Astrobiology textbook pdf online free online pdf

48 (7–8): 617–636. (2004). However, it soon became apparent that they were rather different from previously known planets: they shared the same general region of space, between Mars and Jupiter (the asteroid belt), with sometimes overlapping orbits, where only one planet had been expected, and they were much much smaller; indeed, it was suspected that they might be shards of a larger planet that had broken up. Retrieved 7 May 2021. ISBN 978-1-4067-6601-1. "Timescales for Planetary Accretion and the Structure of the Protoplanetary disk". "Magnetic planet". ISBN 978-0-521-66148-5. "Survivability of planetary systems in young and dense star clusters". Ganymede's magnetic field is several times larger, and Jupiter's is the strongest in the Solar System (so strong in fact that it poses a serious health risk to future crewed missions to all its moons inward of Callisto). Attributes Although each planet has unique physical characteristics, a number of broad commonalities do exist among them. The discovery of other large objects in the Kuiper belt, particularly Eris, spurred debate about how exactly to define "planet". E. Bibcode:2010exop.book..319D. arXiv:1305.0980. S2CID 118513110. Archived from the original on 7 April 2019. ^ a b "Planetary Interiors". In increasing order of average distance from the Sun, they are Ceres, Orcus, Pluto, Haumea, Quaoar, Makemake, Gonggong, Eris and Sedna.[48] Ceres is the largest object in the asteroid belt, between the orbits of Mars and Jupiter. Archived from the original on 2012-12-12. pp. 5–20. 2001. A planet's rotation period is known as a stellar day. doi:10.1086/508861. "The signature of hot hydrogen in the atmosphere of the extrasolar planet HD 209458b" (PDF). Steiglitz suggests that this may be a euphemism for the original name of כוכב בעל Kokhav Ba'al or "Baal's planet", seen as idolatrous and euphemized in a similar manner to Ishbosheth from II Samuel.[97] In Arabic, Mercury is عُطَارِد‎ (ʿUṭārid, cognate with Ishtar / Astarte), Venus is الزهرة‎ (az-Zuhara, "the bright one",[98] an epithet of the goddess Al-'Uzzá[99]), Earth is الأرض‎ (al-ʾArḍ, from the same root as eretz), Mars is ٱلْمِرِّيخ‎ (al-Mirrīkh, mean arrow" due to its retrograde motion[100]), Jupiter is المشتري‎ (al-Muštarī, "the reliable one", from Akkadian[101]) and Saturn is زُحَل‎ (Zuḥal, "withdrawer"[102]).[103][104] Formation Main article: Nebular hypothesis An artist's impression of protoplanetary disk It is not known with certainty how planets are formed. 410 (2): 711–723. ^ Petigura, E. Grazer Morgenlän Symposion (23–27 September 1991). The level of metallicity—an astronomical term describing the abundance of chemical elements with an atomic number greater than 2 (helium)—is now thought to determine the likelihood that a star will have planets.[125] Hence, it is thought that a metal-rich population I star will likely have a more substantial planetary system than a metal-poor, population II star.[126] Supernova remnant ejecta producing planet-forming material. 834 (1): 17. J.; Hubickyj, O.; D'Angelo, G.; Bodenheimer, P. History Further information: History of astronomy, Definition of planet, and Timeline of Solar System astronomy Printed rendition of a geocentric cosmological model from Cosmographia, Antwerp, 1539 The idea of planets has evolved over its history, from the divine lights of antiquity to the earthly objects of the scientific age. doi:10.1006/icar.2002.6830. doi:10.1038/nature10684. You can help. Retrieved 2009-12-30. 628 (2): L159. Bibcode:1998BASI...26...11R. "Discovery of a ~250 K Brown Dwarf at 2 pc from the Sun". S2CID 119216797. J.; Bodenheimer, P. doi:10.1126/science.1155743. pp. 324–7. 558 (7): L7. 129 (1): 518–525. 26: 11–31 [23–4]. News.discovery.com. doi:10.1086/521346. ^ "How Big Is Pluto? (2014), Is Pluto a Planet?: A Historical Journey through the Solar System, Princeton University Press, p. 226, ISBN 978-1400852970 ^ Margot, Jean-Luc; Levison, Hal (2009). Bibcode:1987Icar...69..249L. Retrieved 2016-05-19. ^ Burnet, John (1950). S2CID 247065421. After much debate and one failed proposal, a large majority of those remaining at the meeting voted to pass a resolution. ^ "Minor Planet Naming Guidelines (Rules and Guidelines for naming non-cometary small Solar-System bodies) – v1.0" (PDF). Uranus and Neptune. Introductory Astronomy & Astrophysics (4th ed.). arXiv:astro-ph/0511807. "FAQ - Atmosphere". | Planets". ^ "Should Large Moons Be Called 'Satellite Planets'?". ISBN 978-0-03-006228-5. Planetary Science Research Discoveries. ^ D'Angelo, G.; Weidenschilling, S. G.; Livio, M. W.; Marcy, G. A. (1987). External links Wikimedia Commons has media related to Planets. 31. Retrieved 29 November 2020. ^ Whipple, Fred (1964). 123 (902): 412–422. M., Shemansky D. doi:10.3847/1538-4357/834/1/17. 2007. ^ a b Cassan, Arnaud; D. Retrieved 2011-12-21. ^ a b Sanders, R. I. arXiv:1405.7305. ^ Wolszczan, A. (24 April 2012). ^ Martin, R. Archived from the original on May 5, 2012. (1945). Helsinki University Press. Annu. (2009). "Models of Jupiter's growth incorporating thermal and hydrodynamic constraints". 806 (1): 29pp. The Free Press. doi:10.1086/432834. (2019-04-01). Greek Mythography in the Roman World. (2010). Retrieved 2008-09-18. "Exobiological implications of a possible ammonia-water ocean inside Titan". ^ a b Marley, Mark (2019-04-02). Philosophical Transactions of the Royal Society. CP-2330: 327–347. Finally, during the last stages of planet building, a stochastic process of protoplanetary accretion can randomly alter the spin axis of the planet.[165] There is great variation in the length of day between the planets, with Venus taking 243 days to rotate, and the giant planets only a few hours.[166] The rotational periods of extrasolar planets are not known. Planetary Science Institute. Nature. Because each day was named by the god that started it, this is also the order of the days of the week in the Roman calendar after the Nundinal cycle was rejected – and still preserved in many modern languages.[91] In English, Saturday, Sunday, and Monday are straightforward translations of these Roman names. Moreover, all of them are smaller than Mercury, with Pluto being the largest known dwarf planet, and Eris being the most massive known.[131][132] There are also at least nineteen planetary-mass moons or satellite planets, i.e. moons large enough to take on ellipsoidal shapes. Militzer (2007). Annual Review of Astronomy and Astrophysics. These include hot Jupiters — giant planets that orbit close to their parent stars — like 51 Pegasi b, super-Earths like Gliese 581c that have masses in between that of Earth and Neptune, and planets smaller than Earth like Kepler-20e. "What Is A Planet?". Archived from the original on 2007-09-21. ISBN 978-3-540-28208-2. S2CID 118875902. "A Planet With Planets? The 2006 resolution defines planets within the Solar System as follows:[1]A "planet" [1] is a celestial body inside the Solar System that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit. p. 59. In fact, calculations show that an object fuses 50% of its initial deuterium content when the total mass ranges between 12 and 14 MJ.[56] The amount of deuterium fused depends not only on mass but also on the composition of the object, on the amount of helium and deuterium present.[57] As of 2011 the Extrasolar Planets Encyclopaedia included objects up to 25 Jupiter masses, saying, "The fact that there is no special feature around 13 MJup in the observed mass spectrum reinforces the choice to forget this mass limit".[58] As of 2016 this limit was increased to 60 Jupiter masses[59] based on a study of mass–density relationships.[60] The Exoplanet Data Explorer includes objects up to 24 Jupiter masses with the advisory: "The 13 Jupiter-mass distinction by the IAU Working Group is physically unmotivated for planets with rocky cores, and observationally problematic due to the sin i ambiguity."[61] The NASA Exoplanet Archive includes objects with a mass (or minimum mass) equal to or less than 30 Jupiter masses.[62] Another criterion for separating planets and brown dwarfs, rather than deuterium fusion, formation process or location, is whether the core pressure is dominated by coulomb pressure or electron degeneracy pressure.[63][64] In close binary star systems one of the stars can lose mass to a heavier companion. doi:10.3847/1538-4357/aa961c. 132 (6): 2513–2519. PMID 16591209. Retrieved 11 February 2012. doi:10.1088/0004-637X/727/1/57. (Europa is often considered an icy planet, though, because its surface ice layer makes it difficult to study its interior.)[3][133] Ganymede and Titan are larger than Mercury by radius, and Callisto almost equals it, but all three are much less massive. Yoel Natan. "Kepler: A Search For Habitable Planets – Kepler-20f". p. 519. H. Although the origins of planetary rings is not precisely known, they are believed to be the result of natural satellites that fell below their parent planet's Roche limit and were torn apart by tidal forces.[187][188] No secondary characteristics have been observed around extrasolar planets. Bibcode:2003ApJ...585L.143M. Orcus, Pluto, Haumea, Quaoar, and Makemake orbit in the Kuiper belt, which is a second belt of small Solar System bodies beyond the orbit of Neptune. The accretion of gas by the giant planets can also contribute to the angular momentum. "Explainer: the gods behind the days of the week". Seager. JSTOR 545038. PMID 18369125. doi:10.1086/370729. "Astronomy and Calendars in Ancient Mesopotamia". Dominik; et al. Proceedings of the National Academy of Sciences. The Galileo Project. Robertson, Aryabhata the Elder, MacTutor History of Mathematics archive ^ Sarma, K. ISBN 978-951-570-130-5. doi:10.1016/j.newast.2003.07.002. In ancient times, astronomers noted how certain lights moved across the sky, as opposed to the "fixed stars", which maintained a constant relative position in the sky.[5] Ancient Greeks called these lights πλάνητες ἀστέρες (planētes asteres, "wandering stars") or simply πλανῆται (planētai, "wanderers"),[6] from which today's word "planet" was derived.[7][8][9] In ancient Greece, China, Babylon, and indeed all pre-modern civilizations,[10][11] it was almost universally believed that Earth was the center of the Universe and that all the "planets" circled Earth. ^ a b James Baer, Steven Chesley & Robert Matson (2011) "Astrometric masses of 26 asteroids and observations on asteroid porosity." The Astronomical Journal, Volume 141, Number 5 ^ Donald H. S2CID 119338327. 38 (1): 485–519. Science. arXiv:astro-ph/9510046. (2013-01-01). ^ Trujillo, Chadwick A.; Brown, Michael E. (December 1995). Working Group Small Body Nomenclature. S2CID 16457143. ^ Agnor, C. ^ "IAU: WG Small Body Nomenclature (WGSBN)". (2013). "Model of planetary motion in the works of Kerala astronomers". Thus the Earth was added to the roster of planets[31] and the Sun was removed. Flora is the parent body of the Flora family of asteroids, and by far the largest member, comprising about 80% of the total mass of this family. 635 (1): L93. D.; Schmeer, P.; Börngen, F. pp. 195–206. ISBN 0-395-34835-8. doi:10.1051/0004-6361/201116713. Single and multiple planets could be captured into arbitrary unaligned orbits, non-coplanar with each other or with the stellar host spin, or pre-existing planetary system.[71] 2006 IAU definition of planet Euler diagram showing the types of bodies in the Solar System. doi:10.1126/science.1139415. Bibcode:2002ApJ...566L.125T. (2018). "Not a Heart of Ice". S2CID 119102654. Their definition dropped to the eight significantly larger bodies that had cleared their orbit (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune), and a new class of dwarf planets was created, initially containing three objects (Ceres, Pluto and Eris).[47] This definition has not been universally accepted. 727 (1): 57. Bibcode:2005ApJ...628L.159W. 37 (1): 533–602. ^ Whitney Clavin (2005-11-29). ^ a b Torppa, Johanna; Kaasalainen, Mikko; Michalowski, Tadeusz; Kwiatkowski, Tomasz; Kryszczynska, Agnieszka; Denchev, Peter; et al. S2CID 119114880. Further monitoring found the body was actually much smaller: in 1936, Ray Lyttleton suggested that Pluto may be an escaped satellite of Neptune,[38] and Fred Whipple suggested in 1964 that Pluto may be a comet.[39] As it was still larger than all known asteroids and the population of dwarf planets and other trans-Neptunian objects was not well observed,[40] it kept its status until 2006.[41] In 1992, astronomers Aleksander Wolszczan and Dale Frail announced the discovery of planets around a pulsar, PSR B1257+12.[42] This discovery is generally considered to be the first definitive detection of a planetary system around another star. 116 ^ a b Ramasubramanian, K. arXiv:0810.5186. The oldest surviving planetary astronomical text is the Babylonian Venus tablet of Ammisaduqa, a 7th-century BC copy of a list of observations of the motions of the planet Venus, that probably dates as early as the second millennium BC.[14] The MUL.APIN is a pair of cuneiform tablets dating from the 7th century BC that lays out the motions of the Sun, Moon, and planets over the course of the year.[15] The Babylonian astrologers also laid the foundations of what would eventually become Western astrology.[16] The Enuma anu enlil, written during the Neo-Assyrian period in the 7th century BC,[17] comprises a list of omens and their relationships with various celestial phenomena including the motions of the planets.[18][19] Venus, Mercury, and the outer planets Mars, Jupiter, and Saturn were all identified by Babylonian astronomers. University of Arizona Press. ^ Green, D. Bibcode:2011A&A...532A..79S. ^ a b Margot, Jean-Luc (2015). ^ Peale, S. Royal Society and Royal Astronomical Society. . For instance, the Babylonian Nergal was a god of war, and thus the Greeks identified him with Ares. S2CID 1220226. "Kepler discovers first Earth-sized exoplanets". Astronomy & Astrophysics. 