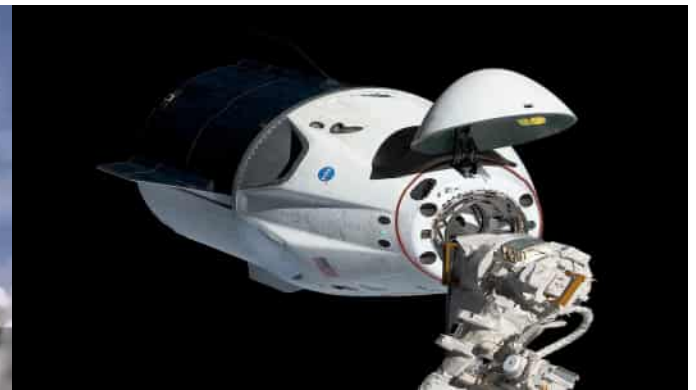


## SpaceX launches Dragon cargo capsule to space station, lands rocket at sea



SpaceX launched its 28th cargo mission to the International Space Station for NASA on Monday (June 5) after a two-day weather delay.

A SpaceX Falcon 9 rocket launched a robotic Dragon cargo capsule toward the orbiting lab on June 5 at 11:47 a.m. EDT (1547 GMT) from NASA's Kennedy Space Center in Florida.

Nine minutes later, the Falcon 9's first stage came back to Earth for a pinpoint touchdown on the SpaceX dronship A Shortfall of Gravitas, which was stationed off the Florida coast. It was the fifth liftoff and landing for this particular booster, SpaceX said in a mission description.

The Falcon 9 upper stage deployed the uncrewed Dragon capsule in low Earth orbit as planned about 12 minutes after liftoff.

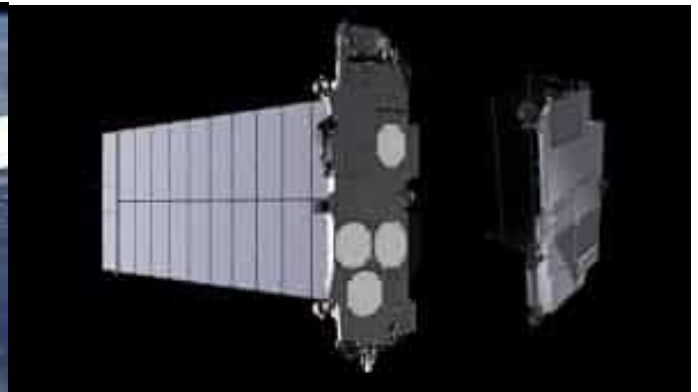
The spacecraft will now make an 18-hour trek to the International Space Station (ISS), with docking scheduled for Tuesday (June 6) at 5:50 a.m. EDT (0950 GMT). You can watch

that rendezvous here at Space.com when the time comes. Dragon is carrying about 7,000 pounds (3,175 kilograms) of science investigation supplies and provisions for the station's crew. A delayed launch of Northrop Grumman's Cygnus ISS resupply vehicle, NG-19, prompted NASA to transfer some of that mission's intended cargo to Dragon in order to keep the space station's cache from diminishing too much.

NASA's ISS chief scientist Kirt Costello said that CRS-28 is "making up for the delays we had in our NG Cygnus vehicle arriving at Station. So, we're sending up lots of extra logistics crew supplies for the crew to keep them going throughout the end of the year."

SpaceX's cargo Dragon is designed as a reusable vehicle, and will return scientific samples from over 34 investigations aboard the ISS at the end of its stay at the station. Like its crewed counterpart, the cargo Dragon comes back to Earth for soft, parachute-aided ocean splashdowns.

# SpaceX launches 22 Starlink 'V2 mini' satellites into orbit, lands rocket at sea



SpaceX launched a fleet of new Starlink internet satellites into orbit early Sunday (June 4) in a stunning morning liftoff.

