Dr. MGR-ACS Space Technology Centre

SPACE EXPLORER

"An Ingress to Borderless world"

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Chandrayaan-3 successfully clears LVM 3 launch

The Chandrayaan-3 mission by the Indian Space Research Organisation (ISRO) successfully lifted off from the Satish Dhawan Space Centre in Sriharikota, Andhra Pradesh, at 2.35 PM IST on Friday, July 14.

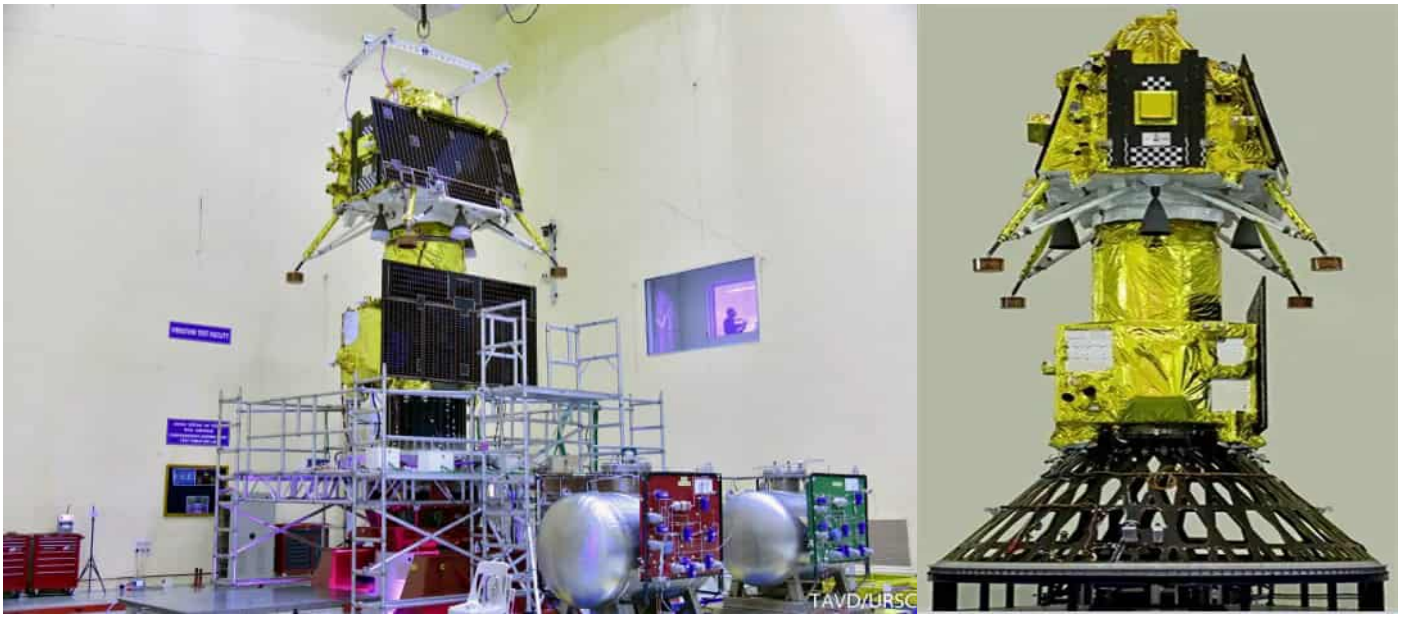
The mission follows Chandrayaan-2 where scientists aim to demonstrate various capabilities including reaching the orbit of the moon, making a soft-landing on the lunar surface using a lander, and a rover coming out of the lander to study the surface of the moon.

Sixteen minutes after lift-off, propulsion module successfully separated from the rocket and would orbit the earth for about 5-6 times in an elliptical cycle with 170 km closest and 36,500 km farthest from earth moving towards the lunar orbit.

Chandrayaan-3 is a follow-on mission to Chandrayaan-2 to demonstrate end-to-end capability in safe landing and roving on the lunar surface. It consists of Lander and Rover configuration. It will be launched by LVM3 from SDSC SHAR, Sriharikota. The propulsion module will carry the lander and rover configuration till 100 km lunar orbit. The propulsion module has Spectro-polarimetry of Habitable Planet Earth (SHAPE) payload to study the spectral and Polari metric measurements of Earth from the lunar orbit.

Lander payloads: Chandra's Surface Thermophysical Experiment (ChaSTE) to measure the thermal conductivity and temperature; Instrument for Lunar Seismic Activity (ILSA) for measuring the seismicity around the landing site; Langmuir Probe (LP) to estimate the plasma density and its variations. A passive Laser Retroreflector Array from NASA is accommodated for lunar laser ranging studies.

Rover payloads: Alpha Particle X-ray Spectrometer (APXS) and Laser Induced Breakdown Spectroscope (LIBS) for deriving the elemental composition in the vicinity of landing site.



Chandrayaan-3 consists of an indigenous Lander module (LM), Propulsion module (PM) and a Rover with an objective of developing and demonstrating new technologies required for Inter planetary missions. The Lander will have the capability to soft land at a specified lunar site and deploy the Rover which will carry out in-situ chemical analysis of the lunar surface during the course of its mobility. The Lander and the Rover have scientific payloads to carry out experiments on the lunar surface. The main function of PM is to carry the LM from launch vehicle injection till final lunar 100 km circular polar orbit and separate the LM from PM. Apart from this, the Propulsion Module also has one scientific payload as a value addition which will be operated post separation of Lander Module. The launcher identified for Chandrayaan-3 is LVM3 M4 which will place the integrated module in an Elliptic Parking Orbit (EPO) of size ~170 x 36500 km.