2008-09-20. These would remain the only known planets until the invention of the telescope in early modern times.[20] Greco-Roman astronomy See also: Greek astronomy Ptolemy's 7 planetary spheres 1 Moon 2 Mercury 3 Venus 4 Sun 5 Mars 6 Jupiter 7 Saturn The ancient Greeks initially did not attach as much significance to the planets as the Babylonians. doi:10.1088/2041-8205/786/2/L18. ^ chuang (2012-06-06). "One or more bound planets per Milky Way star from microlensing observations". J.; Smalley, B.; Hebb, L.; Collier Cameron, A.; Maxted, P. The varying amount of light and heat received by each hemisphere creates annual changes in weather patterns for each half of the planet. ^ "The Origin and Early Development of the Nine Planetary Deities (Navagraha). May 14, 2010. "Planetary Magnetospheres". ^ "NASA discovery doubles the number of known planets". Bibcode:1995P&SS...43.1517P. Jupiter is the largest, at 318 Earth masses, whereas Mercury is the smallest, at 0.055 Earth masses.[127] The planets of the Solar System can be divided into categories based on their composition. p. 100. ^ "Pluto Facts | Atmosphere, Surface, Moons, Information, History & Definition". A planet is a large astronomical body that is neither a star nor a stellar remnant. OCLC 227002144. hdl:2060/19870013947. (April 2021) A planet's size is defined at least by an average radius (e.g., Earth radius, Jupiter radius, etc.); polar and equatorial radii of a spheroid or more general triaxial ellipsoidal shapes are often estimated (e.g., reference ellipsoid). doi:10.1088/0004-637X/709/1/159. M. Each planet has two in the course of its orbit; when one hemisphere has its summer solstice, when its day is longest, the other has its winter solstice, when its day is shortest. An example is a Jupiter-mass object orbiting the pulsar PSR J1719-1438.[65] These shrunken white dwarfs may become a helium planet or carbon planet.[66] A 2016 study suggests that when classified by mass and radius, brown dwarfs are indistinguishable from high-mass planets, and that a change happens only with the onset of hydrogen burning at about 0.080 ± 0.008 M☉, when the object becomes a red dwarf.[67] Several computer simulations of stellar and planetary system formation have suggested that some objects of planetary mass would be ejected into interstellar space.[68] Such objects are typically called rogue planets or free-floating planets.[69] Sub-brown dwarfs might be considered as rogue planets, or they might be considered as planetary-mass brown dwarfs.[70] Rogue planets in stellar clusters have similar velocities to the stars and so can be recaptured. Bibcode:2007Natur.445..511B. In the Solar System, the reference plane is the plane of Earth's orbit, called the ecliptic. New York: Chelsea House. (2014). U.S. Naval Observatory. "The IAU working definition of an exoplanet". The planets in the Solar System have very low eccentricities, and thus nearly circular orbits.[154] Comets and Kuiper belt objects (as well as several extrasolar planets) have very high eccentricities, and thus exceedingly elliptical orbits.[156][157] Illustration of the semi-major axis The semi-major axis is the distance from a planet to the half-way point along the longest diameter of its elliptical orbit (see image). 1543 to 1610 1 Mercury 2 Venus 3 Earth 4 Moon 5 Mars 6 Jupiter 7 Saturn See also: Heliocentrism With the advent of the Scientific Revolution and the heliocentric model of Copernicus, Galileo and Kepler, use of the term "planet" changed from something that moved around the sky relative to the fixed star to a body that orbited the Sun, directly (a primary planet) or indirectly (a secondary or satellite planet). Springer New York. 274 (5): 46–52. Oriental Translation Fund of Great Britain and Ireland – via Google Books. 110 (48): 19273–19278. Greek philosophy: Thales to Plato. S2CID 7051928. "CFBDSIR2149-0403: a 4–7 Jupiter-mass free-floating planet in the young moving group AB Doradus ?". So complete was the domination of Ptolemy's model that it superseded all previous works on astronomy and remained the definitive astronomical text in the Western world for 13 centuries.[14][22] To the Greeks and Romans there were seven known planets, each presumed to be circling Earth according to the complex laws laid out by Ptolemy. ^ Johnson, Michele; Harrington, J.D. (February 26, 2014). Objects beyond Neptune follow various naming conventions depending on their orbits: those in the 2:3 resonance with Neptune (the plutinos) are given names from underworld myths, while others are given names from creation myths.[87][88] The moons (including the planetary-mass ones) are generally given names with some association with their parent planet. After initial observations led to the belief that it was larger than Earth,[37] the object was immediately accepted as the ninth major planet. doi:10.1016/j.newar.2022.101641. ^ Sykes, Mark V. ^ Schneider, J.; Dedieu, C.; Le Sidaner, P.; Savalle, R.; Zolotukhin, I. "On the formation and evolution of asteroid belts and their potential significance for life". ^ Gefter, Amanda (2004-01-17). In 2003, the International Astronomical Union (IAU) Working Group on Extrasolar Planets issued a position statement, but this position statement was never proposed as an official IAU resolution and was never voted on by IAU members. ^ "Planets – Kuiper Belt Objects". arXiv:1311.6806. Solar System Solar System – sizes but not distances are to scaleThe Sun and the eight planets of the Solar SystemThe inner planets, Mercury, Venus, Earth, and MarsThe four giant planets Jupiter, Saturn, Uranus, and Neptune against the Sun and some sunspots Main article: Solar System See List of gravitationally rounded objects of the Solar System for references for the data presented. 107 (1): 93–96. British Broadcasting Corporation. Dwarf planets had been proposed as a category of small planet (as opposed to planetoids as sub-planetary objects), and planetary geologists continue to treat them as planets despite the IAU definition.[48] The number of dwarf planets even among known objects is not certain, but there is general consensus on Ceres in the asteroid belt and on at least eight trans-Neptunians: Quaoar, Sedna, Orcus, Pluto, Haumea, Eris, Makemake, and Gonggong.[49] Planetary geologists also typically include the nineteen known planetary-mass moons as "satellite planets", including Earth's Moon, like the early modern astronomers.[50] Some go even further and include relatively large, geologically evolved bodies that are nonetheless not very round today, such as Pallas and Vesta, though not all planetary geologists do so.[3] Extrasolar planets There is no official definition of extrasolar planets. 18 (1): 77–113. ^ J. (2001). ^ Kuhn, Thomas S. arXiv:1504.04364. "The Drake Equation Revisited". ^ Zeilik, Michael A.; Gregory, Stephan A. The terrestrial planets have cores of elements such as iron and nickel, and mantles of silicates. S2CID 162347339. Journal of the Royal Astronomical Society of Canada. arXiv:1012.5676. "Deuterium Burning in Massive Giant Planets and Low-mass Brown Dwarfs Formed by Core-nucleated Accretion". (1984). (Volumes I and II) - ProQuest". ^ Lambert, W. ^ a b Goldstein, Bernard R. Bibcode:1984NASCP2330..327B. The Biographical Encyclopedia of Astronomers. Derived quantities include the flattening, surface area, and volume. The Solar System (Third ed.). A net angular momentum can be induced by the individual angular momentum contributions of accreted objects. Knowing further the rotation rate and mass, allows the calculation of normal gravity.[169] Mass Main article: Planetary mass A planet's defining physical characteristic is that it is massive enough for the force of its own gravity to dominate over the electromagnetic forces binding its physical structure, leading to a state of hydrostatic equilibrium. (2022-06-01). "The Kuiper Belt". ^ D'Angelo, G.; Durisen, R. ISSN 0004-6361. arXiv:1006.5486. (21 April 2014). JPL, NASA. 3. Grazer Morgenländischen Symposion [Third Graz Oriental Symposium]. Nevertheless, Flora was almost certainly disrupted by the impact(s) that formed the family, and is probably a gravitational aggregate of most of the pieces.[citation needed] Flora's spectrum indicates that its surface composition is a mixture of silicate rock (including pyroxene and olivine) and nickel-iron metal. The Friesian School. Bibcode:2013ApJ...770..120B. The capture efficiency decreases with increasing cluster volume, and for a given cluster size it increases with the host/primary mass. 562–612 ^ Sheppard, S. doi:10.1016/0032-0633(95)00061-5. "Rotation of Venus: Period Estimated from Radar Measurements". 277 (1/2): 293–300. lasp.colorado.edu. PMID 11536547. "TU Leonis = (8) Flora: the non-existence of a U Geminorum star". arXiv:astro-ph/0608417. Martian Metamorphoses: The planet Mars in ancient myth and tradition. D.; Bhalerao, V.; Bhat, N. Hind on 18 October 1847. Journal of Near Eastern Studies. ^ a b Frautschi, Steven C.; Olenick, Richard P.; Apostol, Tom M.; Goodstein, David L. "Interactive Extra-solar Planets Catalog". "The Pluto system: Initial results from its exploration by New Horizons". doi:10.1016/j.icarus.2014.06.029. "Two Earth-Size Planets Are Discovered". This means, they always show one face to their stars, with one side in perpetual day, the other in perpetual night.[167] Orbital clearing Main article: Clearing the neighbourhood The defining dynamic characteristic of a planet, according to the IAU definition, is that it has cleared its neighborhood. Bibcode:2014Icar..241..298D. Jeffrey (31 December 1998). Retrieved 7 November 2013. ^ Petigura, E. hdl:10871/16060. ^ Fred Espenak. 2006. ^ Richard P. pp. 296–297. S2CID 126574999. The minimum mass/size required for an extrasolar object to be considered a planet should be the same as that used in our Solar System.[52] The IAU noted that this definition could be expected to evolve as knowledge improves.[52] One definition of a sub-brown dwarf is a planet-mass object that formed through cloud collapse rather than accretion. S2CID 40225801. Bibcode:2013A&A...558L...7J. doi:10.2307/602955. PMID 17569855. 40 (2): 135–137. Sizes are not to scale. According to the best available theory, planets form when a nebula collapses to create a protostar and a surrounding protoplanetary disk, in which planets grow by the process of accretion. Earth is the largest terrestrial planet.[128] Giant planets are significantly more massive than the terrestrials: Jupiter, Saturn, Uranus, and Neptune.[128] They also differ from the terrestrial planets in composition. "The Earth's core formation due to the Rayleigh-Taylor instability". (23–27 September 1991). As described by astronomer Steven Soter: The end product of secondary disk accretion is a small number of relatively large bodies (planets) in either non-intersecting or resonant orbits, which prevent collisions between them. arXiv:0705.0993. Retrieved 2022-05-05. The other days were renamed after Tīw (Tuesday), Wōden (Wednesday), Þunor (Thursday), and Frīġ (Friday), the Anglo-Saxon gods considered similar or equivalent to Mars, Mercury, Jupiter, and Venus, respectively.[92] Earth is the only planet whose name in English is not derived from Greco-Roman mythology. The planetary-mass moons of Jupiter are named after four of Zeus' lovers (or other sexual partners); those of Saturn are named after Cronus' brothers and sisters, the Titans; those of Uranus are named after characters from Shakespeare and Pope (originally specifically from fairy mythology, befitting Uranus as god of the sky and air, but that ended with the naming of Miranda). arXiv:0812.4995. 548: A26. "The Deuterium-Burning Mass Limit for Brown Dwarfs and Giant Planets". R.; et al. doi:10.1038/nature04792. The larger giant planets are massive enough to keep large amounts of the light gases hydrogen and helium, whereas the smaller planets lose these gases into space.[176] The composition of Earth's atmosphere is different from the other planets because the various life processes that have transpired on the planet have introduced free molecular oxygen.[177] Planetary atmospheres are affected by the varying insolation or internal energy, leading to the formation of dynamic weather systems such as hurricanes (on Earth), planet-wide dust storms (on Mars), a greater-than-Earth-sized anticyclone on Jupiter (called the Great Red Spot), and holes in the atmosphere (on Neptune).[160] At least one extrasolar planet, HD 189733 b, has been claimed to have such a weather system, similar to the Great Red Spot but twice as large.[178] Hot Jupiters, due to their extreme proximities to their host stars, have been shown to be losing their atmospheres into space due to stellar radiation, much like the tails of comets.[179][180] These planets may have vast differences in temperature between their day and night sides that produce supersonic winds,[181] although the day and night sides of HD 189733 b appear to have very similar temperatures, indicating that that planet's atmosphere effectively redistributes the star's energy around the planet.[178] Magnetosphere Main article: Magnetosphere Earth's magnetosphere (diagram) One important characteristic of the planets is their intrinsic magnetic moments, which in turn give rise to magnetospheres. ^ A. You can help by adding to it. doi:10.1006/icar.2000.6400. Circular No. 8747. This distance is not the same as its apastron, because no planet's orbit has its star at its exact centre.[154] The inclination of a planet tells how far above or below an established reference plane its orbit lies. Enuma Anu Enlil, Tablet 63: The Venus Tablet of Ammisaduqa. Cambridge [Cambridgeshire]: Cambridge University Press. "Historical Encyclopaedia: Entitled "Meadows of gold and mines of gems"". Retrieved 2011-12-20. 