Dr. MGR-ACS Space Technology Centre

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"An Ingress to Borderless world"

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ISRO's SSLV-D2 Rocket Marks a Major Milestone for the Indian Space Program

The Indian Space Research Organisation (ISRO) successfully launched the Small Satellite Launch Vehicle (SSLV-D2) on February 10, 2023. The rocket lifted off from the Satish Dhawan Space Centre in Sriharikota, Andhra Pradesh, at 9:18 a.m. IST.

The SSLV-D2 rocket carried three small satellites into orbit: EOS-07, Janus-1, and AzaadiSAT-2. EOS-07 is a remote sensing satellite that will be used to study Earth's environment. Janus-1 is a technology demonstration satellite that will test new communication and navigation technologies. AzaadiSAT-2 is a student-built satellite that will be used to conduct experiments in space.

SSLV-D2 is a four-stage, solid-fueled rocket that is designed to carry up to 500 kilograms of payload into low Earth orbit. The rocket is capable of launching multiple satellites into orbit on a single mission.

By 15.5 minutes later, the 112-foot-tall (34 meters) rocket had deployed all three spacecraft into their designated 280-mile-high (450 kilometers) circular orbits, and mission team members were exchanging smiles and handshakes in the control room.

"With the successful launch of the SSLV-D2/EOS-07 mission, ISRO now has a new credible member in its launch vehicle family," a commentator said on the agency's livestream just after the satellites deployed. "Congratulations to team ISRO!". ISRO officials said in last week's update that they had implemented a number of measures to ensure something similar wouldn't happen on future SSLV flights. For example, the second-stage separation system was swapped out for a different one that's known to produce less-intense vibrations.

The SSLV-D2 is a new and innovative launch vehicle that has the potential to revolutionize the small satellite launch market. The rocket's low cost, flexibility, and rapid turnaround time make it an attractive option for small satellite operators around the world.

ISRO plans to launch a number of SSLV rockets in the coming years. The rocket is expected to play a major role in India's efforts to expand its space program and to promote commercial space activities.

NASA's CAPSTONE moon probe bounces back from 11-day communications glitch

NASA engineers had a nearly two-week battle with a space probe refusing to respond to commands.

CAPSTONE, an experimental spacecraft at the moon meant to test an orbit for NASA's planned Gateway space station, did not listen to communications from Earth for 11 days, the agency said in a blog post Wednesday (Feb. 8).

"The spacecraft remained overall healthy and on-course throughout the issue, sending telemetry data back to Earth," the agency said of CAPSTONE's issue, which began on Jan. 26. The spacecraft rebooted itself on Monday (Feb. 6), however, restoring its ability to listen to commands from home.

That's not the first time CAPSTONE (short for "Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment") encountered drama on its mission, showing how challenging it is to run a cubesat-sized mission in deep space near the moon.

CAPSTONE launched just fine atop a Rocket Lab Electron booster on June 28, 2022, on behalf of NASA with spacecraft operators at Advanced Space and Terran Orbital. The team lost contact with the probe on July 4 during a stage separation maneuver, however.

Sorting that issue only took a day, but another glitch occurred two months later during an engine burn to correct the spacecraft's trajectory. That problem briefly forced the spacecraft into a protective safe mode as a result.

Once engineers found the valve causing this issue, they managed to get the probe back on track to be the first-ever cubesat at the moon on Nov. 13, 2022. Since then, NASA officials reported on Wednesday, CAPSTONE has finished more than 12 near-rectilinear halo orbits as a pathfinder for Gateway. That's double the original manifest of six.

The orbit allows for a close approach to the potentially water-rich moon's south pole, making landings easier for the Artemis program that may put astronauts there as soon as 2025 with Artemis 3. It is fortuitous that CAPSTONE reached its orbit, as another small NASA spacecraft called Lunar Flashlight had to abandon that task this week following several propulsion issues en route.

