Dr. MGR-ACS Space Technology Centre

SPACE EXPLORER

"An Ingress to Borderless world"

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ISRO's GSLV-F12 successfully places navigation satellite NVS-01

ISRO successfully launched NVS-01, the first of the second-generation satellite series, into geosynchronous transfer orbit on May 29. The satellite will ensure the continuity of navigational (NavIC) services and also provide new service in L1 band.

The GSLV-F12 rocket successfully placed the 2232kg weighing satellite at 251km altitude. The satellite is built around the standard I-2K bus and compatible with GSLV. It carries navigation payloads operating in L1, L5 and S bands. The satellite is powered by two solar arrays, capable of generating power up to 2.4kW and a lithium-ion battery supporting payload and bus load during eclipse. The mission life of NVS-01 is expected to be better than 12 years.

The second-generation satellite series includes L1 navigation band and encompasses indigenously developed rubidium atomic clock. The rubidium atomic frequency standard (RAFS), the atomic clock which is the heart of the satellite, acts as a stable frequency reference for the navigation payload.

The L1 navigation band is popular for providing PNT (position, navigation and timing) services for civilian users and for interoperability with other Global Navigation Satellite System or GNSS signals.

The space-qualified rubidium atomic clock, indigenously developed by Space Applications Centre, Ahmedabad is an important technology which only a handful of countries possess, Isro officials said.

The key applications of Navic include terrestrial, aerial and maritime navigation, precision agriculture, geodetic surveying, emergency services, fleet management, location-based services in mobile devices, orbit determination for satellites, marine fisheries, timing services for financial institutions, power grids, and other government agencies, internet-of-things (IoT) based applications and strategic applications.

The successful launch of NVS-01 is a major milestone for the Indian space program and will further strengthen the country's position in the global navigation satellite market.

SpaceX launches Ax-2 private astronaut mission to station, 1st Saudi woman in space on board

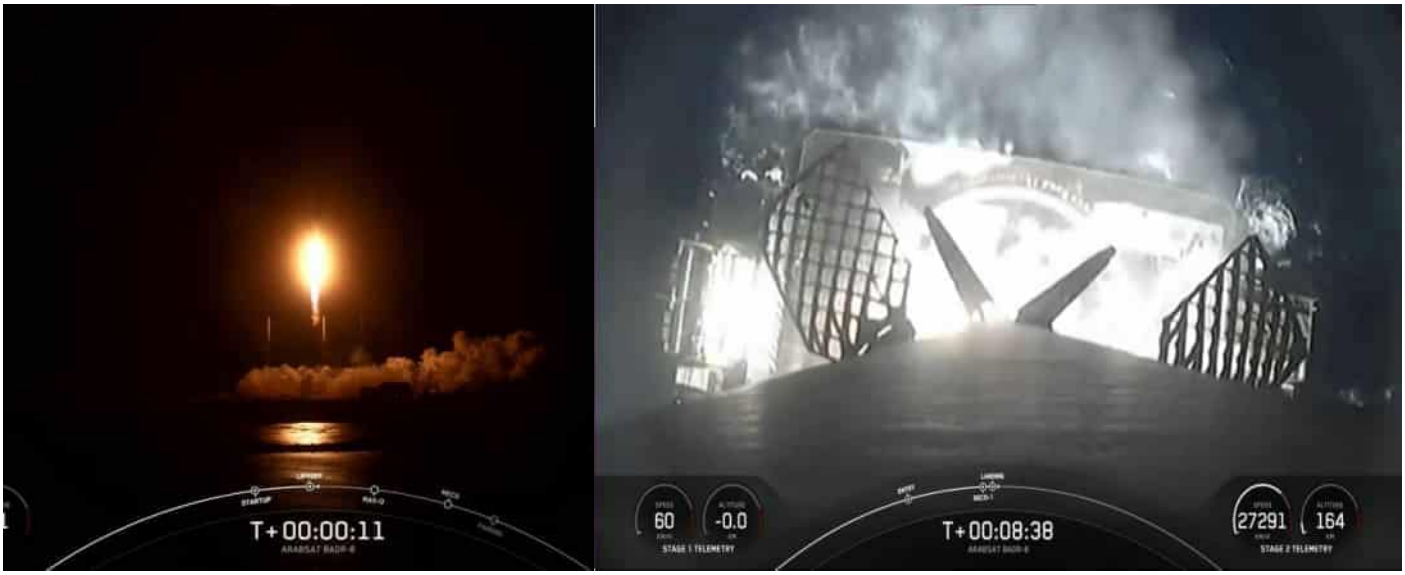
CAPE CANAVERAL, Florida — The second private astronaut mission to the International Space Station is underway. A SpaceX Falcon 9 rocket launched at 5:37 p.m. EDT (2137 GMT) on May 21 from historic Pad 39A at NASA's Kennedy Space Center in Florida, kicking off Houston-based company Axiom Space's four-person Ax-2 mission. Following a successful liftoff and staging, the first stage of Ax-2's Falcon 9 rocket performed a boost-back burn to return to SpaceX's Landing Zone-1, which is not far from Pad 39A. The booster touched down safely at the site about seven minutes and 45 seconds after launch. Ax-2's SpaceX Dragon spacecraft, named Freedom, separated from the Falcon 9's upper stage about 12 minutes after liftoff as planned, spurring celebratory words from the mission's astronauts and the launch team. "Thanks for putting your trust in the Falcon 9 team," SpaceX chief engineer Bill Gerstenmaier told the Ax-2 crew just after the milestone moment. "Hope you enjoyed the ride to space. Have a great trip on Dragon." Gerstenmaier then welcomed Ax-2 commander Peggy Whitson — a former NASA astronaut who has already spent more time in space (665 days) than any other American or any other woman — back to the final frontier. "Good to be here," Whitson responded. "It was a phenomenal ride!"

