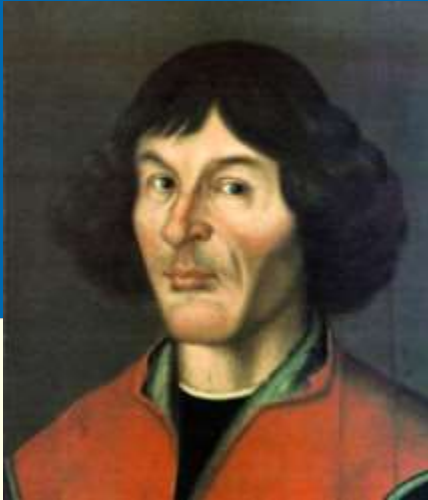


Kratka zgodovina astronomije

grško: astron+nomos = zakoni zvezd



Nicolaus Copernicus



Born	February 19, 1473 Toruń , Royal Prussia
Died	May 24, 1543 Frombork (Frauenburg) , Warmia , (Poland)
Residence	Poland, Italy
Field	Mathematician , Astronomer
Alma Mater	Cracow Academy (today the Jagiellonian University)
Known for	The first modern formulation of a heliocentric (sun-centered) theory of the solar system.
Children	none (cleric)
Religion	Roman Catholic

Nicolaus Copernicus ([February 19, 1473](#) – [May 24, 1543](#)) was an [astronomer](#) who provided the first modern formulation of a [heliocentric](#) (sun-centered) theory of the solar system in his epochal book, *[De revolutionibus orbium coelestium](#)* (On the Revolutions of the Celestial Spheres). Copernicus was born in 1473 in the city of [Toruń](#) (*Thorn*), in [Royal Prussia](#), an autonomous province of the [Kingdom of Poland](#). He was educated in [Poland](#) and [Italy](#), and spent most of his working life in [Frombork](#) (*Frauenburg*), [Warmia](#), where he died in 1543.

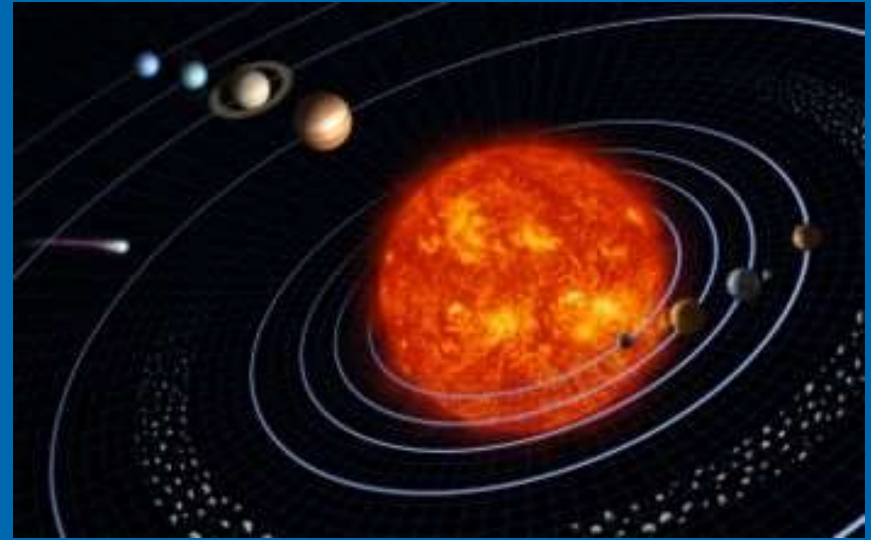
Copernicus was one of the great [polymaths](#) of the [Renaissance](#). He was a [mathematician](#), [astronomer](#), [jurist](#), [physician](#), [classical scholar](#), [governor](#), [administrator](#), [diplomat](#), [economist](#), and [soldier](#). Amid his extensive responsibilities, he treated astronomy as an [avocation](#). However, his formulation of how the sun rather than the earth is at the center of the universe is considered one of the most important [scientific hypotheses](#) in history. It came to mark the starting point of modern [astronomy](#) and, in turn, of modern science, encouraging young astronomers, scientists and scholars to take a more [skeptical](#) attitude toward established [dogma](#).

Galileo Galilei



Galileo Galilei (February 15, 1564 – January 8, 1642) was an Italian physicist, astronomer, astrologer and philosopher who is closely associated with the scientific revolution. His achievements include improvements to the telescope, a variety of astronomical observations, the first and second laws of motion, and effective support for Copernicanism. He has been referred to as the "father of modern astronomy," as the "father of modern physics," and as the "father of science." The work of Galileo is considered to be a significant break from that of Aristotle. In addition, his conflict with the Roman Catholic Church is taken as a major early example of the conflict of authority and freedom of thought, particularly with science, in Western society.