As a positive, however, CAPSTONE has required far fewer maneuvers in orbit to stay on track than what the mission called for. At first, NASA expected the team would need one "orbit maintenance" firing each time the spacecraft circled the moon. But in 12 orbits around the moon, CAPSTONE only needed to fire its engine twice.

"This reduces risk and complexity for the mission and informs plans for future spacecraft flying in this orbit, like Gateway," NASA officials wrote.

SpaceX's huge Starship booster conducts historic 31-engine burn

SpaceX's giant Starship vehicle just took a huge step toward its first-ever orbital test flight, which could take place as soon as next month.

A Starship first-stage prototype known as Booster 7 ignited 31 of its 33 Raptor engines during a "static fire" test on Feb. 9 at SpaceX's Starbase facility in South Texas.

The goal was to fire all 33 Raptors during the test, which occurred at 4:13 p.m. EST (2113 GMT; 3:13 p.m. local Texas time). But SpaceX will take it.

"Team turned off 1 engine just before start & 1 stopped itself, so 31 engines fired overall. But still enough engines to reach orbit!" company founder and CEO Elon Musk said via Twitter just after the test wrapped up.

The static fire lasted about seven seconds, the duration that SpaceX had mapped out beforehand, according to the company. And Booster 7 emerged from the huge cloud of kicked-up dust in one piece, which is something to celebrate as well.

SpaceX views Starship as a potentially revolutionary transportation system, one that could make Mars colonization and other ambitious off-Earth feats economically feasible. The stainless-steel vehicle consists of two elements: A giant booster called Super Heavy and a 165-foot-tall (50 meters) upper-stage spacecraft known as Starship.

Both Starship and Super Heavy are designed to be fully reusable, and both are powered by SpaceX's next-generation Raptor engine — 33 for the booster and six for the upper stage.

For months, SpaceX has been preparing Booster 7 and a Starship prototype called Ship 24 for an orbital flight test. Such work has included a fueling test with the duo, which the company achieved on Jan. 23, and a number of static fires — prelaunch trials in which engines are ignited briefly while a vehicle remains anchored to the ground.

Ship 24 fired up all six of its Raptors at Starbase last September, for example, and Booster 7 ignited 14 of its 33 engines two months later. That was the big first stage's static-fire high until today's test, which apparently checked a crucial box on the road to an orbital attempt.

That highly anticipated flight could occur as early as next month, provided today's test went as well as it appeared to (a verdict SpaceX won't render before analyzing all the data) and remaining checkouts go well, founder and CEO Elon Musk has said.

SLS generated 8.8 million pounds of thrust on that liftoff. Super Heavy's 33 Raptors produce about 16.5 million pounds of thrust at full power, according to SpaceflightNow.

US military shoots down Chinese surveillance balloon

The Chinese spy balloon is no more. An F-22 fighter jet destroyed the Chinese balloon on Saturday (Feb. 4) with a Sidewinder missile, taking it out with a single shot, U.S. military officials said. The uncrewed airship was over the Atlantic Ocean at the time, just off the coast of South Carolina. It was flying at an altitude of 60,000 feet to 65,000 feet (18,300 to 19,800 meters), while the F-22 was at about 58,000 feet (17,700 m), the U.S. Department of Defense (DOD) wrote in an update on Saturday. For perspective: Commercial airliners fly at an average altitude of about 35,000 feet (10,700 m). The U.S. military first detected the balloon on Jan. 28, when it entered national airspace near Alaska's Aleutian islands, the DOD update said. The airship cruised from Alaska into Canada, crossed back into the United States over Idaho, then continued moving southeast over the country's heartland.

On Wednesday (Feb. 1), President Joe Biden ordered the military to take out the balloon as soon as this action could be taken safely, without putting anyone on the ground in danger, according to the DOD update. That opportunity came on Saturday, when the airship left terra firma behind over the Palmetto State.

The remains of the airship fell about 6 miles (10 kilometers) off the South Carolina coast, into water about 47 feet (14 m) deep. The shallow water should allow recovery of at least some debris, analysis of which could reveal details of China's surveillance technology, military officials said.