Freedom will spend the night chasing down the International Space Station (ISS), for a docking scheduled to occur at 9:24 a.m. EDT (1324 GMT) on May 22. Ax-2 is the second space flight for Freedom, which also flew SpaceX's Crew-4 mission to the orbiting lab for NASA. (Falcon 9 first stages are reusable as well, but the Ax-2 booster was flying for the first time.) The flight marks the tenth human spaceflight for SpaceX. This is Axiom's second privately crewed launch to the ISS, after Ax-1 in April 2022, but it comes with a lot of firsts. Whitson, who is Axiom's director of human spaceflight, is the first woman to command a private crewed mission to space. (She was also the first woman to serve as commander aboard the ISS.) Two members of the Ax-2 crew were picked from Saudi Arabia's first astronaut class. Ali AlQarni and Rayyanah Barnawi will be the first Saudi astronauts to visit the ISS, and Barnawi is the first Saudi woman to ever travel to space.

The Ax-2 crew will be performing a host of other experiments during their time aboard the space station. In addition to the above TRISH experiment, the Ax-2 astronauts will conduct research for over 20 different projects and investigations.

Axiom has also been contracted by NASA to develop spacesuits for the lunar surface for astronauts on the space agency's Artemis 3 mission, which is scheduled to launch toward the moon's south pole in late 2025.

SpaceX launches huge Arabsat BADR-8 satellite into orbit, lands rocket at sea



SpaceX launched a big telecommunications satellite to orbit on May 27, moving the company closer to 200 successful landings of their first stage rocket boosters.

A Falcon 9 rocket topped with the Arabsat BADR-8 satellite lifted off from Cape Canaveral Space Force Station in Florida on May 27 at 12:30 a.m. ET (0430 GMT). The rocket's first stage landed on SpaceX's droneship Just Read the Instructions eight minutes and 46 seconds later.

Tonight's mission marked the 195th successful landing for SpaceX overall between both Falcon 9 and Falcon Heavy rockets, SpaceX's Veronica Foreman said during the launch livestream.

Bad weather forced SpaceX to push two previous attempts of this mission earlier this week. The conditions were much more favorable tonight, leading to a successful nighttime liftoff through the humid skies of Florida's Space Coast.

It was the 14th mission for this particular Falcon 9 first stage, according to a SpaceX mission description. Among those previous flights are two private astronaut missions, September 2021's Inspiration4 and April 2022's Ax-1.

