THE EXPANSE

System

2352-05-16 (395-03-28)

Contents

Here we have notable Solar System bodies and distances between them for communication and travel. This is a living document: positions of bodies change over the time. Effective date can be seen in image and table titles.

Legend

System maps use two different scales, either Gm or AU. Gm is a standard SI unit gigameter (million kilometers). AU is an astronomical unit: distance from the Earth to the Sun (roughly 150 million kilometers or 150 Gm). Gm is used within gas giant systems (Jupiter and Saturn).

System objects are displayed as small filled circles. Sun is yellow, Earth is blue and Mars is red. Otherwise, following colors are used:

Green Important planets.

Purple Permanent human colonies.

Orange Artificial constructs.

Gray Other system objetcs.

Notable objects have orbit dots displaying their future positions. Orbit dot color is is same as the object color. Legend info in the map tells the time interval between dots. Note that some objets may have retrograde orbits rotating in opposite direction.

All asteroid labels include their number. Objects without number are either planets, moons or artificial constructs.

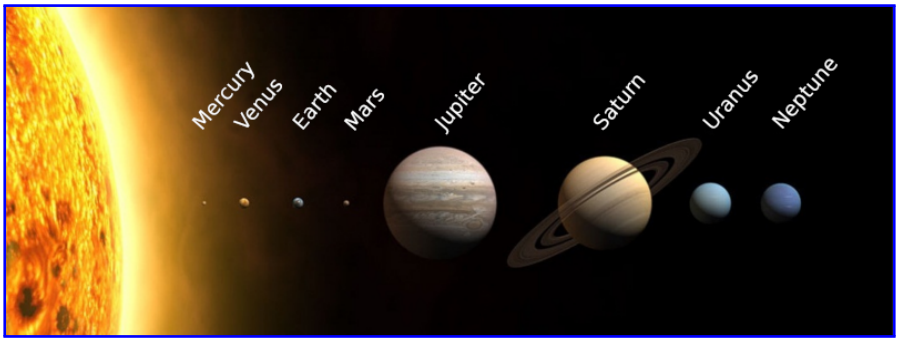


Image above shows relative sizes major Solar system objects.

1 Inner System

The inner system map (page 7) shows positions of notable objects inside Jupiter's orbit. Future orbit positions are displayed for some bodies at one month intervals.

Mercury

Mercury is the closest planet to the Sun. The smallest planet in the Solar System, it has no natural satellites. Besides impact craters, its only known geological features are lobed ridges or rupes that were probably produced by a period of contraction early in its history. Mercury's very tenuous atmosphere consists of atoms blasted off its surface by the solar wind. Its has relatively large iron core and thin mantle.

Venus

Venus is the solar system's second planet, and while similar in size and mass to Earth, it is strikingly different in almost every other way. Venus has a retrograde rotation, meaning it rotates clockwise, as opposed to the counter-clockwise rotations of most of the solar system's other planets. Although Venus' gravity is just slightly lower than that of Earth, the planet's incredibly dense carbon dioxide atmosphere results in crushing atmospheric pressure at the surface 92 times greater than Earth's. It also creates a powerful greenhouse effect, leading to surface temperatures of 735 K, making Venus the hottest planet in the solar system — hotter even than the surface of Mercury. Venus has no moons.

Earth

The third planet from the Sun and the birthplace of humanity, Earth stands as the cultural, political, and economic center of the solar system. It remains the only world in the system with a breathable atmosphere where people can live outdoors under an open sky. Home to 30 billion people, Earth struggles under the effects of climate change, environmental pollution, overpopulation, and widespread unemployment, but its corporations are the wealthiest and most powerful in the system. It is heavily reliant on the resources of the Belt to keep the engine of its economy running, yet the grip Earth once held on its interplanetary colonies is slowly slipping away.

Luna Luna is Earth's only natural satellite. It is only a quarter of Earth's diameter, with a gravity of 0.16 g — lighter than many spin stations in the Belt. Only 384,402 kilometers away from Earth, Luna was the site of humanity's first landing on another planet, as well as the location of Earth's first inter-

planetary colony, established in the early 21st century. This first permanent lunar base was a shared military and scientific endeavor, and while elements of both remain, Luna is now much more of a civilian station. Like Earth, Luna is governed by the United Nations, and the approximately one billion inhabitants of Luna are considered full UN citizens.

Mars

Mars is the fourth planet from the Sun and the second-smallest planet in the Solar System, being larger than only Mercury. The the iron oxide prevalent on Mars's surface gives it a reddish appearance distinctive among the astronomical bodies visible to the naked eye. Mars is a terrestrial planet with a thin atmosphere, with surface features reminiscent of the impact craters of the Moon and the valleys, deserts and polar ice caps of Earth.

The Martian Congressional Republic rules over four billion people who are spread across Mars, associated orbital stations, and the small but highly advanced military fleets cruising the solar system. Settled in the 21st century after a number of lengthy exploratory missions, Mars is a world of dreamers, devoted to a single vision: the greening of the red planet.

Phobos Phobos is the innermost and larger of the two natural satellites of Mars. It is a small, irregularly shaped object with a mean radius of 11 km. Phobos orbits 6,000 km from the Martian surface, closer to its primary body than any other known planetary moon. It is so close that it orbits Mars much faster than Mars rotates, and completes an orbit in just 7 hours and 39 minutes. As a result, from the surface of Mars it appears to rise in the west, move across the sky in 4 hours and 15 minutes or less, and set in the east, twice each Martian day.

Deimos Deimos was the smaller and outermost of the two natural satellites of Mars. It no longer exists as such. Following nuclear annihilation of the Earth-Mars joint Phoebe Research Station and the Saturnian satellite in the wake of the Eros Incident, the United Nations destroyed one of Mars' two moons. Prior to becoming a smudge in the Martian sky, Deimos hosted military facilities and a deep radar station.

1.1 Near-Earth Objects

A near-Earth object is any small Solar System body whose orbit brings it into proximity with Earth.

Atira asteroids are asteroids whose orbits are entirely confined within Earth's orbit. They are by far the smallest group of near-Earth objects.

Earth-crossers whose semi-major axes are smaller than Earth's are Aten asteroids. The remaining ones are Apollo asteroids, which are the largest group of near-Earth objects.

Amor asteroids is a subgroup of the near-Earth asteroids that approach the orbit of Earth from beyond, but do not cross. The most famous of these is, of course, Eros.

433 Eros Eros was a stony and elongated asteroid of the Amor group with a mean diameter of approximately 16.8 kilometers. The first artificially rotated asteroid habitat and often called as a birthplace of the Belt. Nowadays famous for the Venus Incident.

1036 Ganymed A stony asteroid on a highly eccentric orbit, classified as a near-Earth object of the Amor group. With a diameter of 35 kilometers, it is the largest of all near-Earth objects.

1221 Amor Amor is an S-type asteroid and near-Earth object on an eccentric orbit, approximately 1 kilometer in diameter. It is the namesake of the Amor asteroids.

1862 Apollo Apollo is a stony asteroid, approximately 1.5 kilometers in diameter. It is the namesake and the first recognized member of the Apollo asteroids. In addition, since Apollo's orbit is highly eccentric, it crosses the orbits of Venus and Mars and is therefore called a Venus-crosser and Mars-crosser as well.

3753 Cruithne Aten asteroid in orbit around the Sun in 1:1 orbital resonance with Earth, making it a co-orbital object. Cruithne is approximately 5 kilometres in diameter.

163693 Atira Atira is a binary asteroid, a system of two asteroids orbiting their common barycenter. The primary component with a diameter of approximately 4.8 kilometers is orbited by a minor-planet moon that measures about 1 km. Atira is the namesake and the first numbered body of the Atira asteroids.

2 Asteroid Belt

The asteroid belt is a torus-shaped region in the Solar System, located roughly between the orbits of the planets Jupiter and Mars, that is occupied by a great many solid, irregularly shaped bodies, of many sizes but much smaller than planets, called asteroids or minor planets. About half the mass of the belt is contained in the four largest asteroids: Ceres, Vesta, Pallas, and Hygiea. The total mass of the asteroid belt is approximately 4% that of the Moon.

Tycho Station The Belt headquarters of Tycho Manufacturing and Engineering Concern is the largest mobile construction platform in the Sol System. Fifteen thousand workers and their families live within Tycho, building megastructures or massive ships far beyond the reach of a planet.

