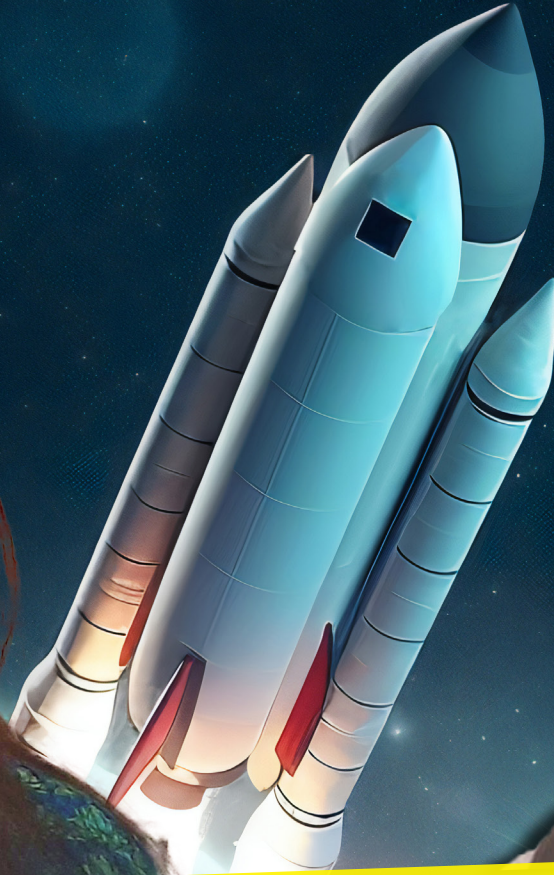


A Space Explore Edition...

# spacepreneur

₹ 500

Vol 1 » Issue 5 » Nov-Dec 2023



## Dr. Mila Mitra

Co Founder - STEM & SPACE  
Former NASA Scientist

## Dr. (Hon). M.R.K Menon

Founder & CEO  
Global Aerosports



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Professor & Head of Geospatial Research Programme,  
Takshashila Institution



Mr. Shrish Dhyani

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Dr. Mila Mitra  
Co Founder, STEM  
& SPACE , Former  
NASA Scientist

*The news from the deepest parts of the enormous cosmos is brought to you in this episode of space exploration.*

## **B. KARTIKEYA**

Editor-in-chief



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*Hello my dear readers,*

**S**pacepreneur is the top source for news on astronomy, innovation, and space travel, documenting (and applauding) humanity's continued exploration of the last frontier. The news from the deepest parts of the enormous cosmos is brought to you in this episode of space exploration.

I really appreciate how Space Industry in India is growing & the whole eco system is shaping up. There are challenges in skilling/upskilling/re-skilling so as a team we decided to interact with Space Tutors who are registered with ISRO. One such Interview With Mr. DR MRK Menon who is the Founder & CEO of Global Aero sports who converted his Hobby into a Career and enjoying it. Another Interesting conversation with Dr. Mila Mitra Co-Founder of STEM & SPACE and also a Former NASA Scientist says as an ISRO tutor," we will continuously strive to build

***"There are challenges in skilling/  
upskilling/re-skilling so as a team we  
decided to interact with Space Tutors  
who are registered with ISRO."***

such future ready skills. We also aim to continue our efforts in science outreach so that students are aware of current and future space missions and achievements."

From our Next issue onwards we will make STEM as a category and Interviews /Conversations with industry Space tutors happens on regular Basis. In Future we would like to bring Job Openings/ Internships to bridge the gap between Industry & Academia.

Dr Y Nithyanandam, Professor & Head of Geospatial Research Programme, Takshashila Institution shares his views on India's Space and Geospatial Policies: Unlocking New Horizons. Special feature by Mr. Shrish Dhyani talked about Engineering Simulation aka Computer aided engineering (CAE) & it's Importance.

We always strive to bring up pertinent business challenges and highlight critical aspects of the astronomy sector's expansion. A collection of well known, accomplished professionals and journalists with years of experience and considered authorities in their industries have written the pieces for this magazine. I acknowledge everyone who took the time to write for us as a distinguished guest author.

Preparation for the New Year is underway. The clock is ticking, and we'll all be ringing in the New Year in 2024 with more exciting news. With that, I take your leave this month. More when we meet again in our next issue.

Till then, stay safe, God bless.



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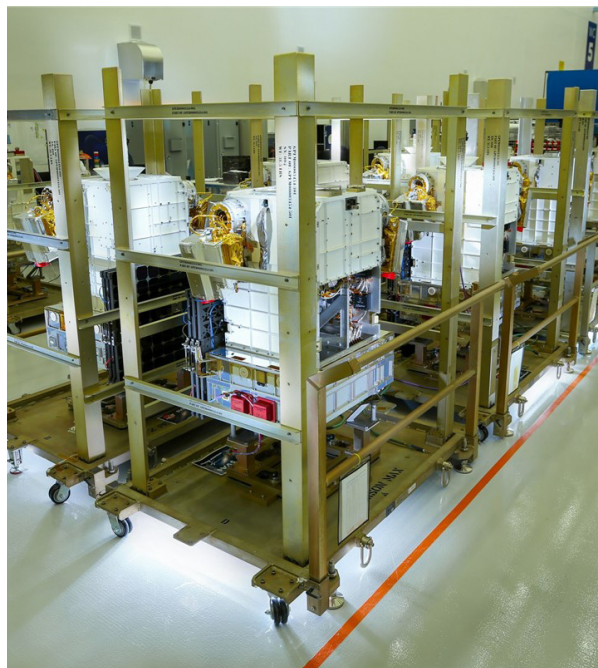
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# Lockheed Martin's Transport Layer Satellites Launch as Part of the SDA's Tranche 0 Mission

**T**en Lockheed Martin-built satellites have successfully been deployed into low-Earth orbit (LEO) in support of the Space Development Agency's (SDA) Tranche 0 Transport Layer (ToTL) mission. SDA's ToTL is a proliferated LEO constellation that will demonstrate low-latency communication and provide a resilient network of integrated capabilities.



The small satellites launched aboard a SpaceX Falcon 9 rocket from Vandenberg Space Force Base in California at 7:26 a.m. PDT today. Soon after liftoff, SDA confirmed separation of all 10 of the Lockheed Martin-built satellites from the launch vehicle.

"We look forward to contributing more of our expertise to this mission to strengthening deterrence and deliver advanced military capabilities in space," said Joe Rickers.

**Lockheed Martin is proud to be part of SDA's mission to rapidly bring a threat-driven, resilient set of integrated space capabilities to life.**

**-Joe Rickers, Lockheed Martin's vice president for Protected Communications**

Each satellite incorporates a Terran Orbital bus and payload processors and is equipped with SmartSat™, Lockheed Martin's software platform

that makes it easier to dynamically add and quickly change missions in orbit through simple app uploads. The satellites also host Link 16 radios to introduce a terrestrial-proven network in space. Link-16 will enable sensor-to-shooter targeting by connecting systems that include fighter aircraft and Integrated Air and Missile Defense (IAMD) networks.

Lockheed Martin is currently building 42 satellites for SDA's Tranche 1 Transport Layer (T1TL) and was recently awarded an agreement to build 36 of SDA's 72 Beta variant satellites for its Tranche 2 Transport Layer (T2TL) constellation. The T1TL and T2TL Beta satellites will be assembled, integrated, and tested in Lockheed Martin's new small satellite (smallsat) processing facility that is designed for the high-volume delivery of complete satellites.

Lockheed Martin is partnering with the best minds in the industry to support SDA's mission to provide resilient national security space capabilities through a revolutionary approach of proliferation and spiral development. A diverse supplier base and small business partnerships, in addition to streamlined smallsat processing methods, enable the company to accelerate technology innovation and delivery.

# Firefly Aerospace Awarded Multi-Launch Agreement with L3Harris

**F**irefly Aerospace, Inc., an end-to-end space transportation company announced it signed a multi-launch agreement with L3Harris Technologies [NYSE:LHX] for three dedicated launches on Firefly's Alpha vehicle in 2026. The agreement further positions Firefly as the leader in small-lift launch services as the company ramps up production of its Alpha vehicle to support the growing needs of both government and commercial customers.

"Firefly is honored to support the ongoing mission needs of L3Harris as they continue to deliver satellite systems that advance our national security," said Bill Weber, CEO of Firefly Aerospace. "Firefly's team, facilities, and manufacturing capabilities are positioned to rapidly respond to industry demand for our small- and medium-lift launch services, ensuring mission success for each customer."

Firefly will provide rapid launch capabilities for L3Harris to achieve direct access to low Earth orbit at a lower cost and support the responsive space needs of the U.S. government. The three missions will launch from Firefly's SLC-2 launch site at the Vandenberg Space Force Base.

With the capability to launch more than 1,000 kg to low Earth orbit, Firefly's Alpha vehicle provides affordable, responsive, and reliable launch services for small satellites and spacecraft. Firefly is ramping up Alpha production at its rocket manufacturing and test site in Briggs, Texas, to support multiple government and commercial launches, while also doubling the size of its facilities to support the ongoing development of its medium launch vehicle that will first launch in 2025.



# NASA's Webb Snaps Supersonic Outflow of Young Star



**H**erbig-Haro (HH) objects are luminous regions surrounding newborn stars, formed when stellar winds or jets of gas spewing from these newborn stars form shock waves colliding with nearby gas and dust at high speeds. This image of HH 211 from NASA's James Webb Space Telescope reveals an outflow from a Class 0 protostar, an infantile analog of our Sun when it was no more than a few tens of thousands of years old and with a mass only 8% of the present-day Sun (it will eventually grow into a star like the Sun).

Infrared imaging is powerful in studying newborn stars and their outflows, because such stars are invariably still embedded within the gas from the molecular cloud in which they formed. The infrared emission of the star's outflows penetrates the obscuring gas and dust, making a Herbig-Haro object like HH 211 ideal for observation with Webb's sensitive infrared instruments. Molecules excited by the turbulent conditions, including molecular hydrogen, carbon monoxide, and silicon monoxide, emit infrared light that Webb can collect to map out the structure of the outflows.

The image showcases a series of bow shocks to the southeast (lower-left) and northwest (upper-right) as well as the narrow bipolar jet that powers them. Webb reveals this scene in unprecedented detail — roughly 5 to 10 times higher spatial resolution than any previous images of HH 211. The inner jet is seen to “wiggle” with mirror symmetry on either side of the central protostar. This is in agreement with observations on smaller scales and suggests that the protostar may in fact be an unresolved binary star.

Earlier observations of HH 211 with ground-based telescopes revealed giant bow shocks moving

away from us (northwest) and moving towards us (southeast) and cavity-like structures in shocked hydrogen and carbon monoxide respectively, as well as a knotty and wiggling bipolar jet in silicon monoxide. Researchers have used Webb's new observations to determine that the object's outflow is relatively slow in comparison to more evolved protostars with similar types of outflows.

The team measured the velocities of the innermost outflow structures to be roughly 48-60 miles per second (80 to 100 kilometers per second). However, the difference in velocity between these sections of the outflow and the leading material they're colliding with — the shockwave — is much smaller. The researchers concluded that outflows from the youngest stars, like that in the center of HH 211, are mostly made up of molecules, because the comparatively low shock wave velocities are not energetic enough to break the molecules apart into simpler atoms and ions.