The mission objectives of Chandrayaan-3 are:

To demonstrate Safe and Soft Landing on Lunar Surface

To demonstrate Rover roving on the moon and

To conduct in-situ scientific experiments.

To achieve the mission objectives, several advanced technologies are present in Lander such as,

- Altimeters: Laser & RF based Altimeters

- Velocimeters: Laser Doppler Velocimeter & Lander Horizontal Velocity Camera

- Inertial Measurement: Laser Gyro based Inertial referencing and Accelerometer package

- Propulsion System: 800N Throttleable Liquid Engines, 58N attitude thrusters & Throttleable Engine Control Electronics

- Navigation, Guidance & Control (NGC): Powered Descent Trajectory design and associate software elements

- Hazard Detection and Avoidance: Lander Hazard Detection & Avoidance Camera and Processing Algorithm

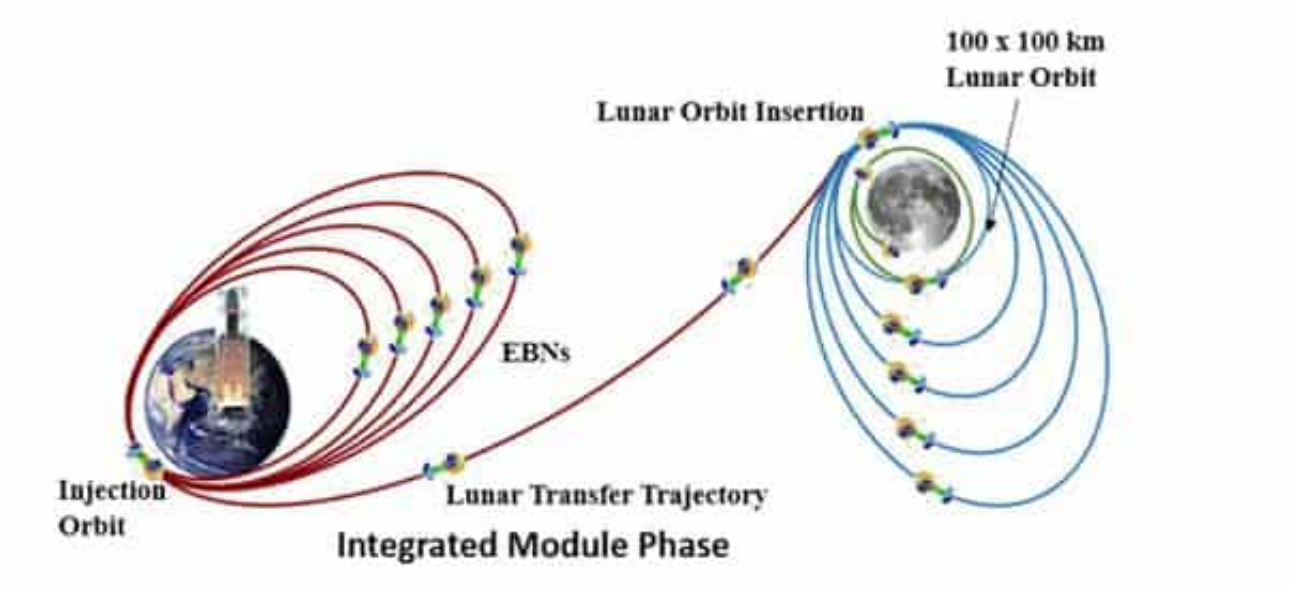
- Landing Leg Mechanism.

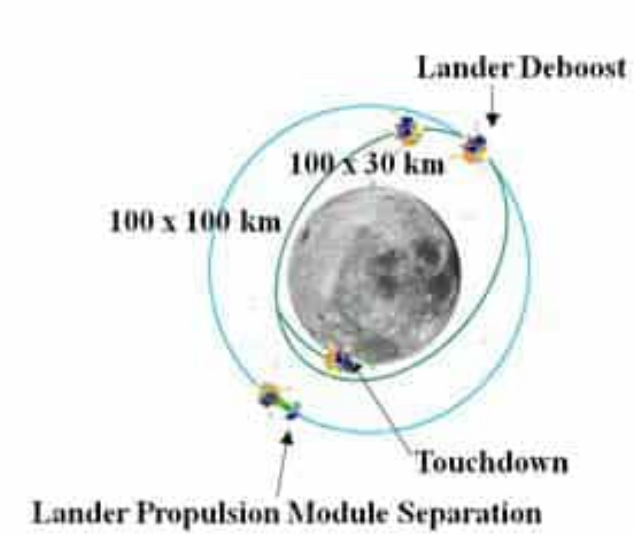
To demonstrate the above said advanced technologies in earth condition, several Lander special tests have been planned and carried out successfully viz.

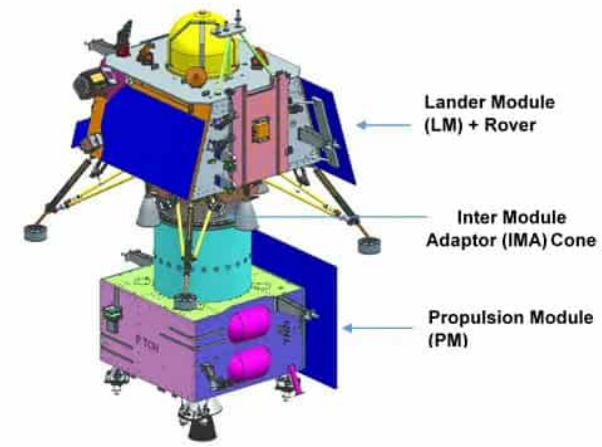
- Integrated Cold Test - For the demonstration of Integrated Sensors & Navigation performance test using helicopter as test platform