2.1 Colonized Asteroids

1 Ceres The only dwarf planet in the inner solar system, and the first asteroid discovered by humanity. Only object in the asteroid belt rounded by its own gravity. Tycho corporation spun up the asteroid in a dramatic feat of engineering, granting it a gravity of 0.3g. Now the most important port of call in the Belt with population of approximately six million permanent residents

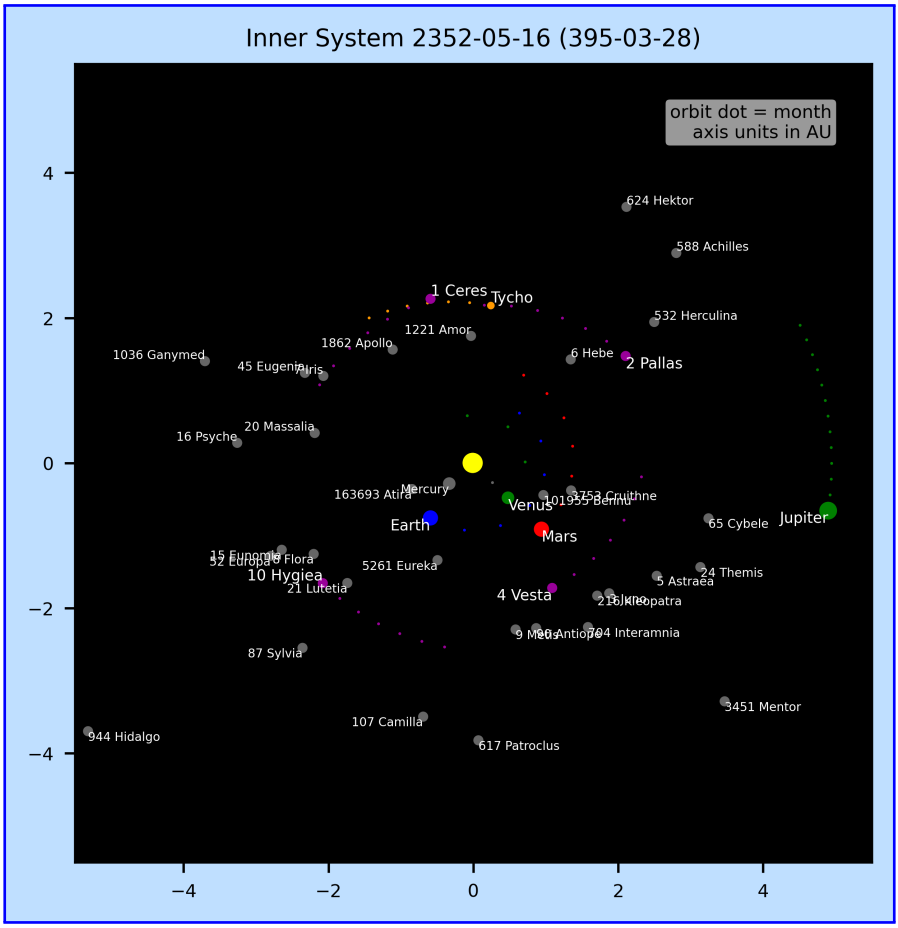
2 Pallas The third largest asteroid in the asteroid Belt, and the second asteroid discovered by humanity. It hosts one of the oldest stations, Pallas Station, in the outer planets, but is also known for a revolt at its colony. The station itself has a long history of a refinement station for the mining operations of the Belt. Due to this legacy, it continues to have its infrastructure maintained and upgraded, making use of its older equipment as overflow capacity.

4 Vesta The second-most-massive asteroid in the asteroid Belt after Ceres and the only known remaining rocky protoplanet of the kind that formed the terrestrial planets. It hosts one of the largest settlements in the outer planets. At some time during the UN-MCR Cold War, Vesta was the site of the Vesta Blockade, a confrontation between the UN and MCR that would delay the Martian terraforming efforts for over a century.

10 Hygiea The fourth largest asteroid in the asteroid Belt and somewhat oblong. It hosts Hygeia Station. Like many places in the Belt, its population suffered from high UN taxes that made survival expensive and kept the population routinely destitute.

2.2 Notable Asteroids

3 Juno One of the two largest stony asteroids, along with 15 Eunomia. It contains about 1% of the total mass of the asteroid Belt. Its orbit has an extreme eccentricity which brings Juno closer to the Sun at perihelion than Vesta and further out at aphelion than Ceres.



5 Astraea The fifth asteroid discovered. Physically unremarkable but notable because after its discovery, thousands of other asteroids would follow. The discovery of Astraea proved to be the starting point for the eventual demotion of the four original asteroids (which were regarded as planets at the time) to their current status.

6 Hebe Large main-belt asteroid, containing around 0.5% of the mass of the Belt. This high bulk density means an extremely solid body that has not been impacted by collisions, which is not typical of asteroids of its size. In brightness, Hebe is the fifth-brightest object in the asteroid Belt.

7 Iris Large main-belt asteroid orbiting the Sun between Mars and Jupiter. It is the fourth-brightest object in the asteroid belt. It is classified as an S-type asteroid, meaning that it has a stony composition.

8 Flora Large, bright main-belt asteroid. It is the innermost large asteroid: no asteroid closer to the Sun has a diameter above 25 kilometres or two-elevenths that of Flora itself, and not until the tiny 149 Medusa was discovered was a single asteroid orbiting at a closer mean distance known.

9 Metis One of the larger main-belt asteroids. It is composed of silicates and metallic nickel-iron, and may be the core remnant of a large asteroid that was destroyed by an ancient collision. Metis is estimated to contain just under half a percent of the total mass of the asteroid Belt.

15 Eunomia The largest of the stony asteroids with mean diameter of 268 km. Eunomian family is the most prominent family in the intermediate asteroid belt and the 6th-largest family with nearly six thousand known members, or approximately 1.4% of all asteroids in the asteroid Belt.

16 Psyche One of the most massive asteroids in the asteroid belt. This object is over 200 km in diameter and contains about 1% of the mass of the entire asteroid belt. It is thought to be the exposed iron core of a protoplanet, and is the most massive metallic M-type asteroid.

20 Massalia Stony asteroid and the parent body of the Massalia family located in the inner region of the asteroid belt, approximately 145 kilometers in diameter. The family is fairly young, estimated to have been created by an impact 150 to 200 million years ago.

21 Lutetia A large asteroid in the asteroid belt of an unusual spectral type. It measures about 100 kilometers in diameter and is heavily cratered, with the largest impact crater reaching 45 km in diameter. The surface is geologically heterogeneous and is intersected by a system of grooves and scarps. One of the few planetesimals in the Belt.

24 Themis The largest member of the Themistian family with surface completely covered in ice. There is also organic compounds in the form of tholins, high-molecular weight organics found in the outer solar system, distinguished by a brown or reddish color in optical spectra.

45 Eugenia Famed as one of the first asteroids to be found to have a moon orbiting it, and the first one to been discovered by an Earth-based telescope. Eugenia I Petit-Prince is the larger (diameter of 13 km), outer moon. A second, smaller (diameter of 6 km) satellite orbits closer to Eugenia.

52 Europa The 6th-largest asteroid in the asteroid belt, having an average diameter of around 315 km. It is not round but is shaped like an ellipsoid of approximately 380×330×250 km. Europa is a very dark carbonaceous C-type, and is the second largest of this group.

65 Cybele One of the largest asteroids in the Solar System and is located in the outer asteroid belt. It gives its name to the Cybele group of asteroids that orbit outward from the Sun from the 2:1 orbital resonance with Jupiter. The last outpost of an extended asteroid belt.

87 Sylvia The 8th-largest asteroid in the asteroid belt. It is the parent body of the Sylvia family and member of Cybele group located beyond the core of the belt. Sylvia was the first asteroid known to possess more than one moon. They have been named (87) Sylvia I Romulus and (87) Sylvia II Remus.

90 Antiope A double asteroid in the outer asteroid belt. It was found to consist of two almost-equally-sized bodies orbiting each other. At average diameters of about 88 km and 84 km, both components are among the 500 largest asteroids.

107 Camilla One of the largest asteroids from the outermost edge of the asteroid belt, approximately 220 kilometers. It is a member of the Sylvia family and located within the Cybele group. The X-type asteroid is a rare trinary asteroid with two minor-planet moons.

216 Kleopatra A metallic, ham-bone-shaped asteroid and trinary system orbiting in the central region of the asteroid belt, approximately 138 kilometers in diameter. It is believed that Kleopatra's shape, rotation, and moons are due to an oblique impact perhaps 100 million years ago.

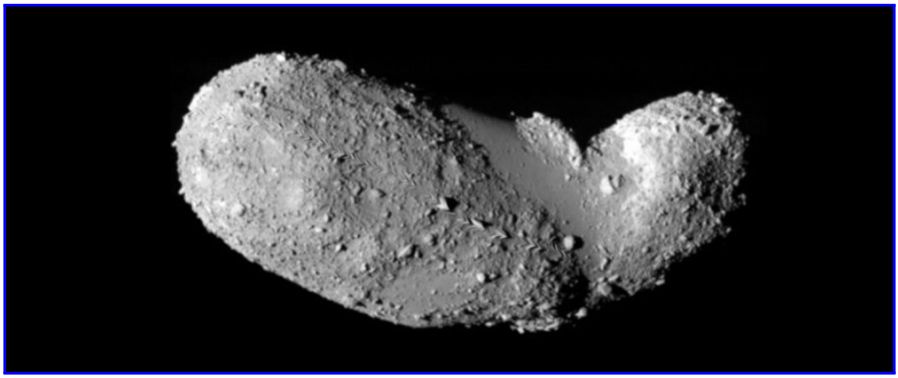
511 Davida One of the ten most-massive asteroids, and the 7th-largest asteroid. It is approximately 270–310 km in diameter and comprises an estimated 1.5% of the total mass of the Asteroid Belt. It is a C-type asteroid, which means that it is dark in colouring with a carbonaceous chondrite composition.