"I would also note that while we took all necessary steps to protect against the PRC surveillance balloon's collection of sensitive information, the surveillance balloon's overflight of U.S. territory was of intelligence value to us," an unnamed senior defense official said in the DOD update. (PRC stands for "People's Republic of China.")

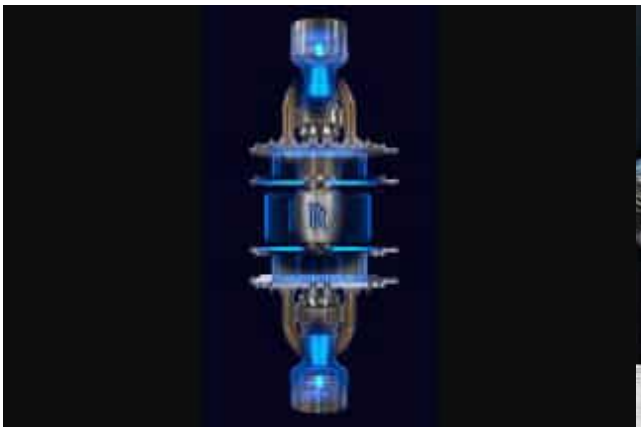
"I can't go into more detail, but we were able to study and scrutinize the balloon and its equipment [in flight], which has been valuable," the official added.

Chinese officials have apologized for the incursion of the airship, which consisted of a solar-panel-equipped truss suspended beneath a big white balloon. They've also claimed that it was an innocuous weather-studying craft that strayed into U.S. airspace accidentally, at the mercy of the winds. But the unnamed DOD official isn't buying it.

"This was a PRC surveillance balloon," the official said. "This surveillance balloon purposely traversed the United States and Canada, and we are confident it was seeking to monitor sensitive military sites."

The official also said that Chinese balloons flew over parts of the continental U.S. at least three times during the administration of Biden's predecessor as president, Donald Trump.

Rolls-Royce unveils early-stage design for space nuclear reactor



A new image shows a possible version of future space propulsion.

Nuclear fission systems, which harness the energy released in the splitting of atoms, could be used to power astronaut bases on the moon or Mars. Or they could help shorten the travel time to the Red Planet, which takes six to nine months to reach with current-generation propulsion systems.

Rolls-Royce could be a part of that ambitious spaceflight future. The venerable company released an early-stage design of a micro-nuclear reactor on Friday (Jan. 27), in the wake of a 2021 agreement with the United Kingdom Space Agency to study future nuclear power options in space exploration.

"Each uranium particle is encapsulated in multiple protective layers that act as a containment system, allowing it to withstand extreme conditions," Rolls-Royce tweeted in a brief description of the system.

Nuclear systems have long flown on robotic space missions. For example, radioisotope thermoelectric generators (RTGs) provide electricity for many probes, including NASA's Voyager 1 and Voyager 2 spacecraft, which are currently exploring interstellar space. Big NASA Mars rovers like Perseverance and Curiosity also use RTGs, though smaller rovers such as Spirit and Opportunity went with solar panels.

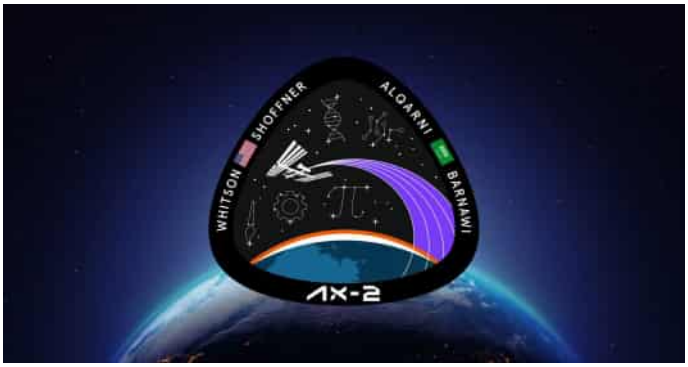
But RTGs are not fission reactors. Rather, they are nuclear batteries, converting to electricity the heat thrown off by the decay of radioactive material. Nuclear fission has yet to power a spacecraft off Earth, though that could change soon; for example, NASA and DARPA recently announced plans to build a nuclear thermal rocket by 2027.