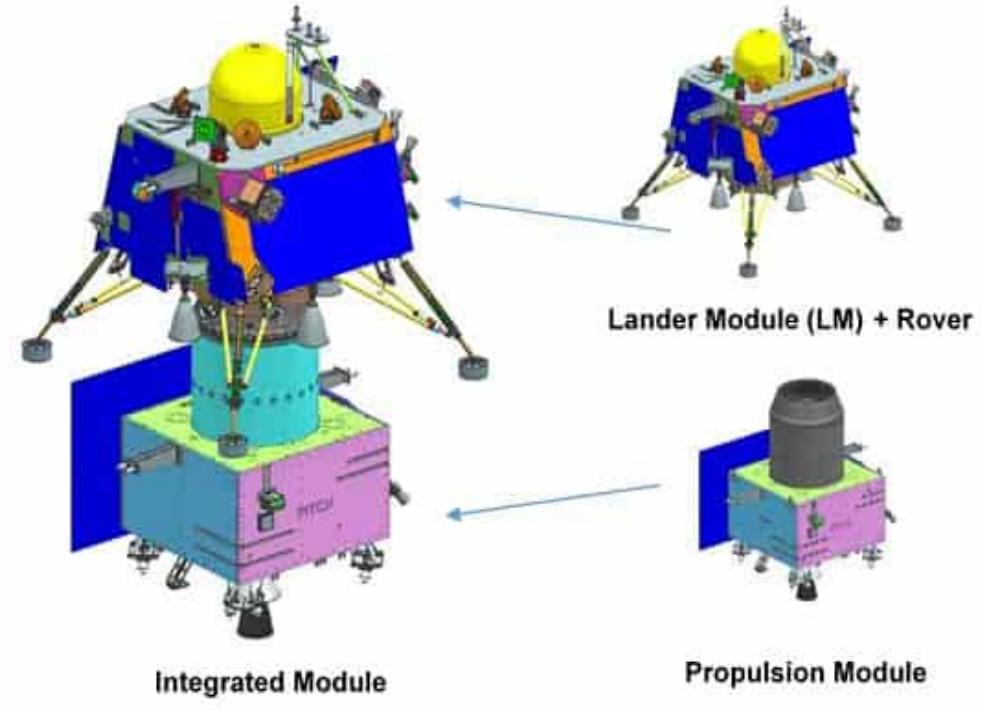
- Integrated Hot test – For the demonstration of closed loop performance test with sensors, actuators and NGC using Tower crane as test platform

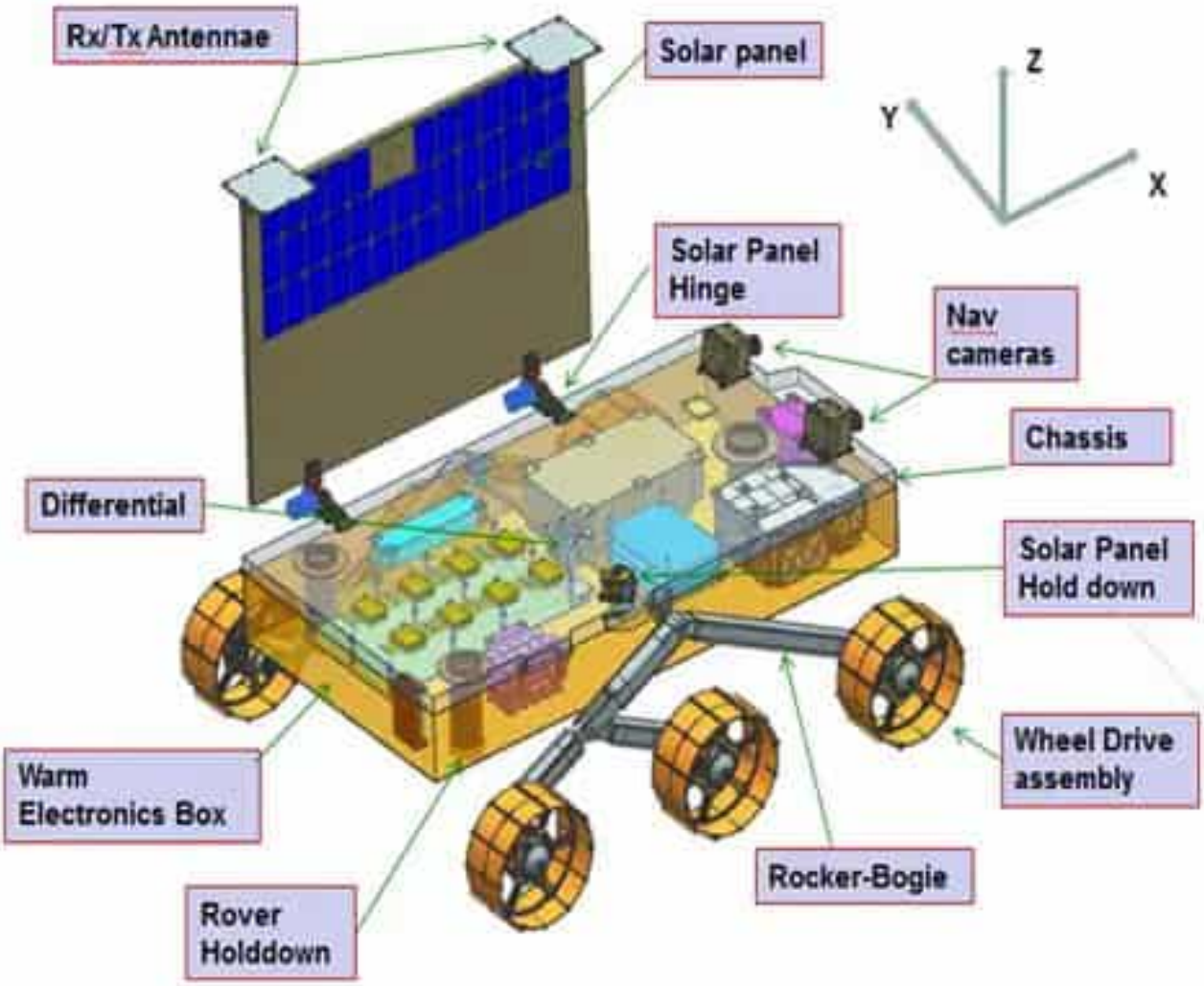
- Lander Leg mechanism performance test on a lunar simulant test bed simulating different touch down conditions.