532 Herculina One of the larger members of the main asteroid belt with size of 260×220×215 km. It is not spherical, but a blocky shape not unlike a battered cuboid - or, as the original analysis described it, it "resembles a toaster". It has multiple largish craters, but no major variation in albedo.

588 Achilles Large Jupiter trojan from the Greek camp. Archillies was the first Jupiter trojan to be discovered. The dark D-type asteroid measures 133 kilometers in diameter which makes it one of the 10 largest Jupiter trojans.

617 Patroclus A binary Jupiter trojan is is a slow rotator due to the 103-hour orbital period of its two components. Patroclus (110 kilometer in diameter) and slightly smaller Menoetius orbit around each other at a distance of roughly 700 km It was the second trojan to be discovered and the only member of the Trojan camp named after a Greek character.

624 Hektor The largest Jupiter trojan and the namesake of the Hektor family, with a highly elongated shape equivalent in volume to a sphere of approximately 225 to 250 kilometers diameter. It has one small 12-kilometer sized satellite, Skamandrios.



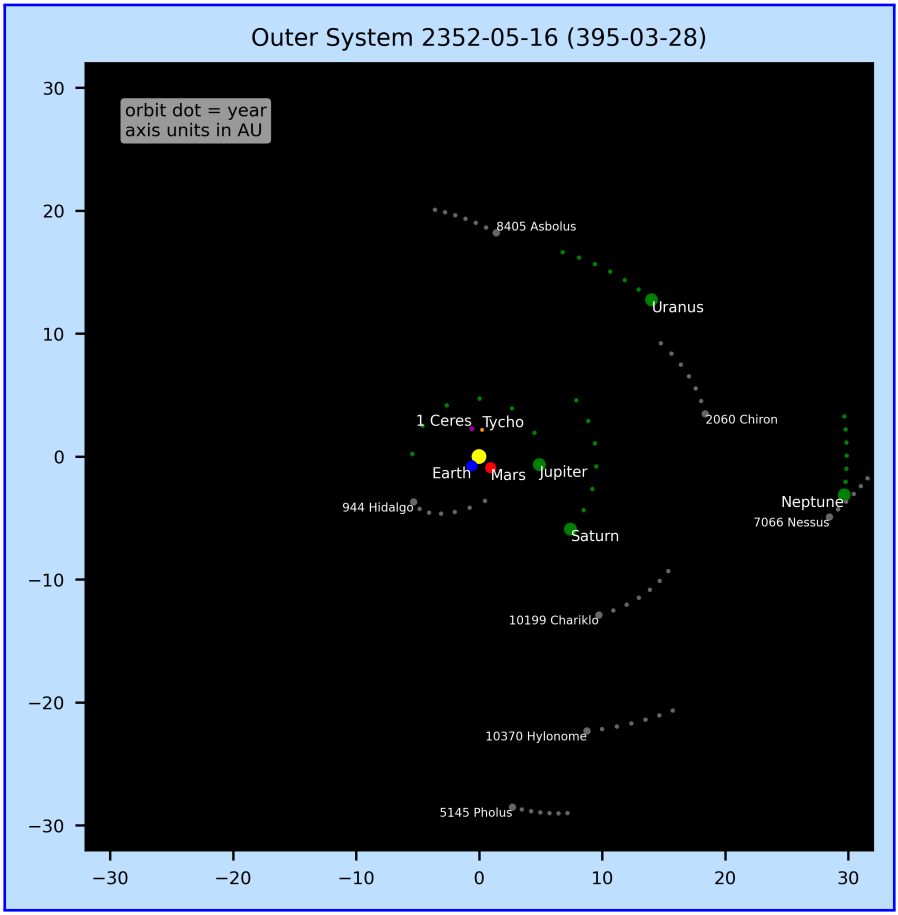
704 Interamnia Large F-type asteroid with an estimated diameter of 350 kilometres. It is the fifth-most-massive asteroid with a mass estimated to be 1.2% of the mass of the Asteroid Belt. Interamnia may represent a transitional body between small solar system bodies and dwarf planets.

3451 Mentor Mentor is a large Jupiter trojan from the Trojan camp, approximately 120 kilometers in diameter. The uncommon Jovian X-type asteroid is one of the largest Jupiter trojans and orbits the Sun at a distance of 4.8–5.5 AU once every 11 years and 8 months.

5261 Eureka Eureka is a trojan trailing Mars at the L5 point. The asteroid is located deep within a stable Lagrangian zone of Mars, which is considered indicative of a primordial origin — meaning the asteroid has most likely been in this orbit for much of the history of the Solar System. It has one natural satellite orbiting 2.1 km from Eureka.

3 Outer System

The outer system map shows positions of giant planets within the orbit of Neptune. Earth, Mars and some asteroid colonies are included for reference. Future orbit positions are displayed for some objects at one year intervals.



Travel beyond Saturn orbit is quite rare. There is a small colony in Uranian moon Titania. Neptunian moon Triton has an astronomy lab and mining research station. No human has ever ventured to Kuiper Belt, but several automated probes have charted it.

3.1 Centaurs

Centaurs are small Solar System bodies with either a perihelion or a semi-major axis between those of the outer planets. They generally have unstable orbits because they cross or have crossed the orbits of one or more of the giant planets; almost all their orbits have dynamic lifetimes of only a few million years. Centaurs typically behave with characteristics of both asteroids and comets.

944 Hidalgo The first member of centaurs ever to be discovered. The dark D-type object has a rotation period of 10.1 hours and an elongated shape with mean diameter of 52 kilometers. Its cometary-like orbit takes it to the inner edge of the Asteroid Belt and as far out as to the orbit of Saturn.

2060 Chiron Although Chiron was initially called an asteroid and classified only as a minor planet, it was later found to exhibit behavior typical of a comet. Now it is classified as both a minor planet and a comet. Chiron's orbit is highly eccentric (0.37), with perihelion just inside the orbit of Saturn and aphelion just outside the perihelion of Uranus. Its diameter is 200 kilometers.

5145 Pholus An eccentric centaur in the outer Solar System, 180 kilometers in diameter, that crosses the orbit of both Saturn and Neptune. The very reddish object has an elongated shape and a rotation period of 9.98 hours. It was the second centaur to be discovered.

7066 Nessus A centaur on an eccentric orbit, located beyond Saturn in the outer Solar System. The dark and reddish minor planet is elongated and measures 60 kilometers in diameter. It has a relatively long orbital half-life of about 4.9 million years.

8405 Asbolus A centaur orbiting in the outer Solar System between the orbits of Jupiter and Neptune. It measures 80 kilometers in diameter and has a fresh impact crater on its surface, less than 10 million years old.

10199 Chariklo The largest centaur with a diameter of 232 km. It orbits the Sun between Saturn and Uranus, grazing the orbit of Uranus. Chariklo has two ice rings (named Oiapoque and Chuí) with radii 396 and 405 km and widths of about 7 km and 3.5 km respectively.

10370 Hylonome A minor planet orbiting in the outer Solar System. The dark and icy body belongs to the class of centaurs and measures approximately 75 kilometers in diameter. It is a Neptune-crosser, and an outer-grazer of the orbit of Uranus, which it hence does not cross.

4 Communication Delay

One of the few true constants in the universe remains the speed of light. Whether communications are sent as radio waves or on the laser of a tightbeam, they travel 300,000 kilometers per second. Often a message can be slowed while the receiver waits for redundant copies of lost packets of data to arrive, or for a message to work its way to the top of the queue at a tightbeam relay station and get passed along on the next stage of its journey. Worse, a distance of 15 light minutes between Earth and Ceres doesn't mean it takes 15 minutes to establish a connection: it means it takes 15 minutes for the first part of the message to travel the distance ("How are you?"), then another 15 minutes for the reply to return ("I'm fine, thanks."). Conversations of alternating messages can take hours or days to complete. Because of this, most transmitted conversations are sent as recorded messages rather than attempting a live conversation, unless the light-speed delay is only a few seconds.

System Communication Delay in Minutes 2352-05-16 (395-03-28)

	Venus	Earth	Mars	Tycho	Ceres	Pallas	Vesta	Hygiea	Jupiter	Saturn
Venus	0	9	6	27	27	21	12	24	37	76
Earth	9	0	13	30	28	29	17	15	46	82
Mars	6	13	0	32	32	22	8	26	33	71
Tycho	27	30	32	0	8	24	39	43	49	97
Ceres	27	28	32	8	0	27	40	39	53	101
Pallas	21	29	22	24	27	0	28	44	29	78
Vesta	12	17	8	39	40	28	0	26	33	65
Hygiea	24	15	26	43	39	44	26	0	59	88
Jupiter	37	46	33	49	53	29	33	59	0	52
Saturn	76	82	71	97	101	78	65	88	52	0

Jovian system outer moons are quite far away and communication delays between them are significant.

