

India signs Artemis Accords with US, commits to space cooperation



Prime Minister Narendra Modi on June 22 signed Artemis Accords with the United States during his state visit, according to the White House. The National Aeronautics and Space Administration (NASA) and Indian Space Research Organisation (ISRO) have also agreed to launch a joint mission to the International Space Station (ISS) in 2024.

Grounded in the United Nations Outer Space Treaty of 1967, the Artemis Accords is a non-binding multilateral arrangement between the US government and other world governments participating in the Artemis program, a US-led effort to return humans to the Moon by 2025, with the ultimate goal of expanding space exploration to Mars and beyond.

As of June 22, 2023, 26 countries and one territory have signed the accords — 10 in Europe, eight in Asia, three in North America, two in Oceania, two in Africa and two in South America.

Drafted by NASA and the US Department of State, the Accords establish a framework for cooperation in civil space exploration and use in the 21st century.

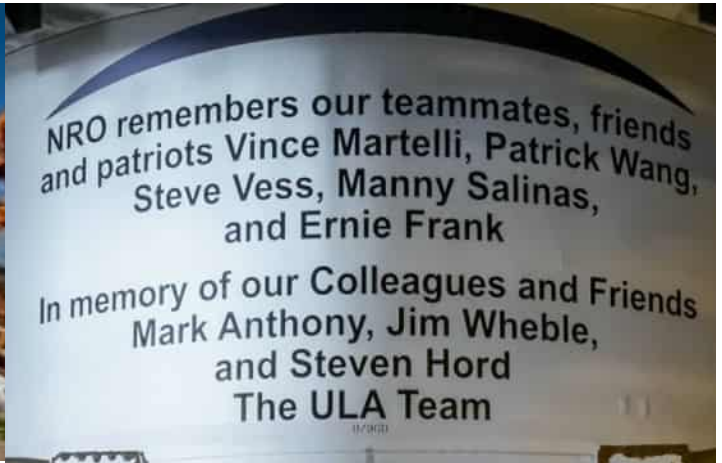
The Artemis Accords outline a set of principles and guidelines that countries participating in lunar missions are expected to adhere to.

These principles include the peaceful exploration of space, transparency and interoperability, the utilization of space resources in a sustainable manner, and the preservation of historic sites and artifacts on the Moon. By signing the accords, countries demonstrate their commitment to these principles and their willingness to collaborate with other nations in lunar exploration.

India's decision to sign the Artemis Accords indicates its commitment to global space cooperation and its interest in participating in lunar exploration missions.

By joining the accords, India can collaborate with other nations, including the United States, in future missions to the Moon, sharing knowledge and expertise while contributing to the broader goals of advancing scientific research, technological development, and expanding humanity's presence in space.

Delta IV Heavy rocket launches US spy satellite on penultimate mission



United Launch Alliance's (ULA) powerful Delta IV Heavy rocket flew for the second-to-last time early Thursday morning (June 22).

The Delta IV Heavy lifted off from Florida's Cape Canaveral Space Force Station on Thursday at 5:18 a.m. EDT (0918 GMT), on a mission for the U.S. National Reconnaissance Office (NRO) called NROL-68.

ULA cut off the webcast 6 minutes 45 seconds after launch at the request of the NRO. About seven hours later, military officials confirmed that the launch succeeded.

"We had another successful launch for the NRO today," U.S. Space Force Maj. Gen. Stephen Purdy, program executive officer for U.S. Space System Command's Assured Access to Space, said in an emailed statement.

"The payload we've put into space today adds to the unique capability the NRO provides to keep us safe and out in front of the pacing challenges posed by our nation's competitors," Purdy added.

We know very little about the satellite that went up on NROL-68. That's no surprise, given that it's an NRO payload; the agency operates the United States' fleet of spy satellites, whose capabilities and activities tend to be classified.

The NROL-68 mission patch — which features a baby dragon, its mother and the moon — of-

fers a few clues, scant though they are.

"The baby dragon illustrates the birth of a new satellite system, while the moon with the mother dragon silhouette represent protection of the Five Eyes community, the nation and its allies," NRO officials wrote in a brief mission description. (Five Eyes is an alliance involving the intelligence communities of the United States, United Kingdom, Australia, Canada and New Zealand.)