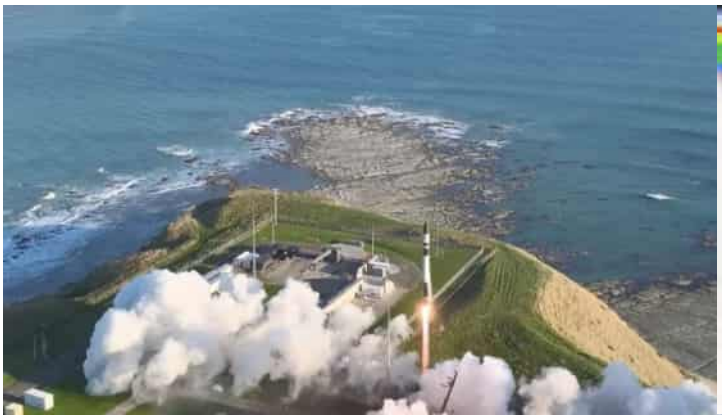
Ax-1, which was operated by Houston-based company Axiom Space, sent four people to the International Space Station for a roughly two-week stay. SpaceX just launched Axiom's second mission, Ax-2, sending its four crewmembers toward the orbiting lab atop a Falcon 9 on May 22.

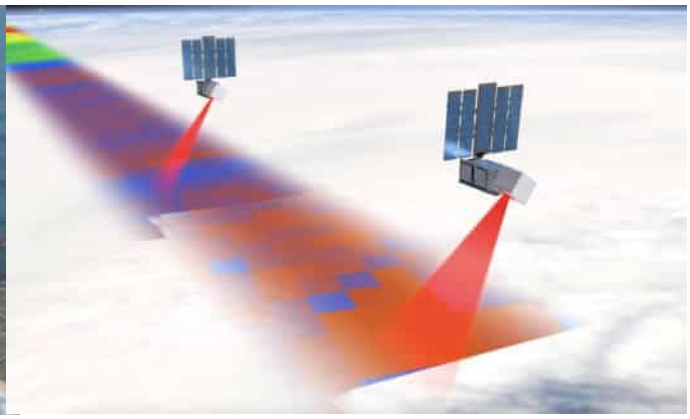
Fourteen flights is not a SpaceX reuse record, by the way. The current mark is 15, set last December on a mission that lofted a big batch of the company's Starlink internet satellites.

Arabsat BADR-8 weighs roughly 9,900 pounds (4,500 kilograms), according to EverydayAstronaut.com. The satellite is bound for geostationary orbit, about 22,200 miles (35,700 kilometers) above Earth.

It'll take four to five months for the satellite to reach its operational orbit. Once it's up there and fully checked out, BADR-8 will beam TV broadcasting and other telecom services to central Africa, Europe, and the Middle East for Saudi Arabia-based Arabsat, EverydayAstronaut.com wrote.

Rocket Lab launches 2 tiny NASA hurricane watching probes to orbit





The second set of NASA's TROPICS cubesats launched on May 25, completing the agency's hurricane-studying miniconstellation. The two tiny satellites lifted off atop a Rocket Lab Electron vehicle from the company's Launch Complex 1 on New Zealand's North Island on May 25 at 11:46 p.m. The Electron deployed the cubesat pair as planned about 34 minutes after liftoff, Rocket Lab confirmed via Twitter. The launch was originally targeted for midnight EDT (0400 GMT) on May 25, but Rocket Lab pushed it back by nearly 24 hours due to bad weather. The launch, dubbed "Coming to a Storm Near You," was the second that Rocket Lab performed for the TROPICS program, whose name is short for "Time-Resolved Observations of Precipitation Structure and Storm Intensity with a Constellation of Small Sats." Rocket Lab's previous TROPICS launch, called "Rocket Like a Hurricane," sent two cubesats of the four spacecraft constellation into low Earth orbit on May 7. It's hoped that the four satellites will all be in operation in time for the start of the 2023 hurricane season in North America.

"The number of hurricanes we're experiencing every year is increasing due to climate change, and the intensity of these storms is also increasing," Jane McNichol, mission manager at Rocket Lab, said during a prelaunch press conference on May 7.

"The current technology that we have on orbit to monitor hurricane development may only be able to check in on these storms every couple of hours, but within that time, we might see a storm increase in intensity quite a bit," she added.