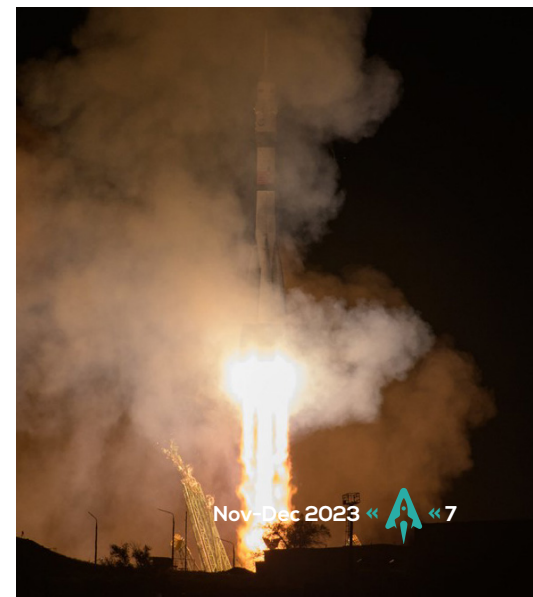
*The James Webb Space Telescope is the world's premier space science observatory. Webb is solving mysteries in our solar system, looking beyond to distant worlds around other stars, and probing the mysterious structures and origins of our universe and our place in it. Webb is an international program led by NASA with its partners, ESA (European Space Agency) and the Canadian Space Agency.*

## NASA Astronaut, Crewmates Reach Space Station for Science Expedition

**N**ASA astronaut Loral O'Hara and two cosmonauts safely arrived at the International Space Station Friday, Sept. 15, bringing its number of residents to 10 for the coming week. The Soyuz MS-24 spacecraft carrying O'Hara, as well as Oleg Kononenko and Nikolai Chub of Roscosmos, docked to the station's Rassvet module at 2:53 p.m. EDT. Docking occurred about three hours after the crew's 11:44 a.m. launch from the Baikonur Cosmodrome in Kazakhstan.

O'Hara, Kononenko, and Chub will join the Expedition 69 crew when hatches open at 5:10 p.m. O'Hara, who is beginning a six-month stay aboard the orbital outpost, and Kononenko and Chub, who will both spend a year on the orbital outpost will work on science and research in technology development, Earth science, biology, and human research for the benefit of all. This marks the first spaceflight for O'Hara, the fifth for Kononenko, and the first for Chub.

Expedition 70 will begin Wednesday, Sept. 27, following the departure of record-breaking NASA astronaut Frank Rubio and Roscosmos cosmonauts Sergey Prokopyev, and Dmitri Petelin. Rubio recently broke the record for longest single spaceflight by an American. Following a yearlong stay aboard the orbiting laboratory, the trio will land in Kazakhstan on Sept. 27, at which point Rubio will have spent a total of 371 days in space—the longest single spaceflight by a U.S. astronaut.



# Vega's Fuel-free Cubesats to Keep Formation with Wings

Spain's trio of ANSER CubeSats, due to fly on Europe's next Vega launcher, will fly like a flock of birds in orbit – in more ways than one. Keeping in formation by following their leader, the three shoebox-sized satellites will image Iberian waters as if they are a single standardised mission. And they will unfurl wing-like flaps to maintain their relative positions, surfing on the scanty airflow at the top of Earth's atmosphere.

ANSER – Advanced Nanosatellite Systems for Earth-observation Research – is a cluster of three CubeSats which will work together in close vicinity as if they are a single satellite. Due to be launched on Europe's next Vega flight, VV23, the ANSER mission is being undertaken by INTA, the Spanish Institute of Aerospace Technology.

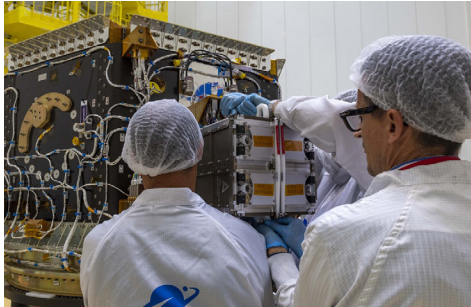
Santiago Rodriguez Bustabad, overseeing the mission, explains: "ANSER is also the Latin name for the wild goose, a good example of birds flying in formation, adopting a leader-follower protocol, which is what our mission is emulating."

These three 3-unit CubeSats will orbit around 500 km altitude, maintaining formation at an optimum 10 km apart from each other. But they do not have any onboard propulsion systems. Instead they control their relative positions by deploying a set of flaps against the trace amounts of air at the top of the atmosphere. These will multiply their wingspan sixfold, allowing them to either drag themselves downward or lift themselves upward and sideways.

He adds: "A specially-developed algorithm will be used to plan these 'Differential Lift and Drag' manoeuvres on the ground for telecommand uplink to the satellites. Increasing the drag effect allows the creation of significant relative movements along track, while the more lightweight lift effect can produce small cross-track shifts.

"The precise aerodynamic resistance is highly dependent on the orbital altitude, but on average we would expect to spend no more than 72 hours to produce 10 km of along-track separation. Later in the mission we might attempt autonomous onboard manoeuvring as well."

One of the CubeSats serves as a leader, undertaking communications with the ground and



connected to the others via inter-satellite links. It will also lead joint observations of ANSER's main target, the quality of inland Iberian lakes and reservoirs, as well as comparable water bodies worldwide.

Santiago continues: "ANSER's hyperspectral imager CINCLUS – named for another bird species – is a fractionated payload distributed across the three CubeSats. The leader satellite has a panchromatic cameras to detect clouds and pre-validate the utility of the hyperspectral images before processing on the ground. The two follower satellites host miniaturised hyperspectral cameras incorporating micro-spectrometers."

These four spectrometers cover the visible to near infrared region, supported by the panchromatic camera, delivering 60 m spatial resolution, offering insight into the suspended contents of water bodies, including its pollution levels or the presence of toxic microorganisms such as harmful phytoplankton blooms.

Santiago notes: "In recent years CubeSats and nanosatellites under 10 kg of mass have transformed from educational tools into highly-valued spacecraft for many commercial and government sectors, favoured for their short development times, rapid assimilation of new components and miniaturised sensors, lower costs – including launch costs – and improved functionality.

"But achieving operational performance can still be a challenge for such small satellites because of their limitations in terms of available power, ground coverage and resolution, revisit times and so on. And the use of commercial-off-the-shelf components and non-space-qualified

parts adds extra risk.

"So to have a real chance of achieving an operational Earth-observing mission we are leaning into distributed systems in the form of clusters and constellations, together with miniaturisation."

Without onboard propulsion, the operational lifespan of an ANSER cluster will be limited to two or three years, depending on their initial altitude. But the fractionated platform approach means this is more of a strength than a weakness because replacement CubeSats can be added to the cluster regularly, offering the chance to perform hardware upgrades in orbit.

Santiago explains: "In time the individual CubeSats would all be deorbited, but replaced in the meantime by more up-to-date versions, so that their overall mission could continue uninterrupted."

ANSER is due to fly on Vega's Small Spacecraft Mission Service, a rideshare service for small satellites, securing its place through the European Commission's In-Orbit Demonstration/In-Orbit Validation programme. Managed on behalf of the Commission by ESA's Small Satellite Platform Unit, this programme allows the early orbital testing of new technologies to make Europe's space sector more competitive.

Santiago comments: "ANSER has been developed using INTA's internal funding, but one of the most important strengths supporting our project over the past four years of work has been its selection for flight – after open competition with other European proposals – through the IOD/IOV Programme. With this support, ANSER could overcome various difficulties, including financial issues and the impact of the COVID pandemic, without losing sight of its main goal of in-orbit demonstration."

Vega flight VV23 is due for lift-off next week from Europe's Spaceport in French Guiana. Along with its main satellite payloads it carries multiple CubeSats including ESA's PRETTY mission investigating reflected satnav for environmental monitoring, the Proba-V Companion CubeSat testing the performance of a previously flown spectral imager aboard a CubeSat and other IOD/IOV CubeSats.



# Intelsat Expands Brazil Infrastructure, Delivers New Services



Intelsat, operator of one of the world's largest integrated satellite and terrestrial networks and leading provider of inflight connectivity (IFC), has launched new services in Brazil that combine local support, new teleport facilities, and broader satellite coverage to deliver connectivity services to more users across the region.

All of the assets, technology and infrastructure in Brazil are operational, including the following:

- **New high-throughput satellite capacity:** Intelsat 46e and Galaxy 28, positioned over Brazil and Latin America, will provide reliable connectivity supporting Enterprise, Mobile Network Operator, Media and Commercial Aviation customers.
- **New teleport facility:** Located outside of Rio de Janeiro, the facility expands Intelsat's existing global network and enables direct connections between Intelsat satellites and Brazil's local terrestrial networks to reduce the distance user internet traffic has to travel.
- **Operations center expansion:** Intelsat's Brazil Network Operations Center (NOC) has grown in staff to deliver better support for regional customers, offering 24/7 access to support

representatives fluent in five languages including Brazilian Portuguese.

"The combination of more satellite capacity, a new teleport and an operations center make it easier for our customers to deliver higher quality services to more users throughout Brazil," said Ricardo La Guardia, RVP of Latin American Sales at Intelsat. "Our expansion in Brazil is part of our strategy to empower the broader Latin America region with unparalleled connectivity, targeting underserved areas and remote regions like the Amazon, fostering digital inclusivity."

According to a recent GSMA report, around 25% of the Brazilian population - more than 50 million people - live within coverage of a network but do not use mobile internet services. Enhancing connectivity options for service providers will help fuel the digital economy and open avenues for business growth across Brazil in sectors like government, education, healthcare and agriculture.

"The availability of local infrastructure and in-country expertise is a key step in improving internet and telecommunication infrastructure across all regions of the country," La Guardia said.



## 10 Satellites Incorporating Terran Orbital Buses Launch as Part of SDA's Tranche 0 Mission

Terran Orbital Corporation, a leading manufacturer of satellite products primarily serving the aerospace and defense industries, announced that 10 satellites incorporating Terran Orbital buses have been deployed in low Earth orbit following a Sept. 2, 2023 launch, from Vandenberg Space Force Base in California. The 10 satellites are part of the Tranche 0 Transport Layer of the Space Development Agency's (SDA) Proliferated Warfighter Space Architecture (PWSA). Terran Orbital manufactured the buses for Lockheed Martin for payload integration and delivery to SDA.

"It is a great honor to contribute to this important mission by delivering our 10 satellite buses to Lockheed Martin. We are thankful to Lockheed Martin for their collaboration and the opportunity to leverage our small satellite solution expertise and to support their missions," said Marc Bell, Co-Founder, Chairman, and CEO of Terran Orbital.

Currently, Terran Orbital is producing 42 satellite buses for Lockheed Martin, which will deliver 42 Tranche 1 Transport Layer satellites for SDA. These 42 satellites are scheduled to launch in 2024. These satellites will have various capabilities, including optical communications links, Link-16 mission communications, a Ka-band RF communications payload, and a BMC3 module that enables on-orbit data processing. These features will support missions for global warfighters.

# Juice: Why's It Taking Sooo Long

## IN BRIEF

At their closest point in orbit, Earth and Jupiter are separated by almost 600 million kilometres. At the time of writing, five months after launch, Juice has already travelled 370 million kilometres, yet in time it's only 5% of the way there. Why is it taking sooo long?

The answer depends on a variety of factors that flight dynamics experts at ESA's Mission Control know well, from the amount of fuel used to the power of the rocket, mass of a spacecraft and geometry of the planets.

Based on this, ESA's flight dynamics experts design a route. The world of orbital mechanics is a counterintuitive place, but with a bit of patience and a lot of planning it allows us to do a great deal of science with just a little fuel, as we'll explain.

## IN-DEPTH

▪ **Straight lines in space? Massive waste of energy :** Track the motion of planets and moons and stars and galaxies, and you'll see they're always in motion around another object. When a mission launches, it doesn't leap from a still Earth but off a planet zooming at about 30 km/s around the Sun.

As such, a spacecraft launched from Earth already has a great deal of 'orbital energy' – the only unit that matters when determining the size of an orbit around a central body. Just after launch, a spacecraft is in more or less the same orbit as our planet is around the Sun.

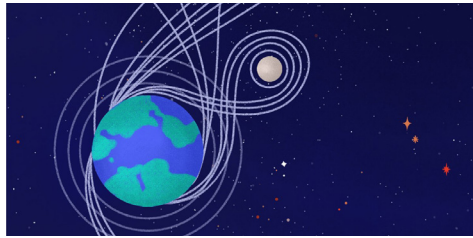
To break free from this orbit and fly in the shortest possible straight line from Earth to Jupiter, would need a big rocket and a lot of fuel. But it can be done. The next problem is, you'd then need even more fuel to brake and go into orbit around Jupiter and not zip right past it.

▪ **Targeting empty space :** Jupiter and Earth are always moving with respect to each other. At their farthest apart, on opposite sides of the Sun, they are separated by 968 million kilometres. The shortest distance between the two planets is when Earth and Jupiter are on the same side of the Sun with just under 600 million kilometres between them. But they're in this position just for a moment before the distance grows again, never remaining at a constant distance.