NROL-68 was ULA's first mission of 2023 and the 15th Delta IV Heavy launch overall.

The burly rocket stands 235 feet (71.6 meters) tall and generates 2.1 million pounds of thrust at liftoff. That's a lot, but it's far from the record. For example, NASA's Space Launch System rocket, which debuted on the successful Artemis 1 moon mission last year, produces 8.8 million pounds of thrust.

NROL-68 was the second leg of a spaceflight doubleheader early Thursday morning: SpaceX launched 47 of its Starlink internet satellites to orbit about two hours earlier.

The original target launch date for NROL-68 was Wednesday (June 21), but a problem with a ground-system valve forced a one-day delay.

Virgin Galactic achieves milestone with successful first commercial spaceflight



Virgin Galactic, Richard Branson's space tourism company, achieved a critical milestone on June 29 when it completed its first commercial spaceflight. The Virgin Space Ship (VSS) Unity spacecraft, carrying the Galactic 01 crew, safely returned to land after a successful journey to space.

Carrier aircraft VMS Eve and spacecraft VSS Unity were used as vehicles for the Galactic 01 mission.

The carrier aircraft VMS Eve lifted off from Spaceport America, New Mexico at 8:30 a.m. MT, carrying the spacecraft VSS Unity to an altitude of roughly 44,500 feet, where it released Unity, which then activated its rocket motor engine to soar into suborbital space. Unity touched down on land at 9:42 a.m. MT.

A team of four crew members embarked aboard the VSS Unity spacecraft on the first commercial spaceflight. The crew had two astronauts from the Italian Air Force, an engineer-astronaut from the National Research Council of Italy, and an astronaut-instructor from Virgin Galactic, who was providing training for the Italian Air Force mission. The spacecraft was piloted by retired American Air Force commander Mike Masucci and former Italian Air Force pilot Nicola Pecile.

Carrier aircraft VMS Eve, responsible for transporting the spacecraft, was piloted by

retired American Air Force commander Kelly Latimer and retired Canadian Air Force pilot Jameel Janjua.

The VSS Unity also carried a total of 13 research payloads. The first commercial spaceflight of Virgin Galactic was solely dedicated to conducting a spectrum of research spanning from the bio-medical field, and thermo food dynamics, to the development of innovative sustainable materials in microgravity conditions. During the flight, the Italian crew had the opportunity to unfurl their nation's flag while floating inside the spacecraft.

The completion of the Galactic 01 mission comes at a critical time for Virgin Galactic, as the Virgin Group company competes with two other prominent US companies, SpaceX led by Elon Musk and Blue Origin led by Jeff Bezos, both of which already flew private passengers to space.

Virgin Galactic's first commercial spaceflight service comes after the successful completion of its final spaceflight test, Unity 25 mission, on May 25 this year. Unity until now has five suborbital test flights under its belt. Prior to the Unity 25 mission, the company's founder Richard Branson and a crew flew to space aboard the Unity 22 mission in July 2021.

Europe's BepiColombo spacecraft zooms within 150 miles of Mercury in close flyby



Europe's Mercury probe BepiColombo will take a close look at its target planet on Monday (June 19), and we can expect some exciting new images to reach Earth soon after that.

The flyby will be BepiColombo's third of Mercury and will see the spacecraft whizz past the planet at a superclose distance of just 147 miles (236 kilometers) at 3:34 p.m. EDT (1934 GMT). That's closer than the probe's two orbiters will circle during the main mission.

The main goal of the flyby, however, is not to take stunning close-ups of Mercury's surface, but to slow the probe down using Mercury's gravity so that it can enter the planet's orbit in late 2025.

"Our spacecraft began with far too much energy because it launched from Earth and, like our planet, is orbiting the sun. To be captured by Mercury, we need to slow down, and we're using the gravity of Earth, Venus and Mercury to do just that," ESA flight dynamics expert Frank Budnik said in a statement.