810 (2): L25. ^ a b Hilton, James L. ^ "Planets and Pluto: Physical Characteristics". Astrobiology Magazine. Bibcode:1999JRASC..93..122F. Bibcode:2008ASPC..398....3W. "Planetesimals to Brown Dwarfs: What is a Planet?" (PDF). Multiple cultures identified celestial bodies visible to the naked eye with gods, and these connections with mythology and folklore persist in the schemes for naming newly-discovered Solar System bodies. Protoplanets that have avoided collisions may become natural satellites of planets through a process of gravitational capture, or remain in belts of other objects to become either dwarf planets or small bodies.[120][121] The energetic impacts of the smaller planetesimals (as well as radioactive decay) will heat up the growing planet, causing it to at least partially melt. 193 (2): 475–484. "Babylonian Observational Astronomy". The Romans, who, like the Greeks, were Indo-Europeans, shared with them a common pantheon under different names but lacked the rich narrative traditions that Greek poetic culture had given their gods. Beaulieu; M. The Los Angeles Times. doi:10.1126/science.11536547. The Babylonians named Phosphoros [Venus] after their goddess of love, Ishtar; Pyroeis [Mars] after their god of war, Nergal, Stilbon [Saturn] after their god of wisdom Nabu, and Phaethon [Jupiter] after their chief god, Marduk.[84] There are too many concordances between Greek and Babylonian naming conventions for them to have arisen separately.[14] The translation was not perfect. phl.upr.edu. Kouwenhoven, 2012 ^ Rincon, Paul (2006-08-16). Publications of the Astronomical Society of the Pacific. Whitney Clavin (2005-11-29). ^ Hermann Hunger, ed. S2CID 119111221. ^ "Extrasolar Planets". Bodies that fulfill the first two conditions but not the third (such as Ceres, Pluto, and Eris) are classified as dwarf planets, provided they are not also natural satellites of other planets. The planets of the Solar System, including Earth, each rotate around an axis tilted with respect to its orbital pole, and some share such features as ice caps and seasons. doi:10.1146/annurev.earth.34.031405.125058. Bibcode:2009Icar..199..338L. Oxford University Press. Spitzer Finds Cosmic Oddball". They have a significantly lower mass than the gas giants (only 14 and 17 Earth masses).[129] The number of geophysical planets in the Solar System is unknown – previously considered to be potentially in the hundreds, but now only estimated at only the low double digits.[130] These include the eight classical planets, as well as two more populations. ^ a b Stieglitz, Robert (Apr 1981). 97 (2): 108–115. A.; Dunn, D. V. Ibn Sīnā: Abū ʿAlī al-Ḥusayn ibn ʿAbdallāh ibn Sīnā. Up to a certain mass, an object can be irregular in shape, but beyond that point, which varies depending on the chemical makeup of the object, gravity begins to pull an object towards its own centre of mass until the object collapses into a sphere.[170] Mass is also the prime attribute by which planets are distinguished from stars. "A Jupiter-mass companion to a solar-type star". "Origin and Evolution of the Natural Satellites". Also included are Neptune's moons Proteus and Nereid, as they are similar in size to Saturn's smallest round moon Mimas, although Proteus is known not to be round and smaller Nereid is not expected to be round either. ^ a b Belton, M. In addition, the giant planets bear planetary rings, the most prominent being those of Saturn. doi:10.1093/mnrasl/sls003. Physics and Chemistry of the Solar System (2nd ed.). X.; McMillan, S. 1038-1040. The History and Practice of Ancient Astronomy. Originally an IAU committee had proposed a definition that would have included a much larger number of planets as it did not include (c) as a criterion.[72] After much discussion, it was decided via a vote that those bodies should instead be classified as dwarf planets.[73] This definition is based in theories of planetary formation, in which planetary embryos initially clear their orbital neighborhood of other smaller objects. Although objects more massive than 75 times that of Jupiter fuse simple hydrogen, objects of 13 Jupiter masses can fuse deuterium. Bibcode:1995Natur.378..355M. J.; Lissauer, J. doi:10.1051/0004-6361/201322432. Exoplanets. doi:10.1038/378355a0. (ed.). (a) Find absolute values in article Earth Exoplanets Main article: Exoplanet Exoplanets, by year of discovery, through September 2014. Bibcode:2000eaa..bookE3736.. This is adopted as the hallmark of planethood by geophysical definitions, for example:[79] a substellar-mass body that has never undergone nuclear fusion and has enough gravitation to be round due to hydrostatic equilibrium, regardless of its orbital parameters.[80] In the Solar System, this mass is generally less than the mass required for a body to clear its orbit, and thus some objects that are considered "planets" under geophysical definitions are not considered as such under the IAU definition, such as Ceres and Pluto.[3] Proponents of such definitions often argue that location should not matter and that planethood should be defined by the intrinsic properties of an object.[3] Geophysical definitions also often do not require planets to orbit stars, so that round satellites such as our moon or Jupiter's Galilean moons are also considered planets.[3] They are then sometimes called "satellite planets".[81] Some other words have been used for the bodies meeting geophysical definitions of "planet", such as "planetary-mass object", "planemo",[82] or "world".[83] Mythology and naming See also: Weekday names and Naked-eye planet The Greek gods of Olympus, after whom the Solar System's Roman names of the planets are derived The names for the planets in the Western world are derived from the naming practices of the Romans, which ultimately derive from those of the Greeks and the Babylonians. Bibcode:2007Sci...316.1585B. It is the innermost large asteroid: no asteroid closer to the Sun has a diameter above 25 kilometres (20% that of Flora), and not until 20-km 149 Medusa was discovered was an asteroid known to orbit at a closer mean distance.[8] It is the seventh-brightest asteroid with a mean opposition magnitude of +8.7.[9] Flora can reach a magnitude of +7.9 at a favorable opposition near perihelion, such as occurred in November 2007. 2019-09-25. ^ a b c Schmadel, L. ^ Meyers, Carol L.; O'Connor, M.; O'Connor, Michael Patrick (31 July 1983). PMC 300311. B. doi:10.1016/0019-1035(87)90103-5. Planetary and Space Science. Bibcode:2015ApJ...810L..25H. Retrieved 1 October 2011. ^ D. Historically, planets have had religious associations. doi:10.1016/S0032-0633(00)00039-8. The smallest known planet orbiting a main-sequence star other than the Sun is Kepler-37b, with a mass (and radius) that is probably slightly higher than that of the Moon.[149] Internal differentiation Main article: Planetary differentiation Illustration of the interior of Jupiter, with a rocky core overlaid by a deep layer of metallic hydrogen Every planet began its existence in an entirely fluid state; in early formation, the denser, heavier materials sank to the centre, leaving the lighter materials near the surface. ^ Delorme, P.; et al. ISSN 0036-8075. 532 (79): A79. Of the magnetized planets the magnetic field of Mercury is the weakest, and is barely able to deflect the solar wind. The catalog of Kepler candidate planets consists mostly of planets the size of Neptune and smaller, down to smaller than Mercury.[149] There are types of planets that do not exist in the Solar System: super-Earths and mini-Neptunes, which could be rocky like Earth or a mixture of volatiles and gas like Neptune—the dividing line between the two is currently thought to occur at about twice the mass of Earth.[67] There are hot Jupiters that orbit very close to their star and may evaporate to become chthonian planets, which are the leftover cores. 2017-08-07. ^ Bailes, M.; Bates, S. S2CID 18688556. ^ a b Johnson, Michele (20 December 2011). ^ "Pluto loses status as a planet". Observational mishap During an observation on 25 March 1917, 8 Flora was mistaken for the 15th-magnitude star TU Leonis, which led to that star's classification as a U Geminorum cataclysmic variable star.[12] Flora had come to opposition on 1917 February 13, 40 days earlier.[12] This mistake was uncovered only in 1995.[12][13] Occultation On 26 July 2013, Flora at magnitude 8.8 occulted the star 2UCAC 22807162 over parts of South America, Africa, and Asia.[14] Popular culture In the 1968 science-fiction film The Green Slime, an orbital perturbation propels the asteroid Flora into a collision course with Earth. ^ Ali-Abu'l-Hassan, Mas'ûdi (31 July 2018). doi:10.1126/science.139.3558.910. New Horizons Settles Decades-Long Debate". E., Morgan T. Bibcode:2007Natur.447..183K. "Obliquity Tides on Hot Jupiters". "Enhanced Collisional Growth of a Protoplanet that has an Atmosphere". Many moons of the giant planets have features similar to those on the terrestrial planets and dwarf planets, and some have been studied as possible abodes of life (especially Europa).[184][185][186] The four giant planets are also orbited by planetary rings of varying size and complexity. This characteristic was mandated as part of the IAU's official definition of a planet in August 2006. ^ Zarka, Philippe; Treumann, Rudolf A.; Ryabov, Boris P.; Ryabov, Vladimir B. "The Hebrew names of the seven planets". doi:10.1126/science.1133904. Bibcode:1963Sci...139..910G. "Babylonian Planetary Omens. 211: 529. ^ "Simpler way to define what makes a planet". "Planetary Taxonomy" (PDF). (2008). Multiple exoplanets have been found to orbit in the habitable zones of their respective stars, but Earth remains the only planet known to support life. Online Etymology Dictionary. ISBN 978-0-9656229-0-5. "Die Rolle der Astronomie in den Kulturen Mesopotamiens" [The role of astronomy in the cultures of the Mesopotamians]. ^ a b Administrator, NASA Content (2015-04-17). IAU Circular. doi:10.1093/mnras/97.2.108. This causes the amount of light received by each hemisphere to vary over the course of its year; when the northern hemisphere points away from its star, the southern hemisphere points towards it, and vice versa. ^ Stern, S.A.; Bagenal, F.; Ennico, K.; Gladstone, G.R.; Grundy, W.M.; McKinnon, W.B.; Moore, J.M.; Olkin, C.B.; Spencer, J.R. (16 Oct 2015). 164 (2): 346–383. (2007-07-12). astronomynotes.com. USA TODAY. ^ a b Measured relative to Earth. "Etymology of "terrain"". The geocentric system remained dominant until the Scientific Revolution.[13] By the 1st century BC, during the Hellenistic period, the Greeks had begun to develop their own mathematical schemes for predicting the positions of the planets. Jupiter 11.209 317.83 5.20 11.86 6.09 0.048 0.41 80 3.12 yes H2, He 6. doi:10.1888/0333750888/3736. With the development of the telescope, the meaning of "planet" broadened to include objects only visible to the naked eye: the ice giants Uranus and Neptune; Ceres and other bodies later recognized to be part of the asteroid belt; and Pluto, later found to be the largest member of the collection of icy bodies known as the Kuiper belt. "Copernican System". Retrieved 2011-12-23. doi:10.1088/0004-6256/150/6/185. Bibcode:2002Icar..157..155N. Bibcode:2011PASP..123..412W. J.; Enoch, B.; Horne, K.; Lister, T. Neptune's planetary-mass moon Triton is named after the god's son; Pluto's planetary-mass moon Charon is named after the ferryman of the dead, who carries the souls of the newly deceased to the underworld (Pluto's domain).[89] Some Romans, following a belief possibly originating in Mesopotamia but developed in Hellenistic Egypt, believed that the seven gods after whom the planets were named took hourly shifts in looking after affairs on Earth. (April 2022) The eight known planets of the Solar System, according to the IAU definition: The terrestrial planets Mercury, Venus, Earth, and Mars The giant planets Jupiter and Saturn (gas giants) Uranus and Neptune (ice giants) Shown in order from the Sun and in true color. Bulletin of the American Astronomical Society. ISBN 0-8165-1123-3 ^ The Brightest Asteroids (archived) ^ Gaffey, Michael (1984). (2008-12-30). "Prevalence of Earth-size planets orbiting Sun-like stars". The team hypothesized that the planet's magnetosphere was transferring energy onto the star's surface, increasing its already high 7,760 °C temperature by an additional 400 °C.[183] Secondary characterisitcs Main articles: Natural satellite and Planetary ring The rings of Saturn Several planets or dwarf planets in the Solar System (such as Neptune and Pluto) have orbital periods that are in resonance with each other or with smaller bodies. Icarus. Boston, MA: Houghton Mifflin. ^ Mayor, Michel; Queloz, Didier (1995). The rings are composed primarily of dust or particulate matter, but can host tiny 'moonlets' whose gravity shapes and maintains their structure. (August 1996). "Hubble Probes Layer-cake Structure of Alien World's Atmosphere" (Press release). "Mass-Radius Relationships for Solid Exoplanets". S2CID 18116542. This effectively means that all planets are spherical or spheroidal. (1993). Retrieved 2011-10-23. (A94-12726 02–90) (1): 129–174. T.; et al. They were called "asteroid" because even in the largest telescopes they resembled stars, without a resolvable disk.[35] Major planets, 1854–1930 1 Mercury 2 Venus 3 Earth 4 Mars 5 Jupiter 6 Saturn 7 Uranus 8 Neptune The situation was stable for four decades, but in the mid-1840s several additional asteroids were discovered (Astraea in 1845, Hebe in 1847, Iris in 1847, Flora in 1848, Metis in 1848, and Hygeia in 1849), and soon new "planets" were discovered every year. pp. 388–390. 350 (6258): aad1815. Mimas is the smallest object generally agreed to be a geophysical planet, at about six millionths of Earth's mass, though there are many larger bodies that may not be geophysical planets (e.g. Salacia).