A Falcon 9 rocket carrying 22 of SpaceX's new "V2 Mini" internet satellites for its Starlink communications constellation lifted off 8:20 a.m. EDT (1220 GMT) on Sunday from Space Launch Complex 40 at Cape Canaveral Space Force Station in Florida. Eight minutes later, the Falcon 9's first stage booster returned to Earth to land on SpaceX's drone ship Just Read The Instructions. in the Atlantic Ocean.

The smooth launch and landing marked the first of two Florida launches planned by SpaceX today. Another Falcon 9 rocket was scheduled to lift off from the nearby Pad 39A at Kennedy Space Center to launch an uncrewed Dragon cargo ship to the International Space Station for NASA, but bad weather forced SpaceX to delay it to Monday (June 5). Today's launch came 13 years to the day of SpaceX's first-ever Falcon 9 launch in 2010.

The launch of SpaceX's Starlink mission today had been delayed from May 30, when the company also launched 52 other Starlink satellites. The need for final technical checks on the Falcon 9 booster and bad weather kept the flight on the ground until Sunday.

Bad weather has been a thorn in SpaceX's side for both the Starlink and Dragon CRS-28 cargo launch, but that may be easing. Earlier Sunday, SpaceX wrote that today's Starlink

launch faced a dismal 15% chance of good weather for flight, but that forecast improved to 90% "go" about an hour before liftoff.

SpaceX's V2 Mini satellites are more powerful versions of its earlier Starlink spacecraft. The new satellites provide greater broadband capacity, according to the company, and are fitted out with Hall thruster electric propulsion systems, which provide more than twice the amount of thrust compared to those used on older iterations.

The 22 new satellites were expected to be deployed into orbit just over one hour after liftoff, according to a SpaceX mission timeline.

There are over 4,000 Starlink satellites in orbit, and the company has regulatory approval to launch up to 12,000 more. SpaceX is, however, applying for permission to add 30,000 more satellites to the project.

Today's Starlink launch marked the third flight for the Falcon 9 first-stage booster used on the mission, SpaceX officials said. It previously flew on SpaceX's Crew-6 astronaut launch for NASA and a commercial satellite flight that launched the SES 03b mPower satellites.

The flight marked SpaceX's 37th launch of 2023 and the 237th successful mission overall. The Falcon 9 touchdown was also SpaceX's 197th successful landing of an orbital-class rocket.

# China's Shenzhou 15 capsule lands safely with 3 Tiangong space station astronauts



China's Shenzhou 15 astronauts returned to Earth with a smooth and safe weekend landing after completing a six-month mission to the country's space station.

Astronauts Fei Junlong, Deng Qingming and Zhang Lu touched down in their Shenzhou 15 spacecraft return capsule at the Dongfeng landing site at 6:33 p.m. EDT on Saturday, June 3, (2233 GMT; or 6:33 a.m. on June 4 Beijing Time), according to the China Manned Space Agency.

The Shenzhou 15 crew launched from Jiuquan in northwest China on Nov. 29 and were part of the first-ever crew handover on China's new Tiangong space station.

Fei and his crewmates had taken over control of the station from the Shenzhou 14 crew in early December. They welcomed the incoming Shenzhou 16 crew on May 29.

"We are feeling good," mission commander Fei said in a brief interview right after exiting the return capsule.

The mission was Deng Qingming's first flight to space, having been selected in China's first batch of astronauts back in 1997. That's a

nearly 26-year wait for his first trip to space.

"Now, I really, really miss my family and my hometown. My experience as an astronaut over the past 25 years makes me believe more firmly in the power of dreams and persistence," Deng told Chinese state media.

The Shenzhou 15 crew embarked on four extravehicular activities, or spacewalks, during their time in space, setting a national record. The trio also carried out a range of science experiments and outreach activities.

Tests included using a two-photon microscope to image an astronaut's skin, testing a free-piston Stirling thermoelectric converter, as well as various experiments using a combustion chamber. Two of Tiangong's three modules are science modules which contain a number of experiment racks.