The BepiColombo mission, a joint project by the European Space Agency (ESA) and the Japan Aerospace Exploration Agency (JAXA), is only the third spacecraft in history to take a look at Mercury, the solar system's innermost planet, which is notoriously difficult to study.

Although Mercury is on average 10 times closer to Earth than Jupiter is, it takes just as long to get to the innermost planet as it does

to reach the gas giant. That's because a Mercury-bound spacecraft has to constantly brake against the powerful gravitational pull of the sun. To do that BepiColombo, which launched in 2018, is making carefully calculated flybys of planets along its way while in orbit of the sun. The probe has previously flown past Mercury twice, in October 2021 and in July 2022. Prior to that, the spacecraft also visited Earth once and Venus twice.

"As BepiColombo starts feeling Mercury's gravitational pull, it will be traveling at 3.6 km/s [2.2 miles per second] with respect to the planet. That's just over half the speed it approached during the previous two Mercury flybys," Budnik said. The flyby will further reduce the spacecraft's velocity magnitude compared to the sun by 0.5 miles per second (0.8 km/s), and change its direction by 2.6 degrees, Budnik added.

There will be three further Mercury flybys before BepiColombo is finally slow enough to be captured by the rocky planet, which is only somewhat larger than Earth's moon: in September 2024, in December that same year and the final one in January 2025.

The previous two Mercury flybys have already produced interesting science results, Johannes Benkhoff, BepiColombo project scientist at ESA, said in the statement. The probe made the first-ever measurements of the planet's feeble southern inner magnetosphere, for example, and revealed the composition of charged particles in this region.

China launches national-record 41 satellites on single rocket



China just broke its own national record for satellites launched by a single rocket.

A Long March 2D rocket lifted off from Taiyuan Satellite Launch Center in north China Thursday (June 15) at 1:30 a.m. EDT (0530 GMT, or 13:30 local time). Insulation tiles fell away from the rocket as it rose into blue skies above the hills surrounding Taiyuan, and shock diamonds were visible in its purple exhaust plume.

A total of 41 small satellites were released into orbit. These were the Jilin-1 GF06A0 satellites 1-30, Jilin-1GF03D 19-26, HEGS-1 and Jilin-1 PT02A01/02 for Chinese commercial remote sensing satellite company Changguang Satellite (CGST).

The launch broke the previous Chinese record of 26 satellites on a single launch, set just days earlier by a Lijian 1 rocket developed by commercial company CAS Space. The overall record is 143 satellites, set during SpaceX's Transporter-1 rideshare mission in January 2021.

The satellites launched on Thursday mainly add to CGST's Jilin-1 commercial remote sensing constellation. CGST aims to put more than 300 satellites in orbit by 2025, more than doubling its earlier plan of launching 138 Jilin-1 satellites by the end of that year.

The Jilin-1 Gaofen 06A17-18 satellites are

small, light, high-resolution optical remote sensing satellites also known as Golden Bauhinia satellites 37-38. They're part of the Golden Bauhinia constellation planned by the Hong Kong Aerospace Science and Technology Group. HEGS-1 is a satellite jointly developed by CGST and Aerospace (Xinjiang) Science and Technology Research Institute Co., Ltd. It's the first satellite for a constellation focused on aiding the social development of Xinjiang and the construction of the Belt and Road project.

The PT02A01 and 02 satellites are described by CGST as being low-cost, high-capacity, high-resolution remote sensing satellites carrying the company's self-developed laser communication loads. They'll be used to verify high-speed inter-satellite and satellite-to-ground communication technologies.

CGST is a satellite manufacturer and operator based in Jilin in northeast China, spun off from an institute under the Chinese Academy of Sciences.

The 135-foot-tall (41 meters) Long March 2D can carry 2,866 pounds (1,300 kilograms) of payload to a 435-mile-high (700 kilometers) sun-synchronous orbit. The mission was the 25th launch carrying Jilin-1 satellites.

The launch was China's 24th of the year. The country plans to launch more than 200 spacecraft across 2023.

Rocket Lab's modified Electron rocket HASTE achieves first suborbital launch



Rocket Lab's new suborbital launch vehicle—Hypersonic Accelerator Suborbital Test Electron (HASTE) — successfully completed a test flight on Saturday, June. 17.