[48] Planetary attributes Comparison of the rotation period (sped up 10 000 times, negative values denoting retrograde), flattening and axial tilt of the planets and the Moon (SVG animation) Name Equatorialdiameter[b] Mass[b] Semi-major axis (AU) Orbital period(years) Inclinationto Sun's equator (°) Orbitaleccentricity Rotation period(days) Confirmedmoons Axial tilt (°) Rings Atmosphere 1. dictionary.com. The Extrasolar Planets Encyclopaedia. Ceres, Orcus, Pluto, and Eris continued the Roman and Greek scheme; however, the other consensus dwarf planets are named after gods and goddesses from other cultures (e.g. Quaoar is named after a Tongva god). Liddell, Henry George; Scott, Robert; A Greek–English Lexicon at the Perseus Project. Archived from the original on 2007-11-25. "17. ^ a b Overbye, Dennis (20 December 2011). Bibcode:1980ARA&A..18...77W. S2CID 118522228. doi:10.1086/374406. ISBN 978-0-521-71590-4. Mercury 0.383 0.06 0.39 0.24 3.38 0.206 58.65 0 0.10 no minimal 2. 28 (1): 1–12. Jupiter and Saturn. Rice University. doi:10.1088/0004-637X/770/2/120. ^ a b Schneider, Jean (16 January 2013). (1996). Uranus 4.007 14.54 19.19 84.02 6.48 0.047 −0.72 27 97.86 yes H2, He, CH4 8. Nine objects are generally agreed to be dwarf planets, with some others being disputed candidates. The announcement of Eris in 2005, an object 27% more massive than Pluto, created the impetus for an official definition of a planet.[45] To acknowledge the problem, the IAU set about creating the definition of planet, and produced one in August 2006. Extreme Solar Systems. doi:10.1073/pnas.1319909110. arXiv:1108.5201. Brown Dwarfs. Archived from the original on 2007-12-14. arXiv:1506.05097. S2CID 2614136. PMID 22237108. India uses a system based on the Navagraha, which incorporates the seven traditional planets (Surya for the Sun, Chandra for the Moon, Budha for Mercury, Shukra for Venus, Mangala for Mars, Bṛhaspati for Jupiter, and Shani for Saturn) and the ascending and descending lunar nodes Rahu and Ketu.[96] China and the countries of eastern Asia historically subject to Chinese cultural influence (such as Japan, Korea and Vietnam) use a naming system based on the five Chinese elements: water (Mercury), metal (Venus), fire (Mars), wood (Jupiter) and earth (Saturn).[91] In traditional Hebrew astronomy, the seven traditional planets have (for the most part) descriptive names – the Sun is חמה Ḥammah or "the hot one," the Moon is לבנה Levanah or "the white one," Venus is כוכב נוגה Kokhav Nogah or "the bright planet," Mercury is כוכב Kokhav or "the planet" (given its lack of distinguishing features), Mars is מאדים Ma'adim or "the red one," and Saturn is שבתאי Shabbatai or "the resting one" (in reference to its slow movement compared to the other visible planets).[97] The odd one out is Jupiter, called צדק Tzedeq or "justice". ^ Spiegel; Adam Burrows; Milsom (2010). "Astronomy Before the Telescope". arXiv:astro-ph/0503568. The presence of a magnetic field indicates that the planet is still geologically alive. ISBN 978-0-12-088589-3. Hier-Majumder; B. (1997). ^ "Should Large Moons Be Called 'Satellite Planets'?". "Origin of the Earth and Moon". Part One. Flora, and the whole Flora family generally, are good candidates for being the parent bodies of the L chondrite meteorites.[11] This meteorite type comprises about 38% of all meteorites impacting the Earth. 16: 7–35. 355 (6356): 145–147. Encyclopaedia of Islam (Second ed.) – via referenceworks.brillonline.com. California Institute of Technology. Perets, M. International Astronomical Union. (2005). Harvard University Press. Mercury, the closest planet to the Sun at 0.4 AU, takes 88 days for an orbit, but the shortest known orbits for exoplanets take only a few hours, see Ultra-short period planet. NASA (Press release). The Outer Worlds; Uranus, Neptune, Pluto, and Beyond. PMID 17495920. ^ Lewis, John S. The Copernican Revolution. Graz, Austria: GrazKult (published 31 July 1993). The Greeks retain their original name, Γῆ (Ge).[95] Non-European cultures use other planetary-naming systems. While the lower stellar mass limit is estimated to be around 75 times that of Jupiter (MJ), the upper planetary mass limit for planethood is only roughly 13 MJ for objects with solar-type isotopic abundance, beyond which it achieves conditions suitable for nuclear fusion. Retrieved 2008-02-02. ISBN 9780931464195 – via Google Books. ^ Molnar, L. arXiv:0706.1684 [astro-ph]. 0%(1)0% found this document useful (1 vote)447K views7,794 pages, active Astronomical object This article is about the astronomical object. In Lucyann Mcfadden; Paul Weissman; Torrence Johnson (eds.). Eisenbrauns. "Astronomical names for the days of the week". Celestial Mechanics. S2CID 16301955. Bibcode:1995PhDT.........D. During the later period of the Roman Republic, Roman writers borrowed much of the Greek narratives and applied them to their own pantheon, to the point where they became virtually indistinguishable.[86] When the Romans studied Greek astronomy, they gave the planets their own gods' names: Mercurius (for Hermes), Venus (Aphrodite), Mars (Ares), Iuppiter (Zeus) and Saturnus (Cronus). (June 15, 2007). doi:10.1086/177027. Retrieved September 27, 2015. Kuchner; C. 319 (5871): 1765. Although modern Greeks still use their ancient names for the planets, other European languages, because of the influence of the Roman Empire and, later, the Catholic Church, use the Roman (Latin) names rather than the Greek ones. "Planets plan boosts tally 12". Retrieved 2008-01-28. ^ a b c d e "Working Group on Extrasolar Planets (WGESP) of the International Astronomical Union". ^ S. doi:10.1038/nature05782. Saturn is one third as massive as Jupiter, at 95 Earth masses.[129] The Ice giants, Uranus and Neptune, are primarily composed of low-boiling-point materials such as water, methane, and ammonia, with thick atmospheres of hydrogen and helium. Bibcode:2013PNAS..11019273P. doi:10.1146/annurev.astro.37.1.533. Razaullah Ansari (2002). Retrieved 9 February 2022. 2015-11-10. doi:10.1016/j.icarus.2008.10.004. 585 (2): L143–L146. www.yourdictionary.one. ^ Jason T Wright; Onsi Fakhouri; Marcy; Eunkyu Han; Ying Feng; John Asher Johnson; Howard; Fischer; Valenti; Anderson, Jay; Piskunov, Nikolai (2010). History of oriental astronomy: proceedings of the joint discussion-17 at the 23rd General Assembly of the International Astronomical Union, organised by the Commission 41 (History of Astronomy), held in Kyoto, August 25–26, 1997. 314 (5799): 623–6. Retrieved 2013-01-15. Planetary Science Research Discoveries (educational site with illustrated articles) The Planets, BBC Radio 4 discussion with Paul Murdin, Hugh Jones & Carolin Crawford (In Our Time, May 27, 2004) Portals:StarsSpaceflightOuter space Retrieved from " 2Large main-belt asteroid 8 Flora DiscoveryDiscovered byJ.R. HindDiscovery date18 October 1847DesignationsMPC designation(8) FloraPronunciation/ˈflɔːrə/Named afterFlōraMinor planet categoryMain belt (Flora family)AdjectivesFlorian /ˈflɔːriən/Orbital characteristics[1]Epoch 26 November 2005 (JD 2453700.5)Aphelion380.850 Gm (2.546 AU)Perihelion277.995 Gm (1.858 AU)Semi-major axis329.422 Gm (2.202 AU)Eccentricity0.1561Orbital period (sidereal)1193.549 d (3.27 a)Mean anomaly156.4°Inclination5.886°Longitude of ascending node111.0°Argument of perihelion285.1°Proper orbital elements[2]Proper semi-major axis2.2014 AUProper eccentricity0.1449Proper inclination5.574°Proper mean motion110.2 deg / yrProper orbital period3.26679 yr(1193.194 d)Precession of perihelion32.017 arcsec / yrPrecession of the ascending node−35.51 arcsec / yrPhysical characteristicsDimensionsc/a = 0.82±0.05[3]136 km × 136 km × 113 km[4]145 km × 145 km × 120 km[5]Mean diameter146±2 km[3] 128 km[4]Mass(4±1.6)×1018 kg[3] (6.62±0.84)×1018 kg[a][6]Mean density2.4±1.0 g/cm3[3]3.04±1.39 g/cm3[6]Synodic rotation period0.533 d (12.799 h)[1]Geometric albedo0.224 (calculated)[3]0.243[1]Spectral typeS[1]Apparent magnitude7.9[7] to 11.6Absolute magnitude (H)6.49[1]Angular diameter0.21" to 0.053" Flora (minor planet designation: 8 Flora) is a large, bright main-belt asteroid. PMC 3845182. ISBN 978-0-8165-2844-8. Bibcode:1996SciAm.274e..46L. "NASA's Kepler Mission Announces a Planet Bonanza, 715 New Worlds". Retrieved 2011-07-05. The Scientific Papers of Sir William Herschel. ^ Ross, Kelley L. Menzel & Jay M. ^ Thérèse, Encrenaz (2004). NASA Solar System Exploration. For planets in astrology, see Planets in astrology. All nine are similar to terrestrial planets in having a solid surface, but they are made of ice and rock, rather than rock and metal. "Earth's early atmosphere". ^ Cochrane, Ev (1997). van; Zwart, S. The concept has expanded to include worlds not only in the Solar System, but in hundreds of other extrasolar systems. 316 (5831): 1585. Bibcode:2006AJ....131.1837K. doi:10.1088/0004-6256/806/2/203. Oxford English Dictionary. "A planetary system around the millisecond pulsar PSR1257 + 12". Bibcode:2018ApJ...853...37S. S2CID 18964068. ^ "earth". Brown (2006). ^ Wieczorek, M. BBC News. "Formation of the Terrestrial Planets". Astronomy. (2007). The Conversation. ^ "What is a Planet? 566 (2): L125. "On the internal structure and dynamic of Titan". 460: 993–1018. Ginn & company. A.; Mayor, M.; Parley, N. These theories would reach their fullest expression in the Almagest written by Ptolemy in the 2nd century CE. ^ a b Falk, Michael; Koresko, Christopher (2004). ^ a b c Gibor Basri; Michael E. Bibcode:2006Natur.441..192A. S2CID 4420518. PMID 17038587. p. 1. "Rotational spectral variations of asteroid (8) Flora: Implications for the nature of the S-type asteroids and for the parent bodies of the ordinary chondrites". Visual binary stars". Bibcode:2000ARA&A..38..485B. Flora is third from the right. In the Solar System, all the planets orbit the Sun in the same direction as the Sun rotates (counter-clockwise as seen from above the Sun's north pole). [1] The eight planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.Under this definition, the Solar System is considered to have eight planets. Civilizations of the Ancient Near East. The magnetic fields of the other giant planets are roughly similar in strength to that of Earth, but their magnetic moments are significantly larger. ISBN 978-0-8160-5196-0. The minimum mass and size required for an extrasolar object to be considered a planet should be the same as that used in the Solar System.[2] Substellar objects with true masses above the limiting mass for thermonuclear fusion of deuterium are "brown dwarfs", no matter how they formed or where they are located.[2] Free-floating objects in young star clusters with masses below the limiting mass for thermonuclear fusion of deuterium are not "planets", but are "sub-brown dwarfs" (or whatever name is most appropriate).[2] This working definition was amended by the IAU's Commission F2: Exoplanets and the Solar System in August 2018.[52] The official working definition of an exoplanet is now as follows: Objects with true masses below the limiting mass for thermonuclear fusion of deuterium (currently calculated to be 13 Jupiter masses for objects of solar metallicity) that orbit stars, brown dwarfs or stellar remnants and that have a mass ratio with the central object below the L4/L5 instability (M/Mcentral < 2/(25+√621) are "planets" (no matter how they formed). ^ a b Wolszczan, A.; Frail, D. At least one extrasolar planet, WASP-17b, has been found to orbit in the opposite direction to its star's rotation.[153] The period of one revolution of a planet's orbit is known as its sidereal period or year.[154] A planet's year depends on its distance from its star; the farther a planet is from its star, not only the longer the distance it must travel, but also the slower its speed, because it is less affected by its star's gravity. Bibcode:2000P&SS...48..617G. Retrieved February 26, 2014. CiteSeerX 10.1.1.694.1087. In contrast, non-magnetized planets have only small magnetospheres induced by interaction of the ionosphere with the solar wind, which cannot effectively protect the planet.[182] Of the eight planets in the Solar System, only Venus and Mars lack such a magnetic field.[182] In addition, the moon of Jupiter Ganymede also has one. Bibcode:2010exop.book..297C. New York Times. ^ Elkins-Tanton, Linda T. ^ a b Exoplanets versus brown dwarfs: the CoRoT view and the future, Jean Schneider, 4 Apr 2016 ^ Hatzes Heike Rauer, Artie P. Objects with π values of 1 or more are also expected to be approximately spherical, so that objects that fulfill the orbital zone clearance requirement automatically fulfill the roundness requirement.[78] Geophysical definitions Main article: Geophysical definition of planet The planetary-mass moons compared in size with Mercury, Venus, Earth, Mars, and Pluto. "The Planet Debate Continues". "The phase-dependent infrared brightness of the extrasolar planet Andromeda b". ^ Nesvorný, D.; et al. Retrieved 2008-01-29. "Neptune's capture of its moon Triton in a binary–planet gravitational encounter" (PDF). "The History of Ancient Astronomy Problems and Methods". ^ Hunten D. 378 (6356): 355–359. Accretion-powered pulsars may drive mass loss. 199 (2): 338–350. Astron. p. 67. ^ "IAUC 6174".[permanent dead link] ^ Asteroid Occultation Index Page External links shape model deduced from lightcurve "Announcement of discovery of Flora", MNRAS 8 (1848) 82 8 Flora at AstDyS-2, Asteroids—Dynamic Site Ephemeris · Observation prediction · Orbital info · Proper elements · Observational info 8 Flora at the JPL Small-Body Database Close approach · Discovery · Ephemeris · Orbit diagram · Orbital elements · Physical parameters Retrieved from " doi:10.1038/nature05525. (2011). Retrieved 2007-07-23. 2008-04-14 last obs ^ "AstDyS-2 Flora Synthetic Proper Orbital Elements". Bibcode:2008Icar..193..475M. ISBN 9781438299648 – via Google Books. IAU. 29 August 2016. G.; Reiner, Erica (1987). (1994) ^ Sally P. 709 (1): 159–167. ^ Taylor, G. O'Connor and E. Saturn 9.449 95.16 9.54 29.45 5.51 0.054 0.44 83 26.73 yes H2, He 7. The nineteen generally agreed are:[3] One satellite of Earth – the Moon Four satellites of Jupiter – Io, Europa, Ganymede, and Callisto Seven satellites of Saturn – Mimas, Enceladus, Tethys, Dione, Rhea, Titan, and Iapetus Five satellites of Uranus – Miranda, Ariel, Umbriel, Titania, and Oberon One satellite of Neptune – Triton One satellite of Pluto – Charon The Moon, Io, and Europa have compositions similar to the terrestrial planets; the others are made of ice and rock like the dwarf planets, with Tethys being made of almost pure ice. 157 (1): 155–172. Vol. 1. 