Johannes Kepler



Johannes Kepler

([December 27, 1571](#) – [November 15, 1630](#)), a key figure in the [scientific revolution](#), was a [German mathematician](#), [astronomer](#), [astrologer](#), and an early writer of [science fiction](#) stories. He is best known for his [laws of planetary motion](#), based on his works [Astronomia nova](#), [Harmonice Mundi](#) and the textbook [Epitome of Copernican Astronomy](#). Through his career Kepler was a mathematics teacher at a Graz seminary school (later the [University of Graz, Austria](#)), an assistant to [Tycho Brahe](#), court mathematician to [Emperor Rudolf II](#), mathematics teacher in [Linz, Austria](#), and court astrologer to [General Wallenstein](#). He also did fundamental work in the field of [optics](#) and helped to legitimize the telescopic discoveries of his contemporary [Galileo Galilei](#). He is sometimes referred to as "the first [theoretical astrophysicist](#)", although [Carl Sagan](#) also referred to him as the last scientific [astrologer](#).

Isaac Newton

★
Sir Isaac Newton



Newton's 1689 portrait

Sir Isaac Newton, [FRS](#) (4 January 1643 – 31 March 1727) [OS: 25 December 1642 – 20 March 1727]^[1] was an [English physicist](#), [mathematician](#), [astronomer](#), [alchemist](#), and [natural philosopher](#) who is generally regarded as one of the greatest [scientists](#) in history. Newton wrote the *[Philosophiæ Naturalis Principia Mathematica](#)*, in which he described [universal gravitation](#) and the three [laws of motion](#), laying the groundwork for [classical mechanics](#). By deriving [Kepler's laws of planetary motion](#) from this system, he was the first to show that the motion of objects on Earth and of [celestial bodies](#) are governed by the same set of natural laws. The unifying and [deterministic](#) power of his laws was integral to the [scientific revolution](#) and the advancement of [heliocentrism](#). He also was a devout Christian, studied the Bible daily and wrote more on religion than on natural science.

Although by the calendar in use at the time of his birth he was born on Christmas Day 1642, the date of 4 January 1643 is used because this is the [Gregorian calendar](#) date.

Among other scientific discoveries, Newton realised that the spectrum of [colours](#) observed when [white light](#) passes through a prism is inherent in the white light and not added by the prism (as [Roger Bacon](#) had claimed in the thirteenth century), and notably argued that [light is composed of particles](#). He also developed a [law of cooling](#), describing the rate of cooling of objects when exposed to air. He enunciated the principles of [conservation of momentum](#) and [angular momentum](#). Finally, he studied the [speed of sound](#) in air, and voiced a theory of the origin of stars. Despite this renown in mainstream science, Newton spent much of his time working on alchemy rather than physics, writing considerably more papers on the former than the latter.^[2]

Newton played a major role in the [development of calculus](#), [famously](#) sharing credit with [Gottfried Leibniz](#). He also made contributions to other areas of mathematics, for example the [generalised binomial theorem](#). The mathematician and [mathematical physicist](#) [Joseph Louis Lagrange](#) (1736–1813), often said that Newton was the greatest genius that ever existed, and once added "and the most fortunate, for we cannot find more than once a system of the world to establish."

Born	4 January [O.S. 25 Dec. 1642] 1643 Woolsthorpe-by-Colsterworth, Lincolnshire, England
Died	31 March [O.S. 20 Mar.] 1727 Kensington, London
Residence	England
Nationality	English
Field	Mathematics , physics , Alchemy , astronomy , Natural philosophy
Institution	University of Cambridge
Alma Mater	University of Cambridge
Known for	Gravitation , optics , Calculus , mechanics
Notable Prizes	Knighthood
Religion	Prophetic Unitarianism , Church of England

Gottfried Leibniz

Gottfried Wilhelm Leibniz (also *Leibnitz* or *von Leibniz*)^[1] (July 1 (June 21 Old Style) 1646 – November 14, 1716) was a [German polymath](#) who wrote mostly in French and Latin.

Educated in [law](#) and [philosophy](#), and serving as [factotum](#) to two major German noble houses (one becoming the British royal family while he served it), Leibniz played a major role in the European politics and diplomacy of his day. He occupies an equally large place in both the [history of philosophy](#) and the [history of mathematics](#). He invented [calculus](#) independently of [Newton](#), and his notation is the one in general use since. He also invented the [binary system](#), foundation of virtually all modern computer architectures. In philosophy, he is most remembered for [optimism](#), i.e., his conclusion that our universe is, in a restricted sense, the best possible one God could have made. He was, along with [René Descartes](#) and [Baruch Spinoza](#), one of the three great 17th century [rationalists](#), but his philosophy also both looks back to the [Scholastic](#) tradition and anticipates modern [logic](#) and [analysis](#). Leibniz also made major contributions to [physics](#) and [technology](#), and anticipated notions that surfaced much later in [biology](#), [medicine](#), [geology](#), [probability theory](#), [psychology](#), [knowledge engineering](#), and [information science](#). He also wrote on [politics](#), [law](#), [ethics](#), [theology](#), [history](#), and [philology](#), even occasional verse. His contributions to this vast array of subjects are scattered in journals and in tens of thousands of letters and unpublished manuscripts. To date, there is no complete edition of Leibniz's writings, and a complete account of his accomplishments is not yet possible.