McNichol said that TROPICS will investigate intense tropical storms in terms of precipitation, temperature and humidity nearly hourly. Such data has the potential to save lives and livelihoods, she stressed.

"The ability to advance our understanding of tropical cyclones from space has been limited by the ability to take frequent measurements, particularly from microwave instruments that see into the storms," Will McCarty, program scientist for the TROPICS Mission, said in a statement on April 10. "Historically, satellites have been too large and expensive to provide observations at a time-frequency that is consistent with the timescales at which tropical cyclones can evolve."

McCarty added that the cubesat era has allowed for smaller, less expensive satellites, allowing for the design of a constellation that optimizes the scientific utility of the mission and facilitates low-cost launches.

"These factors enable TROPICS to provide a new understanding of tropical cyclones by decreasing the time by which a given storm is revisited by the satellites," he said.

China launches 3 astronauts to Tiangong space station on Shenzhou 16 spacecraft

A Long March 2F rocket launched the Shenzhou 16 crew spacecraft from the Jiuquan Satellite Launch Center in the Gobi Desert on May 29 at 9:31 p.m. EDT. Spacecraft separation occurred around 10 minutes later, according to the China National Space Administration, which declared the launch "a complete success."

Jing Haipeng (the mission's commander) and rookies Zhu Yangzhu and Gui Haichao— the first members of a third astronaut selection group to fly to space — are set to spend six months aboard the Tiangong space station. CNSA officials announced the crew just one day before launch.

Jing Haipeng is a veteran of the Shenzhou 7, 9 and 11 missions, while Zhu Yangzhu and Gui Haichao are heading to orbit for the first time. Zhu is a spaceflight engineer and was selected in China's third batch of astronauts in 2020. Gui is also from the third astronaut group and will be China's first payload specialist to fly to Tiangong.

"It is a great honor for me to serve as the commander for the third time. This time, I am mainly responsible for organization and coordination, including space-Earth communication and mission command," Jing told reporters in the press conference. "In particular, I have to ensure the safety of the mission and our crew."

After reaching orbit and docking with Tiangong, the crew will be greeted aboard the space station by the outpost's current Shenzhou 15 crew. Mission commander Fei Junlong and crewmates Deng Qingming and Zhang Lu have been aboard Tiangong since November and will hand over control of the space station to the new crew before returning home in early June.

China completed its three-module Tiangong in late 2022 and aims to keep the orbital outpost permanently occupied for at least a decade. The station is about 20% as massive as the International Space Station, according to Chinese space officials.

The country is also looking to see foreign astronauts travel to Tiangong, as well as open the space station to potential tourist visits.

Earlier this month China also launched the Tianzhou 6 cargo spacecraft to Tiangong to deliver supplies for the six-month-long Shenzhou 16 mission, as well as science experiments, equipment and propellant for the space station to maintain its orbit.

China has prepared Shenzhou and Long March 2F rockets for potential emergencies as part of its operation of the Tiangong space station. China’s human spaceflight agency has previously revealed that the rocket and spacecraft can be readied to launch with 8.5 days' notice.

ULA calls off critical Vulcan Centaur rocket test on launch pad due to engine ignition delay

The United Launch Alliance called off the first-ever engine test of its new Vulcan Centaur rocket on the launch pad in Florida on May 25 due to a technical issue on the booster.

The Vulcan Centaur rocket engine test, called a Flight Readiness Firing, was scheduled for 6 p.m. EDT (2200 GMT) at Space Launch Complex 41 at Cape Canaveral Space Force Station in Florida. But two hours before the test, United Launch Alliance (ULA) announced it was standing down. "During the countdown, the team observed a delayed response from the booster engine ignition system that needs further review prior to proceeding with the flight readiness firing," ULA officials wrote in a Twitter update. The Vulcan Centaur rocket's first stage was then rolled back to its Vertical Integration Facility hangar for further review. "The team will continue to review data and determine when Vulcan Rocket can roll back to the pad to conduct the flight readiness firing," ULA wrote in a follow-up update. If Vulcan's eventual static fire and wet dress rehearsal go smoothly, the rocket's first launch will be its next major milestone. Bruno has previously indicated sometime in June or July as Vulcan's earliest likely launch date, with launch windows available 4 to 5 days every month. That timeline depends on the success of the upcoming static fire test. ULA previously completed a successful tanking test on the company's new Vulcan on May 12, filling the rocket with over a million pounds of fuel during the test. ULA engineers then evaluated the fueling test results against Vulcan's design expectations.