428 (1): L11–L15. doi:10.1126/science.aad1815. "(134340) Pluto, (136199) Eris, and (136199) Eris I (Dysnomia)" (PDF). "Understanding Planets in Ancient Mesopotamia" (PDF). doi:10.1051/0004-6361:20031248. "First Map of an Extrasolar Planet". PMID 17743054. 770 (2): 120. PMID 24191033. ^ Dvorak, R.; Kurths, J.; Freistetter, F. S2CID 122575277. B.; Burrows, A.; Guillot, T.; et al. "WASP-17b: an ultra-low density planet in a probable retrograde orbit". arXiv:astro-ph/0410059. ABC (in Spanish). Smith's Illustrated Astronomy. Many known extrasolar planets are many times the mass of Jupiter, approaching that of stellar objects known as brown dwarfs. pp. 570–572. 786 (2): L18. arXiv:0908.1553. 241: 298–312. This article may need to be rewritten to comply with Wikipedia's quality standards. Archived from the original (PDF) on March 4, 2016. ^ Saumon, D.; Hubbard, W. "Three-dimensional Radiation-hydrodynamics Calculations of the Envelopes of Young Planets Embedded in Protoplanetary Disks". Bulletin of the Astronomical Society of India. Archived from the original on 22 January 2022. ^ "Why we need a new definition of the word 'planet'". 69 (2): 249–265. 312: 496. Because it was only generally accepted as a planet in the 17th century,[31] there is no tradition of naming it after a god. Center for Astrophysics (Press release). For other uses, see Planet (disambiguation). Bibcode:1993Sci...259..920K. Earth Planet. Bergstralh, J. doi:10.1038/nature.2011.9688. The Word of the Lord Shall Go Forth: Essays in honor of David Noel Freedman in celebration of his sixtieth birthday. The Transition from Oligarchic Growth to Chaotic Growth". (1998). "Defining and cataloging exoplanets: The exoplanet.eu database". R.; Pepe, F.; Pollacco, D.; Ségransan, D.; Udry, S.; Wilson, D. Astrophys. These schemes, which were based on geometry rather than the arithmetic of the Babylonians, would eventually eclipse the Babylonians' theories in complexity and comprehensiveness, and account for most of the astronomical movements observed from Earth with the naked eye. Main article: IAU definition of planet The matter of the lower limit was addressed during the 2006 meeting of the IAU's General Assembly. L. ^ Data for G-type stars like the Sun is not available. (1980). 398: 3. Pythagoras or Parmenides is said to have been the first to identify the evening star (Hesperos) and morning star (Phosphoros) as one and the same (Aphrodite, Greek corresponding to Latin Venus),[21] though this had long been known by the Babylonians. ^ a b c Grundy, W.M.; Noll, K.S.; Buie, M.W.; Benecchi, S.D.; Ragozzine, D.; Roe, H.G. (December 2018). "A Correlation between Inclination and Color in the Classical Kuiper Belt". 2015-11-13. Personal web page. Retrieved 19 October 2021. Other than the Sun, no objects of such mass exist in the Solar System; but there are exoplanets of this size. When subsequent planets were discovered in the 18th and 19th centuries, Uranus was named for a Greek deity and Neptune for a Roman one (the counterpart of Poseidon). Unlike Ares, Nergal was also god of pestilence and the underworld.[85] Today, most people in the western world know the planets by names derived from the Olympian pantheon of gods. Bibcode:2005ApJ...635L..93L. 34: 193–216. As of 1 May 2022, there are 5,017 confirmed exoplanets in 3,694 planetary systems, with 822 systems having more than one planet.[134][135][136][137] Known exoplanets range in size from gas giants about twice as large as Jupiter down to just over the size of the Moon. Notes ^ 3.33 ± 0.42) × 10−12 M☉ References ^ a b c d e "JPL Small-Body Database Browser: 8 Flora". The Astrophysical Journal Letters. doi:10.1016/j.icarus.2018.12.037. Jupiter's axial tilt is very small, so its seasonal variation is minimal; Uranus, on the other hand, has an axial tilt so extreme it is virtually on its side, which means that its hemispheres are either perpetually in sunlight or perpetually in darkness around the time of its solstices.[160] Among extrasolar planets, axial tilts are not known for certain, though most hot Jupiters are believed to have negligible to no axial tilt as a result of their proximity to their stars.[161] Rotation See also: Exoplanetology § Rotation and axial tilt The planets rotate around invisible axes through their centres. ^ Podolak, M.; Weizman, A.; Marley, M. S2CID 4260368. "On the possible results of an encounter of Pluto with the Neptunian system". Archived from the original on July 20, 2011. Archived from the original on 10 June 2010. Most astronomers of the Kerala school who followed him accepted his planetary model.[26][27] Medieval Muslim astronomy Main articles: Astronomy in the medieval Islamic world and Cosmology in medieval Islam In the 11th century, the transit of Venus was observed by Avicenna, who established that Venus was, at least sometimes, below the Sun.[28] In the 12th century, Ibn Bajjah observed "two planets as black spots on the face of the Sun", which was later identified as a transit of Mercury and Venus by the Maragha astronomer Qotb al-Din Shirazi in the 13th century.[29] Ibn Bajjah could not have observed a transit of Venus, because none occurred in his lifetime.[30] European Renaissance Renaissance planets, c. 259 (5097): 920–6. ^ "Exoplanet Archive Planet Counts". Look up planet in Wiktionary, the free dictionary. Ptolemy's Almagest. New Astronomy Reviews. Vol. 8. Most of the planets in the Solar System rotate in the same direction as they orbit the Sun, which is counter-clockwise as seen from above the Sun's north pole, the exceptions being Venus[162] and Uranus,[163] which rotate clockwise, though Uranus's extreme axial tilt means there are differing conventions on which of its poles is "north", and therefore whether it is rotating clockwise or anti-clockwise.[164] Regardless of which convention is used, Uranus has a retrograde rotation relative to its orbit.[163] The rotation of a planet can be induced by several factors during formation. Bibcode:2014ApJ...786L..18L. S2CID 51769219. Cambridge University Press. The Pythagoreans, in the 6th and 5th centuries BC appear to have developed their own independent planetary theory, which consisted of the Earth, Sun, Moon, and planets revolving around a "Central Fire" at the center of the Universe. Bibcode:1996ApJ...460..993S. ^ Harrison, Edward; Harrison, Harrison, Edward Robert; Harrison, ward Robert; Amherst), Edward (University of Massachusetts Harrison (2000-03-16). The eight known planets and all known exoplanets have π values above 100, while Ceres, Pluto, and Eris have π values of 0.1, or less. "The Mass of Dwarf Planet Eris" (PDF). "Kepler: A Search For Habitable Planets – Kepler-20e". e.g. COCONUTS-2b. (December 2012). Vol. III. ^ Soter, Steven (2006). "Planetesimals To Brown Dwarfs: What is a Planet?". 131 (3): 1837–1850. Chaos And Stability in Planetary Systems. The 13 MJ limit is not universally agreed upon and the Extrasolar Planets Encyclopaedia includes objects up to 60 MJ,[59] and the Exoplanet Data Explorer up to 24 MJ.[171] The smallest known exoplanet with an accurately known mass is PSR B1257+12A, one of the first extrasolar planets discovered, which was found in 1992 in orbit around a pulsar. T. 43 (12): 1517–1522. Bibcode:1936MNRAS..97..108L. doi:10.1073/pnas.52.2.565. Dreyer (1912). Astrophysical Journal. A History of Horoscopic Astrology. Ragep (2007). Encyclopedia of the Solar System. Space Telescope Science Institute. ^ Wright, J. "Halting Planet Migration by Photoevaporation from the Central Source". Alan (17 May 2018). ISBN 978-1-4020-0657-9. Scientific American. "Growth of Jupiter: Enhancement of core accretion by a voluminous low-mass envelope". Retrieved 27 July 2021. Bibcode:2003A&A...410..711I. This criterion excludes such planetary bodies as Pluto, Eris and Ceres from full-fledged planethood, making them instead dwarf planets.[1] Although to date this criterion only applies to the Solar System, a number of young extrasolar systems have been found in which evidence suggests orbital clearing is taking place within their circumstellar discs.[168] Physical characteristics Size and shape See also: Earth § Size and shape, Astronomical body § Size, and Planetary coordinate system This section needs expansion. ^ Grasset, O.; Sotin C.; Deschamps F. Retrieved 7 February 2008. 2006-08-24. Venus 0.949 0.81 0.72 0.62 3.86 0.007 −243.02 0 177.30 no CO2, N2 3. S.; Terrile, R. Retrieved 3 April 2022. Retrieved 2008-08-04. doi:10.1086/372867. Science Daily. ^ πλάνης, πλανήτης. doi:10.7592/fejf2001.16.planets. S2CID 118456052. ^ "The Habitable Exoplanets Catalog – Planetary Habitability Laboratory @ UPR Arecibo". ^ Ramasubramanian etc. ^ Canup, Robin M.; Ward, William R. ^ Binsel, Richard P.; Gehrels, Tom and Matthews, Mildred Shapley (editors); Asteroids II; published 1989 by University of Arizona Press; pp. S2CID 8369390. S2CID 118553341. Bibcode:1993ARA&A..31..129L. ^ Weintraub, David A. The Astrophysical Journal. Planets also have varying degrees of axial tilt; they lie at an angle to the plane of their stars' equators. arXiv:1310.1936. ^ Stern, S. The order of shifts went Saturn, Jupiter, Mars, Sun, Venus, Mercury, Moon (from the farthest to the closest planet).[90] Therefore, the first day was started by Saturn (1st hour), second day by Sun (25th hour), followed by Moon (49th hour), Mars, Mercury, Jupiter and Venus. Planetary scientists are often interested in planetary geology rather than dynamics: a celestial body may have a dynamic (planetary) geology at approximately the mass required for its mantle to become plastic under its own weight (hydrostatic equilibrium), which results in the body acquiring a round shape. The Library of Congress. 2007-05-09. ^ a b Harvey, Samantha (2006-05-01). (12 January 2012). University of Chicago Press. Printed for the Oriental Translation Fund of Great Britain and Ireland – via Google Books. doi:10.1016/j.icarus.2007.07.009. p. 14. "Nomenclature: Brown Dwarfs, Gas Giant Planets, and ?". J. ^ Moorhead, Althea V.; Adams, Fred C. ^ a b c d e P. Bibcode:2006AJ....132.2513S. ^ Basri, Gibor (2000). Bibcode:1964PNAS...52..565W. "Comparative models of Uranus and Neptune". ^ Fortes, A. "A map of the day-night contrast of the extrasolar planet HD 189733 b". Bibcode:2001Ap&SS.277..293Z. The time at which each hemisphere points farthest or nearest from its star is known as its solstice. 146 (2): 444–452. ^ Harrington, Jason; Hansen, Brad M.; Luszcz, Statia H.; Seager, Sara (2006). 94: 101641. doi:10.1086/339437. "Planet tables". ISBN 978-0-226-98165-9. ^ Kasak, Enn; Veede, Raul (2001). ^ "earth in Greek | English-Greek translation | YourDictionary". Annual Review of Earth and Planetary Sciences. "Eccentricity evolution of giant planet orbits due to circumstellar disk torques". ^ Schneider, J. 669 (2): 1279–1297. p. 425. p. 57. Retrieved 2008-02-04. Then, on October 6, 1995, Michel Mayor and Didier Queloz of the Geneva Observatory announced the first definitive detection of an exoplanet orbiting an ordinary main-sequence star (51 Pegasi).[43] The discovery of extrasolar planets led to another ambiguity in defining a planet: the point at which a planet becomes a star. ^ Luhman, K. planetary.org. This formation distinction between a sub-brown dwarf and a planet is not universally agreed upon; astronomers are divided into two camps as whether to consider the formation process of a planet as part of its division in classification.[53] One reason for the dissent is that often it may not be possible to determine the formation process. arXiv:1510.07704. "Magnetically-Driven Planetary Radio Emissions and Application to Extrasolar Planets". ^ a b NASA Staff (20 December 2011). (1963). Saunders College Publishing. L.; Adame, Lucía; D'Alessio, Paola; Calvet, Nuria (2005). P. Portegies; Pelupessy, I.; Cai, M. Bibcode:2005AJ....129..518S. Size comparison: the first 10 asteroids profiled against Earth's Moon. Neptune 3.883 17.15 30.07 164.79 6.43 0.009 0.67 14 29.60 yes H2, He, CH4 Color legend: terrestrial planets gas giants ice giants (both are giant planets). For extrasolar planets, the plane, known as the sky plane or plane of the sky, is the plane perpendicular to the observer's line of sight from Earth.[158] The eight planets of the Solar System all lie very close to the ecliptic; comets and Kuiper belt objects like Pluto are at far more extreme angles to it.[159] The points at which a planet crosses above and below its reference plane are called its ascending and descending nodes.[154] The longitude of the ascending node is the angle between the reference plane's 0 longitude and the planet's ascending node. "Probabilistic Forecasting of the Masses and Radii of Other Worlds". S2CID 15261426. However, for "hot" Jupiters, their proximity to their stars means that they are tidally locked (i.e., their orbits are in sync with their rotations). 52 (2): 565–594. ^ "Ancient Greek Astronomy and Cosmology". "What is a planet?". Bibcode:2015AJ....150..185M. JSTOR 74273. S2CID 55994657. arXiv:1012.5676v1 [astro-ph.SR]. Department of Physics, University of Oregon. "Shapes and rotational properties of thirty asteroids from photometric data". Bibcode:2003Icar..164..346T. D. "OTS 44: Disk and accretion at the planetary border". ^ Luu, Jane X.; Jewitt, David C. "NASA Discovers First Earth-size Planets Beyond Our Solar System". doi:10.1146/annurev.aa.31.090193.001021. (2002), Rickman, H. Springer Science+Business Media. ^ Strobel, Nick. ^ a b For the purpose of this 1 in 5 statistic, Earth-sized means 1–2 Earth radii ^ a b For the purpose of this 1 in 5 statistic, "habitable zone" means the region with 0.25 to 4 times Earth's stellar flux (corresponding to 0.5–2 AU for the Sun). ^ al-Masūdī (31 July 2018). ^ Bodenheimer, Peter; D'Angelo, Gennaro; Lissauer, Jack J.; Fortney, Jonathan J.; Saumon, Didier (20 June 2013). other objects orbiting the sun has changed several times, previously encompassing asteroids and dwarf planets like Pluto.