Meanwhile, in orbit, the new Shenzhou 16 astronauts are expected to remain aboard Tiangong until this upcoming November, when they will be relieved by the Shenzhou 17 crew. China aims to keep Tiangong operational and permanently occupied for at least a decade.



# Boeing delays 1st Starliner astronaut launch for NASA indefinitely over parachute, wiring safety issues



Boeing is standing down from the first-ever crewed launch of its Starliner astronaut capsule for NASA, possibly indefinitely, due to safety issues with the spacecraft's parachutes and wiring that were discovered last week.

The Starliner astronaut launch, already years behind schedule, was most recently targeted to launch two NASA astronauts to the International Space Station on July 21. Now, it likely won't launch at all this summer, and may not get off the ground this year.

"It's feasible, but I certainly wouldn't want to commit to any dates or timeframes," Mark Nappi, Boeing Starliner program manager and vice president, told reporters in a press conference Thursday (June 1). "We need to spend the next several days understanding what we need to go do to solve these problems."

Two major safety issues are driving the latest delay, both of them discovered last week during in-depth reviews of Starliner to certify the spacecraft for crewed flight, Nappi said.

First, Boeing engineers discovered that the "soft links" used on the suspension lines of Starliner's three main parachutes have a failure load limit that is actually lower than previously thought. It turns out that those links, which secure the parachute lines with their anchor tethers on the capsule, cannot handle

the load of Starliner if one chute fails. Being able to land safely with two of three chutes is a safety requirement for NASA, Nappi said.

The second safety issue Boeing found pertains to the protective tape covering the wiring harnesses throughout the Starliner capsule. That tape, Nappi said, is flammable and there are "hundreds" of feet of it inside Starliner.

Boeing is on the hook for at least seven crewed flights for NASA, including the Crew Flight Test and six operational astronaut missions, as part of its NASA contract. Despite the repeated delays, Nappi said Boeing remains committed to its Starliner spacecraft and fulfilling its NASA obligations.

"We've been talking about the future of Starliner and how we're going to move forward," Nappi said. "We know that there's growing pains in developing vehicles and flying vehicles. This is just part of the business to have these kinds of issues."

NASA wants to have two different spacecraft available for astronaut flights so it is not dependent on a single company to fly astronauts in space, Stich added.

"NASA desperately needs a second provider for transportation," he said. "Our ultimate goal is to have one SpaceX and one Boeing flight per year rotate up to the station."

# Pentagon confirms it's buying SpaceX Starlink services for Ukraine



The contract follows uncertainty over continued SpaceX funding of Starlink for Ukraine.

The Pentagon has confirmed it is buying SpaceX's Starlink broadband services to provide communications in Ukraine.

Elon Musk's SpaceX has been supplying Ukraine with Starlink terminals since the Russian invasion of the country in 2022, providing vital communications after the destruction of infrastructure within the country.

However, SpaceX stated in September 2022 that it could not continue funding the Starlink service for Ukraine and had asked the Pentagon to step in and cover costs. A deal is now in place to provide the vital communications services.

"Satellite communications constitute a vital layer in Ukraine's overall communications network and the department contracts with Starlink for services of this type," Ars

Technica reported, citing a June 1 Department of Defense statement.

"We continue to work with a range of global partners to ensure Ukraine has the satellite and communication capabilities they need," the statement continued.

The Pentagon did not reveal details of the contracts, citing operational security concerns.

SpaceX expressed concerns earlier this year over the use of Starlink by the Ukraine military for offensive means. Company President and Chief Operating Officer Gwynne Shotwell stated that the service was "never, never meant to be weaponized,"

SpaceX revealed in December that it is developing a partner project called Starshield. The service is designed for use by government agencies, particularly those in the national security sector.