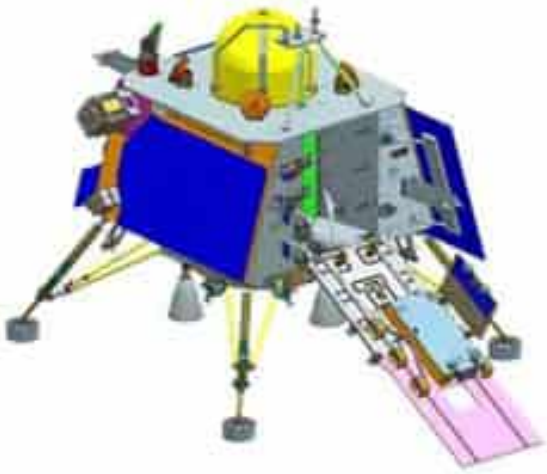

100 x 100 km
Lunar Orbit
Lunar Orbit Insertion
EBNs
Injection
Orbit
Lunar Transfer Trajectory
Integrated Module Phase


Lander Deboost
100 x 30 km
100 x 100 km
Touchdown
Lander Propulsion Module Separation

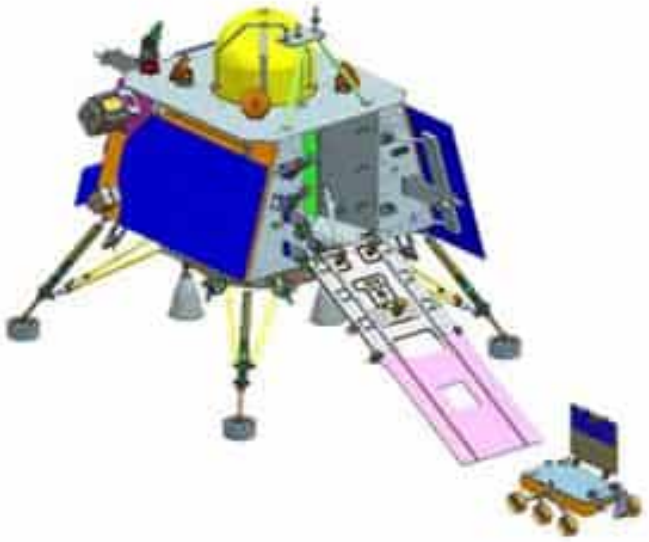

Lander Module
(LM) + Rover
Inter Module
Adaptor (IMA) Cone
Propulsion Module
(PM)


Lander Module (LM) + Rover
Integrated Module
Propulsion Module





Rover on Ramp



Rover Deployed from Lander

SpaceX rocket launches 54 Starlink satellites and lands at sea on record-tying 16th flight

A SpaceX Falcon 9 rocket a new fleet of Starlink satellites into orbit and landed on a platform in the Atlantic Ocean on July 15 in what was a record-tying 16th flight for the booster.

The Falcon 9 rocket topped with 54 of SpaceX's Starlink internet satellites lit up the late night sky as it soared into orbit on July 15 from Cape Canaveral Space Force Station in Florida. Liftoff occurred at 11:50 p.m.

The smooth SpaceX launch came one day late, following an attempted to launch early Friday that SpaceX had to abort at the last minute due to high liquid oxygen levels on on of the rocket's nine first-stage engines, SpaceX components engineer Zachary Luppen said during live commentary.

The Falcon 9's first stage returned to Earth for a vertical touchdown about 8.5 minutes after launch on the SpaceX droneship A Shortfall of Gravitas.

It was the 16th launch and landing for this booster, according to a SpaceX mission description. That ties a record set on July 9 by a different Falcon 9 first stage flying another Starlink mission. The landing also marked SpaceX's 207th orbital rocket landing and 247th mission overall, Luppen said.

The Falcon 9's upper stage, which is not reusable, continued hauling the 54 Starlink satellites to low Earth orbit. It was expected to deploy the satellites about 66 minutes after liftoff.

These batch of Starlink satellites stands out from the thousands SpaceX has launched to date as it is the final set of Starlink Version 1.5 satellites the company will launch, Luppen said. The company is shifting to a new Version 2 of the Starlink internet satellites, and has already launched mini-V2 versions into orbit.

China just launched a methane-fueled rocket into orbit, a world's 1st for spaceflight

A methane-fueled rocket just reached Earth orbit for the first time ever.

The Zhuque-2 rocket, developed by Chinese company Landspace, successfully soared to orbit after launching from the Jiuquan Satellite Launch Center in the Gobi Desert on July 11.

U.S. Space Force tracking confirmed Chinese reports that the methane-fueled rocket made it to orbit, tweeted astrophysicist and satellite tracker Jonathan McDowell.

It was a milestone effort for Zhuque-2, which suffered an anomaly during its debut flight on Dec. 14, 2022. Beijing-based Landspace issued a statement shortly thereafter confirming that the second stage of the rocket was lost (along with a clutch of satellites) and that an investigation would ensue to find the cause, which has not yet been released.