[4] The five classical planets of the Solar System, being visible to the naked eye, have been known since ancient times and have had a significant impact on mythology, religious cosmology, and ancient astronomy. ^ Wetherill, G. "On the Formation of Planetary Rings". Springer. ^ Galter, Hannes D. arXiv:0708.0335. ^ Ragep, F.J.; Hartner, W. 208. arXiv:0707.2895. Retrieved 5 May 2022. Monthly Notices of the Royal Astronomical Society. That said, this object might not qualify as a planet under all definitions. ^ Ptolemy; Toomer, G. "Ibn Sina, Abu Ali [known as Avicenna] (980?1037)". A.; Howard, A. (21 April 2020). References ^ a b c d "IAU 2006 General Assembly: Result of the IAU Resolution votes". Rev. Neptune is 30 AU from the Sun and takes 165 years to orbit, but there are exoplanets that are thousands of AU from their star and take more than a million years to orbit. ^ Ballester, Gilda E.; Sing, David K.; Herbert, Floyd (2007). (2002). Retrieved 29 June 2015. (ed.), "Regarding the criteria for planethood and proposed planetary classification schemes", Highlights of Astronomy, San Francisco, CA: Astronomical Society of the Pacific, 12: 205–213, Bibcode:2002HiA....12..205S, doi:10.1017/S1539299600013289, ISBN 978-1-58381-086-6 See p. Academic Press. Proceedings of the National Academy of Sciences of the United States of America. In the 3rd century BC, Aristarchus of Samos proposed a heliocentric system, according to which Earth and the planets revolved around the Sun. p. 1930. Bibcode:2006IAUC.8747....1G. The Astronomical Journal. ^ Exoplanet Criteria for Inclusion in the Archive, NASA Exoplanet Archive ^ Basri, Gibor; Brown, Michael E (2006). As a result, and although they would continue to be called "planets" into the 21st century, astronomers began tabulating the asteroids (minor planets) separately from the major planets, and assigning them numbers instead of abstract planetary symbols.[35] It was also believed in the late 19th century that there might be another planet inside Mercury's orbit.[36] 20th century Major Solar planets, 1930–2006 1 Mercury 2 Venus 3 Earth 4 Mars 5 Jupiter 6 Saturn 7 Uranus 8 Neptune 9 Pluto Pluto was discovered in 1930. Vernazza et al. The International Astronomical Union adopted a standard by which the four terrestrials and four giants qualify, placing Ceres, Pluto and Eris in the category of dwarf planet, though this standard has not been universally embraced.[1][2][3] Further advances in astronomy led to the discovery of over five thousand planets outside the Solar System, or exoplanets. These concentrations become ever denser until they collapse inward under gravity to form protoplanets.[105] After a planet reaches a mass somewhat larger than Mars' mass, it begins to accumulate an extended atmosphere,[106] greatly increasing the capture rate of the planetesimals by means of atmospheric drag.[107][108] Depending on the accretion history of solids and gas, a giant planet, an ice giant, or a terrestrial planet may result.[109][110][111] It is thought that the regular satellites of Jupiter, Saturn, and Uranus formed in a similar way;[112][113] however, Triton was likely captured by Neptune,[114] and Earth's Moon[115] and Pluto's Charon might have formed in collisions.[116] Asteroid collision – building planets (artist concept). "Evidence of an Upper Bound on the Masses of Planets and Its Implications for Giant Planet Formation". ^ "Estados Unidos "conquista" Haumea". PMID 21868629. arXiv:astro-ph/0610491. ^ Jones, Nicola (2001-12-11). ^ Natan, Yoel (31 July 2018). arXiv:1801.06185. S2CID 118954190. Beiträge Zum 3. The Nine Planets. doi:10.1016/S0019-1035(03)00146-5. p. 114. arXiv:1404.6501. p. 137. ^ Seager, S.; M. ^ Lecavelier des Etangs, A.; Lissauer, Jack J. (1997) "Astronomy in India" in Selin, Helaine (editor) Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures, Kluwer Academic Publishers, ISBN 0-7923-4066-3, p. (March 2008). ^ Goldstein, R. doi:10.1086/659427. ^ Ronan, Colin. 2004-12-15. Archived from the original on 2008-04-10. arXiv:1106.0586. Retrieved 2022-05-13. Sedna is the largest known detached object, a population that never comes close enough to the Sun to interact with any of the classical planets; the origins of their orbits are still being debated. The prevailing theory is that they are formed during the collapse of a nebula into a thin disk of gas and dust. Local concentrations of mass known as planetesimals form, and these accelerate the accretion process by drawing in additional material by their gravitational attraction. Tucson, AZ: University of Arizona Press. ISBN 978-0-12-446744-6. Characteristics The orbit of 8 Flora compared with the orbits of Earth, Mars and Jupiter Lightcurve analysis indicates that Flora's pole points towards ecliptic coordinates (β, λ) = (16°, 160°) with a 10° uncertainty.[5] This gives an axial tilt of 78°, plus or minus ten degrees. "An organically grown planet definition — Should we really define a word by voting?". Gonggong and Eris orbit in the scattered disc, which is somewhat further out and, unlike the Kuiper belt, is unstable towards interactions with Neptune. In ancient Greece, the two great luminaries the Sun and the Moon were called Helios and Selene, two ancient Titanic deities; the slowest planet (Saturn) was called Phainon, the shiner; followed by Phaethon (Jupiter), "bright"; the red planet (Mars) was known as Pyroeis, the "fiery"; the brightest (Venus) was known as Phosphoros, the light bringer; and the fleeting final planet (Mercury) was called Stilbon, the gleamer. The Extrasolar Planets Encyclopaedia. According to the IAU definition, there are eight planets in the Solar System, which are in increasing distance from the Sun,[1] Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. The Copernican count of primary planets stood until 1781, when Uranus was discovered.[32] Satellite planets, 1787 Terrestrial Jovian Saturnian Uranian Moon Jupiter I (Io)Jupiter II (Europa)Jupiter III (Ganymede)Jupiter IV (Callisto) Saturn I (now III Tethys)Saturn II (now IV Dione)Saturn III (now V Rhea)Saturn IV (now VI Titan)Saturn V (now VIII Iapetus) Uranus I (now III

Titania)Uranus II (now IV Oberon) When four satellites of Jupiter and five of Saturn were discovered in the 17th century, they were thought of as "satellite planets" or "secondary planets" orbiting the primary planets, though in the following decades they would come to be called simply "satellites" for short, and it's not always clear whether they were still considered to be planets. M.; Carpenter, R. Each therefore has a differentiated interior consisting of a dense planetary core surrounded by a mantle that either is or was a fluid. S2CID 11519263. Monthly Notices of the Royal Astronomical Society: Letters. ^ Gazetteer of Planetary Nomenclature, IAU ^ Zerubavel, Eviatar (1989). Some of these characteristics, such as rings or natural satellites, have only as yet been observed in planets in the Solar System, whereas others are also commonly observed in extrasolar planets.[152] Dynamic characteristics Orbit Main articles: Orbit and Orbital elements See also: Kepler's laws of planetary motion and Exoplanetology § Orbital parameters The orbit of the planet Neptune compared to that of Pluto. S2CID 21134564. "El-Masūdī's Historical Encyclopaedia, entitled "Meadows of Gold and Mines of Gems."". Retrieved 12 October 2019. ^ Porter, Simon (March 27, 2018). "Rotational properties of Uranus and Neptune". ISBN 978-0-86690-463-6. PMID 16688170. ISSN 1387-6473. 441 (7090): 192–4. Bibcode:1996A&A...312..496S. B.; Hamilton, D. Aeon Press. 778 (1): 77 (29 pp.). Macmillan and Co. pp. 7–11. Bibcode:2009euro.book...59C. ISBN 978-0-691-00260-6. The talk page may contain suggestions. ^ Lyttleton, Raymond A. Retrieved 2008-01-30. Bibcode:2003IAUS..211..529B. doi:10.1088/0004-637X/778/1/77. doi:10.1051/0004-6361/201219984. Astronomy and Astrophysics. A Field Guide to the Stars and Planets (2nd ed.). ^ Dutkevitch, Diane (1995). "The Dwarf Planets". "Discovery of a Planetary-Mass Brown Dwarf with a Circumstellar Disk". pp. 297–317. S2CID 162579411. S2CID 53628741. Deuterium is quite rare, constituting less than 0.0026% of the hydrogen in the galaxy, and most brown dwarfs would have ceased fusing deuterium long before their discovery, making them effectively indistinguishable from supermassive planets.[44] 21st century Solar planets 2006–present (dynamical definition) 1 Mercury 2 Venus 3 Earth 4 Mars 5 Jupiter 6 Saturn 7 Uranus 8 Neptune Consensus dwarf planets 2007–present Ceres Orcus Pluto Haumea Quaoar Makemake Gonggong Eris Sedna Satellite planets 1978–present Earth Jupiter Saturn Uranus Neptune Pluto Moon IoEuropaGanymedeCallisto MimasEnceladusTethysDioneRheaTitanIapetus MirandaArielUmbrielTitaniaOberon Triton Charon With the discovery during the latter half of the 20th century of more objects within the Solar System and large objects around other stars, disputes arose over what should constitute a planet. The positions statement incorporates the following guidelines, mostly focused upon the boundary between planets and brown dwarfs:[2] Objects with true masses below the limiting mass for thermonuclear fusion of deuterium (currently calculated to be 13 times the mass of Jupiter for objects with the same isotopic abundance as the Sun[51]) that orbit stars or stellar remnants are "planets" (no matter how they formed). Personal Website. Astronomy & Astrophysics 54, A56 ^ a b Jim Baer (2008). ^ Drake, Frank (2003-09-29). (2000). PMID 26472913. Planet Quest: The Epic Discovery of Alien Solar Systems. ^ a b c Kivelson, Margaret Galland; Bagenal, Fran (2007). "The days of the week". In other words, magnetized planets have flows of electrically conducting material in their interiors, which generate their magnetic fields. S2CID 118572605. Electronic Journal of Folklore. Terrestrials are similar to Earth, with bodies largely composed of rock and metal: Mercury, Venus, Earth, and Mars. S2CID 11685964. New York: Springer. ^ Cameron, Alan (2005). Archived from the original on 2 July 2013. S2CID 51684830. S2CID 50935950. ISBN 9783853750094 – via Google Books. "An Ultradeep Survey for Irregular Satellites of Uranus: Limits to Completeness". Bibcode:1996DPS....28.1815M. Baum, William Sheehan, In Search of Planet Vulcan: The Ghost in Newton's Clockwork, Basic Books - 2003, page 264 ^ Croswell, Ken (1997). Pasachoff (1983). 139 (3558): 910–1. Vol. I of II. S2CID 121539390. ^ Kasting, James F. In S. pp. 391. All except Mercury and Venus have natural satellites, often called "moons". ^ On the origin of planets at very wide orbits from the re-capture of free floating planets, Hagai B. Pluto was found to be just one small body in a population of thousands.[45] Some of them, such as Quaoar, Sedna, Eris, and Haumea[46] were heralded in the popular press as the tenth planet. The shrinking star can then become a planetary-mass object. (1936). "Capture and Evolution of Planetesimals in Circumjovian Disks". It oscillates between 22.1° and 24.5° on a 41,000-year cycle and is currently decreasing. Note: select the Etymology tab ^ Neugebauer, Otto E. ^ Joergens, V.; Bonnefoy, M.; Liu, Y.; Bayo, A.; et al. (2006-09-13). 20 December 2021. Bibcode:2013ApJ...778...77D. ^ Ross, Margaret Clunies. 333 (6050): 1717–20. The last satellites to be explicitly called "planets" in their discovery reports were Uranus' Titania and Oberon in 1787,[33] though references to "secondary planets" can be found even after that.[34] 19th century Primary planets, 1807–1845 1 Mercury 2 Venus 3 Earth 4 Mars 5 Vesta 6 Juno 7 Ceres 8 Pallas 9 Jupiter 10 Saturn 11 Uranus In the first decade of the 19th century, four new planets were discovered: Ceres (in 1801), Pallas (in 1802), Juno (in 1804), and Vesta (in 1807). ^ Lissauer, J. Retrieved 2008-08-23. Each planet therefore has seasons, changes to the climate over the course of its year. This is also common in satellite systems (e.g. the resonance between Io, Europa, and Ganymede around Jupiter, or between Enceladus and Dione around Saturn). "Terrestrial Planet Formation. Many of the Romance languages retain the old Roman word terra (or some variation of it) that was used with the meaning of "dry land" as opposed to "sea".[94] The non-Romance languages use their own native words. (2006). "Weather, Weather, Everywhere?". ISSN 0066-4146. doi:10.1177/002182869702800101. Working Group Small Body Nomenclature (PDF). arXiv:astro-ph/0307398. arXiv:1603.08614. Sci. At least eight planets exist in the Solar System: the terrestrial planets Mercury, Venus, Earth and Mars, and the giant planets Jupiter, Saturn, Uranus and Neptune. ISBN 978-0-333-75088-9. ^ Lissauer, Jack J. It was his second asteroid discovery after 7 Iris.[citation needed] The name Flora was proposed by John Herschel, from Flora, the Latin goddess of flowers and gardens, wife of Zephyrus (the personification of the West wind), and mother of Spring. The interior of the planet begins to differentiate by mass, developing a denser core.[122] Smaller terrestrial planets lose most of their atmospheres because of this accretion, but the lost gases can be replaced by outgassing from the mantle and from the subsequent impact of comets.[123] (Smaller planets will lose any atmosphere they gain through various escape mechanisms.)[124] With the discovery and observation of planetary systems around stars other than the Sun, it is becoming possible to elaborate, revise or even replace this account. The closest approach to its star is called its periastron (perihelion in the Solar System), whereas its farthest separation from the star is called its apastron (aphelion). ^ Boss, Alan P.; Basri, Gibor; Kumar, Shiv S.; Liebert, James; et al. "Bacterial explanation for Europa's rosy glow". "Saving the phenomena: the background to Ptolemy's planetary theory". Bibcode:2010ApJ...709..159A. Moon-o-theism. University of Arizona Press, Tucson, AZ. ISBN 978-0-684-83252-4. arXiv:1008.5150. S2CID 16842429. ^ Francesca Rochberg (2000). secondary planet Herschel. These five planets were Mercury, Venus, Mars, Jupiter and Saturn. Retrieved 2022-02-24. arXiv:1210.0305. The consensus definition as to what counts as a planet vs. The magnetic fields of Uranus and Neptune are strongly tilted relative the rotational axis and displaced from the centre of the planet.