# SpaceX landed a rocket for the 200th time (and launched 72 satellites) on epic rideshare flight



SpaceX launched 72 small satellites to orbit on June 12 and landed the returning rocket back on Earth, marking the 200th such touchdown in the company's history.

A Falcon 9 rocket topped with 72 spacecraft lifted off from California's Vandenberg Space Force Base at 5:35 p.m. EDT (2135 GMT; 2:35 p.m. local California time), kicking off a rideshare mission called Transporter-8.

The rocket's first stage came back to Earth for a vertical touchdown at Vandenberg a little less than eight minutes after liftoff as planned. It was the ninth launch and landing for this particular booster, SpaceX wrote in a mission description.

More excitingly, it was the 200th booster landing that SpaceX has pulled off during an orbital mission to date. That tally began in December 2015, and Elon Musk's company has made such touchdowns pretty much routine in the 7.5 years since.

The rocket's upper stage, meanwhile, continued hauling aloft the 72 payloads, which included "cubesats, microsats, a re-entry capsule and

orbital transfer vehicles carrying spacecraft to be deployed at a later time," according to a SpaceX mission description.

These satellites deployed as planned from the Falcon 9's upper stage, separating over a 24-minute span beginning an hour after liftoff.

Transporter-8 was SpaceX's second mission in about 14 hours. Early this morning, the company launched 52 of its Starlink internet satellites to orbit from Florida's Cape Canaveral Space Force Station.

Transporter-8 was the eighth small-satellite "rideshare" mission that SpaceX has launched to date, and its third such flight of 2023.

Transporter-6 launched on Jan. 3, sending 114 satellites to orbit, and Transporter-7 lofted 51 spacecraft on April 15.

SpaceX's first dedicated rideshare mission holds the record for most satellites launched on a single rocket: Transporter-1 carried 143 satellites to orbit in January 2021.

# Space Force chooses SpaceX, ULA for 12 military launches in 2025



The United States Space Force is sticking with SpaceX and United Launch Alliance (ULA) for its military satellite launches.

Space Systems Command (SSC), responsible for developing and launching technologies for Space Force, issued a statement on June 8 detailing launch contract assignments for 12 National Security Space Launch (NSSL) missions, divided equally between SpaceX and United Launch Alliance (ULA).

In a statement, SSC's division chief for launch procurement and integration Col. Chad Melone stated, "ULA and SpaceX continue to provide outstanding launch services with their reliable and innovative launch systems, and we are confident in their ability to maintain the unprecedented 100 percent program success for the NSSL missions assigned for launch in FY25."

The missions include a total of seven Space Develop Agency (SDA) missions to low Earth orbit (LEO) containing the first generation of the Tranche 1 communication and missile-tracking satellite constellation.

These transport and tracking layer satellites, with designations T1TL and T1TR, are part of the SDA's Proliferated Warfighter Space

Architecture (PWSA), a network of satellites that allows for advanced weapons detection and high-speed communication among critical military infrastructure.

"Our ongoing commitment to successfully launch our secure communications, GPS, and space awareness satellites, and place them into their orbits, continues to provide our warfighters and nation's decision-makers with the assets and vital information they need every day to stay ahead of and deter adversarial forces," Maj. Gen. Stephen Purdy, SSC's program executive officer for Assured Access to Space, said in the statement.

A SpaceX Falcon Heavy rocket will launch SDA T1TL missions B through E, SDA T1TR-C. A classified mission for the U.S. Space Force, USSF-31, will launch on a SpaceX Falcon 9.

ULA's Vulcan was selected to fly two missions for the National Reconnaissance Organization, NROL-64 and 83, as well the GPS III-08 mission. Vulcan will also be launching SDA T1TR missions B and D, as well as the classified USSF-114.

The SDA's first Tranche 1 launch was originally slated for late 2024, but delays in the development of ULA's new Vulcan rocket make it unlikely the vehicle will be certified for NSSL missions within that time frame.