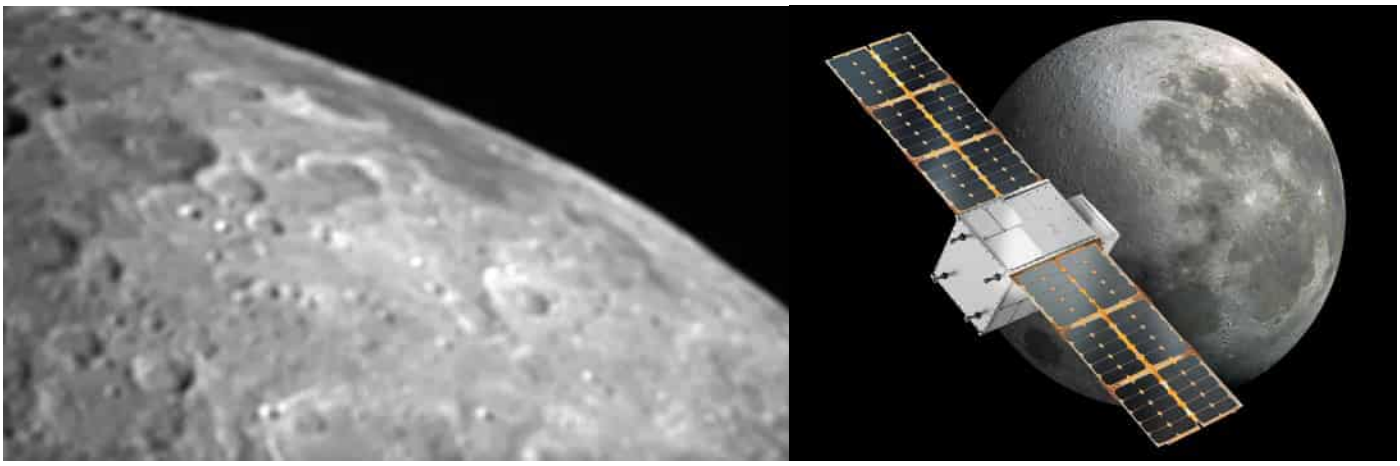
Two days after the successful tanking, Bruno indicated in a May 15 tweet that the tests were "good," but that teams would be making some parameter adjustments ahead of Vulcan's first static fire. That milestone moved Vulcan one step closer to its first launch, with only a static test firing of the engines and wet dress rehearsal left to validate the vehicle.

The rocket's main booster BE-4 engines use liquified natural gas (LNG) and liquid oxygen for fuel, and will be able to produce over half a million pounds of thrust at liftoff. Vulcan's Centaur V second stage RL10 engines are powered using liquid hydrogen and liquid oxygen.

The 202-foot (62-meter) Vulcan Centaur will be capable of lifting 7.7 tons (7 metric tonnes) of payload to geostationary orbit, over 22,000 miles (36,000 km) above the Earth. The rocket was designed to replace ULA's veteran Atlas V and Delta IV launch vehicles that have been in service for two decades.

Already, NASA has added Vulcan to its lineup of rockets for future missions. Amazon has also contracted ULA for 38 Vulcan launches to support the deployment of its Project Kuiper communications satellite constellation.

NASA's tiny CAPSTONE probe snaps 1st photo of the moon, begins extended mission



CAPSTONE is still going strong after more than six months in lunar orbit NASA's tiny moon-orbiting CAPSTONE spacecraft has taken its first images of Earth's nearest neighbour. CAPSTONE, built by Terran Orbital and operated for NASA by Colorado company Advanced Space, was designed to help lay the foundation for the Gateway space station, which will orbit the moon as part of the Artemis program. CAPSTONE (short for "Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment") is testing a unique orbit around the moon, known as a near rectilinear halo orbit (NRHO), that will be occupied by Gateway.

The NRHO is highly elliptical and located at a precise balance point in the gravities of Earth and the moon. It requires little energy to stay in this orbit, offering long-term stability for outposts like Gateway.