The planets are all moving at different rates in their orbits around the Sun. Imagine throwing a ball at a moving target from a moving vehicle. Engineers must calculate the ideal time to make the jump on a circular path from Earth's orbit to where Jupiter will be when the spacecraft arrives, not where it is when the spacecraft leaves Earth.

So, assuming we have the most powerful launcher available, and we launch on the shortest trajectory at the right time when the planets are aligned correctly, how long would it take?

Early space missions, such as the Voyager and Pioneer



probes, made the journey in less than two years, and the fastest any object has travelled to Jupiter was the New Horizons mission. Launched on 19 January 2006, New Horizons made its closest approach to Jupiter on 28 February 2007, taking a little over a year to reach the planet. All these missions continued onwards, excellent examples to determine how long it takes for a Jupiter flyby on the way to somewhere else.

▪ **The longer the stay, the slower the approach :** To get into orbit around the huge planet to study it from all sides and over time, perhaps even get into orbit around one of its moons – a Juice 'first' – you'll need to lose some energy. This 'deceleration' will require a lot of fuel for a large orbit insertion manoeuvre. If you don't want to launch with vast amounts of fuel, you take the scenic route, with a transfer duration of 2.5 years.

This is where we see the mass of the spacecraft as a crucial factor in determining the time it takes to get anywhere. Engineers need to control the spacecraft's mass, balancing the amount of fuel with the instruments it needs to carry to complete its mission. The more mass the spacecraft has, the more fuel it needs to carry, which increases its weight and makes it more difficult to launch.

And this is where the launching rocket's performance comes in. The spacecraft needs to be launched with sufficient velocity to escape Earth's gravity and be flung on its way to the outer Solar System. The better the shove, the easier the trip.

Juice is one of the heaviest interplanetary probes ever launched, at just over 6000 kg, with the largest suite of scientific instruments ever flown to Jupiter. Even the massive boost from the Ariane 5 heavy-lift rocket wasn't enough to send Juice directly there in a couple of years.

Therefore, missions such as Juice and Europa Clipper, or like Galileo and Juno in the past, have to make use of 'gravity-assist' or 'flyby' manoeuvres to pick up extra speed. The more powerful the rocket, the shorter the transfer.

## TRADING ENERGY WITH THE SOLAR SYSTEM

Pluto, at the edge of the Solar System, travels in a much larger orbit than Mercury, the innermost planet. Although Pluto moves more slowly with respect to the Sun, its orbital energy is far, far greater than Mercury's.

To get a spacecraft into orbit around another planet, we must match its orbital energy. When BepiColombo was launched, its orbital energy was the same as Earth's. It had

to lose energy to fall closer to the centre of the Solar System and did so by shedding excess orbital energy by flying close to neighbouring planets.

The same works in reverse to voyage to the outer Solar System. To get into a larger orbit, farther from the Sun, Juice is on a path that will let it steal orbital energy from Earth, Venus and Mars.

Depending on the relative direction of motion of the planet and the spacecraft, a gravity assist can either speed up, slow down or change the direction of the mission. (The spacecraft also deflects the planet, but by such a minuscule amount as to be insignificant. Nonetheless, Newton's third law of motion has been preserved: 'To every action there is an equal and opposite reaction'.)

Juice will use series of flybys of Earth, the Earth-Moon system and Venus to set it on course for its July 2031 rendezvous in the jovian system.

## ORBIT ON A KNIFE EDGE

The most challenging part for the ESA's flight control team comes when Juice finally arrives at Jupiter in 2031 and during its tour of Jupiter's planetary system.

Juice's challenging trajectory involves multiple gravity assists on the way to Jupiter – including the first ever Lunar-Earth flyby – and, once there, an impressive 35 flybys of its Galilean moons Europa, Ganymede and Callisto. The final focus will be on Ganymede, making Juice the first spacecraft ever to orbit a moon other than our own.

The single most important manoeuvre that teams at ESA's mission control in Germany will oversee, will be the slowing down of Juice by about 1 km/s only 13 hours after a Ganymede gravity assist, and 'taking the exit' to enter the Jupiter system, inserting the spacecraft into orbit around the gas giant.

Getting into orbit around another celestial body is hard. A spacecraft must approach with the perfect speed, from a precise angle, then execute a vital, big manoeuvre at just the right moment, in a specific direction and of the correct size.

Approaching too fast or slow, too shallow or steep, or manoeuvring at the wrong time, with the wrong amount or direction and you're lost in space. Or you're far enough off track that it will take a lot – perhaps too much – fuel to correct your path.

Juice will get close to Jupiter's moons, trading energy with them that they've held onto for billions of years, to get a view of these environments like never before. Could there be life under the frozen oceans of Ganymede, Callisto or Europa? What can we learn about the formation of planets and moons throughout the Universe? Through the wonder of flight dynamics, by trading energy with the Universe, we will soon(ish) find out.

# TRIO OF SENTINEL SATELLITES MAP METHANE SUPER-EMITTERS

In the quest to address climate change and reduce greenhouse gas emissions, detecting methane leaks - a potent contributor to global warming - has become increasingly vital. Researchers are harnessing the capabilities of cutting-edge satellite technology to monitor these leaks from space.

Why methane matters in the fight against climate change. Methane is a powerful greenhouse gas and is the second-largest contributor to climate warming after carbon dioxide. A tonne of methane, despite its shorter lifespan of about 10 years in the atmosphere, can retain an astounding 30 times more heat than a tonne of carbon dioxide over the course of a century. This means that when it comes to warming our planet, methane is a potent player.

But here's the good news: because methane doesn't stick around as long as carbon dioxide, it provides us with an opportunity to take relatively swift climate action. If we reduce methane emissions, we can actually see a tangible reduction in global methane levels within just a decade. This, in turn, helps to mitigate the enhanced greenhouse effect.

Now, let's talk about 'super-emitters'. While methane emitters refer to any source of methane ranging from natural processes like wetlands or human activities such as agriculture, methane super-emitters release a disproportionately large amount of methane compared to other emitters. These are typically found amongst industrial facilities, such as oil and gas operations, coal mines, or even landfills, that have equipment or infrastructure issues leading to significant methane leaks. These super-emitters are the low-hanging fruits in our quest to cut emissions. Fixing these super-emitters doesn't require complex or expensive solutions. In many cases, relatively simple repairs can result in significant climate gains.

However, there's a challenge: we first need to identify these super-emitters. That way, we can target our efforts effectively and start making a difference in the fight against climate change.

## USING MACHINE LEARNING FOR METHANE DETECTION

The Tropomi instrument onboard the Copernicus Sentinel-5P satellite is the only satellite instrument that produces a global map of methane concentrations every day.

The satellite measures methane by observing Earth's atmosphere and, specifically, the shortwave infrared bands. These bands are like unique fingerprints for methane, allowing Sentinel-5P to detect its presence with remarkable precision.

This wealth of data plays a critical role in our efforts to comprehend and address the consequences of methane emissions on our climate and environment, making it an

indispensable tool in the battle against climate change.

Researchers from SRON Netherlands Institute for Space Research have announced a new algorithm that automatically discovers methane super-emitter plumes in Sentinel-5P data using machine learning. It also automatically calculates the associated emissions based on the measured concentrations and concurrent wind speeds.

Berend Schuit from SRON explains, "Before, we manually identified the largest emitters, but it remains difficult to search through the millions of Tropomi pixels. A methane plume often only covers a few pixels. We now automatically get a list of detections from the machine learning model every day.

"We check those manually every week to make sure we are confident about the detections. What remains, dozens of methane plumes every week, we publish online. We communicate persistent leaks to other satellites with higher resolution so they can precisely identify the source."

"This information is used by the United Nations' International Methane Emissions Observatory to find a solution together with the responsible companies or authorities."

Co-author Bram Maasackers, from SRON, added, "The dozens of methane plumes that Tropomi detects every week really present a golden opportunity in the fight against global warming." "If it's visible from space, it is serious. For the first time, we now get a good global picture of these super-emitters. In our publication, we describe the 2974 plumes that we found in 2021; 45% originate from oil and gas facilities but we also see plumes from urban areas (35%) and coal mines (20%).

"We detect human-made emissions with a climate impact that is significantly larger than total greenhouse gas emissions of The Netherlands. In many cases, those leaks are easy to fix."

The paper, published today in Atmospheric Chemistry and Physics, can be accessed by clicking here.

## A THREE-TIERED APPROACH FOR METHANE DETECTION

Typically, the detection of methane emissions relies on Copernicus Sentinel-5P. Until fairly recently, scientists have only begun harnessing the power of combining data from multiple satellites to monitor methane emissions from space which included the combined capabilities of Copernicus Sentinel-5P and Sentinel-2 satellites. These high-tech space-based tools work in tandem to monitor and assess methane emissions on a global scale, allowing researchers to not only detect the presence of methane but also to localise and quantify emissions accurately.

With daily global coverage, Sentinel-5P is renowned for its high-precision methane measurements and can detect

methane leaks anywhere on Earth. However, there's a catch. The spatial resolution is relatively coarse, at 7x5.5 km. This means it can identify the presence of methane but not pinpoint its source with precision. The Sentinel-2 satellites, on the other hand, are equipped with multi-band instruments that are not designed to observe methane concentrations but can identify precise locations of major methane leaks (emitting more than one tonne per hour) with a remarkable resolution of 20 m. But Sentinel-2 lacks daily global coverage, so it might miss out on capturing crucial data during certain emission periods. But what about the Sentinel-3 mission? The satellites are equipped with multi-band radiometers that can observe shortwave infrared bands which are sensitive to methane concentrations. These satellites offer global coverage on a daily basis and a ground pixel resolution of 500 m. In a recent paper published in Remote Sensing of Environment, researchers from SRON found that the Sentinel-3 satellites can retrieve methane enhancements from its shortwave infrared band measurements. Impressively, it can detect the largest methane leaks of at least 10 tonnes per hour, depending on factors like location and wind conditions, every single day. This puts it in a unique position to identify and monitor methane leaks.

Near the Hassi Messaoud oil/gas field in Algeria, researchers identified a continuous methane emission from a leaking facility for six days. The methane plume, detected by Sentinel-5P over Algeria on 4 January 2020, extended for more than 200 km northeast. The team used a Sentinel-2 image to zoom in on the plumes' origins and pinpointed the exact location of the leak to be an oil/gas well, while Sentinel-3 showed the leak continued for six days.

When analysing these leaks, both Sentinel-2 and Sentinel-3 provided similar estimates of methane emissions - showcasing Sentinel-3's utility in quantifying emissions. Combining the data from these two satellites allows researchers to zoom in with precision, identifying, quantifying and monitoring methane sources corresponding to plumes observed in Sentinel-5P's global scans.

Sudhanshu Pandey, lead author and now scientist at NASA Jet Propulsion Laboratory, commented, "Who would have thought we can use three different Sentinel missions in a tiered approach to first spot methane super emitters from space globally with Tropomi on Sentinel-5P, then zooming in with Sentinel-3 and Sentinel-2, we're able to identify the exact source responsible at facility level. This is the type of information we need to take swift action."

In the fight against climate change, understanding and mitigating methane emissions are of paramount importance. Sentinel-3, with its unique combination of daily global coverage and high-resolution methane detection, emerges as a valuable asset in the arsenal of tools to track down and address these elusive leaks. As technology advances and our understanding deepens, satellite observations will play a pivotal role in the global effort to combat climate change.




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The visuals of ISRO where everyone is celebrating and cheering in the command center is still fresh in the memory. It was a historic moment for India to be the first country to soft land on the south pole of the moon. It gives a lot of confidence to the nation and to the common people of India. But have we wondered how the scientists are able to design such great systems? The answer is Engineering Simulation aka Computer aided engineering.

A simulation is a computer-based model

that relies on physics and mathematics concepts. It makes it possible to create, test, and improve goods and solutions. In simple terms it's a software that can take inputs from the user and simulate the behavior of the object under defined conditions.

Because it provides design verification and validation for R&D activities, businesses are drawn to simulation and analysis technologies. The desire for cost-effective solutions to lower manufacturing costs, simulation software's capabilities are expanding in relation to cutting-edge technologies like digital twins, AR/VR, and 3D printing.