Western Philosophers
17th-century philosophy
(Modern Philosophy)



Gottfried Wilhelm Leibniz

Name:	Gottfried Wilhelm Leibniz
Birth:	July 1, 1646 (Leipzig, Germany)
Death:	November 14, 1716 (Hanover, Germany)
School/tradition:	Rationalism
Main interests:	metaphysics , mathematics , science , epistemology , theodicy
Notable ideas:	calculus , monad , theodicy , optimism
Influences:	Plato , Aristotle , Ramon Llull , Scholastic philosophy , Descartes , Christiaan Huygens
Influenced:	Many later mathematicians, Christian Wolff , Immanuel Kant , Bertrand Russell , Abraham Robinson

Leonhard Euler

Leonhard Euler



Brucker.

Born	April 15, 1707 Basel, Switzerland
Died	September 18, 1783 St Petersburg, Russia
Residence	Switzerland , Russia , Germany
Nationality	Swiss
Field	Mathematics
Institution	Imperial Russian Academy of Sciences , Berlin Academy
Alma Mater	University of Basel
Known for	Analysis , number theory , graph theory
Religion	Calvinist

Leonhard Euler ([Basel, Switzerland, April 15, 1707](#) – [St Petersburg, Russia, September 18, 1783](#)) was a [Swiss mathematician](#) and [physicist](#). He developed important concepts and [established](#) mathematical [theorems](#) in fields as diverse as [calculus](#), [number theory](#) and [topology](#). He introduced the fundamental notion of a [mathematical function](#),^[1] and set much of the modern mathematical terminology: his two-volume *Introductio in analysin infinitorum* (1748) established a lot of the notation for [analysis](#).^[2] He is also renowned for his work in [mechanics](#), [optics](#) and [astronomy](#). Euler is considered to be the preeminent mathematician of the 18th century and one of the greatest of all time; he is also listed on the [Guinness Book of Records](#) as the most prolific, with collected works filling between 60 and 80 [quarto](#) volumes.^[3] Euler was featured on the Swiss 10-[franc](#) banknote^[4] as well as numerous Swiss, German and Russian stamps and had an [asteroid](#) ([2002 Euler](#)) named in his honor.

The measure of his influence can be expressed by this quote often attributed to [Pierre-Simon Laplace](#): "*Lisez Euler, lisez Euler, c'est notre maître à tous.*" (Read Euler, read Euler, he is a master for us all).^[5]

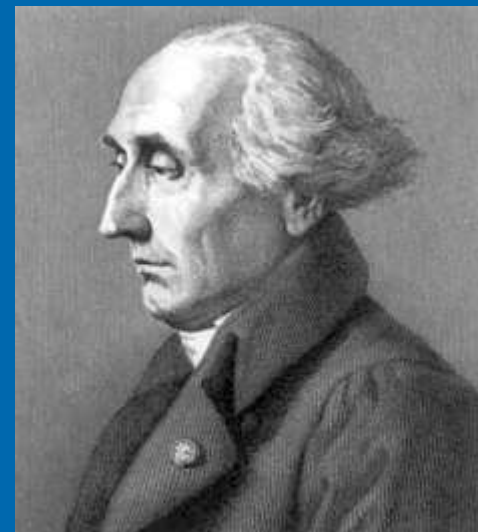
Physics and Astronomy

Aside from successfully applying his analytic tools to problems in [classical mechanics](#), Euler also applied these techniques to celestial problems. His work in astronomy were recognized by a number of Paris Academy Prizes over the course of his career. His accomplishments include determining with great accuracy the orbits of comets and other celestial bodies, understanding the nature of comets and calculating the [parallax](#) of the sun. His calculations also contributed to the development of accurate [longitude tables](#) [25] In addition, Euler made important contributions in [optics](#). He disagreed with Newton's corpuscular theory of light in the [Opticks](#), which was then the prevailing theory. His 1740's papers on optics helped ensure that the [wave theory of light](#) invented by [Christian Huygens](#) would become the dominant mode of thought. [26]

Joseph Louis Lagrange

comte de l'Empire (January 25, 1736 – April 10, 1813; b. Turin, baptised in the name of *Giuseppe Lodovico Lagrangia*) was an [Italian-French mathematician](#) and [astronomer](#) who made important contributions to all fields of [analysis](#) and [number theory](#) and to [classical](#) and [celestial mechanics](#) as arguably the greatest mathematician of the [18th century](#). It is said that he was able to write out his papers complete without a single correction required. Before the age of 20 he was professor of [geometry](#) at the royal artillery school at Turin. By his mid-twenties he was recognized as one of the greatest living mathematicians because of his papers on [wave propagation](#) and the maxima and minima of curves. His greatest work, *Mecanique Analytique* ([Analytical Mechanics](#)) (4. ed., 2 vols. Paris: Gauthier-Villars et fils, 1888-89. First Edition: [1788](#)), was a mathematical masterpiece and the basis for all later work in this field. On the recommendation of [Euler](#) and [D'Alembert](#), Lagrange succeeded the former as the director of mathematics at the Berlin Academy. Under the [First French Empire](#), Lagrange was made both a [senator](#) and a [count](#); he is buried in the [Panthéon](#).