# 1st-ever private Venus mission delayed until at least 2025



The first private mission to Venus won't launch this year after all. The Rocket Lab mission, which was initially set to launch last month, has been delayed until at least January 2025, TechCrunch reported. "Our focus right now is on delivering customer missions as a priority," a Rocket Lab spokesperson told the website, without offering a detailed explanation for the delay. January 2025 was the original backup launch window for the Venus probe, according to the MIT Technology Review.

Rocket Lab announced its planned Venus mission in August 2020, then fleshed out its architecture in a paper published in the journal *Aerospace* two years later. The primary goal is to investigate the Venusian atmosphere to search for conditions needed for life to exist. Venus, the hottest planet in the solar system, is generally considered a hellscape, with surface temperatures hot enough to melt lead. But some clues have emerged indicating that microbial life might be able to exist high in Venus' skies, where conditions are more Earth-like. In 2020, researchers discovered signs of phosphine in the clouds of Venus. This created quite a stir, because here on Earth, this colorless, flammable toxic compound is found in swamps and other locations as a byproduct of microbial life.

"I've always felt that Venus has got a hard rap," Rocket Lab founder and CEO Peter Beck said last year while talking about the mission. "The discovery of phosphine was the

catalyst. We need to go to Venus to look for life."

The purported Venus phosphine find — a claim that remains disputed today — helped renew scientific interest in the second planet from the sun. For example, NASA is developing two Venus missions, DAVINCI and VERITAS, set to launch in the late 2020s and early 2030s.

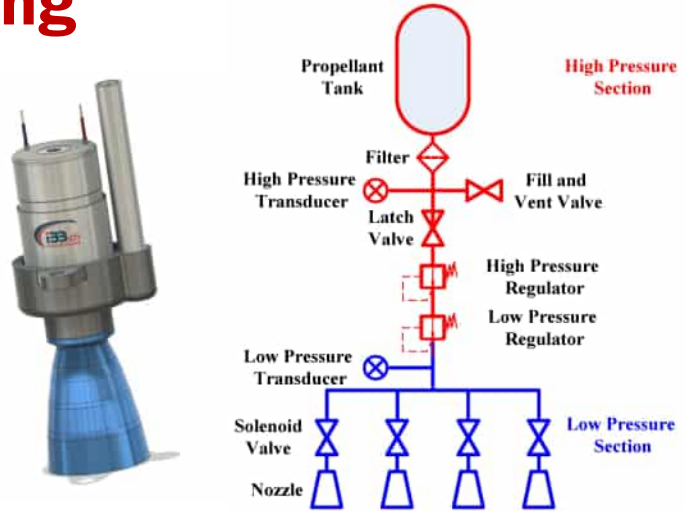
The probe proposed by Rocket Lab, a California-based launch company, would get to Venus before those NASA spacecraft and also be much cheaper. The mission is funded by Rocket Lab, the Massachusetts Institute of Technology (MIT) and undisclosed philanthropists and is estimated to cost just \$10 million. This is just 1% of the estimated combined cost for both of NASA's coming Venus missions.

The probe will also be diminutive, measuring 15 inches (38 centimeters) across, just a bit larger than a basketball hoop, and weighing a mere 45 pounds (20.4 kilograms). The tiny Venus probe will leave Earth on Rocket Lab's Electron rocket and will then be carried to the hellish planet by the company's Photon spacecraft bus.

The probe's journey to Venus will be brief, lasting just five months, but its data collection period will be even shorter. The probe will have just three to five minutes to collect data as it plummets from an altitude of 37 to 28 miles (60 to 45 km) in Venus' atmosphere, the region in which scientists saw signs of phosphine in 2020.



# Cold Gas Thrusters: The Unsung Heroes of Spacecraft Maneuvering



Cold gas thrusters are a type of rocket engine that uses the expansion of a pressurized gas to generate thrust. They are a simple and versatile propulsion system that is used in a variety of applications, including attitude control, maneuvering, and spacecraft propulsion.