For example, if a rocket is to be designed and its aerodynamics to be tested and optimized then CAE can come to the rescue. The CAE software is installed on the system,

and it can help you in virtually testing the flow of air around the body of the rocket. It helps in visualizing the air flow and helping to identify which parts of the rocket need attention and possibly redesign. Thus, CAE helps in saving time, effort and money by helping to virtually test various possibilities.

### **Applications**

Engineering Simulation Software is used for research, product design verification and validation. CAE software can be used in Fluid, Electronics, Mechanical Simulation and lot of many other areas. Below are the two most interesting applications:

#### **Virtual product prototyping**

Virtual product prototyping is used for developing a virtual product on a computer

which will simulate the real-life behaviour of the product. For a desired behaviour of the product, changes are made in the virtual prototype till satisfactory virtual performance is achieved. This saves a lot of effort as otherwise physical prototypes would have to be created and tested individually.

**Digital Twin**

A digital twin is a digital model of an intended or actual real-world physical product, system, or process that serves as the effectively indistinguishable digital counterpart of it for practical purposes, such as simulation, integration, testing, monitoring, and maintenance. We can understand this with the help of an example of an aircraft engine which has a digital twin sitting in a computer. The sensors in the aircraft will relay the data in real time to the digital twin thus helping the engineers know the state of the aircraft engine and actions can be taken accordingly.

**Emerging Markets in India**

These are the two high tech emerging markets in India which will need Engineering simulation in product research and development. Projected revenue growth in these sectors is a testament to that.

**Space**

- » Current Size: INR 62320 crore (7.6 Bn usd)
- » Size by 2025: INR 410000 crore (50 Bn Usd approx.)

**Defence:**

- » Current market size: 88000 Cr Defense Manufacturing (~11.3 Bn)
- » Size by 2025: INR 1.75 Lakh crore (~22 Bn)

Ministry of Defence has set a target of achieving a turnover of INR 1.75 lakh crore in aerospace and defence Manufacturing by 2025. Till April 2023, a total of 606 Industrial Licences have been issued to 369 companies operating in Defence Sector.

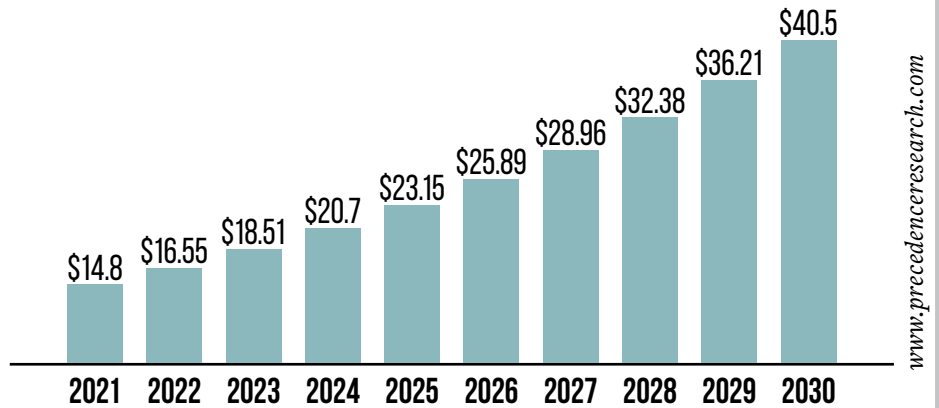
The government has also announced 2

**Global Simulation Market**

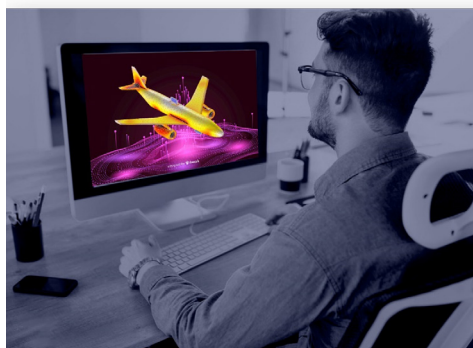
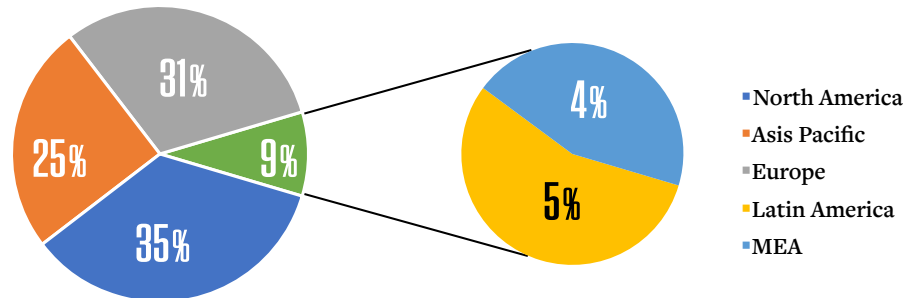
The global simulation software market size was estimated at USD 16.55 billion in 2022 and it is projected to hit around USD 40.5 billion by 2030 and is expected to grow at a CAGR of 11.83% during the forecast period 2022 to 2030.



**Simulation Software Market Size, 2021 to 2030 (usd billion)**



**Market Share (2021)**



dedicated Defence Industrial Corridors in the States of Tamil Nadu and Uttar Pradesh to act as clusters of defence manufacturing that leverage existing infrastructure, and human capital. Further, to enable innovation within Defence & Aerospace eco-system there are supportive government schemes such as iDEX (Innovations for Defence Excellence) and DTIS (Defence Testing Infrastructure Scheme).

Defence info source Link:  
<https://lnkd.in/dZDgV7ta>

Space Policy Link:  
<https://lnkd.in/dG57pdqw>

CAE Report Link:  
<https://lnkd.in/dJWzJN3c>

# Sierra Space Reinvents the Space Station, Putting Affordable In-Space Infrastructure Within Reach

Sierra Space, a leading, pureplay commercial space company building the first end-to-end business and technology platform in space, today announced it completed a fifth, sub-scale test of their revolutionary LIFE™ habitat (Large Integrated Flexible Environment). ILC Dover is the exclusive softgoods technology partner on the Sierra Space platform.

This latest successful milestone and the first one in the testing campaign to include a metallic window sub-structure - or blanking plate - now propels Sierra Space into full-scale testing of LIFE by the end of this year. The milestone cements the company's position as the industry leader in commercial space station development for use in low-Earth orbit (LEO) and deep space.

"Sierra Space is putting affordable in-space infrastructure within reach so every boardroom can now look to space for their next breakthrough products," said Sierra Space CEO Tom Vice. "Our revolutionary space station technology, combined with our highly reusable Dream Chaser spaceplane, significantly decreases the cost of in-space infrastructure and is ushering in the commercialization of Low Earth Orbit."

On Aug. 17, Sierra Space, in collaboration with ILC Dover and NASA subject-matter experts, conducted an Ultimate Burst Pressure (UBP) test on a one-third-scale version of the inflatable habitat. This test article included a blanking plate - a metallic structure inserted into the softgoods shell to emulate a future design component, such as a window, robotic arm or antenna attachment point. For this burst test, a steel blanking plate was used as a stand-in for a future window. Sierra Space LIFE Habitat Space Station Burst Test

This recent UBP test of the sub-scale LIFE with a blanking plate surpassed all other previous test article maximum burst pressures. The results of this test provide a 33% margin over the certification standard for full-scale LIFE testing, and nearly a 20% improvement over the previous design, aligning with Sierra Space's two previous sub-scale UBP tests conducted in July and November 2022. Sierra Space is the only active commercial space company to test both UBP (3) and Creep (2) on an inflatable softgoods architecture at sub or full scale and now with a blanking plate.



*"Inclusion of the blanking plate hard structure was a game-changer because this was the first time that we infused metallics into our softgoods pressure shell technology prior to conducting a UBP test."*

**-hawn Buckley,**  
Sr. Director Engineering and  
Product Evolution Director for  
Sierra Space Destinations

"With this added component, once again, we successfully demonstrated that LIFE's current architecture at one-third scale meets the minimum 4x safety factor required for softgoods inflatables structures. This is a phenomenal achievement and provides the necessary engineering foundation that allows us to move into the next phase of the LIFE product line development - full-scale testing of LIFE."

Once fully developed, the LIFE habitat will house a minimum of two windows, and they are a critical feature in the development of the LIFE habitat. They help crew members deal with any feelings of living in a confined space. More importantly, windows provide the crew an opportunity to witness the

beauty of planet Earth in a way that can forever change them as people.

"As pioneers in softgoods solutions, such as inflatable habitats, we are dedicated to advancing the next era of human spaceflight and sustaining life in low-Earth orbit," said Robert Reed, President, Space and Engineered Solutions at ILC Dover. "The milestone of this recent burst test underscores our commitment to safeguarding explorers as they push the boundaries and embark on transformative journeys beyond our planet. We are proud to have contributed to this crucial endeavor and further showcase the reliability of our inflatable habitat."

This recent UBP test was performed with support from NASA via a Reimbursable Space Act Agreement in which Marshall Space Flight Center provides services to Sierra Space in support of its exploration and commercial low-Earth orbit (LEO) technology development and risk reduction activities. The test occurred in Huntsville, Ala., on Redstone Arsenal in the flame trench of the historic Saturn 1/1B test stand.

Sierra Space's full-scale LIFE habitat product line is a key component of the company's in-space destinations technology portfolio. The inflatable module is a three-story commercial habitation, science and bio pharma platform designed to allow humans to live and work comfortably in LEO and beyond. It is constructed of high strength, "softgoods" materials (sewn and woven fabrics, primarily Vectran) that become rigid structures when pressurized.

# Autonomous Systems Help NASA's Perseverance Do More Science on Mars

In about a third of the time it would have taken other NASA Mars rovers, Perseverance recently navigated its way through a field of boulders more than 1,700 feet wide (about a half-kilometer). While planners map out the rover's general routes, Perseverance managed the finer points of navigating the field, nicknamed "Snowdrift Peak," on its own, courtesy of AutoNav, the self-driving system that helps cut down driving time between areas of scientific interest.

In fact, Perseverance has set rover speed records on Mars since landing in February 2021. The feats of AutoNav were detailed in a paper about the rover's autonomous systems published in the July issue of the journal *Science Robotics*.

Tyler Del Sesto has worked on the software for Perseverance's AutoNav for seven years. He used to think that sometimes the obstacles placed before Perseverance's Earthly twin OPTIMISM during testing in the Mars Yard at NASA's Jet Propulsion Laboratory went a little overboard. He changed his mind after Snowdrift Peak.

"It was much denser than anything Perseverance has encountered before – just absolutely littered with these big rocks," said Del Sesto, deputy rover planner lead for Perseverance at JPL in Southern California. "We didn't want to go around it because it would have taken us weeks. More time driving means less time for science, so we just dove right in."

On June 26, Perseverance entered the eastern edge of Snowdrift Peak. Including two stops for boulders that the science team wanted to inspect, the straight-line route through Snowdrift would cover 1,706 feet (520 meters). By the time the rover exited the western edge of the boulder field on July 31, it had logged 2,490 feet (759 meters) – with much of the extra distance coming from AutoNav maneuvering around rocks not visible in the orbiter images used to plan the route.

"If you take out the sols (Martian days) dedicated to mission science, the traverse through Snowdrift Peak only took six autonomous drive sols, which is probably 12 sols faster than Curiosity would have taken," said Del Sesto. "Of course, everybody on the team knows we only got to this level of performance by standing on the shoulders of giants. Sojourner, Spirit, Opportunity, and Curiosity were the trailblazers."

## ON THE WHEELS OF GIANTS

Some form of silicon-based navigator has been in use since the first Mars rover started dodging rocks



in 1997. Back then, the microwave oven-size Sojourner needed to stop every 5.1 inches (13 centimeters) for its computer brain to take stock of its new environs before proceeding farther. The next Mars rovers – the golf cart-size Spirit and Opportunity (which arrived in 2004) – could drive distances up to 1.6 feet (0.5 meters) before they too had to halt and figure out next moves.