Methane, aside from burning with a pretty blue color during launch, has been billed by advocates as being more environmentally friendly. While methane is a greenhouse gas, it is cleaner than the standard RP-1 (kerosene) used in many rockets.

Many U.S. companies are working on methane-fueled rockets as well, including SpaceX with its Starship system, Blue Origin with New Glenn, Rocket Lab with Neutron, United Launch Alliance with Vulcan Centaur and Relativity Space with its Terran line. Some of these vehicles have suffered issues in recent months, however.

Terran 1 failed to reach orbit on its debut launch in March, for example, and SpaceX issued a self-destruct command to Starship during its first fully stacked launch in April after the vehicle suffered several anomalies. (SpaceX is developing Starship to help settle Mars, and methane fuel can be sourced on the Red Planet, company founder and CEO Elon Musk has stressed.)

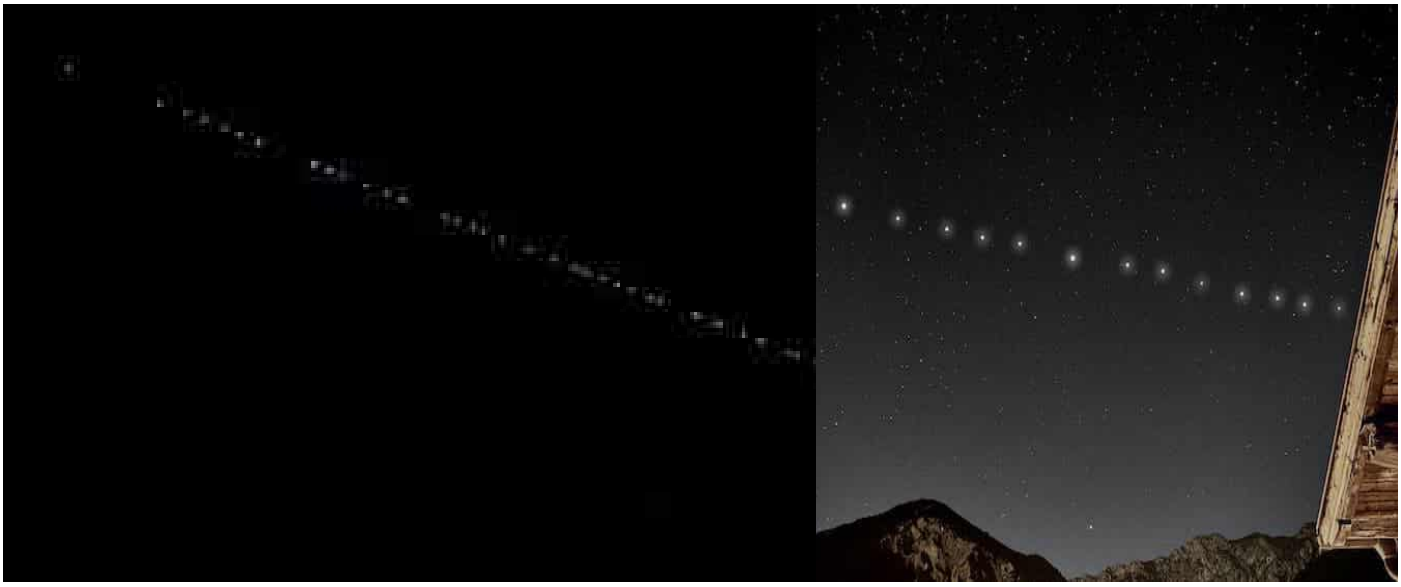
Vulcan Centaur was supposed to fly for the first time in early May, but that liftoff has been delayed after an anomaly occurred during testing of the rocket's upper stage.

Blue Origin's New Glenn development is also uncertain following reports on July 11 that one of the company's BE-4 rocket engines exploded during testing in late June.

The BE-4 engine not only powers New Glenn, but also the first stage of Vulcan Centaur. More information about impacts to the two vehicles may come during an already-scheduled phone call with reporters on July 13 by ULA CEO and President Tory Bruno concerning progress of his company's rocket.

China and its private space companies have been on a tear in terms of launches, taking 54 missions to orbit in 2022 and targeting more than 60 in 2023. By comparison, SpaceX (by far the busiest U.S. launcher) launched 61 rockets to space in 2022.

SpaceX Starlink satellites had to make 25,000 collision-avoidance maneuvers in just 6 months — and it will only get worse



Since the launch of the first Starlink spacecraft in 2019, the SpaceX satellites have been forced to move over 50,000 times to prevent collisions.

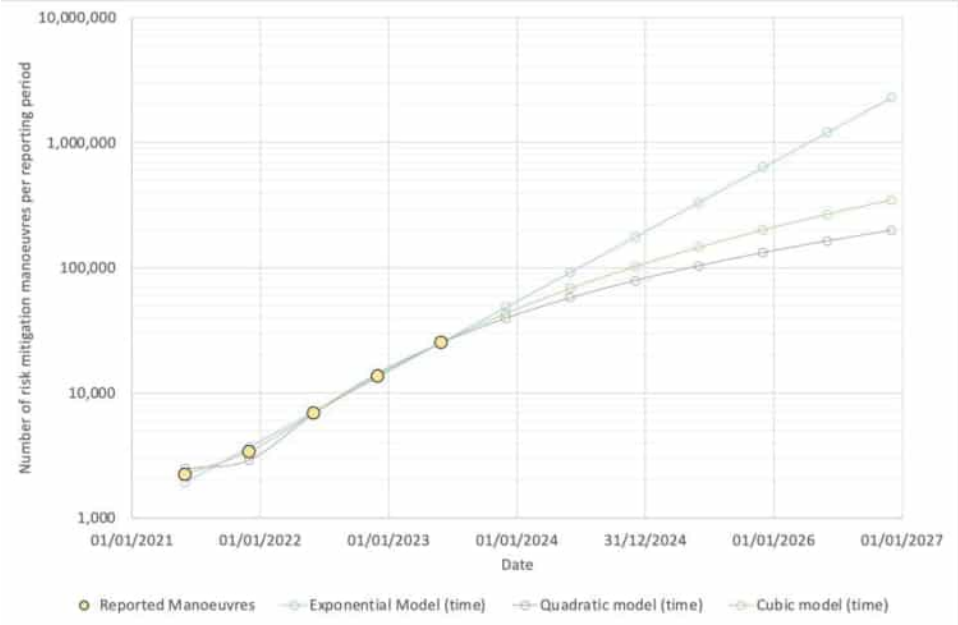
Staggering growth in Starlink collision-avoidance maneuvers in the past six months is sparking concerns over the long-term sustainability of satellite operations as thousands of new spacecraft are poised to launch into orbit in the coming years.