Nuclear fusion — the power source of the sun and other stars, which flows from the merging of atoms — could also one day be part of humanity's spaceflight portfolio. That possible future is a long-term one, however; our species has yet to harness this power source here on Earth. (But U.S. scientists did announce a big breakthrough recently: a fusion experiment that produced more energy than it consumed.)

Speaking generally, some of the concerns of space fission or fusion power include safety for astronauts; portability, as more mass means a more expensive mission; and longevity in a harsh and rugged environment.

But nuclear power is a staple of space exploration nonetheless, both in reality and in science fiction. The technology even helped fuel a joke in the 2015 movie "The Martian." In the film, astronaut Mark Watney (played by Matt Damon) — in search of warmth in an unheated rover and desperately digging up a reactor buried in regolith for safety reasons — said his Red Planet training manual had a section about surface operations labeled "Don't Dig Up The Big Box of Plutonium, Mark."

SpaceX to launch 1st Saudi woman to space on private Ax-2 mission



A Saudi Arabian woman will reach space for the first time a few months from now, if all goes according to plan.

On Sunday (Feb. 12), the Saudi government and Houston-based company Axiom Space announced(opens in new tab) the final two members of the four-person Ax-2 mission to the International Space Station (ISS), which is scheduled to launch atop a SpaceX Falcon 9 rocket no earlier than May.

Those two are Rayyanah Barnawi and Ali AlQarni, members of the inaugural Saudi astronaut class. They'll become the first Saudi Arabians to travel to the ISS and just the second and third people from the kingdom ever to reach space. And Barnawi will be the first Saudi woman to make it to the final frontier.

"Human spaceflight is a symbol of countries' superiority and global competitiveness in many fields such as technology, engineering, research and innovation," a Sunday press release from the state-run Saudi Press Agency reads.

"This mission is also historic, as it will make the Kingdom one of the few countries in the world that brings two astronauts of the same nationality aboard the International Space Station simultaneously," it adds.

As its name suggests, Ax-2 will be the second mission to the ISS organized by Axiom Space. The first, Ax-1, sent three paying customers and Axiom's Michael López-Alegría, a former NASA astronaut, to the station for more than two weeks in April 2022 aboard a SpaceX Dragon capsule.

Ax-2 will also use SpaceX hardware and will be led by a decorated former NASA spaceflyer — Peggy Whitson, who has spent more time in space (665 days) than any other woman or American and is now a consultant for Axiom.

The fourth crewmember is investor John Shoffner, a paying customer who will serve as Ax-2's pilot. Barnawi and Ali AlQarni will be mission specialists.

The inclusion of the Saudi duo is not a surprise; NASA and Axiom announced late last year that two of Ax-2's crewmembers would hail from the desert kingdom. But the spaceflyers' identities had remained a mystery until now. (NASA is involved with private astronaut missions such as Ax-2; the agency, and the other ISS partners, must approve crews that visit the orbiting lab.)

The only Saudi citizen to reach space to date is prince Sultan bin Salman Al Saud, who flew on the weeklong STS-51-G mission of the space shuttle Discovery in 1985. Al Saud was the first Arab, the first Muslim and the first member of a royal family to go to orbit.

Ax-2 will obviously be followed closely in Saudi Arabia, and Barnawi's inclusion makes the flight particularly meaningful. Women in the kingdom have historically enjoyed fewer rights than men; Saudi women weren't allowed to drive cars until 2018.

Relativity Space stacks 3D-printed rocket on launch pad ahead of 1st flight

The 3D-printed Terran 1 rocket from Relativity Space may make its debut flight later this month if all goes to plan. A 3D-printed rocket is once again fully assembled at the launch pad ahead of its debut mission. Relativity Space put together the stages of its expendable Terran 1 rocket, a two-stage small-lift vehicle, on the launch pad for "final ground tests" ahead of its debut flight, CEO Tim Ellis shared Monday (Feb. 6) on Twitter.

