

= Upsilon Andromedae =

Upsilon Andromedae (abbreviated ϵ Andromedae , ϵ And) is a binary star located approximately 44 light @-@ years from Earth in the constellation of Andromeda . The system consists of an F @-@ type main @-@ sequence star (designated ϵ Andromedae A , also named Titawin) and a smaller red dwarf (ϵ Andromedae B) .

As of 2010 , four extrasolar planets (designated Upsilon Andromedae b , c , d and e ; the first three named Saffar , Samh and Majriti , respectively) are believed to orbit ϵ Andromedae A. All four are likely to be jovian planets that are comparable in size to Jupiter . This was both the first multiple @-@ planet system to be discovered around a main @-@ sequence star , and the first multiple @-@ planet system known in a multiple star system .

= = Nomenclature = =

Upsilon Andromedae is the system 's Bayer designation . Under the rules for naming objects in binary star systems the two components are designated A and B. Under the same rules , the first planet discovered orbiting ϵ Andromedae A should be designated ϵ Andromedae Ab . Though this more formal form is occasionally used to avoid confusion with the secondary star ϵ Andromedae B , it is more commonly referred to as ϵ Andromedae b . The other planets discovered were designated ϵ Andromedae c , d and e , in order of their discovery .

In July 2014 the International Astronomical Union launched a process for giving proper names to certain exoplanets and their host stars . The process involved public nomination and voting for the new names . In December 2015 , the IAU announced the winning names were Titawin for ϵ Andromedae A and Saffar , Samh and Majriti for three of its planets (b , c , and d , respectively) .

The winning names were those submitted by the Vega Astronomy Club of Morocco . The star is named after the settlement in northern Morocco and UNESCO World Heritage Site now known as the medina (old town) of Tétouan . The planets honour the 10th and 11th Century astronomers Ibn al @-@ Saffar , Ibn al @-@ Samh and Maslama al @-@ Majriti of Muslim Spain .

In Chinese , 天市大將軍 (*Tiān Dà Jīng Jūn*) , meaning Heaven 's Great General , refers to an asterism consisting of ϵ Andromedae , ϵ Andromedae , ϵ Persei , 51 Andromedae , 49 Andromedae , ϵ Andromedae , ϵ Andromedae , 56 Andromedae , ϵ Trianguli , ϵ Trianguli and ϵ Trianguli . Consequently , ϵ Andromedae itself is known as 天市六 (*Tiān Dà Jīng Jūn liù* , English : the Sixth Star of Heaven 's Great General .) .

= = Stellar system = =

= = = Distance and visibility = = =

Upsilon Andromedae is located fairly close to the Solar System : the parallax of Upsilon Andromedae A was measured by the Hipparcos astrometry satellite as 74 @.@ 12 milliarcseconds , corresponding to a distance of 13 @.@ 49 parsecs (44 light years) . Upsilon Andromedae A has an apparent magnitude of + 4 @.@ 09 , making it visible to the naked eye even under moderately light @-@ polluted skies , about 10 degrees east of the Andromeda Galaxy . The dimmer star Upsilon Andromedae B is only visible with a telescope .

= = = System components = = =

Upsilon Andromedae A is a yellow @-@ white dwarf of spectral type F8V , similar to the Sun , but younger , more massive , and more luminous . According to its entry in the Geneva ϵ Copenhagen survey , the star is around 3 @.@ 1 billion years old , and has a similar proportion of iron relative to hydrogen to the Sun . At around 1 @.@ 3 solar masses , it will have a shorter lifetime than the Sun . The amount of ultraviolet radiation received by any planets in the star 's habitable zone would be

similar to the ultraviolet flux the Earth receives from the Sun .

Upsilon Andromedae A was ranked 21st in the list of top 100 target stars for NASA 's cancelled Terrestrial Planet Finder mission .

Upsilon Andromedae B is a red dwarf of spectral type M4.5V located at a projected separation of 750 AU from the primary star . The true separation between the two stars is unknown because the displacement along the line of sight between us and the Upsilon Andromedae stars is unknown , so this value is a minimum separation . Based upon its motion through space , this is a common proper motion companion to the primary . It was discovered in 2002 in data collected as part of the Two Micron All Sky Survey . The star is less massive and far less luminous than the Sun .

The Washington Double Star Catalog lists two optical components ; however , these do not share the system 's proper motion and only appear close to Upsilon Andromedae because they happen to lie near the same line of sight .

= = Planetary system = =

The star rotates at an inclination of 58 ± 9
? 7 degrees relative to Earth .

The innermost planet of the Upsilon Andromedae system was discovered in 1996 and announced in January 1997 , together with the planet of Tau Boötis and the innermost planet of 55 Cancri . The discovery was made by Geoffrey Marcy and R. Paul Butler , both astronomers at San Francisco State University . The planet , designated Upsilon Andromedae b , was discovered by measuring changes in the star 's radial velocity induced by the planet 's gravity . Because of its closeness to the parent star , it induced a large wobble which was detected relatively easily . The planet appears to be responsible for enhanced activity in the chromosphere of its star .

Even when this planet was taken into account , there still remained significant residuals in the radial velocity measurements , and it was suggested there might be a second planet in orbit . In 1999 , astronomers at both San Francisco State University and the Harvard @-@ Smithsonian Center for Astrophysics independently concluded that a three @-@ planet model best fit the data . The two outer planets were designated Upsilon Andromedae c and Upsilon Andromedae d in order of increasing distance from the star . Both of these planets are in more eccentric orbits than any of the planets in the Solar System (including Pluto) . Upsilon Andromedae d resides in the system 's habitable zone .

The system is not coplanar , with each other or with the stellar rotation . The mutual inclination between c and d is 30 degrees . In 2001 , preliminary astrometric measurements suggested the orbit of the outermost planet is inclined at $155 \pm 5^\circ$ to the plane of the sky . However , subsequent investigation of the data reduction techniques used suggests that the Hipparcos measurements are not precise enough to adequately characterize the orbits of substellar companions . Astrometry of the innermost planet , meanwhile , constrained its inclination to 30 ± 90 degrees . Full publication is expected in 2008 . The orbit of Upsilon Andromedae c gradually oscillates between circular and eccentric states every 6 @, 700 years . The existence of further planets too small or distant to detect has not been ruled out , though the presence of Jupiter @-@ mass planets as close as 5 AU from Upsilon Andromedae A would make the system unstable .

Some simulations show that the eccentricity of the system 's planets may have arisen from a close encounter between the outer planet and a fourth planet , with the result that the fourth planet was ejected from the system or destroyed . If so , the rogue planet would have had to eject immediately ; it is unclear how likely this situation might be . Other models are possible . However , a fourth planet (Upsilon Andromedae e) was discovered in 2010 . This planet is in a 3 : 1 resonance with Upsilon Andromedae d .

Upsilon Andromedae does not appear to have a circumstellar dust disk similar to the Kuiper belt in the Solar System . This may be the result of perturbations from the companion star removing material from the outer regions of the Upsilon Andromedae A system .