The Hypersonic Accelerator Suborbital Test Electron (HASTE) lifted off at 21:24 EDT (01:24 GMT) from Rocket Lab's Launch Complex 2 at Virginia's Mid-Atlantic Regional Spaceport within NASA's Wallops Flight Facility, according to a press release from the company.

The company tweeted about the successful launch, writing: "Mission success for the launch of our new suborbital launch vehicle! HASTE took to the skies from Rocket Lab LC-2 in Virginia for a suborbital mission at 21:24pm Eastern. Congratulations to our mission partners, and welcome to a new era of hypersonic test launch capability!"

HASTE, which was launched for a confidential customer, is a suborbital launch vehicle that is derived from Rocket Lab's Electron rocket. The Electron is already the world's most frequently launched commercial small launch vehicle, according to Rocket Lab.

The company added that HASTE would leverage this heritage to offer "true commercial testing capability at a fraction of the cost of current full-scale tests."

Comprised of the same innovative carbon

composite structure and with the same 3D printed Rutherford engines as the Electron rocket, HASTE has a modified third stage for enables it to perform hypersonic suborbital payload deployment. The third stage of HASTE can be controlled to give it flight trajectories and payload release conditions that can be adjusted in accordance with the individual needs of client missions.

In addition to this, HASTE has an increased payload capacity with the launch system capable of hauling 1540 pounds (700 kilograms) to orbit. Rocket Lab said it also has the ability to be tailored to lift even larger payloads to space.

HASTE, which will operate under Rocket Lab National Security (RLNS), a Rocket Lab subsidiary created to serve the U.S. defense and intelligence community, also be capable of carrying air-breathing, ballistic re-entry, boost-glide, and space-based applications payloads.

"The success of this mission demonstrates collaboration across government and industry partners to change the paradigm in hypersonic testing," Global Launch Services Senior Director Brian Rogers said in a statement. "HASTE enables the frequent, affordable flight testing needed to advance the nation's hypersonic technology development, and we're proud to be delivering this vital capability."

US Space Force wants private companies to help it counter 'emerging threats' in space



The U.S. Space Force is seeking to maintain space superiority by opening a new office that will help it partner with the private sector and acquire new technologies more quickly.

A ribbon-cutting ceremony held Tuesday, June 6, marked the official opening for Space System Command's (SSC) new Commercial Space Marketplace for Innovation and Collaboration office, or COSMIC. The Chantilly, Virginia facility will serve as headquarters for SSC's Commercial Space Office (COMSO), which was established last year to bolster relationships between the U.S. Space Force and the private sector and capitalize on emerging technologies, according to a Space Force statement.

SSC is the U.S. Space Force's organization for development and acquisitions, and opened COSMIC in a partnership with Virginia Tech Applied Research Corporation (VT-ARC), and in cooperation with the Air Force Research Laboratory's (AFRL) Air Force Office of Scientific Research.

COSMIC's debut comes amidst an ongoing shift in strategy at SSC, as they begin to pivot from developing their own technologies to strengthening partnerships with private companies. In opening remarks at the ribbon-cutting ceremony, Space Force Maj. Gen. Steve Whitney said that as the service transitions from a small number of larger, more vulnerable satellites to constellations of smaller, more expendable ones, "institutions

like COSMIC are more important than ever." USSF Col. Rich Kniseley serves as Senior Material Leader, and runs COMSIC. Kniseley said that COSMIC provides "a place and means for us all to get together and best collaborate on commercial space capabilities, warfighter requirements, and how to best deliver those capabilities."

Indeed, unlike SSC, which is headquartered in Los Angeles, COSMIC's northern Virginia locale puts it just outside the borders of Washington, D.C., and close to several government intelligence agencies and commercial space company offices. "The National Capital Region is a sweet spot for connecting with government agencies in the intelligence community as well as with key space agencies such as NASA and the Space Development Agency," Kniseley said.