"We are vertical again!!" tweeted Ellis about Terran 1, which is rumored to be launching as soon as this month from Cape Canaveral Space Force Station in Florida providing these tests go to plan. (Relativity Space has not disclosed an official launch date yet.)The debut Relativity mission is called GLHF (Good Luck, Have Fun) and will be a key launch test of the 110-foot (33-meter) Terran 1 before it flies customer payloads.

The company's rocket is 85 percent 3D-printed by mass and is said to be "the largest 3D printed object to exist and to attempt orbital flight" by the company. Eventually, they plan to create Terran 1 rockets that are 95 percent 3D-printed.

The nine Aeon engines on the first stage of the rocket, along with the Aeon Vac engine on the second, are also all 3D-printed. They will use liquid oxygen as well as liquid natural gas, which is a rare combination in the industry. In fact, a natural gas-fueled rocket has not yet reached orbit successfully.

Should the natural gas fuel prove itself in low Earth orbit, Relativity hopes to eventually port the technology to the Red Planet because the propulsion is reusable and "the easiest to eventually transition to methane on Mars," company officials state. (Relativity aims to reach the Red Planet eventually.)

Co-founders Tim Ellis and Jordan Noone founded Relativity in 2015 after working at Blue Origin and SpaceX, respectively. Terran 1 can deliver a maximum payload of up to 2,756 pounds (1,250 kilograms) to low-Earth orbit, according to Relativity, and that's not all the company is working on.

In 2021, Relativity unveiled the much more powerful and better-performing Terran R, which will be 216 feet (66 m) tall by 16 feet (4.9 m) wide. It will also boost nearly 25 times the payload mass of Terran 1 into space, hefting 44,100 lbs. (20,000 kg) to low Earth orbit, representatives said at the time. Terran R will also be fully reusable and may launch as soon as 2024.

Terran R's forecasted payload capacity will bring it close to a big competitor: SpaceX's Falcon 9, which has been lifting satellite clusters and large payloads into orbit and beyond for nearly a decade. Falcon 9 seeks its reusability through landing the first stage on land or on a nearby drone ship.

Europe's JUICE Jupiter spacecraft arrives at spaceport ahead of April launch

Europe's flagship JUICE mission will study the Jupiter moons Europa, Callisto and Ganymede.

The European Space Agency's Jupiter Icy Moons Explorer (JUICE) spacecraft has arrived at Europe's Spaceport in French Guiana for the final preparations for launch.

JUICE departed from Airbus facilities in Toulouse, France, on Feb. 9 and has been unpacked at Kourou spaceport. The 13,668 pound (6,200 kilograms) spacecraft will go through final checks and fueling ahead of launch on an Ariane 5 rocket.

The mission is scheduled to lift off on April 13, when it will embark on an eight-year voyage to Jupiter to observe its icy moons Europa, Callisto and Ganymede.