SpaceX's Starlink broadband satellites were forced to swerve more than 25,000 times between Dec. 1, 2022, and May 31, 2023 to avoid potentially dangerous approaches to other spacecraft and orbital debris, according to a report filed by SpaceX with the U.S. Federal Communications Commission (FCC) on June 30. That's about double the number of avoidance maneuvers reported by SpaceX in the previous six month period that ran from June to November 2022. Since the launch of the first Starlink spacecraft in 2019, the SpaceX satellites have been forced to move over 50,000 times to prevent collisions.

The steep increase in the number of maneuvers worries experts because it follows an exponential curve, leading to concerns that safety of operations in the orbital environment might soon get out of hand.

"Right now, the number of maneuvers is growing exponentially," Hugh Lewis, a professor of astronautics at the University of Southampton in the U.K. and a leading expert on the impact of megaconstellations on orbital safety, told Space.com. "It's been doubling every six months, and the problem with exponential trends is that they get to very large numbers very quickly."

Data compiled by Lewis shows that, in the first half of 2021, Starlink satellites conducted 2,219 collision-avoidance maneuvers. The number grew to 3,333 in the following six-month period ending in December 2021 and then doubled to 6,873 between December 2021 and June 2022. In the second half of 2022, SpaceX had to alter the paths of its satellites 13,612 times to avoid potential collisions. In the latest report to the FCC, the company declared 25,299 collision-avoidance maneuvers over the past six months, with every satellite having been made to move an average of 6 times.



"Right now, every six months, the number of maneuvers that are being made doubles," said Lewis. "It has gone up by a factor of 10 in just two years, and if you project that out, you'll have 50,000 within the next six-month period, then 100,000 within the next, then 200,000, and so on."

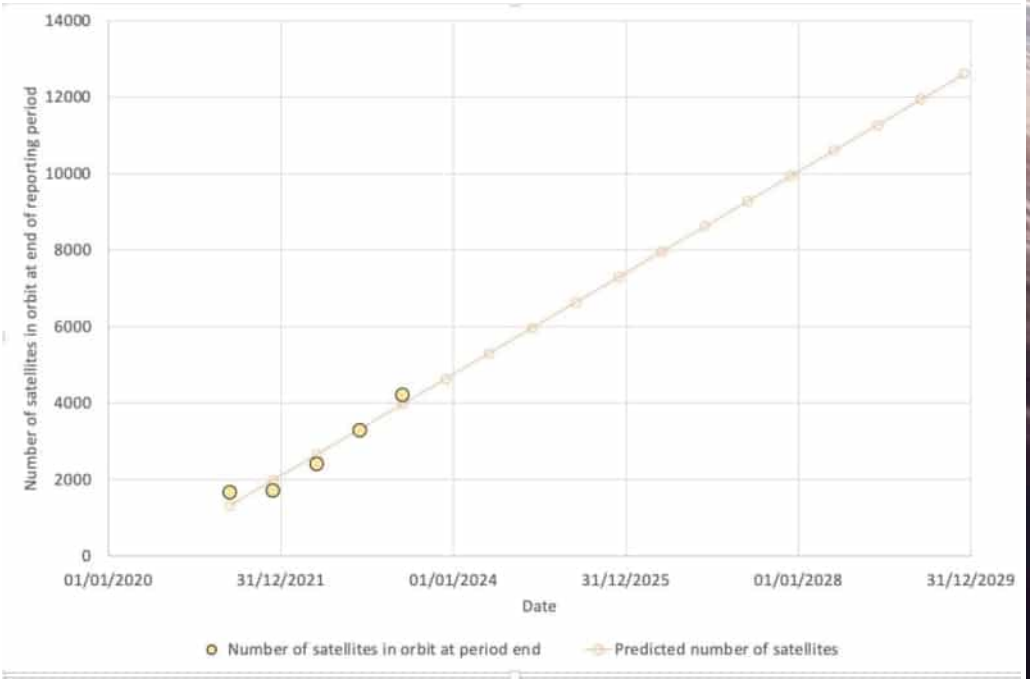
If the trend continues, by 2028, Starlink satellites will have to maneuver nearly a million times in a half-year to minimize the risk of orbital collisions. And Lewis doesn't expect such growth to slow down any time soon. SpaceX has so far deployed about one-third of its planned first-generation constellation of 12,000 spacecraft and has been launching at a regular pace of over 800 satellites per year, a trend that is expected to continue for the foreseeable future.