Cold gas thrusters are typically used for small spacecraft because they have low thrust and are not as efficient as other types of rocket engines. However, they are also very reliable and can operate for long periods of time without failure.

One of the advantages of cold gas thrusters is that they are safe to operate in close proximity to other spacecraft or delicate instruments. This is because they do not produce any combustion products.

There are a number of advantages to using cold gas thrusters, including:

**Simple design:** Cold gas thrusters are relatively simple to design and build, which makes them a cost-effective option for small spacecraft.

**Safe operation:** Cold gas thrusters do not produce any combustion products, which makes them safe to operate in close proximity to other spacecraft or delicate instruments.

**Reliability:** Cold gas thrusters are very reliable and can operate for long periods of time without failure.

**Low-power consumption:** Cold gas thrusters require very little electrical power to operate,

which is important for spacecraft with limited power budgets.

Cold gas thrusters are used in a variety of applications, including:

**Attitude control:** Cold gas thrusters are used to maintain the attitude of spacecraft. This is important for spacecraft that need to point their sensors at specific targets or that need to maintain a stable orbit.

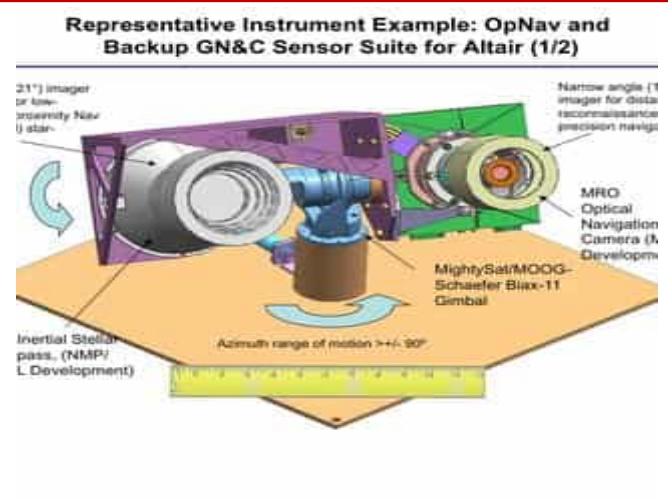
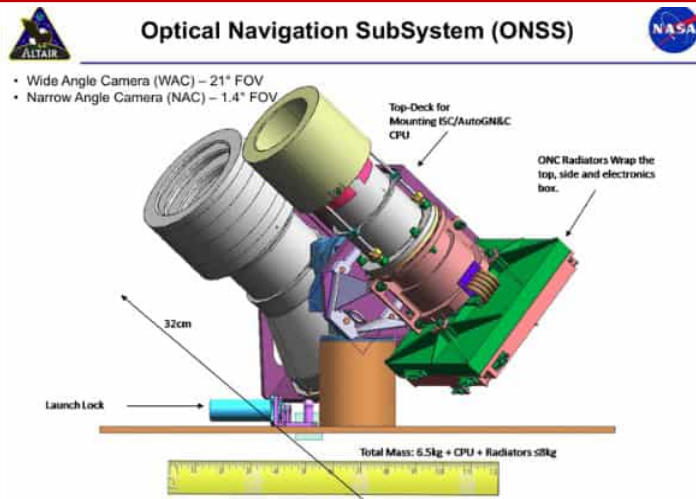
**Maneuvering:** Cold gas thrusters are used to maneuver spacecraft. This can be used to change the orbit of a spacecraft, to dock with another spacecraft, or to escape from a dangerous situation.

**Spacecraft propulsion:** Cold gas thrusters can be used as the primary propulsion system for small spacecraft. This is particularly useful for spacecraft that need to operate in close proximity to other spacecraft or delicate instruments.

Another advantage of cold gas thrusters is that they are relatively low-cost to design and build. This makes them a cost-effective option for small spacecraft.

