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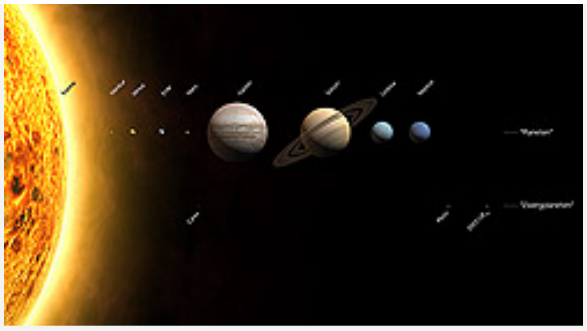
And then there were eight: astronomers no longer count Pluto as a planet

25 August 2006



The new Solar System

On Thursday 24 August in Prague, the 26th General Assembly of the International Astronomical Union (IAU) agreed on the first ever scientific definition of a planet. Objects in the Solar System will now be grouped into three categories. Firstly there are the eight planets, already well-known to astronomers even before the 20th century. Then there is the ever-growing number of dwarf planets, identified as the result of numerous observations, and lastly, there are the countless small bodies of our Solar System. The eight planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Pluto, named after the Roman god of the underworld, is now classified as a dwarf planet – like the trans-Neptunian object 2003 UB_{313} and the asteroid Ceres.

"For many of our peers, the idea of having eight planets and leaving Pluto out of the equation will take some getting used to," says Tilman Spohn, Director of the Institute for Planetary Research at the German Aerospace Center (DLR) in Berlin-Adlershof and Professor of Planetary Physics at the University of Münster. "But the IAU's definition of a planet is essentially well-founded and so it makes sense that Pluto, popular ever since it was discovered in 1930, and its moon Charon should no longer be counted as a true planet but be assigned with its relatives to a category of its own."

What is a planet?

At first glance it might seem a trivial question, but it's one that has had astronomers and planetary researchers scratching their heads for several years. At the General Assembly of the IAU, it was the main topic discussed by more than 2500 scientists for two weeks.

From now on, in order to qualify as a planet an object must:

- be a celestial body that orbits a central star on an elliptical orbit and is not itself a star, and
- have sufficient mass for its own gravity to make it virtually spherical and hydrostatically balanced, and
- have 'cleared the neighbourhood' of other cosmic material during the development of the Solar System.

Voting during the 26th General Assembly of the International Astronomical Union

In line with the definition agreed upon by the IAU, bodies which fulfil the first two conditions but which have not 'cleared the neighbourhood' of cosmic material will be categorised as dwarf planets. They must also not be satellites of a planet. At this stage, according to the IAU, the resolution applies only to our own solar system. To date, astronomers have obtained indirect evidence of the existence of planets orbiting some 180 nearby stars.

The General Assembly of the IAU thus rejected a proposal that hit the headlines around the world during the first week of the conference. It had been proposed that the family of planets be extended to twelve celestial bodies. The first of the proposed extra planets was the object known as 2003 UB_{313}, located even farther from the Sun than Pluto and even larger than Pluto in terms of size. The other proposed new planets were Pluto's moon Charon and the asteroid Ceres, which orbits the Sun in the asteroid belt between Mars and Jupiter.

A good definition

"Now that these criteria have been defined, we have a clear set of boundaries, even though the third criterion could be construed as somewhat unquantifiable," says Tilman Spohn. "With more refined observation techniques we're certain to find a whole lot of other objects beyond Neptune, but these will actually belong to a quite different category of bodies in the solar system and now have their own classification, just like the 'dwarf planets'."

Right up until the early twentieth century, generations of astronomers were content with the knowledge that, on the basis of their observations, the planets were the eight bodies that could be seen with the naked eye or with a telescope and which orbited the Sun. The orbital paths of planets differ noticeably from those of 'fixed' stars, which appear to rotate around the celestial poles. The planets themselves move against this backdrop of stars. The term 'planet' comes from the Greek word meaning 'wanderer'. The planets, including Earth, are in turn orbited by satellites (in other words moons).

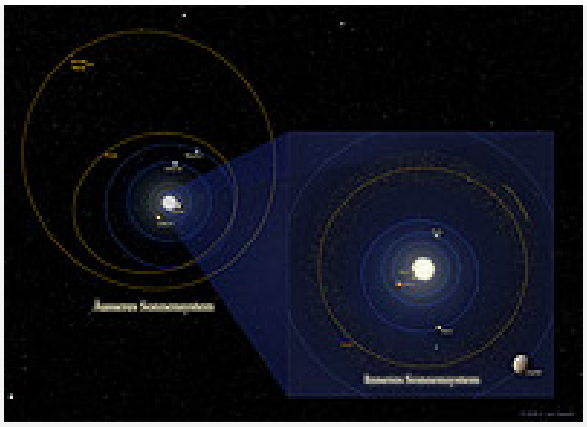
A lengthy debate: what is a planet?