COSMIC spans 10,000 square feet (929 square meters), and includes office and conference spaces that are geared toward commercial outreach services. Acting director for the AFRL Office of Scientific Research, U.S. Air Force Col. Janelle T. H. Jackson stressed the importance of COSMIC's initiatives, saying the U.S. faces an increasing threat of military competition. "Our competitors and adversaries are rapidly moving to challenge and surpass the U.S. science and technology advantage and gain superiority in the air and space domains," Jackson said. "Taking an integrative approach by partnering with industry and academia are one of many ways we can lead the challenge."

Chinese astronauts install radiation-exposure experiment outside Tiangong space station



China is running a biological radiation exposure experiment outside its space station.

The country's Shenzhou 16 astronauts — Jing Haipeng, Zhu Yangzhu and Gui Haichao — installed the experiment outside the Tiangong space station's Mengtian science module on June 10, China's National Space Science Center (NSSC) announced in a statement.

The experiment was deployed using Mengtian's dedicated payload airlock and attached to an external payload adapter using the space station's small robotic arm.

The experiment payload contains 13 sample box units loaded with biomaterials. These are designed to study the impact of cosmic radiation and microgravity on organisms, the origin and evolution of life and the development of space radiation mutagenic resources.

The equipment can be used for in-orbit experiments on biological samples, including plant seeds, microorganisms and small animals, according to NSSC. The temperature inside each sample container unit can be adjusted to suit the organisms it is hosting.

On-orbit medical research involving space radiation biological exposure is of great significance to supporting China's human spaceflight program. That program is ambitious, with plans to launch long-term crewed missions in Earth orbit and send people to the surface of the moon, the Chinese-language outlet Science and Technology Daily reported.

The experiment payload was developed jointly by the NSSC and Dalian Maritime University. It is intended to operate for five years and is planned to be used for several scientific projects.

The Shenzhou 16 crew arrived at Tiangong on May 30 and will remain aboard the space station until November.

Cold Gas Thrusters: The Unsung Heroes of Spacecraft Maneuvering



Hot gas thrusters are a type of rocket engine that uses the expansion of a heated gas to generate thrust. They are a more powerful and efficient type of thruster than cold gas thrusters, but they are also more complex and expensive.

A hot gas thruster works by heating a gas, typically a propellant such as hydrogen or ammonia, to a high temperature. The heated gas is then expanded through a nozzle, creating thrust. The amount of thrust generated depends on the temperature of the gas and the size of the nozzle.

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

High thrust: Hot gas thrusters can produce much higher thrust than cold gas thrusters, which makes them suitable for larger spacecraft or for maneuvers that require a lot of thrust.

High efficiency: Hot gas thrusters are more efficient than cold gas thrusters, which means that they can achieve the same amount of thrust with less propellant.

Long lifetime: Hot gas thrusters have a longer lifetime than cold gas thrusters, which makes them a more cost-effective option for long-duration missions.

There are also a few disadvantages to using hot gas thrusters, including:

Complex design: Hot gas thrusters are more complex to design and build than cold gas thrusters, which makes them more expensive.

Hazardous operation: Hot gas thrusters can produce hot gases that can be hazardous to operate in close proximity to other spacecraft or delicate instruments.

Limited applications: Hot gas thrusters are not as versatile as cold gas thrusters, and they are not suitable for all applications.