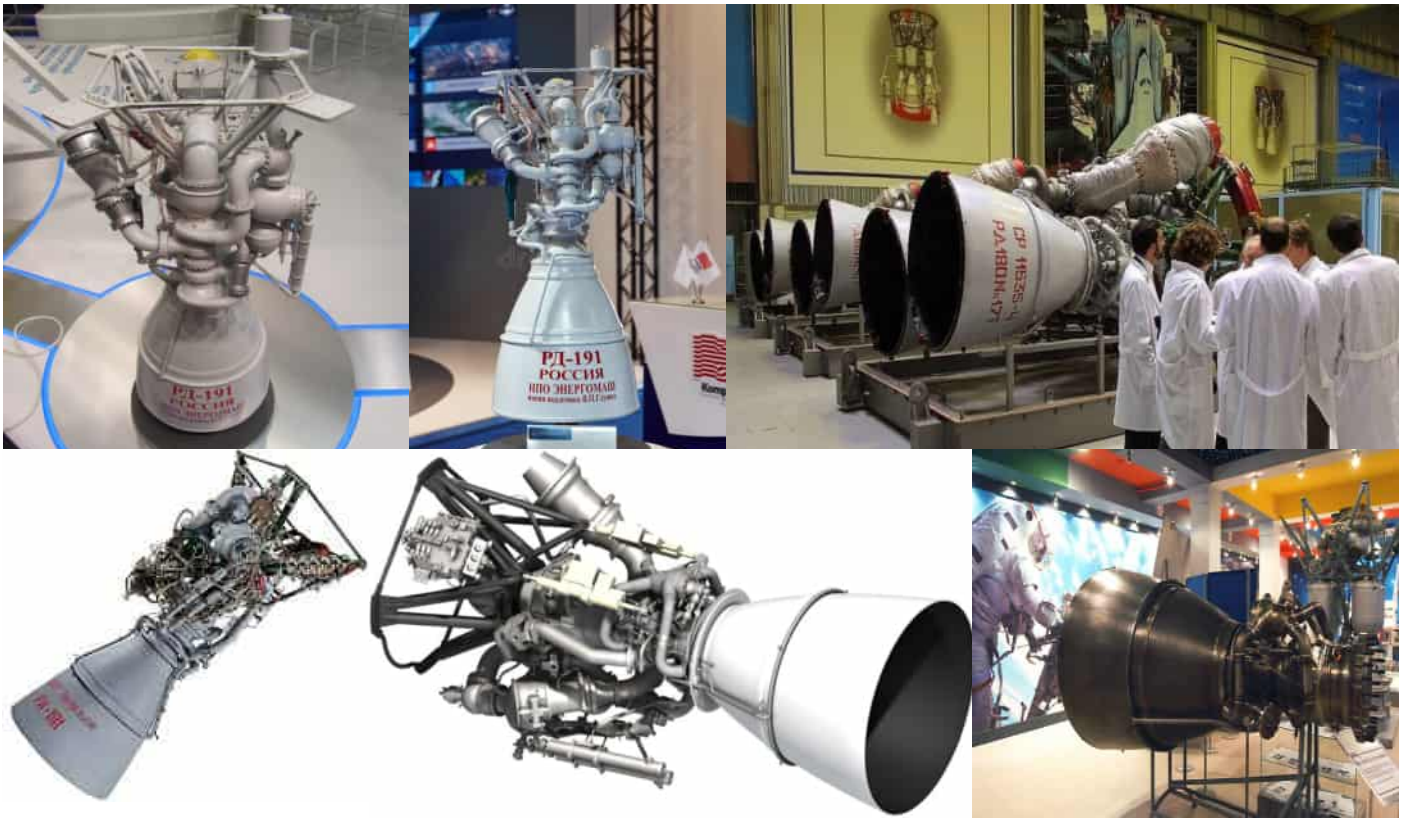
The spacecraft carries 10 science payloads and will make 35 flybys of the moons, studying their magnetic fields and looking for clues about the conditions in their subsurface oceans and if these could potentially support life.

JUICE will finally enter orbit around Ganymede in 2034 for the final part of its mission and become the first spacecraft to orbit a moon other than our own.

Once in space, JUICE will deploy huge solar arrays with a total area of 915 square feet (85 square meters), which will be needed to power the spacecraft while orbiting Jupiter at an average distance of 484 million miles (778 million kilometers) away from the sun.

JUICE was selected by ESA as a flagship mission in 2012 as part of its Cosmic Vision program. NASA, the Japan Aerospace Exploration Agency (JAXA) and the Israel Space Agency also contributed to the mission. NASA, meanwhile, is working to ready its Europa Clipper mission for launch in 2024.

RD-191: Rocket Engine Revolution



The RD-191 engine is a powerful liquid rocket engine designed by NPO Energomash, a Russian rocket engine manufacturer. This engine is one of the most advanced and powerful engines currently in use in the aerospace industry, with a thrust of 200 tons and the ability to provide high levels of efficiency and reliability.