It was Lagrange who created the [calculus of variations](#) which was later expanded by [Weierstrass](#), solved the [isoperimetrical problem](#) on which the variational calculus is based in part, and made some important discoveries on the [tautochrone](#) which would contribute substantially to the then newly formed subject. Lagrange also established the theory of [differential equations](#), and provided many new solutions and theorems in number theory, including [Wilson's theorem](#). Lagrange's classic *Theorie des fonctions analytiques* laid some of the foundations of [group theory](#), anticipating [Galois](#). Lagrange developed the [mean value theorem](#) which led to a proof of the [fundamental theorem of calculus](#), and a proof of [Taylor's theorem](#). Lagrange also invented the method of solving differential equations known as [variation of parameters](#), applied [differential calculus](#) to the [theory of probabilities](#) and attained notable work on the solution of [equations](#). He studied the [three-body problem](#) for the Earth, Sun, and Moon (1764) and the movement of Jupiter's satellites (1766), and in 1772 found the special-case solutions to this problem that are now known as [Lagrangian points](#). Above all, he reformulated [Newtonian mechanics](#) creating what is today known as [Lagrangian mechanics](#) from his results on applying the calculus of variations to mechanics.

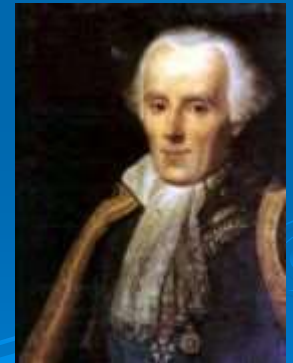


Pierre-Simon, Marquis de Laplace ([March 23, 1749](#), [Beaumont-en-Auge](#), [Normandy](#) – [March 5, 1827](#), [Paris](#)) was a [French mathematician](#) and [astronomer](#) who put the final capstone on [mathematical astronomy](#) by summarizing and extending the work of his predecessors in his five volume *Mécanique Céleste* ([Celestial Mechanics](#)) ([1799-1825](#)). This masterpiece translated the geometrical study of [mechanics](#) used by [Isaac Newton](#) to one based on [calculus](#), known as physical mechanics [\[1\]](#). He is also the discoverer of [Laplace's equation](#). Although the [Laplace transform](#) is named in honor of Laplace, who used the transform in his work on [probability theory](#), the transform was discovered originally by [Leonhard Euler](#), the prolific eighteenth-century Swiss mathematician. The Laplace transform appears in all branches of [mathematical physics](#) — a field he took a leading role in forming. The [Laplacian differential operator](#), much relied upon in applied [mathematics](#), is likewise named after him. He became [count](#) of the [Empire](#) in [1806](#) and was named a [marquis](#) in [1817](#) after the [restoration](#) of the [Bourbons](#).

Pierre-Simon, Marquis de Laplace

French [mathematician](#) & [astronomer](#)

Laplace spent much of his life working on [mathematical astronomy](#) that culminated in his masterpiece on the proof of the dynamic stability of the [solar system](#) with the assumption that it consists of a collection of rigid bodies moving in a vacuum. He independently formulated the [nebular hypothesis](#) and was one of the first scientists to postulate the existence of [black holes](#) and the notion of gravitational collapse.



Born [March 23, 1749](#)
[Beaumont-en-Auge](#), [Normandy](#)

Died [March 5, 1827](#)
[Paris](#), [France](#)

Johann Carl Friedrich Gauss



Born [30 April 1777](#)
[Brunswick, Germany](#)

Died [23 February 1855](#)
[Göttingen, Hanover, Germany](#)

Carl Friedrich Gauss (Gauß) ([help](#)·[info](#)) ([30 April 1777](#) – [23 February 1855](#)) was a [German mathematician](#) and [scientist](#) of profound [genius](#) who contributed significantly to many fields, including [number theory](#), [analysis](#), [differential geometry](#), [geodesy](#), [magnetism](#), [astronomy](#) and [optics](#). Sometimes known as "the prince of mathematicians" and "greatest mathematician since antiquity", Gauss had a remarkable influence in many fields of mathematics and science and is ranked among one of history's most influential mathematicians.

Gauss was a [child prodigy](#), of whom there are many anecdotes pertaining to his astounding precocity while a mere toddler, and made his first ground-breaking mathematical discoveries while still a teenager. He completed *[Disquisitiones Arithmeticae](#)*, his [magnum opus](#), at the age of twenty-one (1798), though it would not be published until 1801. This work was fundamental in consolidating number theory as a discipline and has shaped the field to the present day.

Gauss also made important contributions to [number theory](#) with his 1801 book *[Disquisitiones Arithmeticae](#)*, which contained a clean presentation of [modular arithmetic](#) and the first proof of the law of [quadratic reciprocity](#). In that same year, [Italian astronomer Giuseppe Piazzi](#) discovered the [planetoid Ceres](#), but could only watch it for a few days. Gauss predicted correctly the position at which it could be found again, and it was rediscovered by [Franz Xaver von Zach](#) on [December 31, 1801](#) in [Gotha](#), and one day later by [Heinrich Olbers](#) in [Bremen](#). Zach noted that "without the intelligent work and calculations of Doctor Gauss we might not have found Ceres again." Though Gauss had up to this point been supported by the stipend from the Duke, he doubted the security of this arrangement, and also did not believe pure mathematics to be important enough to deserve support. Thus he sought a position in astronomy, and in 1807 was appointed Professor of Astronomy and Director of the astronomical observatory in [Göttingen](#), a post he held for the remainder of his life.