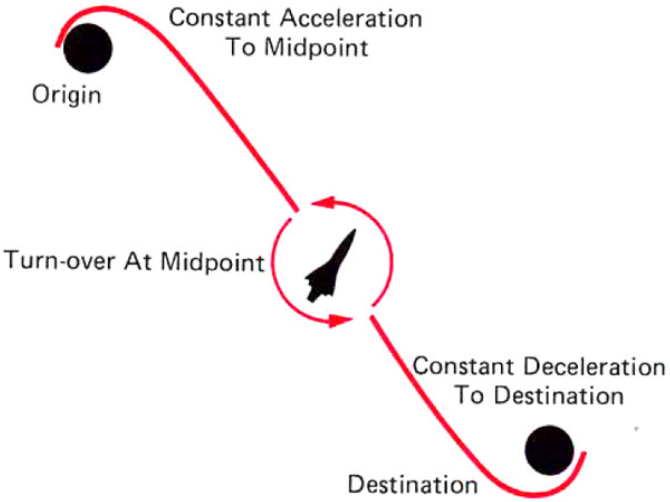
Jovian Communication Delay in Seconds 2352-05-16 (395-03-28)

	Ganym.	Callisto	Leda	Himalia	Elara	Lysithea	Ananke	Pasiphae	Carme	Sinope
Ganym.	0	6	45	40	44	39	76	97	77	75
Callisto	6	0	40	35	46	40	78	93	80	78
Leda	45	40	0	37	61	73	81	82	113	110
Himalia	40	35	37	0	63	52	99	84	101	94
Elara	44	46	61	63	0	77	44	135	115	113
Lysithea	39	40	73	52	77	0	113	92	52	44
Ananke	76	78	81	99	44	113	0	158	141	142
Pasiphae	97	93	82	84	135	92	158	0	109	106
Carme	77	80	113	101	115	52	141	109	0	13
Sinope	75	78	110	94	113	44	142	106	13	0

Delay between Earth and Moon is about 1.3 seconds. Likewise, in Saturn's inner system, delays are always within 2 seconds. Delay between outmost Iapetus and inner Saturn system is less than 15 seconds.

5 Travel Times

Because the Epstein Drive removed Δv limitations to space travel, ships no longer needed to execute Hohmann transfers to maneuver between bodies. To transfer, ships can simply burn prograde at a constant rate, then flip around and decelerate by burning retrograde. This maneuver is called a Brachistochrone trajectory, from the Greek meaning "shortest time." A course using this maneuver tends to be curved as it uses the sun's gravity to increase the ship's acceleration.



The time it takes to execute a flight path along a Brachistochrone trajectory depends on two factors: the distance between the two points, and the acceleration of the ship. The greater the acceleration, the less time it takes to travel, but the multiple g-forces created by these "hard burns" are extremely stressful on the human body. Crash couches and pharmaceutical cocktails like "the juice" alleviate some, but not all, of the damage inflicted by the hardest burns.

Following tables show the time to travel the average distance between the two locations at an average acceleration of 0.3g, 0.5g and 1.0g, presented as total required travel time under acceleration without any of the necessary breaks taken into consideration. The first acceleration is belter standard, the second one is tolerable for belters and the third is suitable for earthers.

The last table starts and ends the journey with an acceleration boost. The central part of the journey uses normal 0.5g acceleration and flip at the middle.

System Travel Time in Days (0.3g) 2352-05-16 (395-03-28)

	Venus	Earth	Mars	Tycho	Ceres	Pallas	Vesta	Hygiea	Jupiter	Saturn
Venus	0	5.5	4.3	9.5	9.4	8.3	6.4	8.9	11.0	15.8
Earth	5.5	0	6.5	10.0	9.6	9.8	7.4	7.1	12.2	16.4
Mars	4.3	6.5	0	10.2	10.3	8.5	5.0	9.3	10.4	15.2
Tycho	9.5	10.0	10.2	0	5.1	8.9	11.3	11.9	12.6	17.8
Ceres	9.4	9.6	10.3	5.1	0	9.4	11.4	11.3	13.2	18.2
Pallas	8.3	9.8	8.5	8.9	9.4	0	9.6	12.0	9.8	16.0
Vesta	6.4	7.4	5.0	11.3	11.4	9.6	0	9.3	10.4	14.6
Hygiea	8.9	7.1	9.3	11.9	11.3	12.0	9.3	0	13.9	17.0
Jupiter	11.0	12.2	10.4	12.6	13.2	9.8	10.4	13.9	0	13.1
Saturn	15.8	16.4	15.2	17.8	18.2	16.0	14.6	17.0	13.1	0

System Travel Time in Days (0.5g) 2352-05-16 (395-03-28)

	Venus	Earth	Mars	Tycho	Ceres	Pallas	Vesta	Hygiea	Jupiter	Saturn
Venus	0	4.3	3.3	7.3	7.3	6.5	5.0	6.9	8.5	12.2
Earth	4.3	0	5.0	7.7	7.4	7.6	5.7	5.5	9.5	12.7
Mars	3.3	5.0	0	7.9	8.0	6.6	3.9	7.2	8.1	11.8
Tycho	7.3	7.7	7.9	0	4.0	6.9	8.8	9.2	9.8	13.8
Ceres	7.3	7.4	8.0	4.0	0	7.3	8.8	8.7	10.2	14.1
Pallas	6.5	7.6	6.6	6.9	7.3	0	7.4	9.3	7.6	12.4
Vesta	5.0	5.7	3.9	8.8	8.8	7.4	0	7.2	8.1	11.3
Hygiea	6.9	5.5	7.2	9.2	8.7	9.3	7.2	0	10.7	13.2
Jupiter	8.5	9.5	8.1	9.8	10.2	7.6	8.1	10.7	0	10.1
Saturn	12.2	12.7	11.8	13.8	14.1	12.4	11.3	13.2	10.1	0

System Travel Time in Days (1.0g) 2352-05-16 (395-03-28)

	Venus	Earth	Mars	Tycho	Ceres	Pallas	Vesta	Hygiea	Jupiter	Saturn
Venus	0	3.0	2.3	5.2	5.2	4.6	3.5	4.9	6.0	8.7
Earth	3.0	0	3.6	5.5	5.3	5.3	4.0	3.9	6.7	9.0
Mars	2.3	3.6	0	5.6	5.6	4.7	2.7	5.1	5.7	8.3
Tycho	5.2	5.5	5.6	0	2.8	4.9	6.2	6.5	6.9	9.8
Ceres	5.2	5.3	5.6	2.8	0	5.2	6.2	6.2	7.2	9.9
Pallas	4.6	5.3	4.7	4.9	5.2	0	5.3	6.5	5.4	8.8
Vesta	3.5	4.0	2.7	6.2	6.2	5.3	0	5.1	5.7	8.0
Hygiea	4.9	3.9	5.1	6.5	6.2	6.5	5.1	0	7.6	9.3
Jupiter	6.0	6.7	5.7	6.9	7.2	5.4	5.7	7.6	0	7.2
Saturn	8.7	9.0	8.3	9.8	9.9	8.8	8.0	9.3	7.2	0

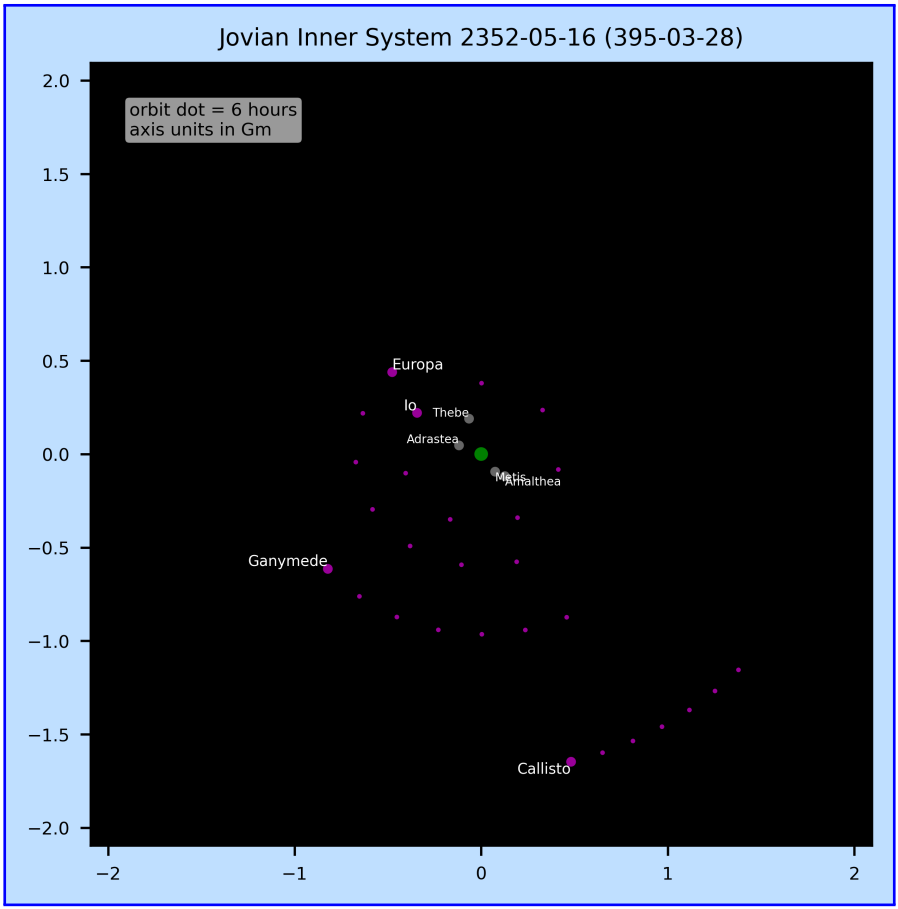
System Travel Time in Days (0.5g + 6g x 4h) 2352-05-16 (395-03-28)