The RD-191 engine is a crucial component of the Angara rocket, which is designed to be a versatile and cost-effective rocket for both government and commercial customers. The Angara rocket family is a modular launch vehicle that can be configured for a range of missions, from delivering satellites to orbit to sending manned spacecraft to the moon and beyond.

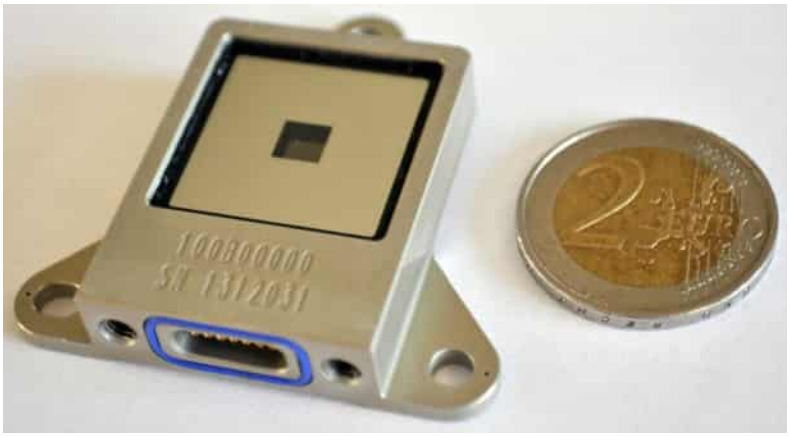
The RD-191 engine uses liquid oxygen and kerosene as fuel, and its advanced design allows it to achieve high levels of performance and efficiency. It features a single chamber, which reduces the complexity of the engine and makes it easier to manufacture and maintain. The engine also uses a high-pressure fuel injection system, which allows for greater precision and control over the combustion process.

One of the key advantages of the RD-191 engine is its high level of reliability. The engine has undergone extensive testing and has a proven track record of successful launches. This reliability is essential for any rocket engine, as it is responsible for powering the entire rocket and ensuring that it can complete its mission safely and effectively.

Another advantage of the RD-191 engine is its cost-effectiveness. The engine is designed to be easily manufactured and assembled, which helps to keep costs low. Additionally, the modular design of the Angara rocket means that it can be configured for a range of missions, which helps to reduce costs further.

Overall, the RD-191 engine is a highly advanced and reliable rocket engine that is essential to the success of the Angara rocket family. With its powerful thrust, high efficiency, and cost-effectiveness, the engine is poised to play a key role in the future of space exploration and commercial space-flight.

SPACE SENSORS



Sun sensors are small devices that play a critical role in space missions. They are used to measure the position of the sun relative to a spacecraft, which is important for determining the spacecraft's orientation and position in space.

Sun sensors work by using a photodiode or other light-sensitive element to detect the position of the sun. By measuring the angle between the sun and the spacecraft's axis of rotation, spacecraft control systems can adjust the spacecraft's attitude and keep it pointing in the right direction.

Sun sensors are used in a wide range of space missions, from Earth observation satellites to deep space probes. In Earth observation missions, sun sensors are used to ensure that the spacecraft's sensors are pointing at the Earth at the correct angle, which is critical for collecting accurate data about the Earth's surface and atmosphere.

In deep space missions, sun sensors are used to navigate and orient spacecraft. For example, NASA's Voyager 1 and Voyager 2 spacecraft, which have been exploring the outer reaches of our solar system since the 1970s, use sun sensors to determine their orientation and position in space.

