbiting them, now we know that it's unusual for a star to not have at least one planet orbiting it.

Satellites and probes are able to transmit back detailed images of the outer reaches of our galaxy. It is partly from these images that we're able to know anything about the potential shape and even buildup of our solar system and galaxy. Given how vast outer space is scientists devised a way of measuring distance other than with miles

or kilometers. They invented the light-year to have a more sensible measure. The light-year is the distance light travels in one Earth year. That averages out to about 6 trillion miles.

Our galaxy, The Milky Way, has three arms spiraling out from the center. We're about 30,000 light-years from the center. In the same way that we orbit the Sun, the Sun is slowly orbiting the center of our galaxy. It takes about 225 million Earth years to make the complete orbit for our Sun. The Milky Way is just one of about 30 galaxies nearby called the Local Group. Most of these galaxies are centered around two core galaxies, The Milky Way (us), and Andromeda.

Scientists class galaxies based on shape after a method first suggested in 1925 by Edwin Hubble. Hubble identified three types of galaxies himself: Spirals like the Milky Way, Ellipticals, and Barred Spirals. Later a few more types got added to the mix by various scientists: Irregular-shaped, Dwarf, and Ring. Scientists believe that Ring galaxies form when a spiral galaxy collides with a smaller galaxy, the ring forms from the shock wave of the collision.

Even with our intensive efforts to discover new galaxies we will never really find an end to the universe and certainly it won't happen for thousands more years. Scientists think that there may be at least one hundred million galaxies out there in the universe, but in truth it is likely way, way more.