	Venus	Earth	Mars	Tycho	Ceres	Pallas	Vesta	Hygiea	Jupiter	Saturn
Venus	0	2.1	1.4	4.6	4.6	3.8	2.6	4.2	5.7	9.2
Earth	2.1	0	2.7	5.0	4.7	4.8	3.2	3.0	6.6	9.6
Mars	1.4	2.7	0	5.1	5.2	4.0	1.8	4.5	5.3	8.7
Tycho	4.6	5.0	5.1	0	1.9	4.2	5.9	6.3	6.8	10.7
Ceres	4.6	4.7	5.2	1.9	0	4.6	6.0	5.9	7.3	10.9
Pallas	3.8	4.8	4.0	4.2	4.6	0	4.7	6.4	4.8	9.3
Vesta	2.6	3.2	1.8	5.9	6.0	4.7	0	4.5	5.3	8.3
Hygiea	4.2	3.0	4.5	6.3	5.9	6.4	4.5	0	7.7	10.0
Jupiter	5.7	6.6	5.3	6.8	7.3	4.8	5.3	7.7	0	7.2
Saturn	9.2	9.6	8.7	10.7	10.9	9.3	8.3	10.0	7.2	0

6 Jovian System

Named for the gas giant it surrounds, the Jovian System has drawn the largest population in the Outer Planets to Jupiter's moons. There are dozens of settlements and orbiting space stations around it and its moons.

The Jovian System is responsible for growing and distributing most of the food in the Outers and the Belt. Most extrasolar astronomy was done in the Jovian System before the Uranian System was colonized. It is a vital piece of humanity's survival in the furthest reaches of the solar system, and of the Belt's economy.

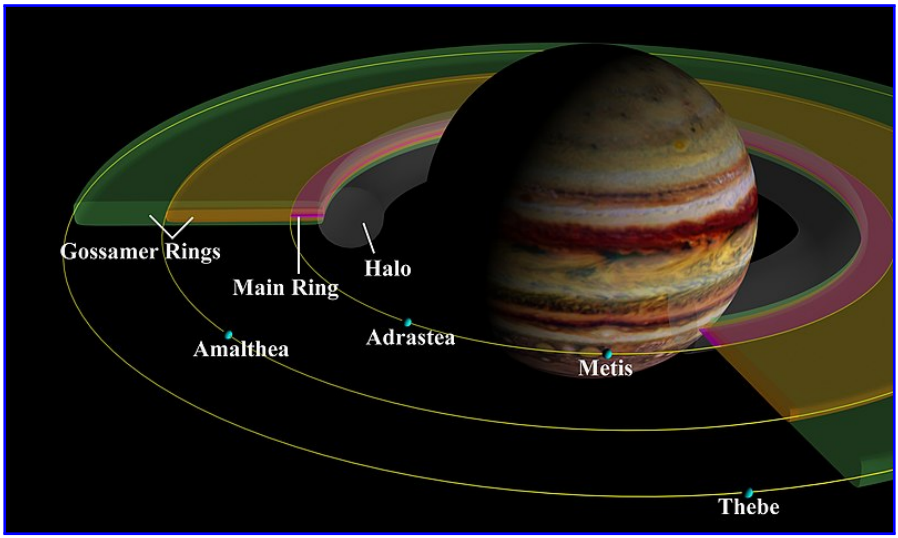


Jupiter is primarily composed of hydrogen with a quarter of its mass being helium, though helium comprises only about a tenth of the number of molecules.

6.1 Ring System

The planet Jupiter has a system of rings known as the rings of Jupiter or the Jovian ring system. It was the third ring system to be discovered in the Solar System, after those of Saturn and Uranus.

The Jovian ring system is faint and consists mainly of dust. It has four main components: a thick inner torus of particles known as the "halo ring"; a relatively bright, exceptionally thin "main ring"; and two wide, thick and faint outer "gossamer rings", named for the moons of whose material they are composed: Amalthea and Thebe.



The main and halo rings consist of dust ejected from the moons Metis, Adrastea, and other unobserved parent bodies as the result of high-velocity impacts. In visible and near-infrared light, the rings have a reddish color, except the halo ring, which is neutral or blue in color.

6.2 Inner Moons

Inner moons are unpopulated primarily due to their proximity to Jupiter and location in its harsh radiation belt — even aboveground structures on moons further from the planet require heavy shielding.

Metis Metis is the innermost moon of Jupiter. It is tidally locked to Jupiter, and its shape is strongly asymmetrical, with one of the diameters being almost twice as large as the smallest one. It is one of the two moons known to orbit

Jupiter in less than the length of Jupiter's day, the other being Adrastea. It orbits within the main ring of Jupiter, and is a major contributor of material to the rings. The surface of Metis is heavily cratered, dark, and appears to be reddish in color.

Adrastea Adrastea is the second by distance, and the smallest of the four inner moons of Jupiter. It also orbits Jupiter in less than the length of planet's day. It orbits at the edge of Jupiter's Main Ring and, like Metis, is the main contributor of material to the rings. Adrastea has an irregular shape.

Amalthea Amalthea has the third closest orbit around Jupiter among known moons. It is in a close orbit around Jupiter and is within the outer edge of the Amalthea Gossamer Ring which is formed from dust ejected from its surface. Jupiter would appear 46.5 degrees in diameter from its surface. Amalthea is the largest of the inner satellites of Jupiter and is irregularly shaped and reddish in color. Its surface features include large craters and ridges.

Thebe Thebe is the fourth of Jupiter's moons by distance from the planet. The second largest of the inner satellites of Jupiter, Thebe orbits within the outer edge of the Thebe gossamer ring that is formed from dust ejected from its surface. It is irregularly shaped and reddish in colour Its surface features include large craters and high mountains — some of them are comparable to the size of the moon itself.

6.3 Galilean Moons

The Galilean moons are the four largest moons of Jupiter. They were first seen by Galileo Galilei in 1609 and were the first objects found to orbit a planet other than the Earth.

Io One of Jupiter's larger moons, Io is an extremely hostile and unforgiving environment for colonists. Its atmosphere of sulfur dixoide and hot spots of volcanic and tectonic activity make Io a very dangerous environment for humanity. Io's volcanos produce vents of heat in excess of 2,000° K, and the moon itself creates an intense electrical field when its nickel and iron core passes through Jupiter's magnetic field, producing in excess of 1 trillion watts. Power stations dotted around the surface converting heat transfer and atmospheric electrical charge into usable energy have made Io one of the primary storable energy production facilities in the Outers.

Europa One of the most populated of Jupiter's moons, Europa has some similarities to Ganymede — they both have stable tectonics and aboveground dome greenhouses, and were amongst the first moons to be colonized. Earthers,

Belters, and Martians all store eggs and sperm on Europa and Ganymede, as well as Luna and Earth. However, while Ganymede has significantly increased its investment in agricultural and medical technology over the decades, Europa has fallen behind. Now, the moon's primary advantage is its thick surface layer of ice, which allows its settlements to supply themselves with water and oxygen without outside help.

Ganymede Ganymede Station is the bread basket and the main birthing center for the Outers and the Belt, and a center of civilization in the far reaches of the solar system. It is the safest station in the Jovian system, where people come to give birth, avoiding the defects that can come with carrying to term in low or zero g. As the only moon with any magnetosphere, it's the only place where dome-grown crops stand a chance in Jupiter's harsh radiation belt, even with heavy shielding on the domes and habitats. Ganymede is also unique in its intricate system of orbital mirror stations that shine concentrated sunlight down onto the dome greenhouses that produce vegetables, fruits, and even some meat. The moon's ice, on the surface and reaching into the depths of the moon, provides all the water necessary for life.

Callisto Callisto is the second-largest moon of Jupiter and the third-largest in the Sol system. Its orbit requires it to be tidally locked – one side constantly faces Jupiter. This large moon's tectonic stability and significant deposits of rare minerals made it an ideal location for Mars' shipyards, the largest in the Outers. Most of the MCRN's fleet has been built orbiting Callisto, where the shipyards are capable of building hulls up to 700 meters in length. Callisto is one of the only moons of Jupiter where radioactive minerals are close enough to the surface for easy extraction, however it hasn't created a strong economy. Mining and shipbuilding are the only sources of revenue, and revenue that comes only from Mars.

