

= 2 Pallas =

Pallas , minor planet designation 2 Pallas , is the second asteroid to have been discovered (after Ceres) , and it is one of the largest asteroids in the Solar System . With an estimated 7 % of the mass of the asteroid belt , it is the third most massive asteroid , being 10 ? 30 % less massive than Vesta . It is 512 kilometers (318 mi) in diameter , somewhat smaller than Vesta . It is likely a remnant protoplanet .

When Pallas was discovered by the German astronomer Heinrich Wilhelm Matthäus Olbers on 28 March 1802 , it was counted as a planet , as were other asteroids in the early 19th century . The discovery of many more asteroids after 1845 eventually led to their reclassification .

Pallas 's surface is most likely composed of a silicate material ; its spectrum and estimated density resemble carbonaceous chondrite meteorites . With an orbital inclination of 34 ° , Pallas 's orbit is unusually highly inclined to the plane of the asteroid belt , and its orbital eccentricity is nearly as large as that of Pluto , making Pallas relatively inaccessible to spacecraft .

It was formerly considered a possible dwarf planet due to its size , but it is no longer considered such due to having significant departures from an ellipsoid .

= = History = =

= = = Discovery = = =

In 1801 , the astronomer Giuseppe Piazzi discovered an object which he initially believed to be a comet . Shortly thereafter he announced his observations of this object , noting that the slow , uniform motion was uncharacteristic of a comet , suggesting it was a different type of object . This was lost from sight for several months , but was recovered later that year by the Baron von Zach and Heinrich W. M. Olbers after a preliminary orbit was computed by Carl Friedrich Gauss . This object came to be named Ceres , and was the first asteroid to be discovered .

A few months later , Olbers was again attempting to locate Ceres when he noticed another moving object in the vicinity . This was the asteroid Pallas , coincidentally passing near Ceres at the time . The discovery of this object created interest in the astronomy community . Before this point it had been speculated by astronomers that there should be a planet in the gap between Mars and Jupiter . Now , unexpectedly , a second such body had been found . When Pallas was discovered , some estimates of its size were as high as 3 ,@ 380 km in diameter . Even as recently as 1979 , Pallas was estimated to be 673 km in diameter , 26 % greater than the currently accepted value .

The orbit of Pallas was determined by Gauss , who found the period of 4 @. 6 years was similar to the period for Ceres . Pallas has a relatively high orbital inclination to the plane of the ecliptic .

= = = Later observations = = =

In 1917 , the Japanese astronomer Kiyotsugu Hirayama began to study asteroid motions . By plotting the mean orbital motion , inclination and eccentricity of a set of asteroids , he discovered several distinct groupings . In a later paper he reported a group of three asteroids associated with Pallas , which became named the Pallas family , after the largest member of the group . Since 1994 more than 10 members of this family have been identified , and these have semi @- major axes between 2 @. 50 ? 2 @. 82 AU and inclinations of 33 ? 38 ° . The validity of this grouping was confirmed in 2002 by a comparison of their spectra .

Pallas has been observed occulting stars several times , including the best observed of all asteroid occultation events on 29 May 1983 , when careful occultation timing measurements were taken by 140 observers . These resulted in the first accurate measurements of its diameter . During the occultation of 29 May 1979 the discovery of a possible tiny satellite with a diameter of about 1 km was reported , which was never confirmed . In 1980 , speckle interferometry was reported as indicating a much larger satellite with a diameter of 175 km , whose existence was later refuted .

Radio signals from spacecraft in orbit around Mars and / or on its surface have been used to estimate the mass of Pallas from the tiny perturbations induced by it onto the motion of Mars .

The Dawn team was granted viewing time on the Hubble Space Telescope in September 2007 for a once @-@ in @-@ twenty @-@ year opportunity to view Pallas at closest approach , to obtain comparative data for Ceres and Vesta .

= = = Naming = = =

2 Pallas is named after Pallas Athena (Ancient Greek : ?????? ?????) , an alternate name for the goddess Athena . In some mythologies Athena killed Pallas , then adopted her friend 's name out of mourning . (There are several male characters of the same name in Greek mythology , but the first asteroids were invariably given female names .)

Pallas is a Greek name and some other languages use variant versions of it for the asteroid : in Italian , Pallade , Russian Pallada , Spanish Palas , and Arabic B?l's , for example . In Chinese , however , the asteroid has a different name , ??? zhìshénxīng (which means " the wisdom @-@ god (dess) star ") , even though the Chinese call the goddess Pallas herself by the Greek name (??? pàl's?) .

The stony @-@ iron Pallasite meteorites are not connected to the Pallas asteroid , being instead named after the German naturalist Peter Simon Pallas . The chemical element palladium , on the other hand , was named after the asteroid , which had been discovered just before the element .