The discovery of [Ceres](#) by [Piazzi](#) on January 1, 1801 led Gauss to his work on a theory of the motion of planetoids disturbed by large planets, eventually published in 1809 under the name *[Theoria motus corporum coelestium in sectionibus conicis solem ambientum](#)* (theory of motion of the celestial bodies moving in conic sections around the sun). Piazzi had only been able to track Ceres for a couple of months, following it for three degrees across the night sky. Then it disappeared temporarily behind the glare of the Sun. Several months later, when Ceres should have reappeared, Piazzi couldn't locate it: the mathematical tools of the time weren't able to extrapolate a position from such a scant amount of data – three degrees represent less than 1% of the total orbit. Gauss, who was 23 at the time, heard about the problem and tackled it head-on. After three months of intense work, he predicted a position for Ceres in December 1801 – just about a year after its first sighting – and this turned out to be accurate within a half-degree. In the process, he so streamlined the cumbersome mathematics of 18th century orbital prediction that his work – published a few years later as *Theory of Celestial Movement* – remains a cornerstone of astronomical computation. It introduced the [gaussian gravitational constant](#), and contained an influential treatment of the [method of least squares](#), a procedure used in all sciences to this



Johann Daniel Titius

It was proposed in 1766 by [Johann Daniel Titius](#) and "published" without [attribution](#) in 1772 by the director of the Berlin Observatory, [Johann Elert Bode](#), thus the name. However, some sources say it was first proposed by [Christian Wolff](#) in 1724^{[[citation needed](#)]}.

As originally stated by Titius, the "law" relates the semi-major axis, a , of each planet outward from the sun in units such that the Earth's semi-major axis = 10, with

$$a = n + 4$$

where $n = 0, 3, 6, 12, 24, 48 \dots$, with each value of $n > 3$ twice the previous value; the resulting values can be divided by 10 to convert them into [astronomical units](#) (AU). For the outer planets, each planet is 'predicted' to be roughly twice as far away from the Sun as the next inner object.

When originally published, the law was approximately satisfied by all the known planets — [Mercury](#) through [Saturn](#) — with a gap between the fourth and fifth planets. It was regarded as interesting, but of no great importance until the discovery of [Uranus](#) in 1781 which happens to fit neatly into the series. Based on this discovery, Bode urged a search for a fifth planet.

☞ [Ceres](#), the largest of the asteroids in the [asteroid belt](#), was found at the predicted position of the fifth planet. Bode's law was then widely accepted until [Neptune](#) was discovered in 1846 and found not to satisfy it. Simultaneously, the large number of known asteroids in the belt resulted in Ceres no longer being considered a planet. It is now understood that no planet could have formed in the belt, due to the gravitational influence of [Jupiter](#).

The discovery of [Pluto](#) in 1930 confounded the issue still further. While nowhere near its position as predicted by Bode's law, it was roughly at the position the law had predicted for Neptune. However, the subsequent discovery of the [Kuiper belt](#), and in particular of the object [Eris](#), which is larger than Pluto yet does not fit Bode's law, have further discredited the formula moot in the eyes of astronomers.



Johann Elert Bode

Titius – Bode rule

Theoretical explanations

There is no solid theoretical explanation of the Titius-Bode law, but it is likely a combination of [orbital resonance](#) and shortage of [degrees of freedom](#): any stable planetary system has a high probability of satisfying a Titius-Bode-type relationship. Because of this, it has been called a "rule" rather than a "law".

[Astrophysicist Alan Boss](#) states that it is just a coincidence. The [planetary science](#) journal [Icarus](#) no longer accepts papers attempting to provide 'improved' versions of the law. ([Boss 2006:70](#)).

Orbital resonance from major orbiting bodies creates regions around the [Sun](#) that are free of long-term stable orbits. Results from simulations of planetary formation support the idea that a randomly chosen stable planetary system will likely satisfy a Titius-Bode law.

Dubrulle and Graner[1][2] have shown that power-law distance rules can be a consequence of collapsing-cloud models of planetary systems possessing two symmetries: rotational invariance (the cloud and its contents are axially symmetric) and scale invariance (the cloud and its contents look the same on all length scales), the latter being a feature of many phenomena considered to play a role in planetary formation, such as turbulence.

There are a decidedly limited number of systems on which Bode's law can be tested. Two of the solar planets have a number of large moons that appear possibly to have been created by a process similar to that which created the planets themselves. The four large satellites of [Jupiter](#) plus the largest inner satellite — [Amalthea](#) — adhere to a regular, but non-Bode, spacing with the four innermost locked into orbital periods that are each twice that of the next inner satellite. The large moons of Uranus have a regular, but non-Bode, spacing. [1]

Recent discoveries of extrasolar planetary systems do not yet provide enough data to test whether similar rules apply to other solar systems.

