PLANETS BEYOND OUR SOLAR SYSTEM
By
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When you look at the night sky through a telescope the only planets you can see are those in our own solar system. Everything else that is visible is a star (sun). Direct evidence for the existence of planets beyond our solar system only became available in the last few years.

I first became conscious about 10 years ago that no one had ever seen a planet outside our solar system. I was very surprised. After all, it is commonly assumed that every second sun in the galaxy has a planet, or planets, rotating around it. Many people also think, sometimes passionately, that a lot of these planets harbour life. Giordano Bruno was incinerated at the stake in 1600 for teaching that the universe is infinite and full of inhabited planets.

A telescope can see an object because it detects light from the object. Stars are readily visible because each is a nuclear reactor radiating light energy with intense luminosity. Planets radiate no light and can be seen only by detecting the light reflected off them from their neighbourhood star. However, from afar, the relatively tiny amount of light reflected by planets is lost in the glare of the intense light emitted by the star. The effect of glare can be easily appreciated by noting that the stars, so clearly visible in our night-sky, become invisible in the sun’s daytime glare.

The first planet to be detected outside our solar system was announced in 1995 by two astronomers from the University of Geneva in Switzerland. The astronomers did not see the planet. They inferred its presence from the effect it exerts on the star that it orbits. The technique used is Doppler Spectroscopy, a well known method for measuring the speed of a receding or approaching source of radiation.

A Garda speed-trap recently used Doppler Spectroscopy to record me driving at 50 m.p.h. in a 40 m.p.h. zone. They kindly sent me a note to this effect and charged me £50. The technique works as follows. A radar gun fires radiation at a car and the radiation is reflected from the car back to the gun. Radiation is a wave motion and is characterised by wavelength, the distance from peak to peak.

If the car is stationary, the reflected radiation has the same wavelength as when it left the gun. If the car is approaching the gun the wavelength of the reflected radiation is decreased in proportion to the speed of the oncoming car. If the car is receding from the gun, the wavelength of the reflected radiation is increased in proportion to the speed of the receding car. The radar gun reads the wavelength of the reflected radiation and calculates the speed of the car.

Now, consider the planet orbiting the star beyond our solar system. Because of the law of universal gravitation, the planet exerts a gravitational pull on the star. When the planet passes between the earth and the star, it pulls the star towards the earth. When the planet orbits the star to the opposite side it pulls the star away from the earth. The star emits light at certain wavelengths and these wavelengths can be measured by telescopes on earth. Because of the pull of the planet on the star these wavelengths are successively shortened and lengthened as they arrive on earth as the star is successively pulled towards the earth and then away from the earth by the planet. Observation of oscillating wavelengths coming from the star convinced the astronomers of the presence of a planet.

The star observed by the Swiss astronomers is about the size and temperature of our sun, and is readily seen in the skies of the northern hemisphere. The planet is large, about the size of Jupiter, and orbits the star at a radius of about 5 million miles, taking 4.2 days to complete an orbit. By contrast, the innermost planet in our solar system, Mercury, orbits the sun at a radius of 36 million miles and completes one orbit in 88 days.

Other workers were also searching for extra-solar planets using Doppler Spectroscopy, but nobody was looking for a planet as big as Jupiter, orbiting close to a star. Workers at San Francisco State University reanalysed their data after the Swiss announcement and uncovered evidence of several new planets. By the end of 1996 astronomers had identified 6 new planets, all of them orbiting stars similar to our sun.

Almost all the extra-solar planets so far discovered are at least as big as Jupiter. The explanation for this coincidence is that the Doppler spectroscopic technique is presently not sensitive enough to detect the pulling power of a planet smaller than Jupiter. However, a really puzzling fact is that these large planets orbit their suns much closer than can be explained by conventional understanding of how solar systems are born.

It is believed that a solar system begins as a large cloud of gas and dust. A condensation of gas at the centre of the cloud becomes the central star, and the solid cores of the planets in a solar-system form from the surrounding disk of gas and dust. The central star begins to burn and the heat drives away the gas that remains close to it. Therefore one expects the inner-most planets to be small and rocky, as in our solar system. Only in the outer reaches of the solar system will enough gas, hydrogen and helium, be available to form gassy planets like Jupiter, Saturn, Uranus and Neptune.

Astronomers feel certain that only the densest clouds, from which solar systems form, contain enough rocky material to form rocky planets as big as the earth. Jupiter is a thousand times the volume of the earth and rocky planets this size seem to be out of the question. It is assumed therefore that the newly discovered extra-solar planets are gassy giants. Perhaps each was originally formed, as theory would predict, far out from the sun in its solar system and later something happened causing it to spiral in closer to the star. Or perhaps these newly discovered ‘planets’ are a kind of object new to astronomers.

This is a fast-moving field. The Hubble Space Telescope recently photographed eerie-looking discs of dust around young stars hundreds of light years away. These discs are probably early formative stages of planetary system.

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