Pluto is a "Dwarf" planet

The quandary first arose in 1801 with the discovery of an object between the orbits of Mars and Jupiter: the asteroid Ceres. Initially, this small bright dot, then calculated as being just under 1000km in diameter, was classified as the eighth planet (this discovery predated the discovery of Neptune) - but this was soon rejected. Instead, astronomers coined the term 'asteroid' to designate the many tens of

thousands of small planets which orbit between Mars and Jupiter. In 1846, German astronomer Johann Gottfried Galle (1812 - 1910) discovered fluctuations in the orbit of the 'true' eighth planet, Neptune, prompting researchers to engage in a long and intensive search into the cause of these orbital deviations, presumably caused by a gravitational force.

When American scientist Clyde Tombaugh discovered Pluto in 1930, the matter seemed to be resolved. It became evident, however, that at just 2360km across, Pluto was much too small to be the cause of the fluctuations measured in Neptune's orbit. It also became clear that Pluto's orbital path did not fit the accepted pattern for a planet. For one thing, its orbit is so elliptical that at certain points during its 248-year journey around the Sun (measured in Earth years), it even passes within the orbit of Neptune. For another thing, Pluto's orbit is tilted against the 'ecliptic', the plane on which the other eight planets move, by an angle of more than 17º. Pluto's small size has also caused much speculation amongst astronomers.



Overview of the Solar System

Pluto had barely been discovered when the contention arose as to whether it could really be classed as planet. It's a debate that has been fuelled over the past ten years by the discovery of yet more objects in these regions of the Solar System. In the 1940s and 1950s, astronomers Kenneth Essex Edgeworth (1880 - 1972) and Gerard Kuiper (1905 - 1973) each independently formulated the hypothesis that there must be thousands of small objects between and beyond the orbits of Uranus and Neptune.

In 1992, thanks to advances in observation technology, the first object was discovered in these distant areas of the Solar System. In fact, the region known as the Edgeworth-Kuiper Belt is home to thousands of small objects, now also known as 'trans-Neptunian objects' or TNOs. Pluto is one of the larger of these objects, and with a diameter of 1200km, its moon Charon, discovered in 1978, is unusually large in relation to the planet it orbits. The debate surrounding the term 'planet' was intensified in 2003 when American astronomers Michael E. Brown, Chadwick A. Trujillo and David Lincoln Rabinowitz discovered an object even larger than Pluto. The dwarf planet, provisionally named 2003 UB313, is approximately 2500km in diameter.

Consolation prize: visit to Pluto in 2015

Pluto has never been observed by a probe at close quarters, but in 2015 the dwarf planet is due to receive a visit. Pluto and Charon, like 2003 UB313, have solid surfaces. At temperatures below -200º Celsius, they consist of ice made of water, methane, carbon monoxide and nitrogen. In this respect they are very similar to the surface of Neptune's largest moon Triton, which many astronomers also assume must be a TNO which was dragged into a new orbit by Neptune's gravity when passing close by the planet.

Because of their elliptical orbit, Pluto and Charon's distance from the Sun is always varying, the furthest being 7400 million kilometres. Just before and after they reach their closest position to the Sun, just 4500 million km away (an occurrence last observed in 1989), part of the surface ice evaporates and forms an atmospheric mist around the dwarf planet. This was one of the reasons why the American space agency NASA was so anxious to launch the New Horizons mission in January of this year. With every year that passes, the time window in which we can study not only the surface of Pluto and Charon, but also Pluto's atmospheric components, becomes narrower. With an orbital period of 248 Earth years, it will be many generations before the opportunity comes round again.

Recently, two new and much smaller moons of Pluto were discovered, around 32km and 70km in diameter. The IAU has named them Nix (in Greek mythology, the goddess of night and the mother of Charon, the ferryman to the Underworld) and Hydra (a nine-headed monster that guarded one of the gates to the Underworld).

Overview of the Solar System

Object	Average distance from the Sun (Millions km)	Diameter (km)	Orbit time	Inclination	Number of moons	Discoverer
Sun		1.391.000				
Mercury	57,91	4.879	87,97 Earth days	7 degrees	0	
Venus	108,21	12.104	224,7 Earth days	3.39 degrees	0	
Earth	149,6	12.756	365,26 Earth days	0.00005 degrees	1	
Mars	227,94	6.794	686,98 Earth days	1.8 degrees	2	
Jupiter	778,41	142.984	11,8565 Earth days	1.305 degrees	63	
Saturn	1426,73	120.536	29,4 Earth years	2.484 degrees	47 (56)	
Uranus	2870,97	51.118	84,02 Earth years	0.770 degrees	29	1781, William Herschel
Neptune	4498,25	49.528	164,79 Earth years	1.769 degrees	13	1846, Johann Gottfried Galle

Die Zwergplaneten

Object	Average distance from the Sun (Millions km)	Diameter (km)	Orbit time	Inclination	Number of moons	Discoverer
Pluto	5906.38	2360	247.92 Earth years	17.14 degrees	3	1930, Clyde Tombaugh
Ceres	414.39	948.8	4.6 Earth years	10.58 degrees	0	1801, Giuseppe Piazzi
2003 UB313	10127.17 (67.69 AU)	2400 ± 100 km	557 Earth years	44.179 degrees	0	2003, M. Brown, C. Trujillo, D. Rabinowitz

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