The future of cold gas thrusters looks promising. As technology advances, cold gas thrusters are becoming more powerful and efficient. This is making them a more attractive option for a wider range of applications.

# SPACE SENSORS



Optical sensors are used in a wide variety of applications in space, including navigation, imaging, and communication. They are essential for many of the tasks that are performed by spacecraft, such as rendezvous and docking, Earth observation, and asteroid detection.

Optical sensors are used for navigation in space by measuring the position and orientation of a spacecraft relative to stars or other celestial objects. This information is used by the spacecraft's guidance and control system to keep it on course.

Optical sensors are used for imaging in space by capturing images of objects in space, such as planets, stars, galaxies, and asteroids. This information is used for scientific research, Earth observation, and national security applications.

Optical sensors are used for communication in space by transmitting and receiving signals between spacecraft and ground stations. This information is used to control spacecraft, transmit data, and provide telemetry.

Optical sensors in space face a number of challenges, including the harsh environment of space, the need for high reliability, and the limited power and weight budgets of spacecraft.

The harsh environment of space includes high levels of radiation, extreme temperatures, and vacuum. These conditions can damage optical sensors and degrade their performance.

Optical sensors need to be highly reliable in

order to function properly in space. They must be able to withstand the harsh environment and operate for long periods of time without failure. Spacecraft have limited power and weight budgets, which can constrain the size and complexity of optical sensors.

There have been a number of advancements in optical sensors in recent years, which have made them more capable and reliable. These advancements include the development of new materials and technologies, such as radiation-hardened materials and microelectromechanical systems (MEMS) sensors.

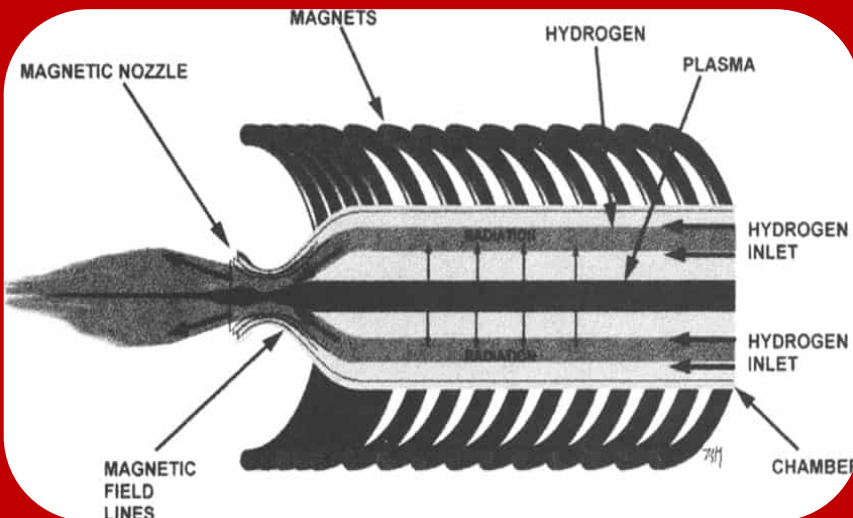
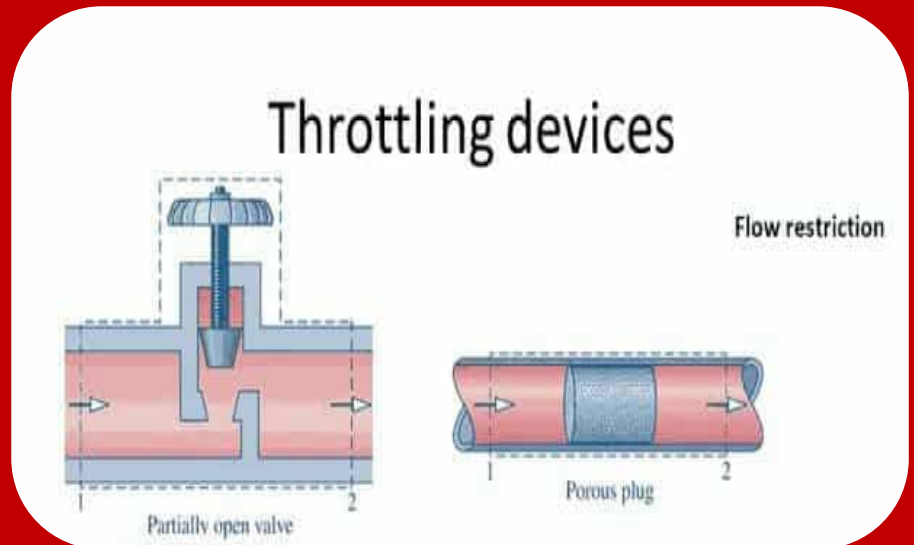
Optical sensors will continue to play an important role in space exploration in the future. As technology advances, optical sensors will become even more capable and reliable. This will enable new and exciting applications in space, such as the exploration of the Moon and Mars, the detection of exoplanets, and the development of new communication and navigation technologies.