Curiosity, which landed in 2012, recently got a software upgrade to help make driving decisions, but Perseverance packs several advantages: With faster cameras, the rover can take images quickly enough to process its route in real-time, and it has an additional computer dedicated entirely to image processing, eliminating the need to pause to decide its next move.

"Our rover is the perfect example of the old adage 'two brains are better than one,'" said Vandl Verma, lead author of the paper and the mission's chief engineer for robotic operations at JPL. "Perseverance is the first rover that has two computer brains working together, allowing it to make decisions on the fly."

This autonomous capability has allowed Perseverance to set new records for Mars off-roading, including a single-day drive distance of 1,140.7 feet (347.7 meters) and longest drive without human review: 2,296.2 feet (699.9 meters). But those achievements took place back when the rover was driving across the relatively flat terrain of Jezero Crater's floor, without large rocks and other craters standing in its way. That's why this recent navigation of boulder-festooned Snowdrift Peak impressed even the engineers who plan rover outings.

## NEW CAMPAIGN NEW TERRAIN

While the boulder field may be in Perseverance's metaphorical rearview mirror, more driving challenges lay ahead. The rover began its fourth science campaign on Sept. 7 by crossing "Mandu Wall," a rolling ridgeline separating two geologic units along the inner edge of

Jezero Crater's western rim. Orbital data indicates the area is filled with carbonates – which may provide invaluable data on Mars' environmental history as well as preserve signs of ancient microbial life, if any existed in the area.

"The time where a rover science team could look at features on the Martian horizon and file them away for future consideration is over," said Ken Farley, Perseverance project scientist at Caltech in Pasadena. "We have to be on our toes because Perseverance's autonomous capabilities can make something we see in the distance on one sol right in front – or even behind us – on the next."

With the new exploration possibilities come new challenges: broken bedrock, higher slopes, and sand dunes, as well as small impact craters in Perseverance's near future.

"This new terrain is definitely going to throw a few curveballs at us and AutoNav," said Mark Maimone, deputy team chief for robotic operations on Perseverance. "But that is where the science is. We're ready."

## MORE ABOUT THE MISSION

A key objective for Perseverance's mission on Mars is astrobiology, including the search for signs of ancient microbial life. The rover will characterize the planet's geology and past climate, pave the way for human exploration of the Red Planet, and be the first mission to collect and cache Martian rock and regolith (broken rock and dust).

Subsequent NASA missions, in cooperation with ESA (European Space Agency), would send spacecraft to Mars to collect these sealed samples from the surface and return them to Earth for in-depth analysis. The Mars 2020 Perseverance mission is part of NASA's Moon to Mars exploration approach, which includes Artemis missions to the Moon that will help prepare for human exploration of the Red Planet. JPL, which is managed for NASA by Caltech in Pasadena, California, built and manages operations of the Perseverance rover.

# Webb Finds Carbon Source on Surface of Jupiter's Moon Europa

Jupiter's moon Europa is one of a handful of worlds in our Solar System that could potentially harbour conditions suitable for life. Previous research has shown that beneath its water-ice crust lies a salty ocean of liquid water with a rocky seafloor. However, planetary scientists had not confirmed whether or not that ocean contained the chemicals needed for life, particularly carbon.

Astronomers using data from the NASA/ESA/CSA James Webb Space Telescope have identified carbon dioxide in a specific region on the icy surface of Europa. Analysis indicates that this carbon likely originated in the subsurface ocean and was not delivered by meteorites or other external sources. Moreover, it was deposited on a geologically recent timescale. This discovery has important implications for the potential habitability of Europa's ocean.

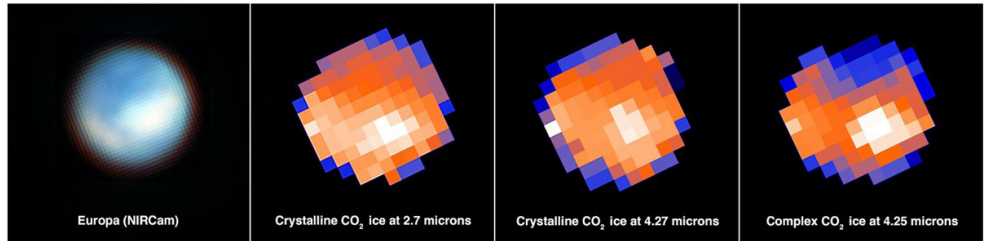
"On Earth, life likes chemical diversity – the more diversity, the better. We're carbon-based life. Understanding the chemistry of Europa's ocean will help us determine whether it's hostile to life as we know it, or whether it might be a good place for life," said Geronimo Villanueva of NASA's Goddard Space Flight Center in Greenbelt, Maryland, lead author of one of two independent papers describing the findings.

"We now think that we have observational evidence that the carbon we see on Europa's surface came from the ocean. That's not a trivial thing. Carbon is a biologically essential element," added Samantha Trumbo of Cornell University in Ithaca, New York, lead author of the second paper analysing this data.

## A SURFACE-OCEAN CONNECTION

Webb finds that on Europa's surface, carbon dioxide is most abundant in a region called Tara Regio – a geologically young area of generally resurfaced terrain known as 'chaos terrain'. The surface ice has been disrupted, and there has likely been an exchange of material between the subsurface ocean and the icy surface.

"Previous observations from the Hubble Space Telescope show evidence for ocean-derived salt in Tara Regio," explained Trumbo. "Now we're seeing that carbon dioxide is heavily concentrated there as well. We think this implies that the carbon probably has its ultimate origin in the internal ocean."



“Scientists are debating to what extent Europa’s ocean connects to its surface. I think that question has been a big driver of Europa exploration.”

-Geronimo Villanueva, NASA's Goddard Space Flight Center in Greenbelt

"This suggests that we may be able to learn some basic things about the ocean's composition even before we drill through the ice to get the full picture," said Villanueva.

Both teams identified the carbon dioxide using data from the integral field unit of Webb's Near-Infrared Spectrograph (NIRSpec). This instrument mode provides spectra with a resolution of 320 x 320 km over a field of view of diameter 3128 km on the surface of Europa, allowing astronomers to determine where specific chemicals are located. Carbon dioxide isn't stable on Europa's surface. Therefore, the scientists say it's likely that it was supplied on a geologically recent timescale – a conclusion bolstered by its concentration in a region of young terrain.

"These observations only took a few minutes of the observatory's time," said Heidi Hammel of the Association of Universities for Research in Astronomy, a Webb interdisciplinary scientist leading Webb's Cycle 1 Guaranteed Time Observations of the Solar System. "Even in this short period of time, we were able to do really big science. This work gives a first hint of all the amazing Solar System science we'll be able to do with Webb."

## SEARCHING FOR A PLUME

Villanueva's team also looked for evidence of a plume of water vapour erupting from Europa's surface. Researchers using the NASA/ESA Hubble Space Telescope reported tentative detections of plumes in 2013, 2016, and 2017. However, finding definitive proof has been difficult.

The new Webb data show no evidence of plume activity, which allowed Villanueva's team to set a strict upper limit on the rate at which material is potentially

being ejected. The team stressed, however, that their non-detection does not rule out a plume.

"There is always a possibility that these plumes are variable and that you can only see them at certain times. All we can say with 100% confidence is that we did not detect a plume at Europa when we made these observations with Webb," said Hammel.

These findings may help inform NASA's Europa Clipper mission, as well as ESA's Jupiter Icy Moons Explorer, Juice, which was launched on 14 April 2023. Juice will make detailed observations of the giant gas planet and its three large ocean-bearing moons – Ganymede, Callisto and Europa – with a suite of remote sensing, geophysical and in situ instruments. The mission will characterise these moons as both planetary objects and possible habitats, explore Jupiter's complex environment in depth, and study the wider Jupiter system as an archetype for gas giants across the Universe.

"This is a great first result of what Webb will bring to the study of Jupiter's moons," said co-author Guillaume Cruz-Mermy, formerly of Université Paris-Saclay and current ESA Research Fellow at the Agency's European Space Astronomy Centre. "I'm looking forward to seeing what else we can learn about their surface properties from these and future observations."

"The results reinforce the importance of the Juice mission," continues Guillaume. "With its MAJIS instrument, Juice will make it possible to observe the same surface over the same range of wavelengths but at a much greater spatial resolution and over a longer period of time, and therefore will further constrain the habitability condition of Europa."

The two papers associated with this research will be published in Science on 21 September 2023.



# NASA's 1st Asteroid Sample Has Landed, Now Secure in Clean Room

The sample return capsule from NASA's OSIRIS-REX mission is seen shortly after touching down in the desert, Sunday, Sept. 24, 2023, at the Department of Defense's Utah Test and Training Range. After years of anticipation and hard work by NASA's OSIRIS-REX (Origins, Spectral Interpretation, Resource Identification and Security – Regolith Explorer) team, a capsule of rocks and dust collected from asteroid Bennu finally is on Earth. It landed at 8:52 a.m. MDT (10:52 a.m. EDT) on Sunday, in a targeted area of the Department of Defense's Utah Test and Training Range near Salt Lake City.

Within an hour and a half, the capsule was transported by helicopter to a temporary clean room set up in a hangar on the training range, where it now is connected to a continuous flow of nitrogen.

Getting the sample under a “nitrogen purge,” as scientists call it, was one of the OSIRIS-REX team's most critical tasks today. Nitrogen is a gas that doesn't interact with most other chemicals, and a continuous flow of it into the sample container inside the capsule will keep out earthly contaminants to leave the sample pure for scientific analyses. The returned samples collected from Bennu will help scientists worldwide make discoveries to better understand planet formation and the origin of organics and water that led to life on Earth, as well as benefit all of humanity by learning more about potentially hazardous asteroids.

“Congratulations to the OSIRIS-REX team on a picture-perfect mission – the first American asteroid sample return in history – which will deepen our understanding of the origin of our solar system and its formation. Not to mention, Bennu is a potentially hazardous asteroid, and what we learn from the sample will help us better understand the types of asteroids that could come our way,” said NASA Administrator Bill Nelson. “With OSIRIS-REX, Psyche launch in a couple of weeks, DART's one year anniversary, and Lucy's first asteroid approach in November, Asteroid Autumn is in full swing. These missions prove once again that NASA does big things. Things that inspire us and unite us. Things that show nothing is beyond our reach when we work together.”



The Bennu sample – an estimated 8.8 ounces, or 250 grams – will be transported in its unopened canister by aircraft to NASA's Johnson Space Center in Houston on Monday, Sept. 25. Curation scientists there will disassemble the canister, extract and weigh the sample, create an inventory of the rocks and dust, and, over time, distribute pieces of Bennu to scientists worldwide.

Today's delivery of an asteroid sample – a first for the U.S. – went according to plan thanks to the massive effort of hundreds of people who remotely directed the spacecraft's journey since it launched on Sept. 8, 2016. The team then guided it to arrival at Bennu on Dec. 3, 2018, through the search for a safe sample-collection site between 2019 and 2020, sample collection on Oct. 20, 2020, and during the return trip home starting on May 10, 2021.

“Today marks an extraordinary milestone not just for the OSIRIS-REX team but for science as a whole,” said Dante Lauretta, principal investigator for OSIRIS-REX at the University of Arizona, Tucson. “Successfully delivering samples from Bennu to Earth is a triumph of collaborative ingenuity and a testament to what we can accomplish when we unite with a common purpose. But let's not forget – while this may feel like the end of an incredible chapter, it's truly just the beginning of another. We now have the unprecedented opportunity to analyze these samples and delve deeper into the secrets of our solar system.”

After traveling billions of miles to Bennu and back, the OSIRIS-REX spacecraft released its sample capsule toward Earth's atmosphere at 6:42 a.m. EDT (4:42 a.m. MDT). The spacecraft was 63,000 miles (102,000 kilometers) from Earth's surface at the time – about one-third the distance from Earth to the Moon. Traveling at 27,650 mph (44,500 kph), the capsule pierced the atmosphere at 10:42 a.m. EDT (8:42 a.m. MDT), off the coast of California at an altitude of about 83 miles (133 kilometers). Within 10 minutes, it landed on the military range. Along the way, two parachutes successfully deployed to stabilize and slow the capsule down to a gentle 11 mph (18 kph) at touchdown.

