= Kepler @-@ 7b =

Kepler @-@ 7b is one of the first five exoplanets to be confirmed by NASA 's Kepler spacecraft , and was confirmed in the first 33 @.@ 5 days of Kepler 's science operations . It orbits a star slightly hotter and significantly larger than the Sun that is expected to soon reach the end of the main sequence . Kepler @-@ 7b is a hot Jupiter that is about half the mass of Jupiter , but is nearly 1 @.@ 5 times its size ; at the time of its discovery , Kepler @-@ 7b was the second most diffuse planet known , surpassed only by WASP @-@ 17b . It orbits its host star every five days at a distance of approximately 0 @.@ 06 AU (9 @,@ 000 @,@ 000 km ; 5 @,@ 600 @,@ 000 mi) . Kepler @-@ 7b was announced at a meeting of the American Astronomical Society on January 4 , 2010 . It is the first extrasolar planet to have a crude map of cloud coverage .

= = Characteristics = =

= = = Mass , temperature , and orbit = = =

Kepler @-@ 7b is a hot Jupiter , a Jupiter @-@ like exoplanet orbiting close to its star . Its equilibrium temperature , due to its proximity to its star , is hot and is measured at nearly 1540 K. However , of the first five planets discovered by Kepler , it is the second coolest , being surpassed only by Kepler @-@ 6b . This is over twelve times hotter than Jupiter . Kepler @-@ 7b has a mass of only 0 @.@ 433 that of Jupiter but due to proximity to its star the planet has expanded to a radius of 1 @.@ 478 that of Jupiter . Because of this its mean density is only 0 @.@ 166 g / cm3 , about the same as expanded polystyrene , a substance used to manufacture lightweight , disposable commercial plastic products . Only WASP @-@ 17b (0.49MJ ; 1.66RJ) was known to have a lower density at the time of Kepler @-@ 7b 's discovery . Such low densities are not predicted by current standard theories of planet formation . Kepler @-@ 7b orbits its host star every 4 @.@ 8855 days at a distance of 0 @.@ 06224 AU , making it the furthest @-@ orbiting planet of the first five discovered by Kepler . Mercury , in contrast , orbits at a distance of 0 @.@ 387 AU every 87 @.@ 97 days . In addition Kepler @-@ 7b has an observed orbital inclination of 86.5º , which means that its orbit is almost edge @-@ on as seen from Earth .

= = = Cloud mapping = = =

Astronomers using data from NASA 's Kepler and Spitzer space telescopes have created a cloud map of the planet . It is the first cloud map to be created beyond the Solar System . Kepler 's visible @-@ light observations of Kepler @-@ 7b 's Moon @-@ like phases led to a rough map of the planet that showed a bright spot on its western hemisphere . But these data were not enough on their own to decipher whether the bright spot was coming from clouds or heat . The Spitzer Space Telescope played a crucial role in answering this question .

Jonathan Fortney , professor of astronomy and astrophysics at UC Santa Cruz , said : " These clouds may well be composed of rock and iron , since the planet is over 1 @,@ 000 degrees Fahrenheit (500 degrees Celsius) . " Brice @-@ Olivier Demory of the Massachusetts Institute of Technology noted that the oceans and continents cannot be detected , but a clear reflective signature has been detected which is interpreted as cloud . Thomas Barclay , Kepler scientist at NASA 's Ames Research Center , said : " Unlike those on Earth , the cloud patterns on this planet do not seem to change much over time ? it has a remarkably stable climate . "

= = = Host star = = =

Kepler @-@ 7 is the largest host star of the first five planets detected by Kepler , and is situated in the Lyra constellation . The star has a radius 184 % that of the Sun . Kepler @-@ 7 also has 135 % the Sun 's mass , and thus is larger and more massive (though less dense) than the Sun . It is

slightly hotter than the Sun , as Kepler @-@ 7 has an effective temperature of 5933 K. The star is near the end of its life on the main sequence . The star 's metallicity is [Fe / H] = 0 @.@ 11 , which means that Kepler @-@ 7 has 128 % the amount of iron than is detected in the Sun .

= = Discovery = =

In 2009 , NASA 's Kepler spacecraft was completing the last of tests on its photometer , the instrument it uses to detect transit events , in which a planet crosses in front of and dims its host star for a brief and roughly regular period of time . In this last test , Kepler observed 50000 stars in the Kepler Input Catalog , including Kepler @-@ 7 ; the preliminary light curves were sent to the Kepler science team for analysis , who chose obvious planetary companions from the bunch for follow @-@ up at observatories . Kepler @-@ 7 was not one of these original candidates . After a resting period of 1 @.@ 3 days , Kepler began a nonstop 33 @.@ 5 @-@ day period in which it observed 150000 targets uninterrupted until June 15 , 2009 , when the collected data was downloaded and tested for false positives . Kepler @-@ 7 's candidate was not found to be one of these false positives , such as an eclipsing binary star that may generate a light curve that mimics that of transiting planetary companions . Kepler @-@ 7 was then observed using Doppler spectroscopy using the Fibre @-@ fed Echelle Spectrograph at the Canary Islands ' Nordic Optical Telescope for ten nights in October 2009 , taken with respect to the star HD 182488 to compensate for possible telescope error . Speckle imaging of the star was taken at WIYN Observatory in Arizona to check for close companions ; when none were found , the High Resolution Echelle Spectrometer instrument at the W.M. Keck Observatory on Hawaii , the Harlan J. Smith Telescope at the McDonald Observatory in Texas , the PRISM camera at the Lowell Observatory , and the Faulkes Telescope North at the Haleakala Observatory on Maui were also used to analyze Doppler spectroscopy of the planetary candidate . The radial velocity observations confirmed that a planetary body was responsible for the dips observed in Kepler @-@ 7 's light curve , thus confirming it as a planet .

Kepler 's first discoveries , including the planets Kepler @-@ 4b , Kepler @-@ 5b , Kepler @-@ 6b , Kepler @-@ 7b , and Kepler @-@ 8b , were first announced on January 4 , 2010 , at the 215th meeting of the American Astronomical Society in Washington , D.C.

In May 2011 , the planet was detected by brightness variations of the star cause by reflected starlight from the planet . It was found that Kepler @-@ 7b has a relatively high geometric albedo of 0 @.@ 3 .