

= Kepler @-@ 11f =

Kepler @-@ 11f is an exoplanet (extrasolar planet) discovered in the orbit of the sun @-@ like star Kepler @-@ 11 by NASA 's Kepler spacecraft , which searches for planets that transit (cross in front of) their host stars . Kepler @-@ 11f is the fifth planet from its star , orbiting one quarter of the distance (.25 AU) of the Earth from the Sun every 47 days . It is the furthest of the first five planets in the system . Kepler @-@ 11f is the least massive of Kepler @-@ 11 's six planets , at nearly twice the mass of Earth ; it is about 2 @. @ 6 times the radius of Earth . Along with planets d and e and unlike the two inner planets in the system , Kepler @-@ 11f has a density lower than that of water and comparable to that of Saturn . This suggests that Kepler @-@ 11f has a significant hydrogen ? helium atmosphere . The Kepler @-@ 11 planets constitute the first system discovered with more than three transiting planets . Kepler @-@ 11f was announced to the public on February 2 , 2011 after follow @-@ up investigations at several observatories . Analysis of the planets and study results were published the next day in the journal Nature .

= = Name and discovery = =

Kepler @-@ 11 , known as KOI @-@ 157 when it was first flagged for a transit event , is the planet 's host star , and it is included in the planet 's name to denote that . Because Kepler @-@ 11f was discovered with five other planets , the planets of Kepler @-@ 11 were sorted by distance from the host star ; thus , since Kepler @-@ 11f is the fifth planet from its star , it was given the letter " f . " The name " Kepler " is derived from the Kepler satellite , a NASA Earth @-@ trailing spacecraft that constantly observes a small patch of sky between the constellations Cygnus and Lyra for stars that are transited by , in particular , terrestrial planets . As these planets cross in front of their host stars with respect to Earth , a small and periodic dip in the star 's brightness occurs ; this dip is noted by the spacecraft and tagged for future study . Scientists then analyze the transit event more carefully to verify if the planet actually exists and to gather information on the planet 's orbit and composition (if possible) .

Follow @-@ up observations were conducted at observatories at the W.M. Keck Observatory 's Keck 1 telescope in Hawaii ; the Shane and Hale telescopes in California ; the Harlan J. Smith and Hobby @-@ Eberly telescopes in Texas ; telescopes at the WIYN (including MMT) and Whipple observatories in Arizona ; and the Nordic Optical Telescope in the Canary Islands . The Spitzer Space Telescope was also used . According to NASA , Kepler @-@ 11 's system is the most compact and the flattest system yet discovered , surpassing even the Solar System .

= = Host star = =

Kepler @-@ 11 is a G @-@ type star , much like the Sun is , and is located 613 parsecs away in the Cygnus constellation . It has 95 % the mass and 110 % the radius of the Sun . Its mass and radius , combined with an approximate iron content (metallicity) of 0 and effective temperature of 5680 K , makes the star very similar to the Sun , though slightly more diffuse and slightly cooler . However , the star is approximately 1 @. @ 74 times the age of the Sun , and is estimated to have existed for eight billion years . Kepler @-@ 11 has six known planets in orbit : Kepler @-@ 11b , Kepler @-@ 11c , Kepler @-@ 11d , Kepler @-@ 11e , Kepler @-@ 11f , and Kepler @-@ 11g . Kepler @-@ 11 's five inner planets orbit closely to their host star , and their orbits would fit within that of Mercury 's .

With an apparent magnitude of 14 @. @ 2 , Kepler @-@ 11 cannot be seen with the naked eye .

= = Characteristics = =

Kepler @-@ 11f is , at 2 @. @ 3 times the mass of Earth , the least massive of the six planets discovered in the orbit of Kepler @-@ 11 , although the planet 's mass may range from 1 @. @ 1 to 4 @. @ 5 , or from approximately that of Earth 's mass to that of Kepler @-@ 10b , a rather large

confidence interval . Its radius is the second smallest of the six planets discovered in the system at 2.207×10^8 km , 61 times the radius of Earth . Kepler -11f has a density of about 0.7 g / cm^3 , comparable to that of the Solar System 's least dense planet , Saturn . Kepler -11f is the fifth planet from Kepler -11 , orbiting its host star every 46 68876 days at a distance of 0.25 AU . Its orbital eccentricity is unknown . In comparison , Mercury orbits the Sun every 87.97 days at a distance of 0.387 AU . Kepler -11f has an orbital inclination of 89.4° ; it can be seen almost edge on with respect to Earth . Its surface equilibrium temperature is 544 K , over twice the surface equilibrium temperature of Earth and about two thirds the surface temperature of Venus .

Kepler -11f 's low density , characteristic of the outer planets of the system , suggests that a large hydrogen ? helium atmosphere is present on these planets , classifying it as " gas dwarf " due to its small size and mass . This low density is not shared by the planets Kepler -11b and Kepler -11c because the solar wind has reduced their atmospheres to a thin layer . The planets accreted such large atmospheres because they formed within the first few million years of the system 's existence , when a protoplanetary disk was still present .