“The whole team had butterflies today, but that's the focused anticipation of a critical event by a well-prepared team,” said Rich Burns, project manager for OSIRIS-REX at NASA's Goddard Space Flight Center in Greenbelt, Maryland. “For us, this was the World Series, ninth inning, bases-loaded moment, and this team knocked it out of the park.”

Radar, infrared, and optical instruments in the air and on the ground tracked the capsule to its landing coordinates inside a 36-mile by 8.5-mile (58-kilometer by 14-kilometer) area on the range. Within several minutes, the recovery team was dispatched to the capsule's location to inspect and retrieve it. The team found the capsule in good shape at 9:07 a.m. MDT (11:07 a.m. EDT) and then determined it was safe to approach. Within 70 minutes, they wrapped it up for safe transport to a temporary clean room on the range, where it remains under continuous supervision and a nitrogen purge.

# Seeking Euclid's Hidden Stars: Commissioning Looks Up

## IN BRIEF

The Universe doesn't give up its secrets easily. There's a reason dark energy and dark matter have their names – although they (allegedly) make up 95% of the Universe, they do not emit, absorb or reflect light, so have not yet been seen. This is why we call Euclid our cosmic detective; its goal is no less than to understand the secret structure and make-up of our Universe. Euclid's engineers and scientists have now also donned their Sherlock Holmes hats, coats and pipes, as they work on three issues that have arisen during Euclid's commissioning.

## IN-DEPTH

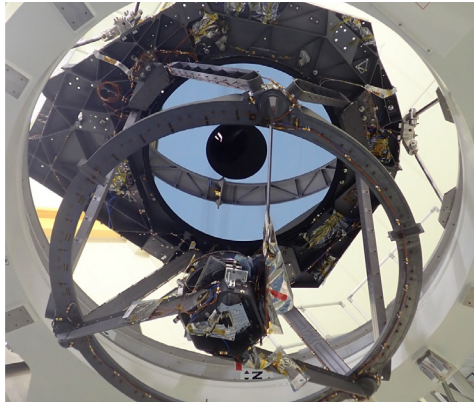
From Euclid's fine guidance sensors intermittently losing track of stars to stray sunlight getting in the way of observing the Universe and X-rays appearing in instrument images, the issues raised do not threaten Euclid's mission but could impact how it carries out its work.

After months of late nights and determination from engineering teams at ESA's mission control, mission scientists and industry, with some tweaking to observation schedules, data processing and by altering the directions Euclid will point in, its looking good for the detective.

## ALL WAS WELL, UNTIL...

Euclid commissioning – the period after launch when a mission's instruments and subsystems are deployed, turned on, tested and calibrated – began well. Teams at ESA's mission control worked 24 hours a day in 12-hour shifts through intense weeks of manoeuvres, tests and calibrations; flying the mission out to Lagrange point 2, its telescope mirrors were de-iced, its NISP and VIS instruments were woken up and saw 'first light' and its telescope mirror was focussed. Euclid's first test images were mesmerising.

However, it is rare, if ever, that all goes perfectly throughout the life of a space mission. After all, we can only perform tests on Earth – space is a different world. To operate a spacecraft, engineering and science teams will always need to detect and quickly resolve issues as they arise, and there are a multitude of ways a mission can go wrong. It's why months are spent in arduous simulations before launch – you never know quite what will happen.



Now it's not an outlook we recommend for daily life, but it's the nature of spacecraft operations to laser focus on the negative. For now, goodbye to Euclid's better-than-expected optical quality and seamless trip to 'L2', time to investigate what's not quite right.

## LOST GUIDE STARS LIKELY FOUND

Euclid is one of the most precise missions ever to be launched, providing razor-sharp images and deep spectra of our Universe, looking back 10 billion years. It will produce a grand survey of one-third of the entire sky. Every 75 minutes for its mission duration of six years, the telescope must point at a new field on the sky with extreme accuracy and stability.

To do this, the spacecraft has a Fine Guidance Sensor (FGS); a completely new development in Europe made of optical sensors that pick out and lock onto stars found by ESA's Gaia mission, using them as guides to navigate and determine exactly where the telescope needs to point in the sky. This information is fed into the 'Attitude and Orbit Control System' which controls Euclid's orientation and orbital motion.

While most systems are performing well, there have been intermittent cases of the Fine Guidance Sensor failing to lock onto faint stars. In orbit, Euclid detects the true sky under real space conditions, something which is very hard to simulate before launch. Plus, cosmic rays from the Sun and the galaxy pollute observations, make the job of the FGS a real challenge.

Euclid's commissioning phase was extended in order to look into the issue, delaying the all-important 'performance verification'. Teams have since been working on a software fix that has now been uploaded onto the spacecraft and is undergoing thorough

testing.

"The issue of Euclid's fine guidance is something we've all been concerned about. Teams at ESA's technical heart (ESTEC), mission control (ESOC), Astronomy Centre (ESAC) and industry have been working day and night, tirelessly for months, and I can't thank them enough for their determination to resolve the issue," says Euclid Operations Director Andreas Rudolph.

Operations Manager Micha Schmidt adds, "I'm relieved to say that initial tests are looking good. We're finding many more stars in all our tests, and while it's too early to celebrate and more observations are needed, the signs are very encouraging."

The updated software has already passed with flying colours on a spacecraft simulator and 'test bench' (Euclid replica) at mission control, then performed perfectly in orbit and will next be tested under the control of the Science Operations Centre at ESA's ESAC Astronomy Centre in Spain.

"Obviously, this is where we will have the real test of truth, as only the science images can provide us with absolute certainty that Euclid's pointing is performing well," cautions Euclid Project Manager, Giuseppe Racca.

"However, all evidence so far makes us very optimistic. We will continue to keep our fingers tightly crossed, but the restart of the performance verification phase gets nearer every day."

## DARK DETECTIVE SEES UNWANTED 'STRAY LIGHT'

While Euclid's faint, guide stars appear to be found, its next, (smaller) issues come from our nearest star.

Euclid is located at Lagrange point 2 in a unique orbit 'behind' Earth. Here, Euclid has its 'back' to the Sun, so all the sensitive parts of its telescope are protected from sunlight by a dedicated sunshield. However, it was known that a thruster bracket lay outside the shadow of the sunshield and would receive direct sunlight.

It seems a small amount of sunlight is reflecting off the bracket towards the VISible (VIS) instrument that is protected by many layers of insulation. However, because of the extreme sensitivity of the VIS instrument, the current theory is that enough light is still getting through this insulation, with stray light being detected in test observations when VIS is turned at specific angles.

The majority of VIS's observations showed no significant stray light interference, but at particular angles, about 10% of observations were affected. Science, engineering and industrial teams spent weeks deciphering which angles let too much of this unwanted light in and have re-designed and optimised Euclid's survey to constrain each pointing's orientation in the sky. While this will not affect Euclid's ability to take the precise images required, it could impact the efficiency of the survey – something that is still under investigation.

### VIS-À-VIS THE SUN

Sunlight isn't the only solar issue Euclid faces. If this were an Agatha Christie novel, we'd start to wonder what the Sun is trying to hide from our cosmic detective. Enter: solar flares – sudden eruptions of electromagnetic radiation from the Sun's surface, made up of light across the entire spectrum, including X-rays.

Euclid's detectors are being shielded from low-energy protons that could do them damage. However, it appears that at particular angles, X-rays emitted by the Sun during solar flares can occasionally reach the detectors, spoiling a portion of the images taken at that moment. Solar activity is currently high as the Sun gets close to the most active period in the current solar cycle, expected to peak in 2024-25.

Analysis currently predicts that, depending on solar activity, Euclid could lose about 3% of its data if this problem were left untackled. However, now that the issue has been discovered teams are able to identify affected pixels and discount them in later analysis and are working on plans to repeat observations to eventually make up for any gaps in Euclid's cosmological survey.

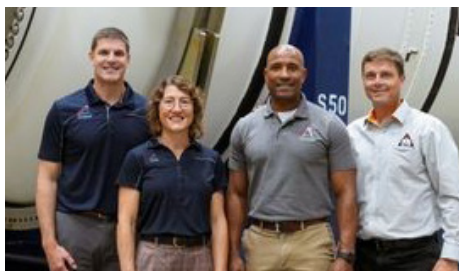
### OPTIMISM FOR SCIENCE RESULTS TO COME

It's important to put the problems above in context. This commissioning period is the time when teams focus hard on uncovering any possible issue that could affect the mission – large or small.

Euclid will take remarkable images of our Universe and help piece together how dark energy and dark matter influence the parts of our world that we can see. Euclid's fine guidance seems close to being solved without any further impact on the mission. The Sun's stray light can be mitigated with clever reprogramming of Euclid's survey and, while the X-ray issue will have a marginal effect, teams are working hard to minimise this through repeat observations and data processing.

Stay tuned for updates, as we get closer to Euclid's first images and start the quest to reveal the nature of dark matter and dark energy.

## NGC Delivers Rocket Booster Segments for NASA's Artemis II Mission



**N**orthrop Grumman Corporation delivered twin solid rocket booster segments to Kennedy Space Center in Florida. The boosters will help power NASA's Space Launch System (SLS) rocket for the Artemis II mission and are the first element of the SLS rocket to be stacked on the mobile launch platform in preparation. The boosters will provide 7.2 million pounds of thrust at launch.

## Peraton Awarded \$330.3M Contract IV to Support NASA Sounding Rocket Operations



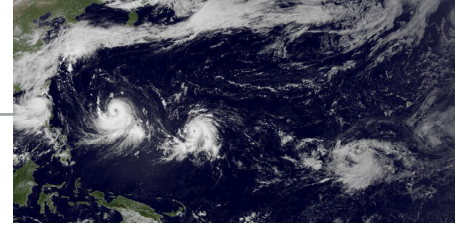
**P**eraton has won a competitive award to support the NASA Sounding Rocket Operations Contract IV (NSROC IV) worth up to \$330.3 million over a five-year period of performance. Sounding rockets are multi-stage solid propellant rockets used for probing the upper atmospheric regions as part of the nation's space research and experimentation efforts. The annual suborbital missions flown by the program provide researchers with unparalleled opportunities to build, test, and fly new concepts that support NASA's strategic vision.

This is a continuation of support as Peraton has an enduring relationship with NASA missions, including the Goddard Space Flight Center (GSFC) and Wallops Flight Facility (WFF). Peraton will design, manufacture, integrate, test and conduct mission launch operations for a wide range of highly complex suborbital payloads and launch vehicles

for NASA's Sounding Rockets Program Office.

The work will be performed at Wallops and White Sands Missile Range, New Mexico; remote launch sites including Poker Flat Research Range in Fairbanks, Alaska, and Andoya Space Center with sites in Andenes and Svalbard, Norway; and mobile launch sites including Reagan Test Site in the Kwajalein Atoll and Equatorial Launch Australia in Nhulunbuy, Australia.

"NSROC IV will continue to be the flagship program of Peraton's suborbital rocket capabilities that also includes adjacent missions for the DoD and military services," said Roger Mason, Ph.D., president, Space & Intelligence sector. "We're honored to be a trusted enabler for these key missions and look forward to continuing our longstanding partnership with NASA and the Princess Anne region."



# New Simulations Shed Light on Origins of Saturn's Rings and Icy Moons

**O**n a clear night, with a decent amateur telescope, Saturn and its series of remarkable rings can be seen from Earth's surface. But how did those rings come to be? And what can they tell us about Saturn and its moons, one of the potential locations NASA hopes to search for life? A new series of supercomputer simulations has offered an answer to the mystery of the rings' origins – one that involves a massive collision, back when dinosaurs still roamed the Earth.

According to new research by NASA and its partners, Saturn's rings could have evolved from the debris of two icy moons that collided and shattered a few hundred million years ago. Debris that didn't end up in the rings could also have contributed to the formation of some of Saturn's present-day moons.

"There's so much we still don't know about the Saturn system, including its moons that host environments that might be suitable for life," said Jacob Kegerreis, a research scientist at NASA's Ames Research Center in California's Silicon Valley. "So, it's exciting to use big simulations like these to explore in detail how they could have evolved."

NASA's Cassini mission helped scientists understand just how young – astronomically speaking – Saturn's rings and probably some of its moons are. And that knowledge opened up new questions about how they formed.

