

Other Planetary Systems (Chapter 13): Extrasolar Planets

The nebular theory suggests that planets should be common around other stars. Planets around other stars are much dimmer than their parent star and have very small angular separations from the parent star, making detection difficult. Over 100 extrasolar planets have been found in the last decade.

A planet orbiting a star actually orbits their centre of mass. The star also orbits the centre of mass, which is usually very close to the centre of the star. Changes in the star's position or velocity, if observed, reveal the presence of the planet. Massive planets far from their star will cause the greatest shift in the star's position, but only over many years. Massive planets close to their star will cause the greatest change in the star's velocity and do so over a short period. Observing the positions of stars, and any changes in those positions, is called astrometry. This technique has not discovered many planets yet, but it is likely to do so in the near future. A star's speed can be measured based on its Doppler shift. This technique has discovered many planets. Some planets have also been detected by transits, when they pass in front of their star and reduce its brightness briefly.

It is possible to measure the orbital period, orbital eccentricity, orbital distance, mass, radius, and density of an extrasolar planet. The Doppler technique reveals the orbital properties and a lower limit on the mass. The transit technique reveals the radius and orbital period. The combination of these two reveals the actual mass and density. Observations of transits at many wavelengths give some compositional information.

Many extrasolar planets have been discovered with masses similar to Jupiter's in elliptical orbits very close to their star. These "hot Jupiters" have large sizes because they are "puffed-up" with heat from their star. It is thought that these planets formed several AU from their star, then migrated inwards. The inward migration of planets may be more important in other planetary systems than our own. Orbital resonances between extrasolar planets are also common.

Current techniques for detecting extrasolar planets are limited, favouring massive planets and planets close to their star. Extrasolar planets have only been detected around 10% of nearby stars. Perhaps the other 90% of planetary systems are similar to our own solar system. Or perhaps they are not.