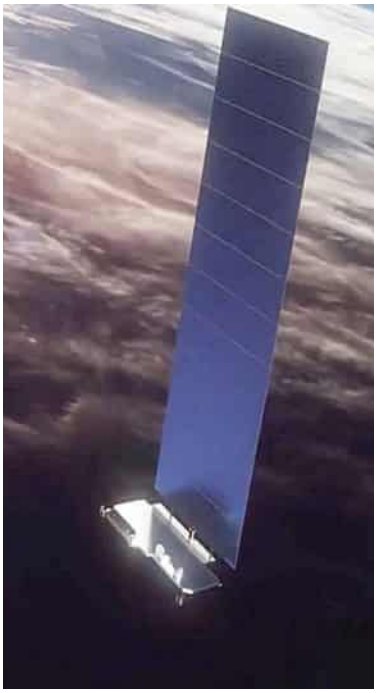
The first-generation Starlink constellation is, however, just the beginning. The FCC has partially approved plans for the second-generation Starlink constellation, which could consist of up to 30,000 satellites. And other players all over the world, including Amazon with its Project Kuiper and China with Guowang, are scrambling to secure orbital slots with thAccording to Joanne Wheeler, a satellite regulations expert at Alden Legal and chair of the U.K.-based Satellite Finance Network, more than 1.7 million satellites have been registered with the International Telecommunication Union, the United Nations' agency overseeing the use of radio frequencies by satellites. Although not all of those plans are likely to come to fruition, the numbers in question are so high that experts such as Lewis question whether order in orbit can be maintained.

"If we're expecting by the end of this decade to have 100,000 active satellites, then my suspicion is that the number of maneuvers collectively that all spacecraft operators will be making will be just enormous," Lewis said. "You're making maneuvers to mitigate the high-risk events, but it's like driving down the highway and swerving every 10 meters to avoid a collision. It's arguably not safe."

Currently there are about 10,500 satellites orbiting our planet, 8,100 of which are operational, according to the European Space Agency. Things only started to get so congested fairly recently. For example in 2019, there were only about 2,300 active satellites circling the planet, according to Statista. The main driver of the growth is Starlink, by far the largest satellite constellation ever assembled.

New satellites are not the only cause behind the increasing need for orbital swerving. The amount of space debris — defunct spacecraft, old rocket stages and various fragments — also continues to grow, making it increasingly difficult for operators to keep their spacecraft safe.





SpaceX currently conducts an avoidance maneuver every time orbital models show a probability higher than 1 in 100,000 that one of the Starlink satellites will cross another object's path. That threshold is 10 times lower than the standard upheld by NASA and other international agencies. eir respective regulators.

Lewis, however, questions whether SpaceX will be able to maintain such a high standard as the number of "conjunction alerts" continues to snowball. He adds that, despite the company's efforts, the residual risk of a collision will continue to rise as well.

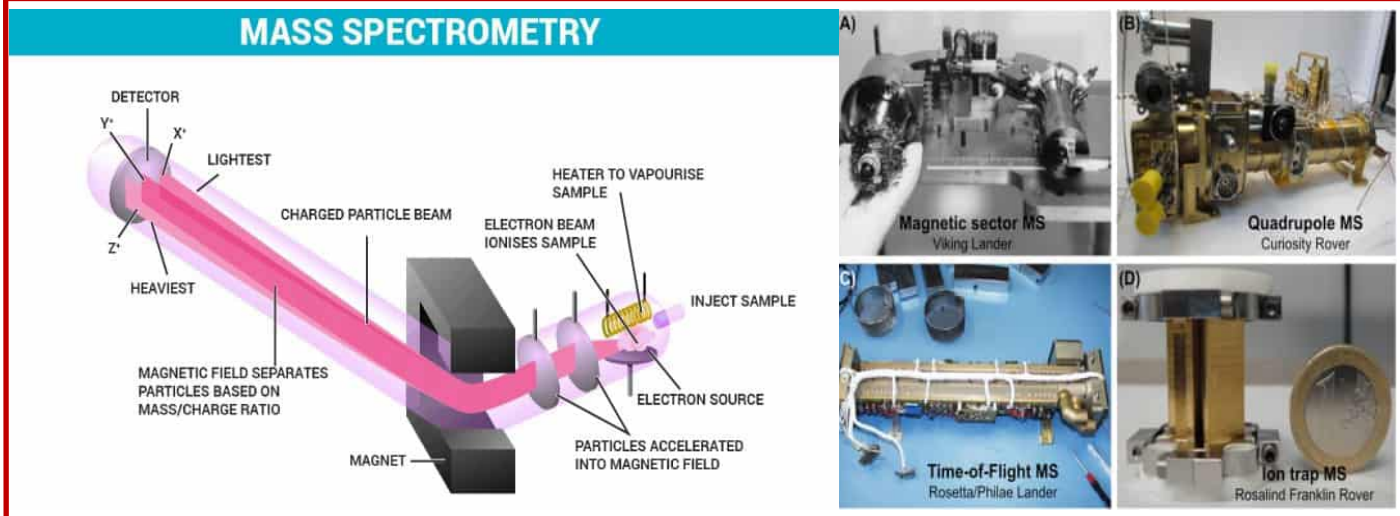
Jonathan McDowell, an astrophysicist at the Harvard–Smithsonian Center for Astrophysics and another frequently heard voice of caution in the satellite megaconstellations debate, agrees with Lewis: "SpaceX are convinced that they can handle the increasing maneuver load," McDowell told Space.com in an email. "I am not convinced that SpaceX have properly taken into account the non-statistical errors (the potential for independent and unpredictable screwups combining to give a bad result - a collision) - so I am concerned that we are operating at the edge of what is safe."

Starlink relies on an autonomous collision avoidance system that instructs satellites to maneuver based on models of orbital trajectories of objects in space. These models provide alerts several days in advance and may not always get it right. Moreover, other factors, such as the changes in the density of Earth's atmosphere at high altitudes caused by space weather, may affect the accuracy of these calculations.

