

= Kepler @-@ 14b =

Kepler @-@ 14b is an extrasolar planet in orbit around the primary star of the binary Kepler @-@ 14 system . It is currently the only planet known to exist in this star system . Kepler @-@ 14b is 8 @. @ 4 times the mass of Jupiter and has a radius 1 @. @ 14 times that of Jupiter , and it orbits its host star every 6 @. @ 79 days . It was discovered by NASA @-@ led Kepler mission , which noted the planet as a planetary candidate as early as March 2009 , around the same time as the discovery of the first five planets discovered by Kepler (Kepler @-@ 4b to Kepler @-@ 8b) . However , the team was unable to confirm the planet until extensive follow @-@ up observations , as high @-@ resolution imaging resolved the star Kepler @-@ 14 as a closely orbiting binary system . The Kepler team would have not noticed that Kepler @-@ 14 was a binary star based solely on initial radial velocity measurements (a standard method for confirming a planet 's existence) , and found that if they had not realized this , their data on Kepler @-@ 14b would have been very inaccurate .

= = Discovery = =

NASA 's Kepler spacecraft , which was launched in March 2009 , collected photometric data continuously over a four @-@ month period in a small area of sky , using a 0.95m Schmidt telescope . When the data collected during this period was analyzed , 1235 planetary candidates were identified amongst the observed 150 @, @ 000 stars ; all of these planetary candidates were suspected of transiting their host stars , in which the planetary body periodically crosses in front of and slightly dims its host star . Because the data collected on the transits of KOI @-@ 98 (later known as Kepler @-@ 14b) seemed very clearly to indicate a planet , Kepler identified KOI @-@ 98 early on in its mission . Data on the object of interest was forwarded to the Kepler Follow @-@ up Program for a follow @-@ up investigation .

The Fibre @-@ fed Échelle Spectrograph (FIES) on the Canary Islands ' Nordic Optical Telescope was operated in October 2009 , using Doppler spectroscopy to gather information that would accompany the gathered photometric observations . The High Resolution Échelle Spectrometer (HIRES) at the W.M. Keck Observatory was also utilized . Use of the WIYN Observatory for speckle imaging found that the host star of KOI @-@ 98 was actually a close @-@ knit binary star , which complicated the analysis . A November 2009 operation of the ARIES instrument on the MMT Observatory and the July 2010 use of the PHARO near @-@ infrared camera on the Palomar Observatory 's 200 inch Hale telescope used adaptive optics to confirm WIYN 's findings . Although suspected as a planet early on , KOI @-@ 98 was not included when Kepler @-@ 4b , Kepler @-@ 5b , Kepler @-@ 6b , Kepler @-@ 7b , and Kepler @-@ 8b were published , as further investigation was still required .

Scientists investigated the possibility that the transit signal detected by Kepler was actually due to a third star in the system that eclipsed its sister stars . However a bisector analysis of the spectra of KOI @-@ 98 's star ruled out that hypothesis .

On August 7 , 2010 , the Infrared Array Camera aboard the Spitzer Space Telescope was used to find the centroid , the point in space around which both of the Kepler @-@ 14 stars orbit . Analysis of the collected data determined which component of the binary star system was the site of the transit signal , and , additionally , that the transit signal came from the primary star in the system (as opposed to the fainter , less prominent star) .

Using the spectral data collected by HIRES and FIES , the Kepler team derived the characteristics of the host star . The HIRES and FIES results agreed on every aspect of the star that had been derived except for the star 's radial velocity . With the stellar parameters known , the Kepler team interpreted the Spitzer data to confirm that Kepler @-@ 14b was indeed a planet .

= = Host star system = =

Kepler @-@ 14 is a binary star system , which means that it is actually composed of two gravitationally bound stars that orbit a common point in space . The system is composed of a

primary star , Kepler @-@ 14A , and a dimmer companion star , Kepler @-@ 14B . When the stars were observed , while searching for the planet Kepler @-@ 14b , the angular separation of the binary system made it extremely difficult to note the dimmer companion star . The stars have such a wide orbit that it takes approximately 2800 years for each star to complete a revolution around the centroid . The two stars are located approximately 980 parsecs (3 @,@ 196 light years) from Earth .

Kepler @-@ 14b 's host star is the primary (A) component of the Kepler @-@ 14 binary system . However , because the binary system is so closely knit , it was impossible at the time of Kepler @-@ 14b 's discovery to distinguish the characteristics of each individual star . If the Kepler @-@ 14 system was an individual star , it would be an F @-@ type star . With an apparent magnitude of 12 @.@ 12 , the star system is not visible from Earth with the naked eye . Kepler @-@ 14 's combined results resemble that of a star that is 1 @.@ 512 solar masses and 2 @.@ 048 solar radii . Its gyrochronological age , or its age as determined by the rate at which a star spins , is estimated at 2 @.@ 2 billion years , far younger than the Sun . It is also hotter , with an effective temperature of 6395 K. With a metallicity of 0 @.@ 12 , Kepler @-@ 14 has 132 % more iron than the amount measured in the Sun .

= = Characteristics = =

Kepler @-@ 14b is the sole planet discovered in the Kepler @-@ 14 system to date . The planet orbits the primary star in the Kepler @-@ 14 binary system . Kepler @-@ 14b is estimated to have 8 @.@ 40 Jupiter masses and 1 @.@ 136 Jupiter radii . In other words , the planet is 8 @.@ 4 times more massive than Jupiter , but only 1 @.@ 136 times Jupiter 's size . This equates to a high density , which is measured at 7 @.@ 1 g cm ³ . According to the Extrasolar Planets Encyclopaedia , which calculated Kepler @-@ 14b 's eccentricity independently , Kepler @-@ 14b has a slightly irregular orbit , with an orbital eccentricity of 0 @.@ 035 . Kepler @-@ 14b takes approximately 6 @.@ 79 days to orbit its host star . The mean distance from its host star is about 8 @.@ 213 times the measured radius of Kepler @-@ 14 .

The authors of Kepler @-@ 14b 's discovery paper noted that , had they not discovered that Kepler @-@ 14 was indeed a binary system , the parameters for Kepler @-@ 14b would have been extremely inaccurate . They noted that other planets discovered using radial velocity measurements might not have accounted for the possibility that their host stars were binary systems ; the only way that this was definitely known in the case of Kepler @-@ 14 was through the use of high @-@ resolution imaging . If the less prominent portion of the Kepler @-@ 14 binary system had not been detected , Kepler @-@ 14b 's mass would have been incorrect by nearly 60 % , and its radius too small by about 10 % .