To learn more, the research team turned to the Durham University location of the Distributed Research using Advanced Computing (DiRAC) supercomputing facility in the United Kingdom. They modeled what different collisions between precursor moons might have looked like. These simulations were conducted at a resolution more than 100 times higher than previous such studies, using the open-source simulation code, SWIFT, and giving scientists their best insights into the Saturn system's history.

Saturn's rings today live close to the planet, within what's known as the Roche limit – the farthest orbit where a planet's gravitational force is powerful enough to disintegrate larger bodies of rock or ice that get any closer. Material orbiting farther out could clump together to form moons.

By simulating almost 200 different versions of the impact, the team discovered that a wide range of collision scenarios could scatter the right amount of ice into Saturn's Roche limit, where it could settle into rings.

And, while alternative explanations haven't been able to show why there would be almost no rock in Saturn's rings – they are made almost entirely of



chunks of ice – this type of collision could explain that.

"This scenario naturally leads to ice-rich rings," said Vincent Eke, Associate Professor in the Department of Physics/Institute for Computational Cosmology, at Durham University and a co-author on the paper. "When the icy progenitor moons smash into one another, the rock in the cores of the colliding bodies is dispersed less widely than the overlying ice."

Ice and rocky debris would also have hit other moons in the system, potentially causing a cascade of collisions. Such a multiplying effect could have disrupted any other precursor moons outside the rings, out of which today's moons could have formed.

But what could have set these events in motion, in the first place? Two of Saturn's former moons could have been pushed into a collision by the usually small effects of the Sun's gravity "adding up" to destabilize their orbits around the planet. In the right configuration of orbits, the extra pull from the Sun can have a snowballing effect – a "resonance" – that elongates and tilts the moons' usually circular and flat orbits until their paths cross, resulting in a high-speed impact.

Saturn's moon Rhea today orbits just beyond where a moon would encounter this resonance. Like the Earth's Moon, Saturn's satellites migrate outward from the planet over time. So, if Rhea were ancient, it would have crossed the resonance in the recent past. However, Rhea's orbit is very circular and flat. This suggests that it did not experience the destabilizing effects of the resonance and, instead, formed more recently.

The new research aligns with evidence that Saturn's rings formed recently, but there are still big open questions. If at least some of the icy moons of Saturn are also young, then what could that mean for the potential for life in the oceans under the surface of worlds like Enceladus? Can we unravel the full story from the planet's original system, before the impact, through to the present day? Future research building on this work will help us learn more about this fascinating planet and the icy worlds that orbit it.

## RTX to Optimize Water Prediction Capabilities for NOAA

**R**aytheon business, has been awarded a contract from the National Oceanic and Atmospheric Administration (NOAA) to develop and optimize the nation's water resources prediction capabilities.

Under the four-year, \$80 million task order, awarded under the General Services Administration Schedule, Raytheon will work closely with the National Weather Service to transform and innovate its prototype Next Generation Water Model Framework, Flood Inundation Mapping and Enterprise Hydrofabric Solution. The goal of this work is to create a climate-ready nation that is prepared for, and responds to, weather, water and climate-dependent events.

"Recent weather events across the U.S. underscore the critical role that accurate, real-time water prediction plays in maintaining our economic stability and national security," said Shawn Miller, technical director of Civil and Autonomous Vehicle Solutions at Raytheon. "By migrating NOAA's prediction capabilities to the cloud, the agency will be able to better address the needs of communities nationwide, facilitating proactive decision making before and during extreme weather events and, ultimately, helping to prevent loss of life and property damage."

For nearly 20 years, Raytheon has partnered closely with NOAA on weather forecasting and data analysis capabilities, including the Advanced Weather Interactive Processing System enterprise, or AWIPS, a weather forecasting data and display toolkit, and the Earth Prediction Innovation Center, or EPIC, the most user-friendly and user-accessible Earth modeling system.

"Working with Raytheon, we will transform our technologies that predict streamflow, flooding, and inundation, as well as deploy improved capabilities to support understanding of drought and water quality challenges," said Edward Clark, director of NOAA's National Water Center. "With these advanced tools deployed, National Weather Service forecasters will deliver enhanced decision support services for a broad spectrum of emergency and water resources managers, and all communities nationwide."

With this award, Raytheon will now provide critical capabilities that support all three of NOAA and NWS's main sectors that contribute to the science and application of weather and weather forecasting: weather, water and climate enterprise.

# Record-Setting NASA Astronaut, Crewmates Return from Space Mission

After spending an American record-breaking 371 days in space, NASA astronaut Frank Rubio safely landed on Earth with his crewmates Wednesday. Rubio departed the International Space Station, along with Roscosmos cosmonauts Sergey Prokopyev and Dmitri Petelin, at 3:54 a.m. EDT, and made a safe, parachute-assisted landing at 7:17 a.m. (5:17 p.m. Kazakhstan time), southeast of the remote town of Dzhezkazgan, Kazakhstan.

“Frank’s record-breaking time in space is not just a milestone; it’s a major contribution to our understanding of long-duration space missions,” said NASA Administrator Bill Nelson. “Our astronauts make extraordinary sacrifices away from their homes and loved ones to further discovery. NASA is immensely grateful for Frank’s dedicated service to our nation and the invaluable scientific contributions he made on the International Space Station. He embodies the true pioneer spirit that will pave the way for future exploration to the Moon, Mars, and beyond.”

Rubio launched on his first spaceflight on Sept. 21, 2022, alongside Prokopyev and Petelin. Rubio’s spaceflight is the longest single spaceflight by a U.S. astronaut, breaking the record previously held at 355 days by NASA astronaut Mark Vande Hei.

During his mission, Rubio completed approximately 5,936 orbits and a journey of more than 157 million miles, roughly the equivalent of 328 trips to the Moon and back. He witnessed the arrival of 15 visiting spacecraft and the departure of 14 visiting spacecraft representing crewed and uncrewed cargo missions.

Rubio’s extended mission provides researchers the opportunity to observe the effects of long-duration spaceflight on humans as the agency plans to return to the Moon through the Artemis missions and prepare for exploration of Mars.

Rubio, Prokopyev, and Petelin launched aboard the Soyuz MS-22 spacecraft but, due to a coolant leak, returned to Earth aboard the Soyuz MS-23. The affected Soyuz MS-22 capsule returned without its crew after the Soyuz MS-23 capsule launched as a replacement on Feb. 23, 2023.

Following post-landing medical checks, the



crew will return to Karaganda, Kazakhstan. Rubio will then board a NASA plane bound for his return to Houston. During his record-breaking mission, Rubio spent many hours on scientific activities aboard the space station, conducting a variety of tasks ranging from plant research to physical sciences studies.

With the undocking of the Soyuz MS-23 spacecraft, Expedition 70 officially began aboard the station. NASA astronauts Loral O’Hara and Jasmin Moghbeli remain aboard the orbital outpost alongside ESA (European Space Agency) astronaut Andreas Mogensen, who became station commander Sept. 26, JAXA (Japan Aerospace Exploration Agency) astronaut Satoshi Furukawa, and Roscosmos cosmonauts Konstantin Borisov, Oleg Kononenko, and Nikolai Chub.

Mogensen, Moghbeli, Furukawa, and Borisov will return to Earth in February 2024, after a short handover with the crew of NASA’s SpaceX Crew-8 mission. O’Hara is scheduled to return to Earth in March 2024, while Kononenko and Chub will spend a year aboard the station, returning in September 2024.

## Terran Orbital Selected by LM to Build Satellite Buses for SDA’s T2TL Constellation

Lockheed Martin has awarded Terran Orbital Corporation a contract to build 36 satellite buses for Space Development Agency’s (SDA) Tranche 2 Transport Layer (T2TL) Beta constellation. Terran Orbital will deliver the buses to Lockheed Martin, which will conduct payload integration and jointly operate the satellites with SDA.

SDA’s T2TL Beta constellation will advance the Proliferated Warfighter Space Architecture’s (PWSA) initial warfighting capability with targeted technology enhancements, mission-focused payload configurations, and increased integration. The PWSA provides a resilient, low-latency communication system to connect warfighter platforms worldwide and help the military target threats and detect and track missiles.

“We congratulate Lockheed Martin on another big contract win in support of SDA’s Transport Layer mission,” said Marc Bell, Terran Orbital Chairman and Chief Executive Officer. “We are proud that Lockheed Martin has selected Terran Orbital to deliver high-quality satellite buses for a vital mission to connect and protect U.S. military personnel worldwide.”

Terran Orbital is currently building 42 buses for Lockheed Martin to help the company fulfill its \$700 million contract for the SDA’s Tranche 1 Transport Layer (T1TL), currently scheduled for a late 2024 launch.

Last spring, Terran Orbital completed a successful Critical Design Review and Manufacturing Readiness Review for the T1TL satellite buses, which are manufactured in the company’s small satellite production facilities in Irvine, California. The MRR confirmed Terran Orbital’s readiness to manufacture and deliver all 42 T1TL satellite buses.

Now, with the completion of Terran Orbital’s T1TL MRR and Lockheed Martin’s CDR, Terran Orbital will deliver the 42 satellite buses to Lockheed Martin for payload integration and testing in the company’s new 20,000-square-foot small satellite assembly facility near Denver. The same facilities will eventually be used for payload integration and testing of the 36 T2TL Beta satellite buses.

Last year, Terran Orbital delivered 10 satellite buses to Lockheed Martin in support of their Tranche 0 Transport Layer contract with SDA. The T2TL Beta satellites are scheduled to be deployed into low Earth orbit during a series of launches starting in 2026.



Spacepreneur Editor  
kartikya in conversation with

**Dr.(Hon).M.R.K Menon**

Founder & CEO - Global Aerosports

**Q** Can you brief us about your journey to our readers?



*I am 66 not out and have been involved in Aerospace Education for 15 years now. Worked with 100,000 students and 200 Plus Teachers in 6 Countries. Built 4 Aerospace Museums in Schools and looking for a suitable place to build my next one. Just converted my Hobby into a Career and enjoying it.*





**Q** Space Industry is evolving very rapidly in India and globally, what are the current Skills/Courses you are currently offering?

**A** We offer a 50 Hour Live Course called the Aerospace Ambassador Program that covers. Aeromodelling, Model Rocketry, Drone Technology, Space Technology, Astronomy and Arduino Circuits. Besides that we train Science, Maths and IT Teachers to implement STEM based methods in their Teaching. This ia 10 Hour Live Certificate Program.

**Q** Tell us something about the process of getting enrolled for Courses as Individuals & Schools?

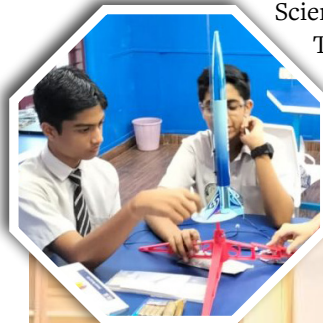
**A** Schools hear about us and then contact us. I do a Free Rocketry and Space Program for them. This usually translates into a longer relationship.

**Q** What are the challenges and opportunities you see in Indian space industry in next 5 Years?

**A** There are opportunities galore for Experts in Space Technology to start their own Organization's by collaborating with ISRO and other entities. The challenge is to find Funding and a trained work force.

**Q** What is your message to youngsters who wish to choose space industry as their Career?

**A** This is the best time to go for studies leading to careers in the Aerospace Sector. Both Civil/ Military Aviation and the Space Sector are going to see unprecedented growth trajectories. I see a tremendous shortage of trained Aerospace Engineers, Scientists, Technicians, Educationists etc.



**Q** As a Space Tutor, what would you like to achieve in next 2 years? How ISRO is helping you & what kind of more implementations you expect from ISRO?

**A** I am focussed on building an Aerospace Park in India which will be easily accessible to kids in India/ Asia. The entire plan is ready. Just looking for 100 Crore in Funding.

I am grateful to ISRO for recognising me as a Space Tutor. As Founder Secretary of Aero Club of India recognised Rocketry Society, I hope to conduct Rocketry and Cansat competitions with the blessings of ISRO.

I am also Chief Mentor to an ISRO Funded Space Innovation Lab in a Govt University in Odisha.I am praying that the project will be implemented soon.

