

= PSR B1620 @-@ 26 b =

PSR B1620 @-@ 26 b is an extrasolar planet located approximately 12 @, @ 400 light @-@ years away from Earth in the constellation of Scorpius . It bears the unofficial nicknames " Methuselah " and " the Genesis planet " due to its extreme age and a few popular sources refer to this object as " PSR B1620 @-@ 26 c " (see below for discussion) . The planet is in a circumbinary orbit around the two stars of PSR B1620 @-@ 26 (which are a pulsar (PSR B1620 @-@ 26 A) and a white dwarf (WD B1620 @-@ 26)) and is the first circumbinary planet ever confirmed . It is also the first planet found in a globular cluster . The planet is one of the oldest known extrasolar planets , believed to be about 12 @. @ 7 billion years old .

= = Characteristics = =

= = = Mass , orbit , and age = = =

PSR has a mass of 2 @. @ 5 times that of Jupiter , and orbits at a distance of 23 AU (3 @. @ 4 billion km) , a little larger than the distance between Uranus and the Sun . Each orbit of the planet takes about 100 years .

The triple system is just outside the core of the globular cluster Messier 4 . The age of the cluster has been estimated to be about 12 @. @ 7 billion years , and because all stars in a cluster form at about the same time , and planets form together with their host stars , it is likely that PSR B1620 @-@ 26 b is also about 12 @. @ 7 billion years old . This is much older than any other known planet , and nearly three times as old as Earth . It has been undergoing many stages through its lifetime .

= = = Host stars = = =

PSR B1620 @-@ 26 b orbits a pair of stars . The primary star , PSR B1620 @-@ 26 , is a pulsar , a neutron star spinning at 100 revolutions per second . The second is a white dwarf with a mass of 0 @. @ 34 M ? . These stars orbit each other at a distance of 1 AU about once every six months . The age of the system is 12 @. @ 7 to 13 billion years old , making this one of the oldest binary stars known . In comparison , the Sun has an age of 4 @. @ 6 billion years .

The binary system 's apparent magnitude , or how bright it appears from Earth 's perspective , is 24 . It is far too dim to be seen with the naked eye .

= = = Evolutionary history = = =

The origin of this pulsar planet is still uncertain , but it probably did not form where it is found today . Because of the decreased gravitational force when the core of star collapses to a neutron star and ejects most of its mass in a supernova explosion , it is unlikely that a planet could remain in orbit after such an event . It is more likely that the planet formed in orbit around the star that has now evolved into the white dwarf , and that the star and planet were only later captured into orbit around the neutron star .

Stellar encounters are not very common in the disk of the Milky Way , where the Sun is , but in the dense core of globular clusters they occur frequently . At some point during the 10 billion years , the neutron star is thought to have encountered and captured the host star of the planet into a tight orbit , probably losing a previous companion star in the process . About half a billion years ago , the newly captured star began to expand into a red giant (see stellar evolution) .

Typical pulsar periods for young pulsars are of the order of one second , and they increase with time ; the very short periods exhibited by so @-@ called millisecond pulsars are due to the transfer of material from a binary companion . The pulse period of PSR B1620 @-@ 26 is a few milliseconds , providing strong evidence for matter transfer . It is believed that as the pulsar 's red giant companion expanded , it filled and then exceeded its Roche lobe , so that its surface layers started

being transferred onto the neutron star .

The infalling matter produced complex and spectacular effects . The infalling matter ' spun up ' the neutron star , due to the transfer of angular momentum , and for a few hundred million years , the stars formed a low @-@ mass X @-@ ray binary , as the infalling matter was heated to temperatures high enough to glow in X @-@ rays .

Mass transfer came to an end when the surface layers of the mass @-@ losing star were depleted , and the core slowly shrunk to a white dwarf . Now the stars peacefully orbit around each other . The long @-@ term prospects for PSR B1620 @-@ 26 b are poor , though . The triple system , which is much more massive than a typical isolated star in M4 , is slowly drifting down into the core of the cluster , where the density of stars is very high . In a billion years or so , the triple will probably have another close encounter with a nearby star . The most common outcome of such encounters is that the lightest companion is ejected from the multiple star system . If this happens , PSR B1620 @-@ 26 b will most likely be ejected completely from M4 , and will spend the rest of its existence wandering alone in interstellar space as an interstellar planet .

= = Detection and discovery = =

Like nearly all extrasolar planets discovered prior to 2008 , PSR B1620 @-@ 26 b was originally detected through the Doppler shifts its orbit induces on radiation from the star it orbits (in this case , changes in the apparent pulsation period of the pulsar) . In the early 1990s , a group of astronomers led by Donald Backer were studying what they thought was a binary pulsar , determined that a third object was needed to explain the observed Doppler shifts . Within a few years , the gravitational effects of the planet on the orbit of the pulsar and white dwarf had been measured , giving an estimate of the mass of the third object that was too small for it to be a star . The conclusion that the third object was a planet was announced by Stephen Thorsett and his collaborators in 1993 .

The study of the planetary orbit allowed the mass of the white dwarf star to be estimated as well , and theories of the formation of the planet suggested that the white dwarf should be young and hot . On July 10 , 2003 , the detection of the white dwarf and confirmation of its predicted properties were announced by a team led by Steinn Sigurdsson , using observations from the Hubble Space Telescope . It was at a NASA press briefing that the name Methuselah was introduced , capturing press attention around the world .

= = Name = =

While the designation PSR B1620 @-@ 26 b is not used in any scientific papers , the planet is listed in the SIMBAD database as PSR B1620 @-@ 26 b . Some popular sources use the designation PSR B1620 @-@ 26 c to refer to the planet , as it was described as the third member of a triple system (composed of the planet and two stars) . This designation doesn 't appear in the SIMBAD database , and more modern naming conventions use a separated lettering system where lower @-@ case letters to refer to planets and upper @-@ case letters to designate stars (e.g. Gliese 667C c is the ' c ' planet orbiting Gliese 667C , which is the ' C ' star of a triple system) , making PSR B1620 @-@ 26 b the designation for a planet orbiting both stars of the PSR B1620 @-@ 26 system . Neither usage is employed in the scientific literature with respect to the PSR B1620 @-@ 26 planet .

Though not officially recognized , the name " Methuselah " is commonly used for the planet in popular articles . The name comes from the biblical person Methuselah (who in Christian mythology was the oldest person who ever lived) . This name is usually used as the informal name to show the similarities to the planets of the solar system , while the " latter name " is used astronomically . Methuselah is the only planet to have received a biblical name , although three additional extrasolar planets have been given mythological names (just like in the Solar System) , those planets being Bellerophon , Zarmina and Osiris .