In the NRHO, CAPSTONE gets as close as 11,000 miles (17,700 kilometers) to one lunar pole during a near pass and then as far away as 43,500 miles (70,000 km) from the other pole every seven days. The microwave-sized satellite imaged the lunar surface for the first time on May 3, as it made a close pass by the north pole. Six days later, the CAPSTONE team used the cubesat to test navigation technology similar to GPS on Earth called the Cislunar Autonomous Positioning System (CAPS). During the successful May 9 experiment, CAPSTONE teamed up with NASA's Lunar Reconnaissance Orbiter (LRO), which has been circling the moon since 2009. CAPSTONE beamed a signal to LRO, which bounced it back to the tiny spacecraft, where it was converted into a measurement of the distance and relative velocity between the two probes. "The test proved the ability to collect measurements that will be utilized by CAPS software to determine the positioning of both spacecraft," NASA officials wrote in an update last week. "This capability could provide autonomous onboard navigation information for future lunar missions." The May 9 test came just a few days before the six-month anniversary of CAPSTONE's insertion into lunar orbit. The six-month milestone, which occurred on May 13, officially concluded the primary mission of the little cubesat. But the trial shows that CAPSTONE can still contribute to NASA's moon efforts going forward. It hasn't been all smooth sailing for CAPSTONE since its launch atop a Rocket Lab Electron vehicle on June 28, 2002. The mission team had to troubleshoot issues with the tiny probe's communications and propulsion systems, for example, before getting it successfully into lunar orbit on Nov. 13, 2022. NASA says that the current "enhanced mission phase" of CAPSTONE will last for around a year and will see the spacecraft continue testing its onboard technology.

Record-breaking amateur rocket soars higher than Mt. Everest

'I fell to my knees, sobbing, from witnessing such an incredible feat.'

An amateur rocket set a new record last month, soaring far higher than Mount Everest.

On April 16, students from Embry-Riddle Aeronautical University launched a small rocket to a maximum altitude of 47,732 feet (14,548 meters) — about 1.6 times higher than Everest, which stands 29,032 feet (8,849 m) tall. The feat also more than doubled the previous record set by U.S. undergraduate and collegiate amateurs, which was 22,000 feet (6,706 m).

"I fell to my knees, sobbing, from witnessing such an incredible feat," student Dalton Songer said in a May 11 statement, evoking the 4,000 hours of work that went into the construction, testing and launch.

"Everyone was celebrating in a giant group hug," Songer said. "That moment was special — something that only happens when a dedicated group of individuals come together and make something incredible happen against all odds."

The launch, from the Mojave Desert in California, isn't the highest ever by amateurs, as other efforts have even reached what is considered space itself (roughly 62 miles, or 100 kilometers). For example, an undergraduate team from the University of Southern California sent their Traveler IV booster beyond the Kármán line in 2019, which likely set a record for students overall, officials said at the time.

Still, in their category (undergraduate liquid-fueled rocket launch), the Embry-Riddle students shone. Their rocket — named Deneb, after a star in the constellation Cygnus — broke the sound barrier easily, reaching Mach 1.5 (1,150 mph or 1,850 kph) during a 26.1-second flight. It took three scrubbed launch attempts to get there, forcing the entire team to camp for an extra night in the desert.

Songer said the launch was worth it. The students, from Embry-Riddle's Prescott, Arizona campus, sheltered in a bunker for the launch but could still see it: "Watching Deneb take off was the most exhilarating moment of my life," Songer said. "We all ran out of the bunker to watch as Deneb burned further and further into the morning sky. It was breathtaking."

"We learned a lot from that rocket," said Zoe Brand, a team member who tested Deneb's engine, said in the same statement. "Altair was very heavy. So, we deliberately focused on making our rocket lighter by integrating the propellant tanks into the structural rigidity of the rocket."

Control Moment Gyroscopes: A Key Technology for Spacecraft Attitude Control

Control moment gyroscopes (CMGs) are a key technology for spacecraft attitude control. They are used to keep spacecraft stable and pointing in the desired direction. CMGs work by storing angular momentum. When a CMG is spun up, it acquires angular momentum. When the wheel is then commanded to stop spinning, it will exert a torque on the spacecraft in the opposite direction, causing the spacecraft to rotate.