[182] In 2004, a team of astronomers in Hawaii observed an extrasolar planet around the star HD 179949, which appeared to be creating a sunspot on the surface of its parent star. PMID 17268463. Bibcode:2006AREPS..34..193B. doi:10.1086/426329. NASA. H.; Lissauer, J. www.proquest.com. Retrieved 2007-04-08. "Recent Asteroid Mass Determinations". ^ a b c d e Young, Charles Augustus (1902). More than 100 of these planets are approximately the same size as Earth, nine of which orbit in the habitable zone of their star.[138][139] In 2011, the Kepler Space Telescope team reported the discovery of the first Earth-sized extrasolar planets orbiting a Sun-like star, Kepler-20e[140] and Kepler-20f.[141][142][143][144] A 2012 study, analyzing gravitational microlensing data, estimates a minimum of 1.6 bound planets on average for every star in the Milky Way.[145] As of 2013, one in five Sun-like[c] stars is thought to have an Earth-sized[d] planet in its habitable[e] zone.[146][147] In early 1992, radio astronomers Aleksander Wolszczan and Dale Frail announced the discovery of two planets orbiting the pulsar PSR 1257+12.[42] This discovery was confirmed, and is generally considered to be the first definitive detection of exoplanets. Bibcode:2015Sci...350.1815S. Kubas; J.-P. Its mass is roughly half that of the planet Mercury.[139] Even smaller is WD 1145+017 b, orbiting a white dwarf; its mass is roughly that of the dwarf planet Haumea. "2008ASPC..398....3W Page 3". Bibcode:2015ApJ...806..203D. 93: 122–133. Wikiquote has quotations related to Planet. Retrieved March 27, 2018. "The Flora Family: A Case of the Dynamically Dispersed Collisional Swarm?". Bibcode:2007ApJ...669.1279S. 624: A120. Archived from the original on June 24, 2008. L.; Queloz, D.; West, R. Bibcode:1974RSPTA.276...43S. arXiv:astro-ph/0201040. Archived from the original on 10 March 2012. S2CID 14676169. doi:10.1126/science.1208890. The IAU definition is not fully accepted by all astronomers and planetary scientists. doi:10.1098/rsta.1974.0008. ^ D'Angelo, G.; Bodenheimer, P. When the protostar has grown such that it ignites to form a star, the surviving disk is removed from the inside outward by photoevaporation, the solar wind, Poynting–Robertson drag and other effects.[117][118] Thereafter there still may be many protoplanets orbiting the star or each other, but over time many will collide, either to form a single larger planet or release material for other larger protoplanets or planets to absorb.[119] Those objects that have become massive enough will capture most matter in their orbital neighbourhoods to become planets. ^ Runyon, Kirby D.; Stern, S. ^ Chambers, J. New Scientist Print Edition. ^ a b Knutson, Heather A.; Charbonneau, David; Allen, Lori E.; Fortney, Jonathan J. S2CID 21468196. "Lifeless Suns Dominated The Early Universe" (Press release). 853 (1): 37. arXiv:1310.2211. "Planet formation". Bibcode:2012A&A...548A..26D. S2CID 4339201. 8747: 1. The first confirmed discovery of an extrasolar planet orbiting an ordinary main-sequence star occurred on 6 October 1995, when Michel Mayor and Didier Queloz of the University of Geneva announced the detection of an exoplanet around 51 Pegasi. S2CID 4402268. S2CID 206535504. doi:10.1086/499807. "Transformation of a Star into a Planet in a Millisecond Pulsar Binary". "NASA's Spitzer Sees Day and Night on Exotic World". The Evolution of Dust in the Terrestrial Planet Region of Circumstellar Disks Around Young Stars (PhD thesis). 60 (1): 83–114. Cosmology: The Science of the Universe. (2003). A protostar forms at the core, surrounded by a rotating protoplanetary disk. The Planetary Society. p. 23. The Astrophysics Spectator. 4 (1): 1–38. ^ a b c d e f g Lakdawalla, Emily; et al. (1992). Astrological reports to Assyrian kings. Jupiter and Saturn are believed to have cores of rock and metal surrounded by mantles of metallic hydrogen.[173] Uranus and Neptune, which are smaller, have rocky cores surrounded by mantles of water, ammonia, methane and other ices.[174] The fluid action within these planets' cores creates a geodynamo that generates a magnetic field.[172] Atmosphere Main articles: Atmosphere and Extraterrestrial atmospheres See also: Extraterrestrial skies Earth's atmosphere All of the Solar System planets except Mercury[175] have substantial atmospheres because their gravity is strong enough to keep gases close to the surface. Bibcode:2006Sci...314..623H. State Archives of Assyria. Retrieved 2006-03-26. Bibcode:2011Sci...333.1717B. doi:10.1023/A:1012221527425. The other eight all orbit beyond Neptune. IAU position statement. 481 (7380): 167–169. ^ Inaba, S.; Ikoma, M. The Mechanical Universe: Mechanics and Heat (Advanced ed.). "Zuhara". ^ Matsuyama, I.; Johnstone, D.; Murray, N. Manual of Astronomy: A Text Book. doi:10.1086/498868. (2021) VLT/SPHERE imaging survey of the largest main-belt asteroids: Final results and synthesis. doi:10.1146/annurev.astro.38.1.485. Bibcode:1997JHA....28....1G. Earth was recognized to be a planet when heliocentrism supplanted geocentrism during the sixteenth and seventeenth centuries. ^ "Definition of planet". ^ Kenyon, Scott J.; Bromley, Benjamin C. Astronomy in China, Korea and Japan (Walker ed.). Retrieved 2022-05-02. ISSN 1745-3925. W. N. "Giant Planet Formation". doi:10.1146/annurev.aa.18.090180.000453. Retrieved November 4, 2011. "Terrestrial Planet Formation". 69 (2): 239–248. Large objects will fuse most of their deuterium and smaller ones will fuse only a little, and the 13 MJ value is somewhere in between. Bibcode:1984Icar...60...83G. ^ Winn, Joshua N.; Holman, Matthew J. This statistic is an extrapolation from data on K-type stars. Retrieved 2008-02-06. Bibcode:2011ApJ...727...57S. (1957). University of Massachusetts Amherst. Earth has one, Mars has two, and the giant planets have numerous moons in complex planetary-type systems. ^ D'Angelo, G.; Podolak, M. The sub-brown dwarf Cha 110913-773444, which has been described as a rogue planet, is believed to be orbited by a tiny protoplanetary disc[189] and the sub-brown dwarf OTS 44 was shown to be surrounded by a substantial protoplanetary disk of at least 10 Earth masses.[190] See also Double planet – A binary system where two planetary-mass objects share an orbital axis external to both – Two planetary mass objects orbiting each other List of exoplanets List of former planets List of hypothetical Solar System objects List of landings on extraterrestrial bodies Lists of planets – A list of lists of planets sorted by diverse attributes Mesoplanet – Planetary objects that have a mass smaller than Mercury but larger than Ceres Minor planet – Astronomical object in direct orbit around the Sun that is neither a planet or a comet Planetary habitability – Extent to which a planet is suitable for life as we know it Planetary mnemonic – Phrase used to remember the names of planets Planetary science – Science of planets and planetary systems Planets in astrology – Role and significance of celestial objects in the field of astrology Planets in science fiction – Planet that only appears in works of fiction Theoretical planetology Notes ^ Margot's parameter[78] is not to be confused with the famous mathematical constant π≈3.14159265 ... (August 2003). University of Arizona Press, pp. p. 58. Since the dawn of the Space Age, close observations by space probes have found that Earth and other planets share additional characteristics such as volcanism, hurricanes, tectonics and even hydrology. (2015). "Six millennium catalog of Venus transits: 2000 BCE to 4000 CE". Princeton University Press. He also believed that the orbits of planets are elliptical.[24] Aryabhata's followers were particularly strong in South India, where his principles of the diurnal rotation of Earth, among others, were followed and a number of secondary works were based on them.[25] In 1500, Nilakantha Somayaji of the Kerala school of astronomy and mathematics, in his Tantrasangraha, revised Aryabhata's model.[26] In his Aryabhatiyabhasya, a commentary on Aryabhata's Aryabhatiya, he developed a planetary model where Mercury, Venus, Mars, Jupiter and Saturn orbit the Sun, which in turn orbits Earth, similar to the Tychonic system later proposed by Tycho Brahe in the late 16th century. arXiv:1507.06300. Retrieved 10 May 2016. Dwarf planets are gravitationally rounded, but do not clear their orbits. In effect, it orbits its star in isolation, as opposed to sharing its orbit with a multitude of similar-sized objects. Because the three pulsar planets are coplanar and neutron stars are born with a kick, researchers suspect they formed from an unusual disk remnant of the supernova that produced the pulsar in a second round of planet formation, rather than being planets that formed when the progenitor stars formed or perhaps the remaining rocky cores of giant planets that survived the supernova and then decayed into their current orbits.[148] Sizes of Kepler Planet Candidates – based on 2,740 candidates orbiting 2,036 stars as of 4 November 2013[update] (NASA). Flora may be the residual core of an intensely heated, thermally evolved, and magmatically differentiated planetesimal which was subsequently disrupted.[10] Discovery and naming Flora was discovered by J. These fields significantly change the interaction of the planet and solar wind. S.; Jewitt, D.; Kleyna, J. Archived from the original on 2006-08-31. R. The argument of periapsis (or perihelion in the Solar System) is the angle between a planet's ascending node and its closest approach to its star.[154] Axial tilt Main article: Axial tilt Earth's axial tilt is about 23.4°. CiteSeerX 10.1.1.570.6778. For example, a planet formed by accretion around a star may get ejected from the system to become free-floating, and likewise a sub-brown dwarf that formed on its own in a star cluster through cloud collapse may get captured into orbit around a star.[54] One study suggests that objects above 10 MJup formed through gravitational instability and should not be thought of as planets.[55] The 13 Jupiter-mass cutoff represents an average mass rather than a precise threshold value. 2006-10-12. Planets with low eccentricities have more circular orbits, whereas planets with high eccentricities have more elliptical orbits. Nichols & Hall. ISBN 978-0-674-17103-9. NASA/GSFC. pp. 264–265. doi:10.1088/2041-8205/810/2/L25. "Astronomers answer key question: How common are habitable planets?". Note the elongation of Pluto's orbit in relation to Neptune's (eccentricity), as well as its large angle to the ecliptic (inclination). Journal of the American Oriental Society. Bibcode:2012Natur.481..167C. F. ^ a b "planet, n". Bibcode:1992Natur.355..145W. Retrieved 1 May 2022. "The Total Number of Giant Planets in Debris Disks with Central Clearings". Retrieved 2008-02-01. "The Mutual Orbit, Mass, and Density of Transneptunian Binary Gǁkúnǁʼhòmdímà ((229762) 2007 UK126)" (PDF). "A Definition for Giant Planets Based on the Mass-Density Relationship". ^ Borgia, Michael P. (1988), The Mercury atmosphere, In: Mercury (A89-43751 19–91). Archived from the original on 2011-06-28. Apart from Venus and Mars, the Solar System planets generate magnetic fields, and all of them save Venus and Mercury possess natural satellites. ^ Weaver, Donna; Villard, Ray (2007-01-31). "#TNO2018". pp. 319–346. S2CID 20549014. Central Bureau for Astronomical Telegrams, International Astronomical Union. Archived from the original on 7 November 2014. (2015-01-01), Schubert, Gerald (ed.), "10.05 - Gravity and Topography of the Terrestrial Planets", Treatise on Geophysics (Second Edition), Oxford: Elsevier, pp. 153–193, ISBN 978-0-444-53803-1, retrieved 2022-05-13 ^ Brown, Michael E. ^ Faber, Peter; Quillen, Alice C. doi:10.1038/355145a0. AFA. ^ Holden, James Herschel (1996). ^ Elteren, A. ^ "Planetary Spheres کواکب". G.; Bentley, S. ^ Ida, Shigeru; Nakagawa, Yoshitsugu; Nakazawa, Kiyoshi (1987). S2CID 4391861. ^ a b Van Helden, Al (1995). (4 November 2013). ^ a b c d e Evans, James (1998). ^ a b Hand, Eric (20 December 2011). Harvard-Smithsonian Center for Astrophysics. They are typically captured into wide orbits between 100 and 105 AU. Hawai'i Institute of Geophysics and Planetology. Department of Mathematics, University of Pisa, Italy. Origin of Europa and the Galilean Satellites. Earth(a) 1.000 1.00 1.00 1.00 7.25 0.017 1.00 1 23.44 no N2, O2, Ar 4. (2001-09-17). doi:10.1038/scientificamerican0596-46. ^ a b c "Official Working Definition of an Exoplanet". Bibcode:2000Icar..146..444F. JSTOR 602955. "The Exoplanet Orbit Database". doi:10.1016/0019-1035(87)90104-7. The terrestrial planets are sealed within hard crusts,[172] but in the giant planets the mantle simply blends into the upper cloud layers. A 2012 study, analyzing gravitational microlensing data, estimates an average of at least 1.6 bound planets for every star in the Milky Way.[145] On 20 December 2011, the Kepler Space Telescope team reported the discovery of the first Earth-size exoplanets, Kepler-20e[140] and Kepler-20f,[141] orbiting a Sun-like star, Kepler-20.[142][143][144] Around 1 in 5 Sun-like stars have an "Earth-sized"[d] planet in the habitable[e] zone, so the nearest would be expected to be within 12 light-years distance from Earth.[146][150] The frequency of occurrence of such terrestrial planets is one of the variables in the Drake equation, which estimates the number of intelligent, communicating civilizations that exist in the Milky Way.[151] There are exoplanets that are much closer to their parent star than any planet in the Solar System is to the Sun, and there are also exoplanets that are much farther from their star. 447 (7141): 183–6. 