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

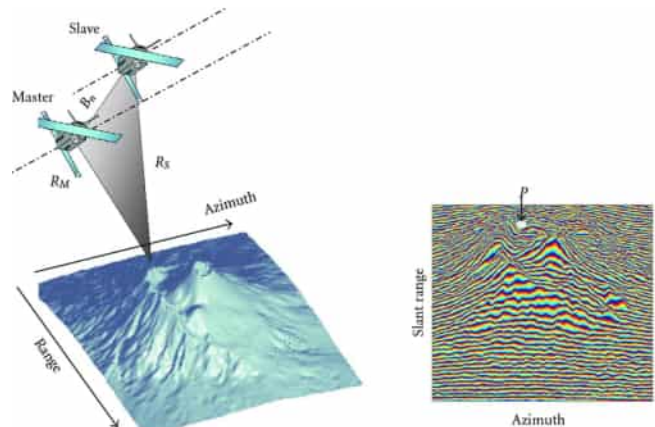
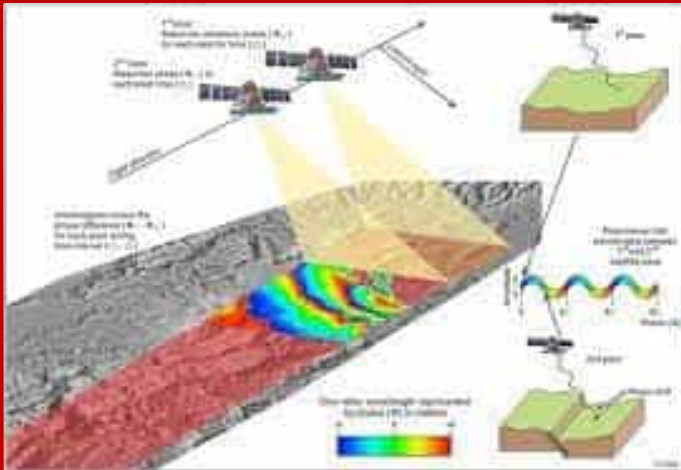
Spacecraft propulsion: Hot gas thrusters can be used as the primary propulsion system for large spacecraft or for spacecraft that need to achieve high speeds.

Attitude control: Hot gas thrusters can be used to maintain the attitude of spacecraft.

Maneuvering: Hot gas thrusters can be used to maneuver spacecraft.

The future of hot gas thrusters looks promising. As technology advances, hot gas thrusters are becoming more powerful and efficient. This is making them a more attractive option for a wider range of applications. In particular, hot gas thrusters are being considered as a potential propulsion system for future spacecraft, such as those that will travel to Mars.

SPACE SENSORS



Synthetic aperture radar (SAR) is a type of radar that uses the motion of a spacecraft to create high-resolution images of the Earth's surface. SAR is used for a variety of applications, including Earth observation, disaster monitoring, and military reconnaissance. SAR works by emitting a beam of microwaves and then measuring the amount of energy that is reflected back from the Earth's surface. The time it takes for the microwaves to travel to the surface and back is used to calculate the distance to the surface. By moving the spacecraft along its orbit, SAR can create a long "virtual" antenna, which allows for high-resolution images. SAR is used for a variety of applications in space, including:

Earth observation: SAR can be used to create images of the Earth's surface, including its topography, vegetation, and water bodies. This information can be used for a variety of purposes, such as monitoring environmental change, assessing natural resources, and planning infrastructure development.

Disaster monitoring: SAR can be used to quickly assess the impact of natural disasters, such as floods, earthquakes, and volcanic eruptions. This information can be used to help with relief efforts and to plan for future disasters.

Military reconnaissance: SAR can be used to create images of enemy territory, which can be used for planning military operations. SAR can also be used to detect and track ships and aircraft. SAR in space faces a number of challenges, including:

Interferences: SAR can be affected by interference from other radar systems, as well as from radio signals from the Earth's surface.

Data volume: SAR images can be very large, which can make it difficult to transmit them to ground stations.

Cost: SAR systems are relatively expensive to develop and operate. The future of SAR in space looks promising. As technology advances, SAR systems will become more capable and affordable. This will enable new and exciting applications for SAR, such as:

Mapping the Earth's subsurface: SAR can be used to create images of the Earth's subsurface, which can be used to map mineral resources and to detect underground structures.

Monitoring climate change: SAR can be used to monitor changes in the Earth's surface, such as the melting of glaciers and the expansion of deserts. This information can be used to help us understand the effects of climate change.