CMGs are a very efficient way to control spacecraft attitude. They are also very reliable and have a long life. However, CMGs have some limitations. They can only store a limited amount of angular momentum, and they can be damaged if they are spun too fast.

Despite their limitations, CMGs are an essential technology for spacecraft attitude control. They are used on a wide variety of spacecraft, including satellites, space telescopes, and space probes.

Here are some of the advantages of using CMGs for spacecraft attitude control:

They are very efficient. CMGs do not require any propellant to operate.

They are very reliable. CMGs have a long life and are not susceptible to the same kind of failures as other attitude control systems, such as thrusters.

They are very precise. CMGs can be used to control spacecraft attitude with very high accuracy.

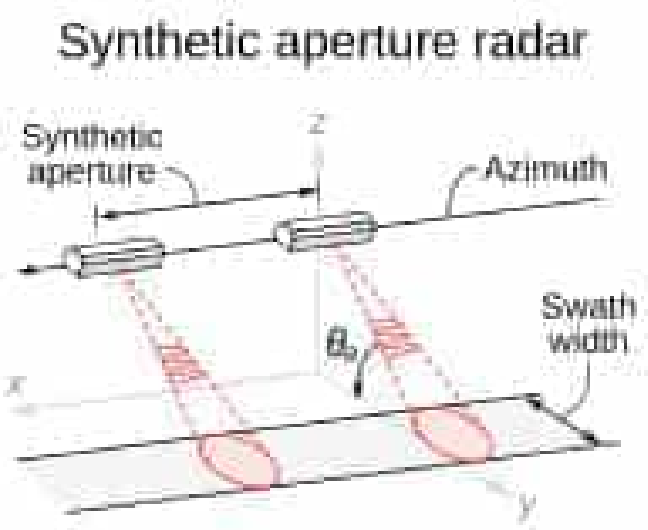
Here are some of the disadvantages of using CMGs for spacecraft attitude control:

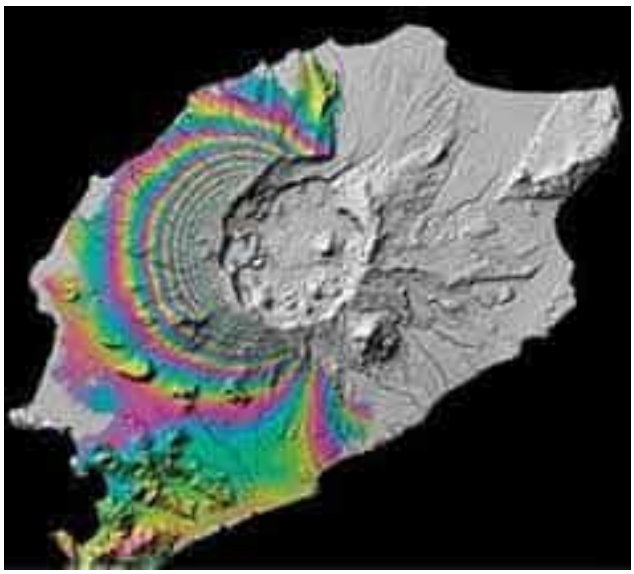
They can only store a limited amount of angular momentum. This means that they can only be used to control spacecraft attitude for a limited period of time.

They can be damaged if they are spun too fast. This is a potential safety hazard.

Overall, CMGs are a very important technology for spacecraft attitude control. They offer a number of advantages, such as efficiency, reliability, and precision. However, they also have some limitations, such as a limited capacity for storing angular momentum.

SPACE SENSORS





Synthetic aperture radar (SAR) is a powerful tool for Earth observation. It can be used to create images of the Earth's surface in all weather conditions, day or night. SAR images are also very detailed, and they can be used to map the Earth's surface with great accuracy.

SAR works by sending out a beam of radar waves and then measuring the reflected waves. The radar waves are reflected by objects on the Earth's surface, and the reflected waves are then used to create an image of the surface.

SAR images can be used for a variety of purposes. They can be used to map the Earth's surface, to monitor changes on the Earth's surface, and to track the movement of objects on the Earth's surface. SAR images can also be used to study the Earth's atmosphere and oceans.

SAR is a versatile tool that can be used for a variety of purposes. It is a valuable tool for Earth observation, and it is used by a wide variety of organizations, including governments, businesses, and universities.