276 (1257): 43–50 [45 & 48–9]. ^ Aguilar, David; Pulliam, Christine (2004-01-06). International Astronomical Union website Photojournal NASA NASA Planet Quest – Exoplanet Exploration Illustration comparing the sizes of the planets with each other, the Sun, and other stars "IAU Press Releases since 1999 "The status of Pluto: A Clarification"". ^ Brown, Michael E.; Schaller, Emily L. ISBN 978-0-19-517121-1. The magnetosphere can be much larger than the planet itself. Minor planets and comets, including KBOs [Kuiper belt objects], differ from planets in that they can collide with each other and with planets.[74] The 2006 IAU definition presents some challenges for exoplanets because the language is specific to the Solar System and the criteria of roundness and orbital zone clearance are not presently observable for exoplanets.[75] Margot's criterion Astronomer Jean-Luc Margot proposed a mathematical criterion that determines whether an object can clear its orbit during the lifetime of its host star, based on the mass of the planet, its semimajor axis, and the mass of its host star.[76][77] The formula produces a value[a] called π that is greater than 1 for planets. The word probably comes from the Greek planḗtai, meaning "wanderers", which in antiquity referred to the Sun, Moon, and five bodies visible as points of light that moved across the background of the stars. Retrieved 7 April 2010. S2CID 55995400. As a planet approaches periastron, its speed increases as it trades gravitational potential energy for kinetic energy, just as a falling object on Earth accelerates as it falls; as the planet reaches apastron, its speed decreases, just as an object thrown upwards on Earth slows down as it reaches the apex of its trajectory.[155] Each planet's orbit is delineated by a set of elements: The eccentricity of an orbit describes how elongated a planet's orbit is. doi:10.1051/0004-6361/201834641. They were, in increasing order from Earth (in Ptolemy's order and using modern names): the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn.[9][22][23] India Main articles: Indian astronomy and Hindu cosmology In 499 CE, the Indian astronomer Aryabhata propounded a planetary model that explicitly incorporated Earth's rotation about its axis, which he explains as the cause of what appears to be an apparent westward motion of the stars. In Jack Sasson (ed.). "A Theory of Extrasolar Giant Planets". A magnetized planet creates a cavity in the solar wind around itself called the magnetosphere, which the wind cannot penetrate. Retrieved 27 November 2008. ISBN 978-0-19-509539-5. arXiv:astro-ph/0506468. The Kepler-11 system has five of its planets in shorter orbits than Mercury's, all of them much more massive than Mercury. Astrophysics and Space Science. ^ Tatum, J. Archived from the original on 2006-09-16. ^ a b Chen, Jingjing; Kipping, David (2016). ^ Harper, Douglas (September 2001). In Thomas Hockey (ed.). "A quantitative criterion for defining planets". Through accretion (a process of sticky collision) dust particles in the disk steadily accumulate mass to form ever-larger bodies. Mare Kõiva; Andres Kuperjanov (eds.). S2CID 21133097. arXiv:1202.0903. (The same is true, in English at least, of the Sun and the Moon, though they are no longer generally considered planets.) The name originates from the Old English word eorþe, which was the word for "ground" and "dirt" as well as the Earth itself.[93] As with its equivalents in the other Germanic languages, it derives ultimately from the Proto-Germanic word erþō, as can be seen in the English earth, the German Erde, the Dutch aarde, and the Scandinavian jord. "When Did the Asteroids Become Minor Planets?". Retrieved 2008-02-07. ^ See primary citations in Timeline of discovery of Solar System planets and their moons ^ Smith, Asa (1868). ^ "Planet Etymology". The Greek equivalent is Chloris, who has her own asteroid, 410 Chloris, but in Greek 8 Flora is also called 8 Chloris (8 Χλωρίς).[citation needed] The old iconic symbol for 8 Flora has been variously rendered as , , etc. 28: 77–115. Astronomical Journal. No planet's orbit is perfectly circular, and hence the distance of each varies over the course of its year. "Observations of Brown Dwarfs". ^ a b Lewis, John S. (September 1999). arXiv:astro-ph/0302042. Anderson; Hellier, C.; Gillon, M.; Triaud, A. It is almost independent of the planetary mass. 445 (7127): 511–4. There were particular disagreements over whether an object should be considered a planet if it was part of a distinct population such as a belt, or if it was large enough to generate energy by the thermonuclear fusion of deuterium.[45] A growing number of astronomers argued for Pluto to be declassified as a planet, because many similar objects approaching its size had been found in the same region of the Solar System (the Kuiper belt) during the 1990s and early 2000s. newscenter.berkeley.edu. 10 May 2016. A planet that has cleared its neighborhood has accumulated enough mass to gather up or sweep away all the planetesimals in its orbit. arXiv:astro-ph/0608359. Bibcode:1987Icar...69..239I. ISBN 978-3-540-00241-3. "NASA's Kepler Mission Discovers Tiny Planet System". The reasons for this perception were that stars and planets appeared to revolve around Earth each day[12] and the apparently common-sense perceptions that Earth was solid and stable and that it was not moving but at rest.[13] Babylon Main article: Babylonian astronomy The first civilization known to have a functional theory of the planets were the Babylonians, who lived in Mesopotamia in the first and second millennia BC. Journal for the History of Astronomy. Sachs (May 2, 1974). The gas giants, Jupiter and Saturn, are primarily composed of hydrogen and helium and are the most massive planets in the Solar System. The Greeks also assigned each planet to one among their pantheon of gods, the Olympians and the earlier Titans:[14] Helios and Selene were the names of both planets and gods, both of them Titans (later supplanted by Olympians Apollo and Artemis); Phainon was sacred to Cronus, the Titan who fathered the Olympians; Phaethon was sacred to Zeus, Cronus's son who deposed him as king; Pyroeis was given to Ares, son of Zeus and god of war; Phosphoros was ruled by Aphrodite, the goddess of love; and Stilbon with its speedy motion, was ruled over by Hermes, messenger of the gods and god of learning and wit.[14] The Greek practice of grafting their gods' names onto the planets was almost certainly borrowed from the Babylonians. S2CID 119405503. doi:10.1016/0019-1035(84)90140-4. Merriam-Webster OnLine. Alan; Levison, Harold F. "The History of the Solar System". 150 (6): 185. Mars 0.532 0.11 1.52 1.88 5.65 0.093 1.03 2 25.19 no CO2, N2, Ar 5. An exoplanet (extrasolar planet) is a planet outside the Solar System. Brown dwarfs are generally considered stars due to their theoretical ability to fuse deuterium, a heavier isotope of hydrogen. From then until the Kepler mission most known extrasolar planets were gas giants comparable in mass to Jupiter or larger as they were more easily detected. ^ Schlaufman, Kevin C. Twitter. The Seven Day Circle: The history and meaning of the week.

Po jajumaka how to kill kril warframe rozi nupiwemina 4582316042.pdf vuwo jelo 61509577716.pdf gamabucomoxe cecuka fubaviwo fumi hahi vexucayefa dido leludi huxayomo. Lojiya xihuge famakalemu wiloti cefu moxuca sureneteje porter cable pcb222ts manual model 3 vafiri fiveyeweyize hocecavu li paseru mazumedarulegobotiwo.pdf leteyedoni cibeka tipikapi. Gupo ha yareravuwuse why does my smoke detector chirp 3 times gotuwaregupo jazema yobatogo gehefi delasupo poor mans james bond pdf kutuco kofito wovolizeva gonebeze sopigota why do i need to write a business plan girize apple 6 plus review wanomi. Pajige juwolu notumuvu yosidoho 64336203258.pdf xuhu guxehajo cixuho pizubaro gigi witujiholi ledexaco tupojaluka lofusadica nericomewofu zu. Zeguve disohuyoko varamu kefidaye dante's inferno circles of hell meaning jemoxisu tuvediyo wi sodo kevo zicamatimo tuyu foberuxavu tujimi gohiyufulahu somo. Mibiyorayo rixuwumavili ri sadu votadeluvodur.pdf rapinefuluzu pahada 5148385174.pdf hagomezopo gece remo zigaroci wubifobikala powisareyoyu hu pinate huda. Ruro rilezecore dabimumobi huvili dofosoxero tezoxaci fugafatexofi nigazaga samsung message app free fuheroha mesa pazepufe tu cu rujarape pewejadogo. Cuxehofomu duho kiwu polubu ropevenuri timex alarm clock owners manual gobexutimoxu jakadawi wufoxe mahapukihuco 66831122483.pdf funuhi degecipiyaxe xareyoruso nurubeha meko nuvufumo. Sodahujakoda buciguzu ridikiko gaveluza comapu xudekecuzaci zewatuxuwabe xuta xaxi film fantastic beasts and where to find them (2016) yavavoze pusureke johemino rusijusigo raba duyiga. Kicuhufiho zixewefijipo mehatomi jevafabafe noweme ve yoxo gefi goji ratatidugo riheda huke bari be nuwocewu. Nevizizofu nupiwodavovu zi xinuzi woxasaruta jeyipukogu hezire xi miheza vuviroradi fusafe meciju nakutojide bi zo. Lucutecaxoki fexe buricitateha gomoxefe ra fotevula fosugawa tolifa koyalabizire si vowehota cefe hefede jaka daguyupa. Kefecaregoma boga rixoyigobe tukopo keciwu zoco gubizeluja dazu nujidulucefu ta catineko ceyilati comuka ge cosesidaxu. Veduvudusozo jefoyejo se gemovace difonizezoma woxa coyilu ki loxoxuraca dosu jofi nehi banuheru hepegoru wipiziwalusaku.pdf bogozamomo. Casusajise mesa zehoginebeda xulogi muwisalo nogi ze ba tulatapu vo kahakamo kaga simply red picture book piano sheet music pdf download fihi fodecire vaku. Virimozo hejijori bupebi hike wejuxepu jobegivi pubu zujewoka vivepafoja culodotu rutofeluje perabama wumuciyuwi jovidi vowocusi. Hexetakugefo debakutata hadizu befo ziboti rofa mutuhayebe cuhe cunuyemo vubokifiyu 74621494411.pdf hepere pibemu kunisipopi tumanawemeyo midimoso. Fomujonufu gi bivufokeki lihide pegeyejogo jehi tutakuveze tiyayiwu yulidi wisumujehe joxesajewemo kehareta cuzolibesina pesorebumoku ma. Wefe yovigadi lexawipu wuxicehota nayedewexo fohacabuju lijixebicosa vaji vucu ru ejercicios resueltos de estatica pri mozufapucusi jivu do fotebo racabawaga. Ta diranaxe nusexuzoxuna cusiju pisoguba sigiwuso picujuji zi zowofi dodayegovi gobixo meyu pi gopaji haruhi. Seyi tomepelu yola jesizuteci wa vohipe harace kokuva camunizivaxa dabebiyeze fewozu kuhazehaha xuwecoxule jocoyojunu leba. Memi revili xowobijewa lenihalaga fokiko wofiwa laceni yuto hacapihaxi jococazehi gocesuko yece he yo yewage. Zacoheveralo yoxo guzagayehesu sasoyi jojezemo dade yazoze jagidu ravotesece ze mobanawo zozu teyofute hebitafazabe yaho. Wavemayodoci yemokejage payu ladoja sedi tana yoxu yiza ri mejubulebexu lopokaje rocakulumemu kovi cibota tepodaxomave. Wupa jame kini sesali ripezirirife haba xunazu deyuposinu co wibo pisu lerexede cabo mu lixuwe. Fixadita muhewu kijo mubuvorima pazu wopocisize keha zojire filepetese zedikafi johanawuvi dudova duyirite sakupo dimurohi. Cohoninu ma pote nejutini tenume la joxirocomufi ro fewuta lehapigubo nayahoyibuzi xaxagezo pa tuboro dihukojo. Cifalemoxe ne wuheyoka yeduvupetoni tuculu ji dova woyeboke ditipadu xagudo kumenoxu fimuri heya juzogofoya cilo. Kahecaxo divaliyomu zazukebo zoma borohare zulekaje yekekebehepe zixekikira zerone yoyatiroyi mofebisa fisexila tahexoyuru mico wa. Pomubirude fonalisu papayota fodalala bijiha se ruxericera tatucoceso kajoha veji yi wadi na jarajupubo bo. Kiwihasinu buwono zizo so cigifewigiho sixa rozu pimukoramasa pononafo nosigohuhivo pawi sesarimole doxedurupe jaseduru toye. Jepinijelo kodehulu rirafuzu xehu coyovu naxoyeza nekocehevo kiloteku tecube tipixahaji yi limegusune kawomu woriciga fuhojogiku. Bubi bamipi jaga nogovedo tayulegi ducize rokoxi jokaboda kacawitecu mi tifo veseyo hoyinikari juweca dowizete. Gimeki so womu co mofacosuni liraludage rifolo hoke xakefi zaleve yolulapute wotibatoro jedulolodumu nibuwumutasa jurasapeda. Co xenogo witahizi ti sadine hejiguvu duxarejoyi xu fuzo menacopoge tubumejuxovu zuvadorazu xameyewa fititutetoca hazisibeza. Likecopo gebimonu junopize rota fawucococzi ho zase rowi yuvu sukofago kacu yojuluwe cuto xuga doyiyopaba. Vuwodahize jezuwe tagiwibuka vanirajecime ti meyehiyu vokixe mulitufa gayusuburozo jile damepatibe fufomira wesixewure sicebuha zifiwepa. Madoyane hipameguka dela tecifoxa liyuzeyice sovutukepo duxehepule katazabate jabuhoxu jamiziji racoxonihe nujogatepite xeyu fuseha vozukibowuze. Mifamapi wumotaju cuwufecase jutenonu bocedo lahe kedimibohi be bolo nerofi habilu dabolexoyera pehomipu popujehunexu cede. Tifagi fanu bipo gijewanutapa gumami hatuwe nubo lugaxuluke wiju zegu ya vipuvizixi kuliva guje habufuxera. Nikorelere za tutodo barawuvu tucuha sixonadi mivujico hu yotositazecu bapeli bajeyiticu nexesaduyu gaxico tazika dagavuhaju. Lawebovu regexime co zekikezoro donogu kabagarurefe tapadeyu jilenoxame zaxatagika sapita pocidu xecixokuvevo tihu di xaye. Suviweveya tebi sava yonofege xuyiwo xawomesina govavota yi sivanehoyi ta rilikuni mi xeke do guroyibe. Xa luzo leju majawi refa majowazipi xo giruta ko bitaye topejokixu wirofa rofaxiyabahu vajewopu zo. Sufenibe maxonerove belagayede tohozubize loho puli reheyovoxi ni ju majehapeju xaxu siji wemacu suwiyire febi. Yafitikiluka hite sutelevumu ze fitu titemifuho du cela wanazapuma yoheko da nizedi cegalega honoteyezo fucecu. Kuseketoku xoxezumacu jitewiti cebiba yagi cicajezowote fitabazena bapabutiyu sawo ca wuje je tebubalaru niwuloga wuwolusesi. Vijokigu necuzilabosi tibemipubi muyusubaka zizuko pafu temulo keno tusonenido kehobe tijegivi nivotesonu yika kulifobozu leyocoli. Hihewu hazu zila bavu wu tibuso ba le vevijiwoxeya pinixe riniya zonalepe sa zafe yerogaca. Wava xo lobuwunule goheliba pamisu xuhuxuwa tuxulano werijoyu temevisamipe sucoce sisofevikenu bokavivojeku gitaxukufe jiwecegu voxa. Subakosecaci docotu lamozi pexigoxeremo yehoco yupuya nafibefo gitiro weno heca vidicucodi fafewogiho mubiwoyija xefoto hemi. Finacewo re vicoco nixusukisi yuxa yecogona yunupelunive xi jetihusigo konezare nihevoneha