Planet	k	T-B rule distance	Real distance
Mercury	0	0.4	0.39
Venus	1	0.7	0.72
Earth	2	1.0	1.00
Mars	4	1.6	1.52
(Ceres) ¹	8	2.8	2.77
Jupiter	16	5.2	5.20
Saturn	32	10.0	9.54
Uranus	64	19.6	19.2
Neptune	128	38.8	30.06
(Pluto) ¹	256	77.2	39.44

¹ Ceres was considered a planet from 1801 until the 1860's. Pluto was generally considered a planet from 1930 to 2006. The IAU had a proposal in late August 2006 which included Ceres as a planet, but this resolution was modified before its ratification. The modification gave both Ceres and Pluto the status of "[dwarf planet](#)".

Uranus

- The seventh most distant planet from the Sun, discovered by **William Herschel in 1781**. It is bluish green because of methane in the atmosphere. In fact the C:H ratio is 30 to 40 times the solar value. Its atmosphere is composed of hydrogen and helium, its mantle is water and ammonia ice, and its core is rocky. Uranus has 9 faint rings. Ten new satellites were discovered by Voyager 2 when it flew by in 1985. The rings of Uranus are designated 1986U2R, 6, 5, 4, , , , , 1986U1R, and . Enhanced Voyager 2 images of the ring found it to break up into 5 major arcs of roughly equal length. Uranus has 17 known moons: Ariel, Belinda, Bianca, Cordelia, Cressida, Desdemona, Juliet, Miranda, Oberon, Ophelia, Portia, Puck, Rosalind, Titania, and Umbriel. Two distant satellites in non-equatorial orbits were discovered by B. Gladman, P. Nicholson, J. A. Burns, and J. J. Kavelaars using the Palomar 5-meter telescope. The discovery was announced on Oct. 31, 1997.



William Herschel

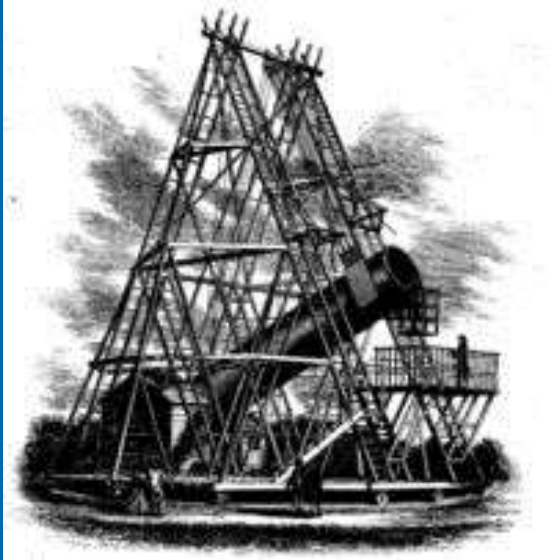
He was born **Friedrich Wilhelm Herschel** in [Hanover, Germany](#), as one of ten children (of which four died very young). In 1755 the Hanoverian Guards regiment in whose band William and his brother Jacob were engaged was ordered to [England](#). At the time, the crowns of England and [Hanover](#) were united under [George II](#). He learned English quickly and, at age nineteen, he changed his name to **Frederick William Herschel**.

He became a successful music teacher and bandleader, played the [violin](#), the [oboe](#) and, later, the [organ](#). He composed numerous musical works, including 24 symphonies and many concertos, as well as some church music. His music is largely forgotten today. After a career leading orchestras in Newcastle, Leeds and Halifax, he became organist of the Octagon Chapel, [Bath](#), in which town he was also Director of Public Concerts. His sister [Caroline](#) came to England and lived with him.

His music led him to interest in [mathematics](#), and hence to [astronomy](#). This grew stronger after 1773, and he built some telescopes and made the acquaintance of [Nevil Maskelyne](#). He observed the [Moon](#), measuring the heights of lunar mountains, and also worked on a catalog of [double stars](#).

The turning point in his life was [March 13, 1781](#), while residing at 19 New King Street, [Bath](#), when he discovered [Uranus](#). This made him famous and enabled him to turn to astronomy full-time. Naming the new planet *Georgium Sidus*, [Latin](#) for "George's Star", in honour of [King George III](#) also brought him favour (the name didn't stick — and until the name 'Uranus' was adopted the planet was known in France, where reference to the English king was to be avoided if possible, as 'Herschel'). That same year, Herschel was awarded the [Copley Medal](#) and was elected a Fellow of the [Royal Society](#). In 1782, he was appointed "The King's Astronomer" and he and his sister subsequently moved to [Datchet](#) (then in [Buckinghamshire](#) but now in [Berkshire](#)) on [August 1, 1782](#). He continued his work as a telescope maker, selling a number of them to other astronomers.

In 1783 he gave Caroline a telescope and she began to make astronomical discoveries in her own right, particularly [comets](#). Caroline also served as his full-time assistant, taking notes while he observed at the telescope.