"There is a concern about the conjunctions that are occurring where no maneuvers are being made," said Lewis. "You could argue that the probability [of a collision in these cases] is very low, but given the very large number of them, they represent a quite substantial risk. It's like buying a ticket in a lottery. If you buy just one, you are unlikely to win, but if you buy a million tickets, you stand a pretty good chance."

Lewis expects that, unless regulators cap the number of satellites in orbit, collisions will soon become a regular part of the space business. Such collisions would lead to rapid growth in the amount of space debris fragments that are completely out of control, which would lead to more and more collisions. The end point of this process might be the Kessler Syndrome, a scenario predicted in the late 1970s by former NASA physicist Donald Kessler. Depicted in the 2013 Oscar-winning movie "Gravity," the Kessler Syndrome is an unstoppable cascade of collisions that might render parts of the orbital environment completely unusable.

SPACE SENSORS



Mass spectrometers are powerful tools for analyzing the composition of matter, and they have been used in space exploration for many years. These instruments have helped scientists to learn about the atmospheres of planets and moons, the composition of comets and asteroids, and the presence of organic molecules in space.

One of the earliest mass spectrometers used in space was the Viking Gas Chromatograph Mass Spectrometer (GCMS), which was carried by the Viking landers to Mars in the 1970s. The GCMS analyzed samples of the Martian atmosphere and surface, and it found evidence of organic molecules, including methane and formaldehyde.

In recent years, mass spectrometers have become even more sophisticated, and they are now used on a variety of space missions. For example, the Cassini spacecraft carried an ion and neutral mass spectrometer (INMS) that analyzed the atmospheres of Saturn, Titan, and Enceladus. The INMS found evidence of complex organic molecules in the atmosphere of Titan, and it also detected water vapor in the plumes of Enceladus, suggesting that the moon may have a subsurface ocean.

Mass spectrometers are an essential tool for space exploration, and they will continue to play a vital role in our understanding of the universe. Here are some of the benefits of using mass spectrometers in space:

They can be used to analyze a wide variety of samples, including gases, liquids, and solids.

They are sensitive enough to detect even trace amounts of substances. They can be used to identify the composition of matter in remote locations. They can be used to study the evolution of planets and moons.

Mass spectrometers are a valuable tool for space exploration, and they will continue to be used on future missions to learn more about the universe. Some examples of how mass spectrometers have been used in space:

The Viking GCMS found evidence of organic molecules on Mars, suggesting that the planet may have once been habitable.

The Cassini INMS found evidence of complex organic molecules in the atmosphere of Titan, suggesting that the moon may have the ingredients for life.

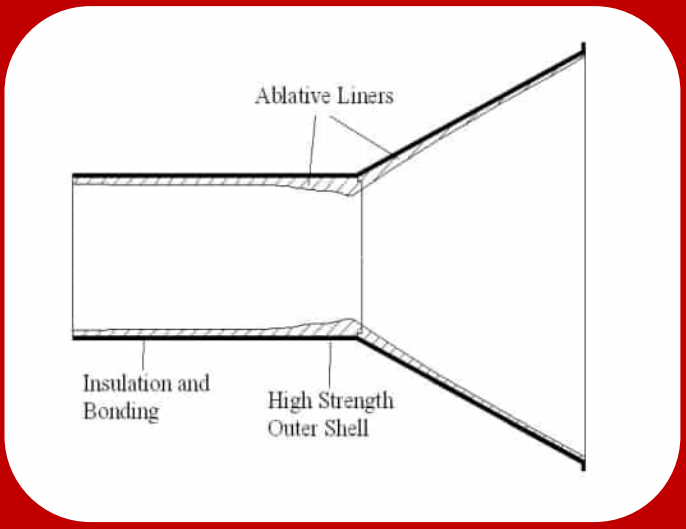
The Curiosity rover is currently using a mass spectrometer to analyze the surface of Mars, looking for evidence of past or present life.

Mass spectrometers are a powerful tool for space exploration, and they will continue to play a vital role in our understanding of the universe. As we continue to explore the solar system and beyond, mass spectrometers will be essential for helping us to understand the composition of other worlds and to search for signs of life.

Space Terms to know about

Ablative Cooling:

Ablative cooling is a method of cooling rocket engines that uses a sacrificial layer of material to absorb the heat from the combustion gases. The material is typically a high temperature polymer or composite that vaporizes when exposed to heat. As the material vaporizes, it carries away the heat from the engine walls, preventing them from melting.



Pintle Injector :

An Pintle injectors are a type of injector used in rocket engines. They consist of a central protrusion, called a pintle, that is surrounded by two concentric tubes. The propellants flow through the tubes and impinge on the pintle, creating a spray of droplets. The droplets then mix and ignite, producing thrust. electric propulsion

Radiative Cooling:

A type of rocket engine that Radiative cooling is a method of cooling rocket engines that uses the emission of thermal radiation to remove heat from the engine walls.

Space-Tech Company

ASTROFORGE

AstroForge is a company that is on a mission to mine asteroids. The company was founded in 2021 with the goal of making space resources accessible on Earth. AstroForge's approach to asteroid mining is to break up the asteroid in space, refine the extracted materials, and then return only the valuable components to Earth. This approach is more efficient, cost-effective, and has a smaller carbon footprint than traditional asteroid mining methods.

AstroForge is still in the early stages of development, but it has made significant progress in recent years. The company has raised over $10 million in funding and launched its first prototype spacecraft. AstroForge is committed to developing the technology to make asteroid mining a reality.

The company's headquarters are located in Huntington Beach, California. The company's CEO is Matt Parker, who has over 20 years of experience in the aerospace industry. AstroForge's target market includes governments, businesses, and research institutions.