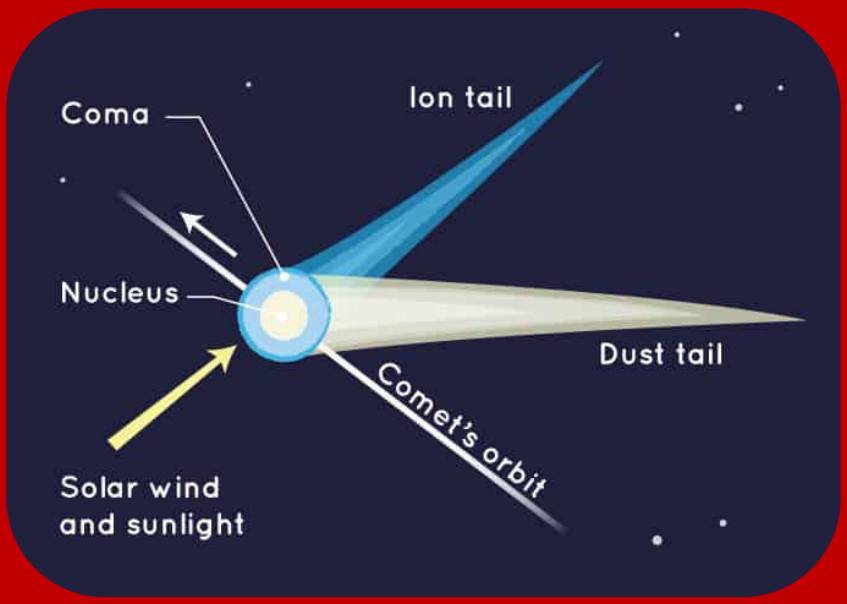
Sun sensors are also used in the development and testing of new spacecraft. Before a spacecraft is launched, it must undergo extensive testing to ensure that it can operate in the harsh conditions of space. Sun sensors are used in these tests to simulate the conditions the spacecraft will encounter in space and to verify that the spacecraft's control systems are working properly.

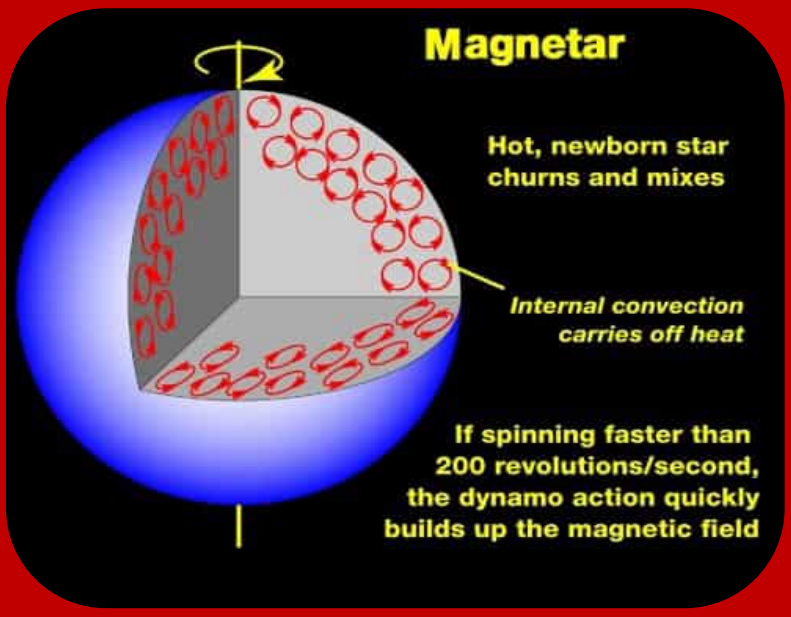
In conclusion, sun sensors are a critical technology for space missions. They allow spacecraft to accurately navigate and orient themselves in space, which is essential for the success of space missions.

Space Terms to know about

Coma :

The fuzzy, diffuse region around the nucleus of a comet, caused by gas and dust being released as the comet approaches the Sun





Magnetar :

A type of neutron star with an extremely strong magnetic field, capable of producing intense bursts of electromagnetic radiation.

Cosmic Dust :

Small particles of matter, usually less than a micrometer in size, that exist in space and can be observed using telescopes.

Space-Tech Company

Epsilon 3

Image Credit: *Epsilon 3*

Developer of spacecraft software technology designed to modernize space missions by building the industry standard of operational software. The company's platform offers interactive real-time synchronized procedures for multiple programs/missions with detailed analytics, reports, and dashboards, enabling satellite operators, space manufacturers, and integrators to save time and money throughout the entire project's lifecycle.