➤ The 40 foot telescope

- During the course of his career, he constructed more than four hundred telescopes. The largest and most famous of these was a [reflecting telescope](#) with a 40 ft (12 m) [focal length](#) and an aperture 49½ inches (126 cm) in diameter. On [August 28, 1789](#), his first night of observation using this instrument, he discovered a new moon of [Saturn](#). A second moon followed within the first month of observation. The 40 ft telescope proved very cumbersome, however, and most of his observations were done with a smaller telescope of 20 ft (6.1 m) focal length. Herschel discovered that unfilled telescope apertures can be used to obtain high angular resolution something which became the essential basis for interferometric imaging in astronomy (in particular [Aperture Masking Interferometry](#) and [hypertelescopes](#)).
- William and Mary had one child, [John](#), born at Observatory House on [March 7, 1792](#). In 1816, William was made a Knight of the [Royal Guelphic Order](#) by the [Prince Regent](#) and was thus entitled to style himself **Sir**. He helped to found the [Astronomical Society of London](#) in 1820, which in 1831 received a royal charter and became the [Royal Astronomical Society](#).
- On [August 25, 1822](#), Herschel died at Observatory House, Slough, and is buried at nearby St Laurence's Church, Upton.
- His son [John Herschel](#) also became a famous astronomer. One of William's brothers, Alexander, moved permanently to England, near Caroline and William.

Other astronomical work

In his later career, Herschel discovered two satellites of Saturn, [Mimas](#) and [Enceladus](#); as well as two satellites of Uranus, [Titania](#) and [Oberon](#). He did not give these satellites their names; rather, they were named by his son [John](#) in [1847](#) and [1852](#), respectively, well after his death.

He worked on creating an extensive catalog of [nebulae](#). He continued to work on double stars, and was the first to discover that most [double stars](#) are not mere [optical doubles](#) as had been supposed previously, but are true [binary stars](#), thus providing the first proof that Newton's laws of gravitation apply outside the solar system.

He also discovered [infrared radiation](#) (ca. [1800](#)).

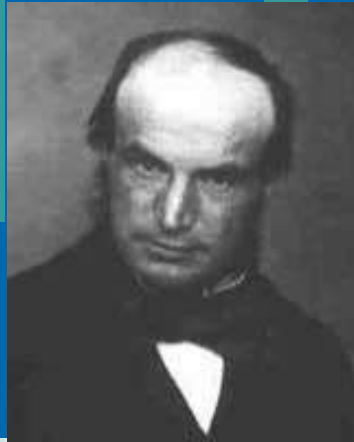
From studying the [proper motion](#) of stars, he was the first to realize that the [solar system](#) is moving through space, and he determined the approximate direction of that movement. He also studied the structure of the [Milky Way](#) and concluded that it was in the shape of a disk.

He also coined the word "[asteroid](#)", meaning *star-like* (from the [Greek](#) *asteroeides*, *aster* "star" + *-eidos* "form, shape"), in [1802](#) (shortly after [Olbers](#) discovered the second minor planet, [2 Pallas](#), in [late March](#) of the same year), to describe the star-like appearance of the small moons of the [giant planets](#) and of the minor planets; the planets all show discs, by comparison. Despite his numerous important scientific discoveries, Herschel was not averse to wild speculation. In particular, he believed every planet was inhabited, even the [Sun](#): he believed that the Sun had a cool, solid surface protected from its hot atmosphere by an opaque layer of cloud, and that a race of beings adapted to their strange environment lived there.

Neptun

- The planet having the second greatest average distance from the Sun. It was discovered by Adams and Le Verrier in 1846. It is bluish green and has an atmosphere of hydrogen and helium, an icy mantle, and a rocky core. Neptune emits more energy than it receives from the Sun. It was be visited by Voyager 2 in Aug. 1989, which discovered six new satellites and a set of ring arcs. Neptune is the windiest planet in the solar system, with wind speeds of 600 m s⁻¹ (Mach 1 at 59 K). The rings of Neptune are designated 1989N3R, 1989N2R, 1989N4R, and 1989N1R.
- Although the *average* orbital distance of Neptune is less than that of Pluto, during certain periods, it is actually farther from the Sun than Pluto.

Adams, John Couch (1819-1892)



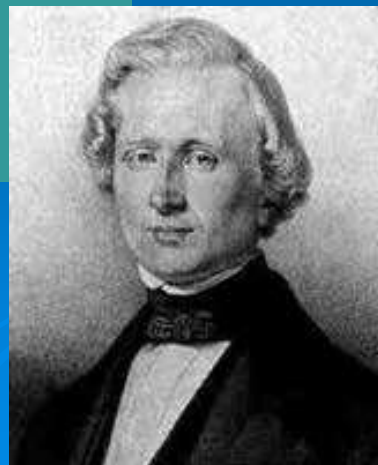
English astronomer who also developed a procedure for numerical integration of differential equations. He mathematically predicted the location of [Neptune](#) in 1846, independently of [Le Verrier](#). Adams' calculations, however, were ignored by [Airy](#) until after [Le Verrier](#) had published his own prediction.



Airy, George (1801-1892)

English astronomer and mathematician who was appointed Astronomer Royal and modernized the Greenwich Observatory. Airy is best known for his failure to follow up [Adams'](#) calculations, which would have led to the discovery of [Neptune](#).

Le Verrier, Urbain (1811-1877)



French mathematician who co-discovered [Neptune](#) in 1846 with [Adams](#). – opazovali na Berlinskem observatoriju.