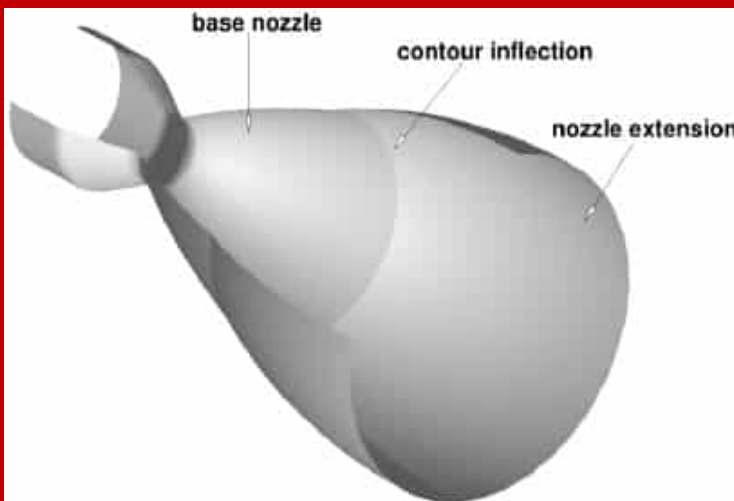
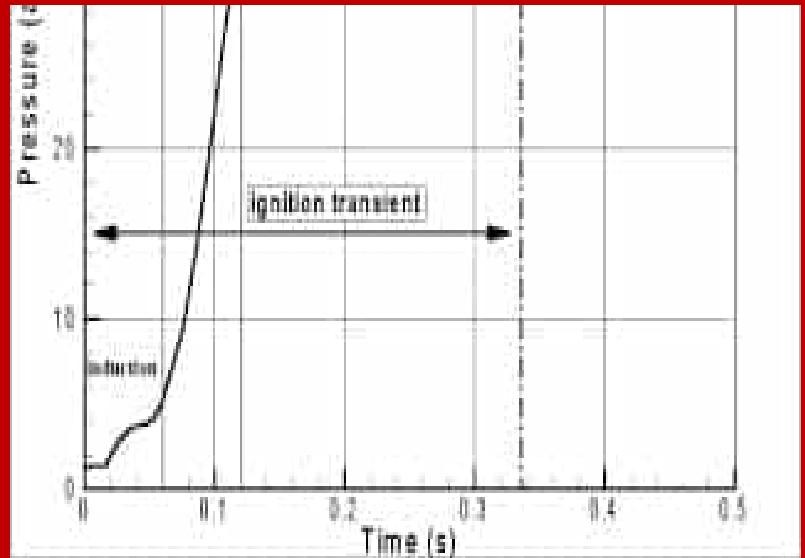
Exploring other planets: SAR can be used to create images of other planets, such as Mars and Venus. This information can be used to help us understand the geology and atmosphere of these planets.

SAR is a powerful tool for Earth observation and space exploration. As technology advances, SAR will become even more capable and affordable, enabling new and exciting applications.

Space Terms to know about

Ignition Transient :

The period between engine ignition and stable combustion. Ignition transients involve rapid changes in engine parameters, such as temperature, pressure, and flow rates, as the combustion stabilizes.

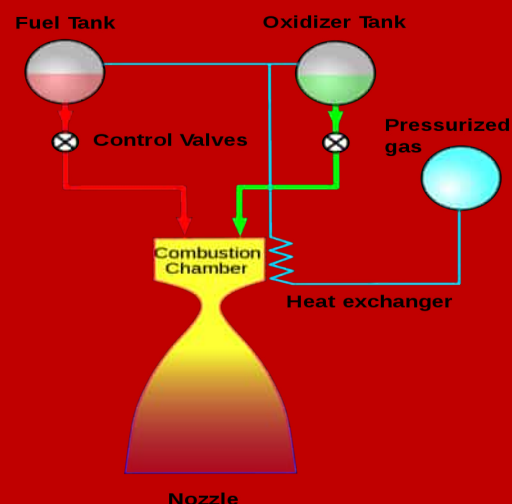


Dual-Bell Nozzle:

A type of rocket nozzle that consists of two separate bell-shaped expansion sections: a shorter one optimized for sea-level conditions and a longer one optimized for vacuum conditions. Dual-bell nozzles increase engine efficiency in both atmospheric and space environments.