6.4 Outer Moons

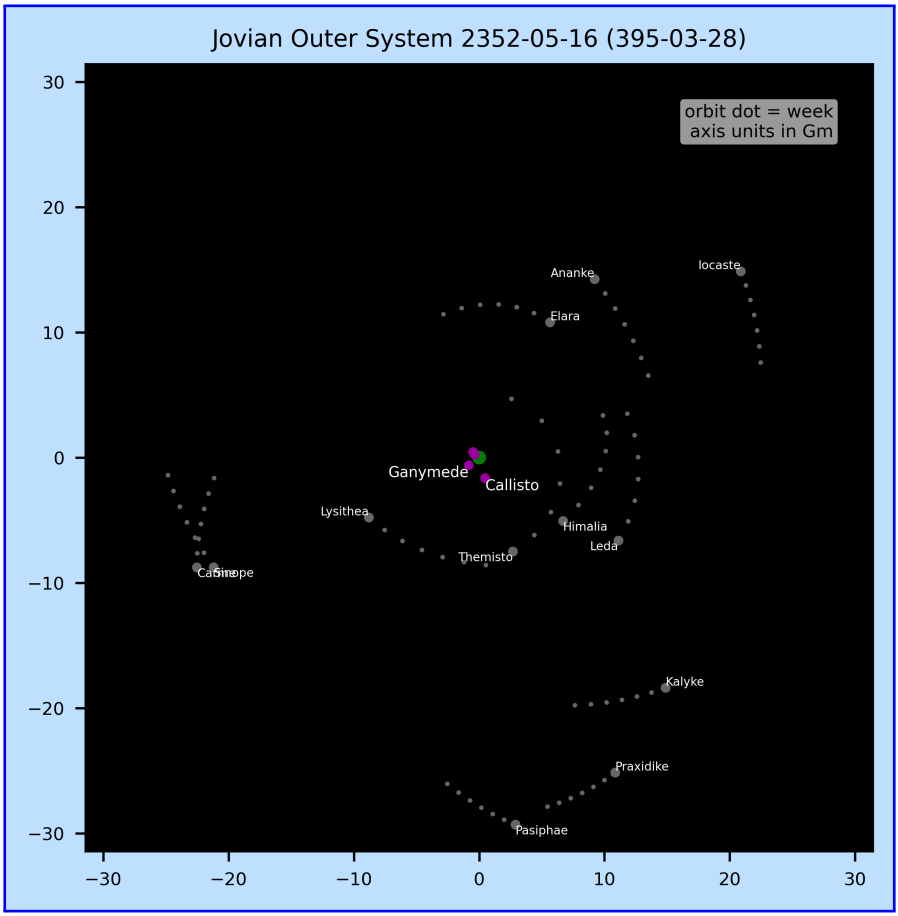
These outer moons are all too small to support a colony, but they are, or have been, used as scientific and mining outposts. Note that some of them have retrograde orbits: clockwise instead of standard counterclockwise rotation within the Solar System.

Themisto Themisto's orbit is unusual: unlike most of Jupiter's moons, which orbit in distinct groups, Themisto orbits alone. The moon is located midway between the Galilean moons and the first group of prograde irregular moons, called the Himalia group. It is about 8 kilometers in diameter.

Leda Leda is a prograde irregular satellite of Jupiter. It belongs to the Himalia

group, five moons orbiting between 11 and 13 Gm from Jupiter at an inclination of about 28°. Its orbit is continuously changing due to solar and planetary perturbations.

Himalia Himalia is the largest irregular satellite of Jupiter, with a diameter of 140 km. It is the fifth largest Jovian satellite, after the four Galilean moons. Himalia's rotational period is 7 h 47 m. There is an abandoned supply waystation for early mining operations.



Elara Elara is a prograde irregular satellite of Jupiter. It is the eighth-largest moon of Jupiter. It has a mean radius of just 43 kilometres, thus it is 2% of the size of Europa. However, it is half the size of Himalia, so it is the second-biggest moon in the Himalia group. It reflects very little light.

Lysithea Lysithea is a prograde irregular satellite of Jupiter. It belongs to the Himalia group, five moons orbiting between 11 and 13 Gm from Jupiter at an inclination of about 28°. Its orbit is continuously changing due to solar and planetary perturbations.

Iocaste Iocaste is a retrograde irregular satellite of Jupiter. It orbits Jupiter at an average distance of 20.723 million kilometers in 609.427 days, at an inclination of 147° to the ecliptic with an eccentricity of 0.2874. Iocaste belongs to the Ananke group, believed to be the remnants of a break-up of a captured heliocentric asteroid. The satellite is about 5 kilometres in diameter and appears grey.

Praxidike Praxidike is a retrograde irregular satellite of Jupiter. It orbits Jupiter at an average distance of 20,824,000 km in 613.904 days, at an inclination of 144° to the ecliptic, in a retrograde direction and with an eccentricity of 0.1840. Praxidike belongs to the Ananke group, believed to be the remnants of a break-up of a captured heliocentric asteroid. With a diameter of 7 km, Praxidike is the second largest member of the group after Ananke itself.

Ananke Ananke is a retrograde irregular moon of Jupiter. It gives its name to the Ananke group, retrograde irregular moons which orbit Jupiter between 19.3 and 22.7 Gm, at inclinations of roughly 150°. Ananke orbits Jupiter on a high-eccentricity and high-inclination retrograde orbit.

Kalyke Kalyke is a retrograde irregular satellite of Jupiter. Kalyke's albedo is measured at 2.9%, corresponding to a diameter of 6.9 kilometres. It belongs to the Carme group, made up of irregular retrograde moons orbiting Jupiter at a distance ranging between 23 and 24 Gm and at an inclination of about 165°.

Pasiphae Pasiphae is a retrograde irregular satellite of Jupiter. Pasiphae orbits Jupiter on a high eccentricity and high inclination retrograde orbit. It gives its name to the Pasiphae group, irregular retrograde moons orbiting Jupiter at distances ranging between 22.8 and 24.1 million km, and with inclinations ranging between 144.5° and 158.3°. Pasiphae is also known to be in a secular resonance with Jupiter. With diameter of 60 km Pasiphae is the largest retrograde and third largest irregular satellite after Himalia and Elara.

Carme Carme is a retrograde irregular satellite of Jupiter. It gives its name to the Carme group, made up of irregular retrograde moons orbiting Jupiter at a distance ranging between 23 and 24 Gm and at an inclination of about 165°. Its orbital elements are continuously changing due to solar and planetary perturbations. It has diameter of 47 km.

Sinope Sinope is a retrograde irregular satellite of Jupiter. Sinope orbits Jupiter on a high-eccentricity and high-inclination retrograde orbit. Its orbit is continuously changing due to solar and planetary perturbations. Sinope belongs to the Pasiphae group of retrograde irregular moons. It is also known to be in a secular resonance with Jupiter, similar to Pasiphae.

Distances within Jovian system are vast, and while travel times aren't as long as in interplanetary journeys, they are still quite significant.

Jovian Travel Time in Hours (0.3g) 2352-05-16 (395-03-28)

	Ganym.	Callisto	Leda	Himalia	Elara	Lysithea	Ananke	Pasiphae	Carme	Sinope
Ganym.	0	13.5	37.6	35.6	37.3	35.0	49.0	55.3	49.4	48.6
Callisto	13.5	0	35.4	33.3	37.9	35.5	49.5	54.1	50.3	49.4
Leda	37.6	35.4	0	34.0	43.8	48.0	50.6	50.8	59.6	58.9
Himalia	35.6	33.3	34.0	0	44.5	40.4	55.9	51.3	56.4	54.5
Elara	37.3	37.9	43.8	44.5	0	49.3	37.4	65.2	60.1	59.6
Lysithea	35.0	35.5	48.0	40.4	49.3	0	59.7	53.7	40.4	37.2
Ananke	49.0	49.5	50.6	55.9	37.4	59.7	0	70.5	66.5	66.9
Pasiphae	55.3	54.1	50.8	51.3	65.2	53.7	70.5	0	58.6	57.7
Carme	49.4	50.3	59.6	56.4	60.1	40.4	66.5	58.6	0	20.5
Sinope	48.6	49.4	58.9	54.5	59.6	37.2	66.9	57.7	20.5	0

Jovian Travel Time in Hours (0.5g) 2352-05-16 (395-03-28)

	Ganym.	Callisto	Leda	Himalia	Elara	Lysithea	Ananke	Pasiphae	Carme	Sinope
Ganym.	0	10.4	29.1	27.6	28.9	27.1	37.9	42.8	38.2	37.6
Callisto	10.4	0	27.4	25.8	29.3	27.5	38.3	41.9	38.9	38.3
Leda	29.1	27.4	0	26.3	33.9	37.2	39.2	39.4	46.2	45.6
Himalia	27.6	25.8	26.3	0	34.4	31.3	43.3	39.7	43.7	42.2
Elara	28.9	29.3	33.9	34.4	0	38.2	29.0	50.5	46.6	46.2
Lysithea	27.1	27.5	37.2	31.3	38.2	0	46.2	41.6	31.3	28.9
Ananke	37.9	38.3	39.2	43.3	29.0	46.2	0	54.6	51.5	51.8
Pasiphae	42.8	41.9	39.4	39.7	50.5	41.6	54.6	0	45.4	44.7
Carme	38.2	38.9	46.2	43.7	46.6	31.3	51.5	45.4	0	15.8
Sinope	37.6	38.3	45.6	42.2	46.2	28.9	51.8	44.7	15.8	0

Jovian Travel Time in Hours (1.0g) 2352-05-16 (395-03-28)

