

= Kepler @-@ 9 =

Kepler @-@ 9 is a sunlike star in the constellation Lyra . Its planetary system , discovered by the Kepler Mission in 2010 was the first detected with the transit method found to contain multiple planets .

= = Nomenclature and history = =

Kepler @-@ 9 was named for the Kepler Mission , a project headed by NASA that was designed to search for Earth @-@ like planets . Unlike stars such as Aldebaran or Sirius , Kepler @-@ 9 does not have a colloquial name .

In June 2010 , some 43 days after Kepler came online , its operating scientists submitted a list of over 700 exoplanet candidates for review . Of those , five were originally suspected to have more than one planet . Kepler @-@ 9 was one of the multiplanetary systems ; it was identified as such when scientists noticed significant variations in the time intervals at which Kepler @-@ 9 was transited . Kepler @-@ 9 holds the first multiplanetary system discovered using the transit method . It is also the first planetary system where transiting planets were confirmed through transit timing variations method , allowing to calculate the masses of planets . The discovery of the planets was announced on August 26 , 2010 .

= = Characteristics = =

Kepler @-@ 9 is located in the constellation Lyra that lies some 650 parsecs away from Earth . With a mass of $1.07 M_{\odot}$ and a radius of $1.02 R_{\odot}$, Kepler @-@ 9 is almost exactly the same size and width of the Sun , being only 7 % more massive and 2 % wider . Kepler @-@ 9 has an effective temperature of $5777 (\pm 61)$ K , as compared to the Sun 's at 5778 K , and is approximately 32 % more metal @-@ rich (in terms of iron) than the Sun . Kepler @-@ 9 is younger than the Sun , and is estimated to be one billion years old .

= = Planetary system = =

There are three confirmed planets , all in direct orbit . The outer two planets , Kepler @-@ 9b (the inner one) and Kepler @-@ 9c (the outer one) , are low density gas giants that are respectively 25 % and 17 % the mass of Jupiter and around 80 % the radius of Jupiter . Both planets have a density less than that of water , similar to Saturn . The innermost planet , Kepler @-@ 9d , is a super @-@ Earth with a radius that is 1.64 times that of Earth , orbiting the star every 1.6 days . It is estimated that there is a 0.59 % chance that the discoveries are false .

From Kepler @-@ 9d (closest to star) to Kepler @-@ 9b (second from star) , the ratio of their orbits is 1 : 12 . However , the ratio of the orbits of the two outer planets is 1 : 2 , a relationship known as a mean motion resonance . Kepler @-@ 9b and Kepler @-@ 9c are the first transiting planets detected in such an orbital configuration . The resonance causes the orbital speeds of each planet to change , and thus causes the transit times of the two planets to oscillate . The period of Kepler @-@ 9b is increasing by 4 minutes per orbit , while that of Kepler @-@ 9c is decreasing by 39 minutes per orbit . These orbital changes allowed the masses of the planets (a parameter not normally obtainable via the transit method) to be estimated using a dynamical model . The mass estimates were further refined using radial velocity measurements obtained with the HIRES instrument of the Keck 1 telescope .

Kepler @-@ 9b and 9c are thought to have formed beyond the " frost line " . They are then thought to have migrated inward due to interactions with the remains of the protoplanetary disk . They would have been captured into orbital resonance during this migration .