= Kepler @-@ 11 =

Kepler @-@ 11 is a Sun @-@ like star slightly larger than the Sun in the constellation Cygnus , located some 2 @,@ 000 light years from Earth . It is located within the field of vision of the Kepler spacecraft , the satellite that NASA 's Kepler Mission uses to detect planets that may be transiting their stars . Announced on February 2 , 2011 , the star system is among the most compact and flattest systems yet discovered . It is the first discovered case of a star system with six transiting planets . All discovered planets are larger than Earth , with the larger ones being about Neptune 's size .

= = Nomenclature and history = =

Kepler @-@ 11 and its planets were discovered by NASA 's Kepler Mission , a mission tasked with discovering planets in transit around their stars . The transit method that Kepler uses involves detecting dips in brightness in stars . These dips in brightness can be interpreted as planets whose orbits move in front of their stars from the perspective of Earth . Kepler @-@ 11 is the first discovered exoplanetary system with more than three transiting planets .

Kepler @-@ 11 is named for the Kepler Mission : it is the 11th star with confirmed planets discovered in the Kepler field of view . The planets are named alphabetically , starting with the innermost : b , c , d , e , f , and g , distinguishers that are tagged onto the name of their home star .

= = Characteristics = =

Kepler @-@ 11 is a G @-@ type star that is approximately 96 % the mass of and 107 % the radius of the Sun . It has a surface temperature of about 5663 K and is estimated to have an age of around 8 @.@ 5 billion years . In comparison , the Sun is about 4 @.@ 6 billion years old and has a surface temperature of 5778 K.

The star 's apparent magnitude , or how bright it appears from Earth 's perspective , is 13 @.@ 7 . Therefore , it cannot be seen with the naked eye .

= = Planetary system = =

All known planets transit the star ; this means that all six planets ' orbits appear to cross in front of their star as viewed from the Earth 's perspective . Their inclinations relative to Earth 's line of sight , or how far above or below the plane of sight they are , vary by a little more than a degree . This allows direct measurements of the planets ' periods and relative diameters (compared to the host star) by monitoring each planet 's transit of the star . Simulations suggest that the mean mutual inclinations of the planetary orbits are about 1 ° , meaning the system is probably more coplanar (flatter) than the Solar System , where the corresponding figure is 2 @.@ 3 ° .

The estimated masses of planets b - f fall in the range between those of Earth and Neptune . Their estimated densities , all lower than that of Earth , imply that none of them have an Earth @-@ like composition ; a significant hydrogen / helium atmosphere is predicted for planets c , d , e , f , and g , while planet b may be surrounded by a steam atmosphere or perhaps by a hydrogen atmosphere . The low densities likely result from high @-@ volume extended atmospheres that surround cores of iron , rock , and possibly H2O . The inner constituents of the Kepler @-@ 11 system were , at the time of their discoveries , the most comprehensively understood extrasolar planets smaller than Neptune . Currently , observations do not place a firm constraint on the mass of planet g (< 25 ME) . However , formation and evolution studies indicate that the mass of planet g is not much greater than about 7 ME .

Kepler @-@ 11 planets may have formed in situ (i.e. , at their observed orbital locations) or may have started their formation farther away from the star while migrating inward through gravitational interactions with a gaseous protoplanetary disk . This second scenario predicts that a substantial fraction of the planets ' mass is in H2O . Regardless of the formation scenario , the gaseous

component of the planets accounts for less than about 20 % of their masses but for ? 40 to ? 60 % of their radii .

The system is among the most compact known ; the orbits of planets b - f would easily fit inside the orbit of Mercury , with g only slightly outside it . Despite this close packing of the orbits , dynamical integrations indicate the system has the potential to be stable on a time scale of billions of years .

None of the planets are in low @-@ ratio orbital resonances , in which multiple planets gravitationally tug on and stabilize each other 's orbits , resulting in simple ratios of their orbital periods . However , b and c are close to a 5 : 4 ratio .

There could conceivably be other planets in the system that do not transit the star , but they would only be detectable by the effects of their gravity on the motion of the visible planets (much as how Neptune was discovered) .