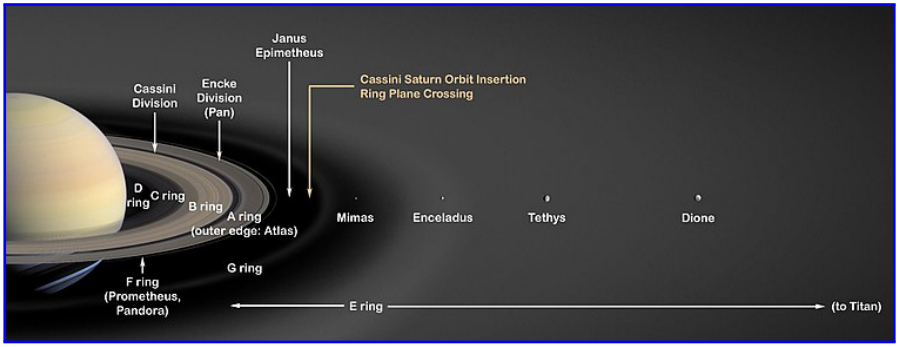
	Ganym.	Callisto	Leda	Himalia	Elara	Lysithea	Ananke	Pasiphae	Carme	Sinope
Ganym.	0	7.4	20.6	19.5	20.4	19.1	26.8	30.3	27.0	26.6
Callisto	7.4	0	19.4	18.3	20.7	19.4	27.1	29.6	27.5	27.1
Leda	20.6	19.4	0	18.6	24.0	26.3	27.7	27.8	32.6	32.3
Himalia	19.5	18.3	18.6	0	24.4	22.1	30.6	28.1	30.9	29.9
Elara	20.4	20.7	24.0	24.4	0	27.0	20.5	35.7	32.9	32.7
Lysithea	19.1	19.4	26.3	22.1	27.0	0	32.7	29.4	22.1	20.4
Ananke	26.8	27.1	27.7	30.6	20.5	32.7	0	38.6	36.4	36.7
Pasiphae	30.3	29.6	27.8	28.1	35.7	29.4	38.6	0	32.1	31.6
Carme	27.0	27.5	32.6	30.9	32.9	22.1	36.4	32.1	0	11.2
Sinope	26.6	27.1	32.3	29.9	32.7	20.4	36.7	31.6	11.2	0

7 Cronian System

Surrounding the second largest gas giant in the solar system, the Saturnian System has — or had — one large orbiting station functioning as a way point for exploration and resource harvesting inside Saturn's rings, and a few settled moons. Pan, Atlas, Prometheus, Pandora, Epimetheus, Janus, Mimas, Enceladus, Tethys, Telesto, Calypso, Dione, and Helene all exist within the rings of Saturn and are too small to support any long-term habitat. Hyperion has not yet been developed.

7.1 Ring System

The rings of Saturn are the most extensive ring system of any planet in the Solar System. They consist of countless small particles, ranging in size from micrometers to meters, that orbit about Saturn. The ring particles are made almost entirely of water ice, with a trace component of rocky material.



The rings have numerous gaps where particle density drops sharply: two opened by known moons embedded within them, and many others at locations of known destabilizing orbital resonances with the moons of Saturn.

D Ring Very faint innermost ring.

C Ring Wide but faint ring located inward of the B Ring.

B Ring The largest, brightest, and most massive of the rings.

A ring The outermost of the large, bright rings.

F Ring Very thin ring near the outer edge of the A ring.

E Ring Wide ring composed of microscopic particles.

7.2 Inner Moons

Shepherd satellites are small moons that orbit within, or just beyond, a planet's ring system. They have the effect of sculpting the rings: giving them sharp edges, and creating gaps between them. Saturn's shepherd moons are Pan, Daphnis, Atlas, Prometheus and Pandora. These moons together with co-orbitals formed as a result of accretion of the friable ring material on preexisting denser cores. The cores with sizes from one-third to one-half the present-day moons are themselves collisional shards formed when a parental satellite of the rings disintegrated.

Janus and Epimetheus are called co-orbital moons. They are of roughly equal size, with Janus being slightly larger than Epimetheus. Janus and Epimetheus have orbits with only a few kilometers difference in semi-major axis, close enough that they would collide if they attempted to pass each other. Instead of colliding, however, their gravitational interaction causes them to swap orbits every four years.

Trojan moons are a unique feature only known from the Saturnian system. A trojan body orbits at either the leading L4 or trailing L5 Lagrange point of a much larger object, such as a large moon or planet. Tethys has two trojan moons, Telesto and Calypso, and Dione also has two, Helene and Polydeuces.

Prometheus Prometheus is extremely elongated, measuring approximately 136 km $\times$ 79 km $\times$ 59 km. It has several ridges and valleys and a number of impact craters of about 20 km diameter are visible, but it is less cratered than nearby Pandora, Epimetheus, and Janus.

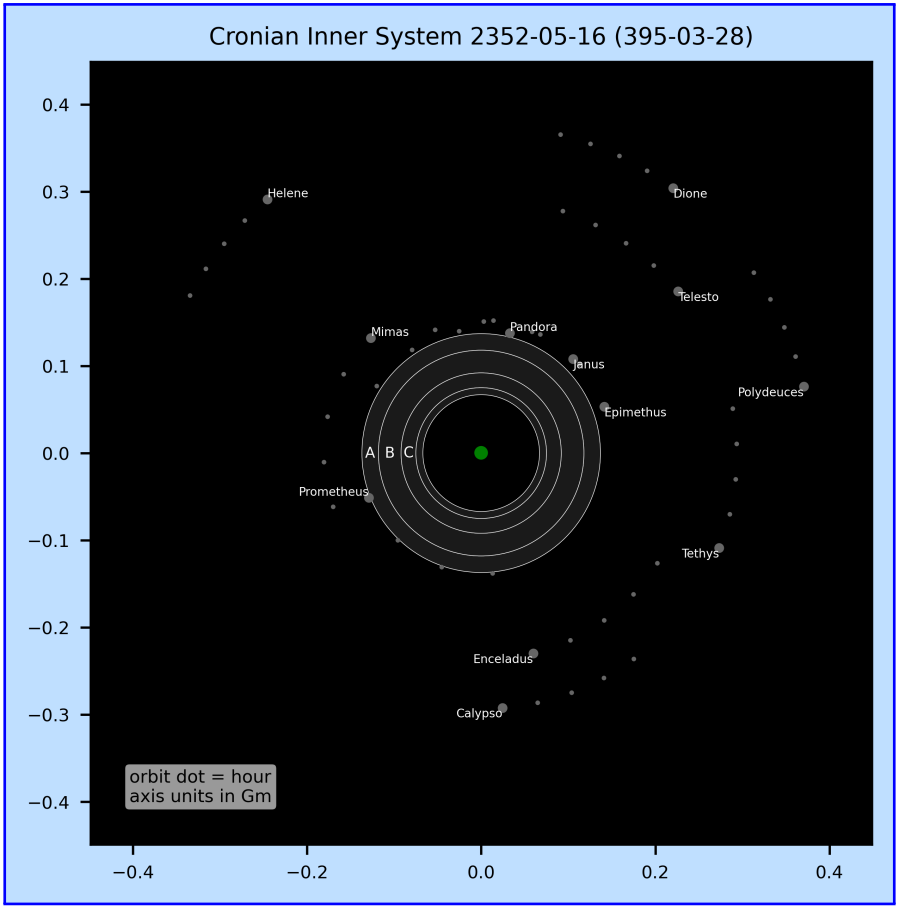
Prometheus is the site of a small mining and ice-processing station.

Pandora Pandora is more heavily cratered than nearby Prometheus, and has at least two large craters 30 kilometres in diameter. The majority of craters on Pandora are shallow as a result of being filled with debris. Ridges and grooves are also present on moon's surface. The orbit of Pandora appears to be chaotic, as a consequence of a series of four 118:121 mean-motion resonances with Prometheus.

Epimethus Epimetheus occupies essentially the same orbit as the moon Janus. There are several Epimethean craters larger than 30 km in diameter, as well as both large and small ridges and grooves. The extensive cratering indicates that Epimetheus must be quite old. Janus and Epimetheus may have formed from a disruption of a single parent to form co-orbital satellites, but if this is the case the disruption must have happened early in the history of the satellite system.

Janus Janus's orbit is co-orbital with that of Epimetheus. Janus is extensively cratered with several craters larger than 30 km, but has few linear features.

Janus's surface appears to be older than Prometheus's but younger than Pandora's.



Mimas With a diameter of 396 kilometres, Mimas is the smallest astronomical body that is known to still be rounded in shape because of self-gravitation. The low density indicates that it is composed mostly of water ice with only a small amount of rock. Due to the tidal forces acting on it, Mimas is noticeably prolate; its longest axis is about 10% longer than the shortest. Mimas's most distinctive feature is a giant impact crater 130 km across, named Herschel, with diameter almost a third of Mimas's own diameter. The Mimantean surface is saturated with smaller impact craters, but no others are anywhere near the size of Herschel.