Optical sensors are essential for many of the tasks that are performed by spacecraft in space. They are used for navigation, imaging, and communication, and they are essential for scientific research, Earth observation, and national security applications. As technology advances, optical sensors will become even more capable and reliable, enabling new and exciting applications in space.

# Space Terms to know about

## Throttling:

*The ability to adjust the thrust level of a rocket engine during operation. Throttling allows for more precise control over the rocket's performance and can be crucial for tasks like orbit insertion or landing.*

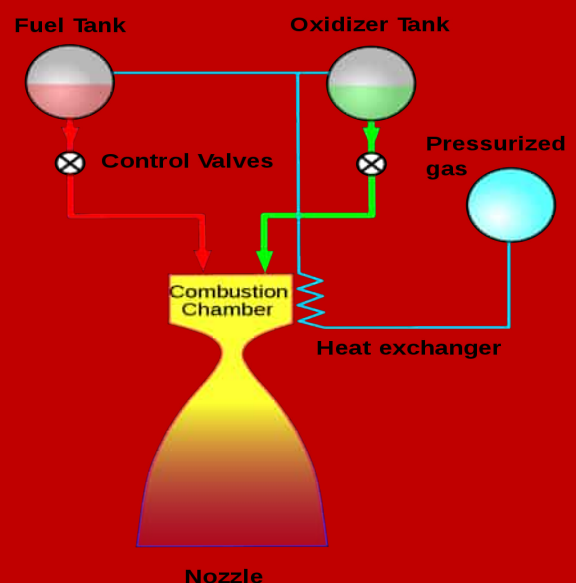


## Gas-Dynamic Mirror (GDM) :

*An electric propulsion system that uses a magnetic field to reflect ions back into the discharge channel, increasing their velocity and thrust.*

## Pressure-Fed Engine:

*A type of rocket engine that relies on high-pressure tanks to deliver propellants directly to the combustion chamber. The propellant flow is driven by the pressure difference, eliminating the need for turbopumps.*





# Space-Tech Company

LIBRE SPACE FOUNDATION



## SatNOGS NETWORK

The Libre Space Foundation is a non-profit organization that promotes the use of open-source software and hardware in space exploration. The foundation was founded in 2015 by a group of Greek space enthusiasts, and it now has members and contributors from all over the world.

The Libre Space Foundation has a number of projects underway, including SatNOGS, a global network of satellite ground stations; QUBIK, a small satellite mission; and SIDLOC, a project to develop a standard for spacecraft identification and localization. The foundation also organizes conferences and workshops on libre space technologies.

The Libre Space Foundation's mission is to "promote, advance and develop libre (free and open source) technologies and knowledge for space." The foundation believes that open-source software and hardware can help to make space exploration more accessible and affordable, and it is working to build a community of space enthusiasts who are committed to these principles.

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