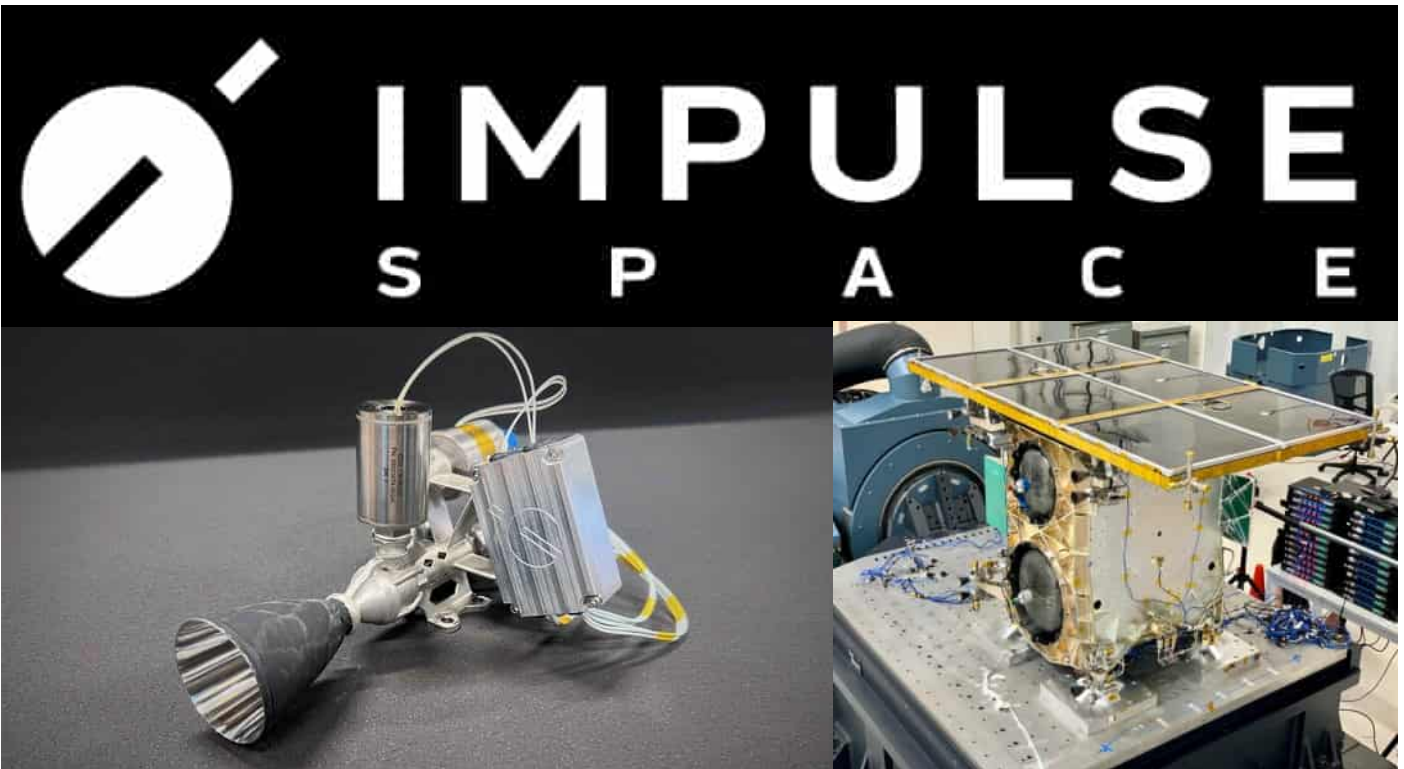
Pump-Fed Engine :

A rocket engine that uses pumps to deliver propellants from storage tanks to the combustion chamber. It typically involves separate pumps for fuel and oxidizer.



Space-Tech Company

IMPULSE SPACE



Impulse Space is a space transportation company founded in 2021 by Tom Mueller, former SpaceX propulsion chief. The company is developing a new class of orbital maneuvering spacecraft that uses high-thrust chemical propulsion to provide agile, economical space logistics services. Impulse Space's long-term goal is to provide delivery services for all classes of payloads to distant destinations such as Geostationary Earth Orbit (GEO), the Moon, and Mars. The company believes that its high-thrust propulsion technology will enable it to offer more affordable and agile space transportation services than traditional chemical rockets.

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