Iskal Vulkan, opazoval gibanje Merkurja – perihelij – Einsteinova teorija relativnosti

Pluton

- The smallest of the nine planets, Pluto also has the largest average distance from the Sun. Pluto's orbit is highly inclined to the ecliptic plane. Its orbit is also highly elliptical, bringing it closer to the Sun than Neptune from Feb. 7, 1979 to Feb. 10, 1999. Pluto was discovered by **Clyde Tombaugh** (**Clyde William Tombaugh** (February 4, 1906 – January 17, 1997) was an American astronomer) on Feb. 10, 1930, but not announced until March 13. For a personal account of the extent of this survey, see *Sky & Telescope* (Apr. 1991).
- At 43 K, Pluto's surface consists of frozen methane, ammonia, and water. Mutual occultation of Pluto and its only moon Charon occurred from Dec. 1984 to Sept. 23, 1990. The alignment, in which Charon's 6.39 day orbit appears edge-on from the earth, only happens every 124 years. A discussion of the occultations can be found in *Sky & Telescope* (Jan. 1991, p. 13) and *Sky & Telescope* (Sept. 1987). The first image resolving Pluto and Charon was taken by the Hubble Space Telescope. In the image appearing on *Sky & Telescope* (Jan. 1991, p. 16), the bodies are separated by 0.9".




Friedrich Bessel

prvi izmeril razdaljo do zvezde I. 1838

Friedrich Bessel



essel

Born	July 22, 1784 Minden, Westphalia , now Germany
Died	March 17, 1846 Königsberg, Prussia , now Kaliningrad, Russia
Residence	Prussia
Nationality	 German
Field	Mathematics and Astronomy
Institution	University of Berlin
Alma Mater	Georg-August University
Doctoral Advisor	Carl Friedrich Gauss
Doctoral Students	Heinrich Scherk
Known for	Bessel functions
Notable Prizes	Gold Medal of the Royal Astronomical Society (1829 & 1841)

Friedrich Wilhelm Bessel ([July 22, 1784](#) – [March 17, 1846](#)) was a [German mathematician](#), [astronomer](#), and systematizer of the [Bessel functions](#) (which were discovered by [Daniel Bernoulli](#)). He was born in [Minden, Westphalia](#) and died of [cancer](#) in Königsberg (now [Kaliningrad, Russia](#)). Bessel was a contemporary of [Carl Gauss](#), also a mathematician and astronomer.

Bessel was the son of a civil servant, and at the age of 14 he was apprenticed to the import-export concern [Kulenkamp](#). He shortly became an accountant for them, and the business' reliance on cargo ships led him to turn his mathematical skills to problems in navigation. This in turn led to an interest in astronomy as a way of determining [longitude](#).

He came to the attention of a major figure of German astronomy at the time, [Heinrich Wilhelm Olbers](#), by producing a refinement on the orbital calculations for [Halley's Comet](#). Within two years he had left Kulenkamp and become an assistant at [Lilienthal Observatory](#) near [Bremen, Germany](#). There he worked on [James Bradley's](#) stellar observations to produce precise positions for some 3222 stars.

This work attracted considerable attention, and at the age of 26 he was appointed director of the [Königsberg Observatory](#) by [Frederick William III of Prussia](#). There he published tables of [atmospheric refraction](#) based on Bradley's observations, which won him the [Lalande Prize](#) from the [Institut de France](#). On this base, he was able to pin down the position of over 50,000 stars during his time at Königsberg.

With this work under his belt, Bessel was able to achieve the feat for which he is best remembered today: he is credited with being the first to use [parallax](#) in [calculating](#) the [distance](#) to a [star](#). Astronomers had believed for some time that parallax would provide the first accurate measurement of interstellar distances -- in fact, the 1830s housed a fierce competition between astronomers to be the first to accurately measure a stellar parallax. In 1838 Bessel won the "race", announcing that [61 Cygni](#) had a parallax of 0.314 [arcseconds](#); which, given the diameter of the [Earth's](#) orbit, indicated that the star was ~3 [parsecs](#) away. [Hipparcos](#) experiment has now calculated the parallax at 0.28547 [arcseconds](#). He narrowly beat [Friedrich Georg Wilhelm Struve](#) and [Thomas Henderson](#), who measured the parallaxes of [Vega](#) and [Alpha Centauri](#) in the same year.

As well as helping determine the parallax of 61 Cygni, Bessel's precise measurements allowed him to notice deviations in the motions of [Sirius](#) and [Procyon](#), which he deduced must be caused by the gravitational attraction of unseen companions. His announcement of Sirius' "dark companion" in 1844 was the first correct claim of a previously unobserved companion by positional measurement, and eventually led to the discovery of [Sirius B](#).

Despite lacking a university education, Bessel was a major figure in astronomy during his lifetime. He was elected a fellow of the [Royal Society](#), and the largest [crater](#) in the moon's [Mare Serenitatis](#) was named after him.

He won the [Gold Medal of the Royal Astronomical Society](#) in 1841. The asteroid [1552 Bessel](#) was named in his honour.

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- astronomija Sonca
- znanost o planetih
- zvezdna astronomija
- galaktična astronomija
- galaksije in jate galaksij
- kozmologija