Enceladus Enceladus is about 500 kilometers in diameter. It is mostly covered by fresh, clean ice, making it one of the most reflective bodies of the Solar System. Geyser observations, along with the finding of escaping internal heat and very few impact craters in the south polar region, show that Enceladus is currently geologically active. Its resonance with Dione excites its orbital eccentricity, which is damped by tidal forces, tidally heating its interior and driving the geological activity. Plumes from Enceladus, which are similar in composition to comets, have been shown to be the source of the material in Saturn's E ring.

Tethys Tethys is a mid-sized moon of Saturn about 1,060 km across. It has the lowest density of all the major moons in the Solar System, indicating that it is made of water ice with just a small fraction of rock. The surface of Tethys is very bright and neutral in color. Tethys is heavily cratered and cut by a number of large faults/graben. The largest impact crater, Odysseus, is about 400 km in diameter, whereas the largest graben, Ithaca Chasma, is more than 2000 km long. Tethys has two small co-orbital moons, **Telesto** and **Calypso** orbiting near Tethys's trojan points L4 and L5 respectively.

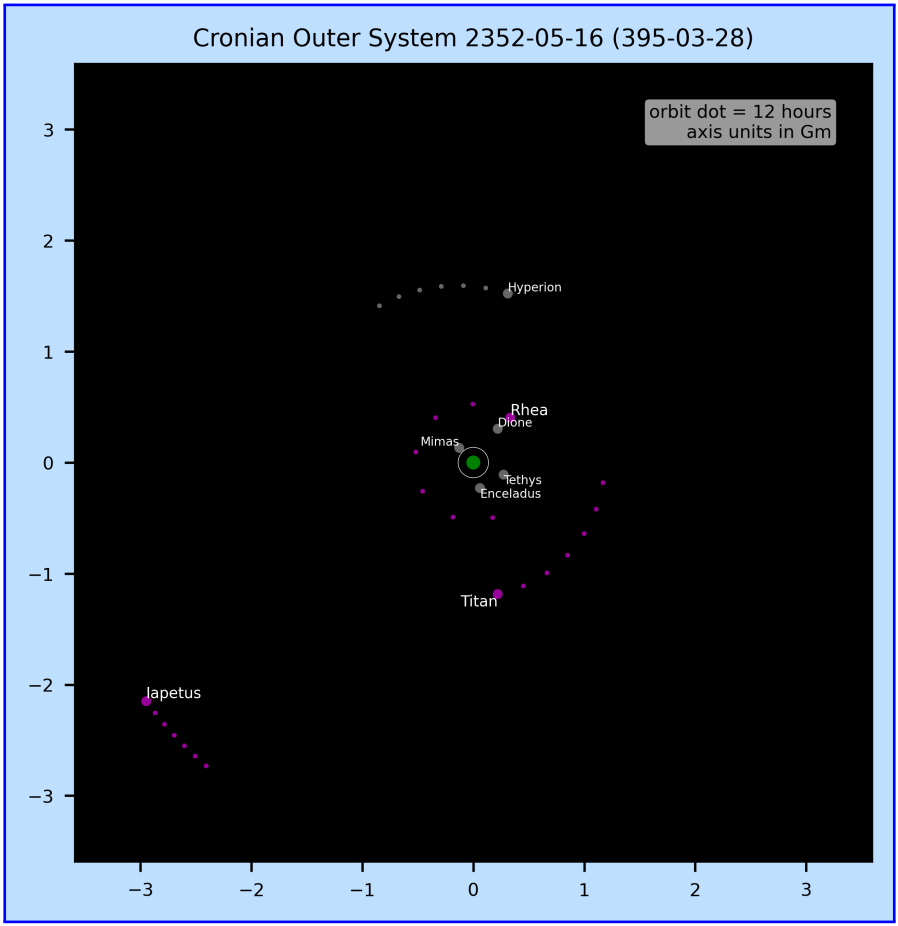
Dione At 1122 km in diameter, Dione is the 15th largest moon in the Solar System. About two thirds of Dione's mass is water ice, and the remaining is a dense core. Dione orbits Saturn with a semimajor axis about 2% less than that of the Moon. However, reflecting Saturn's greater mass, Dione's orbital period is one tenth that of the Moon. Dione is currently in a 1:2 mean-motion orbital resonance with moon Enceladus, completing one orbit of Saturn for every two orbits completed by Enceladus. Dione has two small co-orbital, or trojan, moons, **Helene** and **Polydeuces**. They are located within Dione's Lagrangian points L4 and L5 respectively. Helene is by far the largest trojan moon, while Polydeuces is the smallest and has the most chaotic orbit.

7.3 Outer Moons

These moons all orbit beyond the E Ring. The circle around Saturnus in the outer system map is outer edge of A ring.

Rhea One of the frontiers of human civilization, Rhea is only just large enough for a colony, and primarily composed of water, ice, and rock. The only thing the moon has to offer the rest of the system is Helium-3 deposits, and some small mineral mining operations. Rhea's several small underground habitats provide all the living space required for its population, mostly comprised of miners and workers in the Helium-3 refineries. Most of their food must be imported from Titan, increasing costs, and mineral and Helium-3 exports do not bring much money into the local economy.

Phoebe In the early days of Phoebe's colonization, the story was that a science station was established there by Mars in collaboration with the Protogen corporation to study early solar system formation and Oort cloud objects. Study of the moon suggested, from its unique, eccentric, retrograde orbit and unusual albedo, that it might have been a captured comet or Kuiper Belt object. Now, it's nothing more than dust.



Titan The most populous moon in the system has a thick cloud cover that generates strange and beautiful solar wind displays as the moon moves in and out of Saturn's powerful magnetic field. Titan is also the most chemically active body in the solar system, aside from Earth. Both the atmosphere and icy surface of the moon are filled with organic compounds

not found anywhere else. Easy access to ice suitable for oxygen and water production and a lack of available sunlight have put Titan on the forefront of sunlight-free food production.

Hyperion Hyperion is Titan's nearest neighbor in the Saturn system. The two moons are locked in a 4:3 mean-motion resonance with each other, meaning that while Titan makes four revolutions around Saturn, Hyperion makes exactly three. With an average diameter of about 270 km, Hyperion is smaller and lighter than Mimas. It has an extremely irregular shape, and a very odd, tan-colored icy surface resembling a sponge. It was the first non-round moon to be discovered.

Iapetus The moon is primarily known for its leading and trailing hemispheres being radically different. The albedo of most of the leading hemisphere is as dark as lampblack, while the trailing hemisphere's albedo is as bright as Europa. The 'dark' side of Iapetus is covered in minerals ready for harvesting right there on the surface. The colonists have built special mechs that make regular runs to sweep the surface for these materials for export and sale off-moon.

Travel times within Cronian system are quite short, usually just few hours.

Cronian Travel Time in Hours (0.3g) 2352-05-16 (395-03-28)

	Prometh.	Janus	Mimas	Enceladus	Tethys	Dione	Rhea	Titan	Hyperion	Iapetus
Prometh.	0	5.5	4.4	5.2	6.5	7.3	8.3	11.2	13.1	19.2
Janus	5.5	0	5.0	6.0	5.4	4.9	6.3	11.7	12.3	20.0
Mimas	4.4	5.0	0	6.5	7.0	6.4	7.5	12.0	12.4	19.5
Enceladus	5.2	6.0	6.5	0	5.1	7.7	8.5	10.1	13.6	19.4
Tethys	6.5	5.4	7.0	5.1	0	6.6	7.4	10.6	13.1	20.0
Dione	7.3	4.9	6.4	7.7	6.6	0	4.0	12.5	11.3	20.5
Rhea	8.3	6.3	7.5	8.5	7.4	4.0	0	12.9	10.8	20.9
Titan	11.2	11.7	12.0	10.1	10.6	12.5	12.9	0	16.9	18.6
Hyperion	13.1	12.3	12.4	13.6	13.1	11.3	10.8	16.9	0	22.7
Iapetus	19.2	20.0	19.5	19.4	20.0	20.5	20.9	18.6	22.7	0

Cronian Travel Time in Hours (0.5g) 2352-05-16 (395-03-28)

	Prometh.	Janus	Mimas	Enceladus	Tethys	Dione	Rhea	Titan	Hyperion	Iapetus
Prometh.	0	4.2	3.4	4.0	5.1	5.6	6.4	8.6	10.2	14.9
Janus	4.2	0	3.8	4.6	4.2	3.8	4.9	9.0	9.5	15.5
Mimas	3.4	3.8	0	5.1	5.4	5.0	5.8	9.3	9.6	15.1
Enceladus	4.0	4.6	5.1	0	3.9	5.9	6.6	7.8	10.6	15.0
Tethys	5.1	4.2	5.4	3.9	0	5.1	5.7	8.2	10.1	15.5
Dione	5.6	3.8	5.0	5.9	5.1	0	3.1	9.7	8.8	15.9
Rhea	6.4	4.9	5.8	6.6	5.7	3.1	0	10.0	8.4	16.2
Titan	8.6	9.0	9.3	7.8	8.2	9.7	10.0	0	13.1	14.4
Hyperion	10.2	9.5	9.6	10.6	10.1	8.8	8.4	13.1	0	17.6
Iapetus	14.9	15.5	15.1	15.0	15.5	15.9	16.2	14.4	17.6	0