Here are some of the advantages of using SAR for Earth observation:

Can be used in all weather conditions, day or night.

Can create very detailed images of the Earth's surface.

Can be used to map the Earth's surface with great accuracy.

Can be used for a variety of purposes, including mapping, monitoring, and tracking.

Here are some of the disadvantages of using SAR for Earth observation:

SAR images can be expensive to acquire.

SAR images can be difficult to interpret.

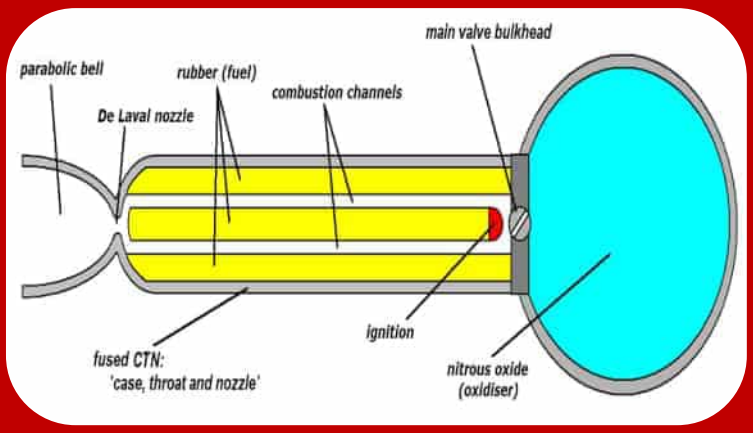
SAR images can be affected by weather conditions.

Overall, SAR is a powerful tool for Earth observation. It offers a number of advantages, such as the ability to create detailed images in all weather conditions. However, it also has some disadvantages, such as the cost of acquiring images and the difficulty of interpreting them.

Space Terms to know about

Throttleable Engine :

A rocket engine that can vary its thrust output during operation. Throttleability allows for precise control over the rocket's acceleration and velocity.

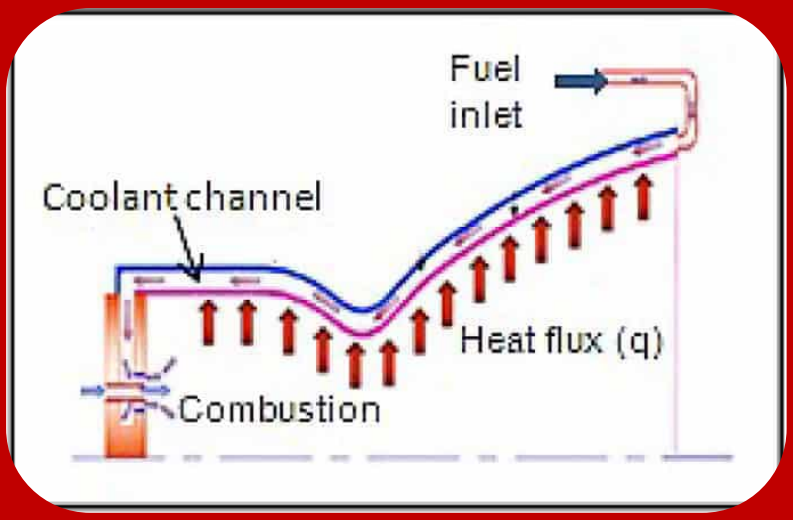


Reusable Rocket :

A rocket that can return to Earth after launch and be used for multiple missions. Reusability aims to reduce the cost of space access by eliminating the need to build new rockets for each launch.

Regenerative Cooling:

A technique used to cool the combustion chamber and nozzle of a rocket engine by circulating a portion of the propellant around these hot surfaces. The propellant absorbs heat and prevents damage to the engine components.



Space-Tech Company

LIFTERO

Liftero is a Polish startup that develops orbital transfer vehicles (OTVs) to enable space logistics. Liftero's OTVs are designed to be small, lightweight, and highly efficient. They will be powered by a new type of green propulsion system. Liftero is currently in the development phase and plans to launch its first commercial OTV in 2024. Liftero's OTVs have the potential to revolutionize space logistics by making it much cheaper and easier to transport satellites and other payloads to different orbits.