As with other asteroids , the astronomical symbol for Pallas is a disk with its discovery number , ? . It also has an older , more iconic symbol , ? (or sometimes) .

= = Orbit and rotation = =

Pallas has unusual dynamic parameters for such a large body . Its orbit is highly inclined and moderately eccentric , despite being at the same distance from the Sun as the central part of the asteroid belt . Furthermore , Pallas has a very high axial tilt of 84° , with its north pole pointing towards ecliptic coordinates (? , ?) = (30° , ? 16°) with a 5° uncertainty in the Ecliptic J2000.0 reference frame . This means that every Palladian summer and winter , large parts of the surface are in constant sunlight or constant darkness for a time on the order of an Earth year , with areas near the poles experiencing continuous sunlight for as long as two years .

= = = Near resonances = = =

Pallas is in a , likely coincidental , near @-@ 1 : 1 orbital resonance with Ceres . Pallas also has a near @-@ 18 : 7 resonance (91 @,@ 000 @-@ year period) and an approximate 5 : 2 resonance (83 @-@ year period) with Jupiter .

= = = Transits of planets from Pallas = = =

From Pallas , Mercury , Venus , Mars , and Earth can occasionally appear to transit , or pass in front of , the Sun . Earth last did so in 1968 and 1998 , and will next transit in 2224 . Mercury did in October 2009 . The last and next by Venus are in 1677 and 2123 , and for Mars they are in 1597 and 2759 .

= = Physical characteristics = =

Both Vesta and Pallas have assumed the title of second @-@ largest asteroid from time to time . At 512 ± 3 km in diameter , Pallas is slightly smaller than 4 Vesta ($525 @.@ 4 \pm 0 @.@ 2$ km) . The mass of Pallas is only 84 % + 7 %

? 13 % that of Vesta , 22 % that of Ceres and about 0 @.@ 3 % that of the Moon .

Pallas is farther from Earth and has a much lower albedo than Vesta , and hence is dimmer as seen

from Earth . Indeed , the much smaller 7 Iris marginally exceeds Pallas in mean opposition magnitude . Pallas 's mean opposition magnitude is + 8 @. @ 0 , which is well within the range of 10 × 50 binoculars , but , unlike Ceres and Vesta , it will require more @-@ powerful optical aid to view at small elongations , when its magnitude can drop as low as + 10 @. @ 6 . During rare perihelic oppositions , Pallas can reach a magnitude of + 6 @. @ 4 , right on the edge of naked @-@ eye visibility . During late February 2014 Pallas shone with magnitude 6 @. @ 96 .

Based on spectroscopic observations , the primary component of the material on Pallas 's surface is a silicate containing little iron and water . Minerals of this type include olivine and pyroxene , which are found in CM chondrules . The surface composition of Pallas is very similar to the Renazzo carbonaceous chondrite (CR) meteorites , which are even lower in hydrous minerals than the CM type . The Renazzo meteorite was discovered in Italy in 1824 and is one of the most primitive meteorites known . Pallas 's visible and near @-@ infrared spectrum is almost flat , being slightly brighter in towards the blue . There is only one clear absorption band in the 3 @-@ micron part , which suggests an anhydrous component mixed with hydrated CM @-@ like silicates .

Very little is known of Pallas 's surface features . Hubble images from 2007 , with a resolution around 70 kilometres (43 mi) per pixel , show pixel @-@ to @-@ pixel variation , but Pallas 's albedo of 0 @. @ 12 placed such features at the lower end of detectability . There is little variability between lightcurves obtained through visible @-@ light and infrared filters , but there are significant deviations in the ultraviolet , suggesting large surface or compositional features near 285 ° (75 ° west longitude) . Pallas 's rotation appears to be prograde .

Pallas is thought to have undergone at least some degree of thermal alteration and partial differentiation , which suggests that it is a remnant protoplanet . During the planetary formation stage of the Solar System , objects grew in size through an accretion process to approximately this size . Many of these objects were incorporated into larger bodies , which became the planets , whereas others were destroyed in collisions with other protoplanets . Pallas and Vesta are likely survivors from this early stage of planetary formation .

Pallas was on a " watchlist " of objects possibly meeting a provisional definition of " planet " in an early draft of the IAU 's 2006 definition of planet .

= = Satellites = =

It has been suggested that Pallas has a moon . A moon about 1 kilometer in diameter was suggested based on occultation data from an occultation on 29 May 1978 , and another one separated from Pallas by 750 kilometers and 175 kilometers in diameter itself was suggested in 1980 , but later shown incorrect in 1983 occultation observations . Considering the level at which Pallas has been studied and observed since it was discovered , it is unlikely that there are any large moons orbiting Pallas .

= = Exploration = =

Pallas has not been visited by spacecraft and there are no plans for exploration of Pallas by spacecraft . A flyby after the Dawn probe 's visits to 4 Vesta and 1 Ceres was discussed but was not possible .