**For Further Details**  
» Contact : +919746335285 » mrk.menon@yahoo.com





## Discovery Alert: The Planet that Shouldn't Be There

**THE DISCOVERY:** A large planet is somehow orbiting a star that should have destroyed it.

**KEY FACTS:** Planet 8 Ursae Minoris b orbits a star some 530 light-years away that is in its death throes. A swollen red giant, the star would have been expected to expand beyond the planet's orbit before receding to its present (still giant) size. In other words, the star would have engulfed and ripped apart any planets orbiting closely around it. Yet the planet remains in a stable, nearly circular orbit. The discovery of this seemingly impossible situation, relying on precise measurements using NASA's Transiting Exoplanet Survey Satellite (TESS), shows that planet formation – and destruction – are likely far more intricate and unpredictable than many scientists might have thought.

**DETAILS:** As stars like our Sun approach the ends of their lives, they begin to exhaust their nuclear fuel. They become red giants, expanding to their maximum size. If that happened in this case, the star would have grown outward from its center to 0.7 astronomical units – that is, about three-quarters the distance from Earth to the Sun. It would have swallowed and destroyed any nearby orbiting planets in the process. But planet b, a large gaseous world, sits at about 0.5 astronomical units, or AU. Because the planet could not have survived engulfment, Marc Hon, the lead author of a recent paper on the discovery, instead proposes two other possibilities: The planet is really the survivor of a merger between two stars, or it's a new planet – formed out of the debris left behind by that merger.

The first scenario begins with two stars about the size of our Sun in close orbit around each other, the planet orbiting both. One of the stars "evolves" a bit faster than the other, going through

its red giant phase, casting off its outer layers and turning into a white dwarf – the tiny but high-mass remnant of a star. The other just reaches the red giant stage before the two collide; what remains is the red giant we see today. This merger, however, stops the red giant from expanding further, sparing the orbiting planet from destruction. In the second scenario, the violent merger of the two stars ejects an abundance of dust and gas, which forms a disk around the remaining red giant. This "protoplanetary" disk provides the raw material for a new planet to coalesce. It's a kind of late-stage second life for a planetary system – though the star still is nearing its end.

**FUN FACTS:** How can astronomers infer such a chaotic series of events from present-day observations? It all comes down to well understood stellar physics. Planet-hunting TESS also can be used to observe the jitters and quakes on distant stars, and these follow known patterns during the red-giant phase. (Tracking such oscillations in stars is known as "asteroseismology.") The pattern of oscillations on 8 Ursae Minoris, the discovery team found, match those of red giants at a late, helium-burning stage – not one that is still expanding as it burns hydrogen. So it isn't that the star is still growing and hasn't yet reached the planet. The crisis has come and gone, but the planet somehow continues to exist.

**THE DISCOVERERS:** The paper describing the TESS result, "A close-in giant planet escapes engulfment by its star," was published in the journal *Nature* in June 2023 by an international science team led by astronomer Marc Hon of the University of Hawaii.

## NASA Conducts 1st Hot Fire of New RS-25 Certification Test Series

**N**ASA conducted the first hot fire of a new RS-25 test series Oct. 17, beginning the final round of certification testing ahead of production of an updated set of the engines for the SLS (Space Launch System) rocket. The engines will help power future Artemis missions to the Moon and beyond.

Operators fired the RS-25 engine for more than nine minutes (550 seconds), longer than the 500 seconds engines must fire during an actual mission, on the Fred Haise Test Stand at NASA's Stennis Space Center, near Bay St. Louis, Mississippi. Operators also fired the engine up to the 111% power level needed during an SLS launch. The hot fire marked the first in a series of 12 tests scheduled to stretch into 2024. The tests are a key step for lead SLS engines contractor Aerojet Rocketdyne, an L3Harris Technologies company, to produce engines that will help power the SLS rocket, beginning with Artemis V.

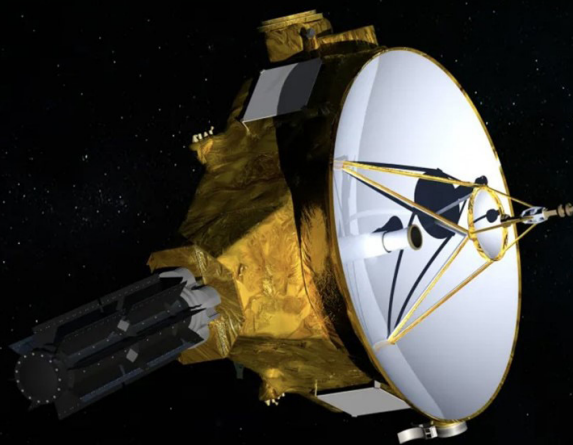
The test series will collect data on the performance of several new key engine components, including a nozzle, hydraulic actuators, flex ducts, and turbopumps. The components match design features of those used during the initial certification test series completed at the south Mississippi site in June. Aerojet Rocketdyne is using advanced manufacturing techniques, such as 3D printing, to reduce the cost and time needed to build the new engines. Four RS-25 engines help power SLS at launch, including on its Artemis missions to the Moon.

Through Artemis, NASA is returning humans, including the first woman and the first person of color, to the Moon to explore the lunar surface and prepare for flights to Mars. SLS is the only rocket capable of sending the agency's Orion spacecraft, astronauts, and supplies to the Moon in a single mission.





# NASA's New Horizons to Continue Exploring Outer Solar System



NASA has announced an updated plan to continue New Horizons' mission of exploration of the outer solar system. Beginning in fiscal year 2025, New Horizons will focus on gathering unique heliophysics data, which can be readily obtained during an extended, low-activity mode of operations.

While the science community is not currently aware of any reachable Kuiper Belt object, this new path allows for the possibility of using the spacecraft for a future close flyby of such an object, should one be identified. It also will enable the spacecraft to preserve fuel and reduce operational complexity while a search is conducted for a compelling flyby candidate.

"The New Horizons mission has a unique position in our solar system to answer important questions about our heliosphere and provide extraordinary opportunities for multidisciplinary science for NASA and the scientific community," said Nicola Fox, associate administrator for NASA's Science Mission Directorate in Washington. "The agency decided that it was best to extend operations for New Horizons until the spacecraft exits the Kuiper Belt, which is expected in 2028 through 2029."

This new, extended mission will be primarily funded by NASA's Planetary Science Division and jointly managed by NASA's Heliophysics and Planetary Science Divisions.

NASA will assess the budget impact of continuing the New Horizons mission so far beyond its original plan of exploration. As a starting point, funding within the New Frontiers program (including science research and data analysis) will be rebalanced to accommodate extended New Horizons operations, and future projects may be impacted.

Launched on January 18, 2006, NASA's New Horizons spacecraft has helped scientists understand worlds at the edge of our solar system by visiting the dwarf planet Pluto (its primary mission) and then venturing farther out for a flyby of the Kuiper belt object Arrokoth, a double-lobed relic of the formation of our solar system, and other more remote observations of similar bodies.

The Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland, designed, built and operates the New Horizons spacecraft, and manages the mission for NASA's Science Mission Directorate. The Marshall Space Flight Center Planetary Management Office provides the NASA oversight for the New Horizons. Southwest Research Institute, based in San Antonio, directs the mission via Principal Investigator Stern, and leads the science team, payload operations and encounter science planning. New Horizons is part of the New Frontiers Program managed by NASA's Marshall Space Flight Center in Huntsville, Alabama.

## Thales Alenia Space celebrates 60 years of expertise and innovation in Belgium

Thales Alenia Space, the joint company between Thales (67%) and Leonardo (33%), is celebrating its 60th anniversary in Belgium during Business Discovery Day on Sunday, October 1st. Held at the company's Charleroi plant, the celebration will be attended by local elected officials, employees and their families, business partners and stakeholders in the local economy. The company is solidly anchored in Charleroi, home to its Belgian headquarters.

Over the last 60 years, the company has contributed to most European space programs and to a large number of satellites from around the world. Thales Alenia Space in Belgium is the country's largest space company and a world leader in electrical power supplies for satellites. More than 170 satellites now in orbit use equipment from Thales Alenia Space in Belgium.

The company has contributed to European launch vehicles since the 1970s, from Ariane 1 to Ariane 5, along with Vega and Soyuz launches from the Guiana Space Center in Kourou, French Guiana. In addition, Thales Alenia Space in Belgium supplies power and control electronics for Ariane 6's nozzle control and range safety systems.

"With this 60th anniversary celebration in Belgium, we're honoring not only our longstanding heritage, but also the future we're building along with our employees and local partners to spur major technological advances across the satellite industry," said Emmanuel Terrasse, Vice President, European Countries & Equipment at Thales Alenia Space.



# Arianespace's Next Vega Mission Will Embark 12 Passengers

Arianespace's next mission is targeted on Friday, October 6, 2023 at 10:36 p.m. local time (October 7, at 01:36 a.m. UTC), from Europe's Spaceport in French Guiana with a Vega launcher. The mission, called VV23, will place its passengers into sun-synchronous orbit.

This mission will embark a main passenger, THEOS-2, and a secondary one, FORMOSAT-7R/TRITON:

THEOS-2 is a high-resolution Earth observation optical satellite, part of the next-generation national geo-information system provided by Airbus Defence and Space to support the Kingdom of Thailand's key development priorities. Delivering 0.5-meter ground resolution imagery, this end to end system will complement THEOS-1, launched in 2008 for Thailand, one of the few nations in the world able to fully exploit geo-information for societal benefits.

FORMOSAT-7R/TRITON, developed by the Taiwanese Space Agency (TASA), is equipped with the Global Navigation Satellite System-Reflectometry (GNSS-R), which collects signals that bounce off the sea surface. It helps scientists calculate the wind field over the oceans. This data will be shared with the global meteorology community, contributing to the forecast of typhoon intensity and trajectory.

The 21st mission of Europe's Vega light launcher will also orbit ten auxiliary payloads for six different clients:

ANSER (Advanced Nanosatellite Systems for Earth observation Research) LEADER, ANSER FOLLOWER 1 and ANSER FOLLOWER 2. This cluster of three cubesats working together to study and monitor the quality of inland (reservoirs) water over Iberian Peninsula is led by the Instituto Nacional de Técnica Aeroespacial. The launch services is funded by the IOD/IOV program of the European Union.

ESTCube-2, manufactured by the University of Tartu (Estonia), aims to demonstrate deorbiting with plasma brake technology and qualify a deep-space nanospacecraft platform for future missions that will use the electric solar wind sail. The launch services for this mission is funded by the IOD/IOV



program of the European Union.

N3SS (Nanosat 3U pour la Surveillance du Spectre) project is a demonstration system for detecting and localize radio-frequency jammers on civil spectrum. CNES is responsible for the system and satellite development and also in charge of the in-flight operations of the satellite. U-Space is the prime contractor for the platform development and the satellite AIT/AIV.

PRETTY (Passive Reflectometry and dosimetry) and MACSAT that will be launched on behalf of SAB-LS. The first one is a 3U cubesat with a primary payload equipped with a passive reflectometer in the L5 Band for GPS and Galileo; and the second one is an in-orbit demonstration (IOD) mission to demonstrate IoT (Internet of things) communication over 5G.

PVCC (Proba-V Companion Cubesat), a 12U cubesat aiming at testing the performance of the payload on a cubesat platform in order to provide data to support the calibration of cubesat Earth observation missions. PVCC is an ESA mission lead by ESA/TEC for the design, launch and commissioning phases and by ESA/ESRIN and ESA/REDU for the operational and end-of-life phases.

CSC-1 & 2, two 6U multi-payload IOD cubesats aggregating 7 payloads from 5 countries: Belgium, Spain, Estonia, France and Czechia. They are part of the European Union IOD/IOV program for which ISISPACE/ISL is responsible for the mission implementation.

These small satellites will be carried as auxiliary payloads on the innovative Small Spacecraft Mission Service (SSMS) deployment system. The SSMS rideshare service, developed with the support of the European space industry, was first deployed by Arianespace in September 2020. Funded by the European Space Agency (ESA), Arianespace's SSMS service will soon be joined by the Multiple Launch Service (MLS), a similar offering designed for the Ariane 6 launch vehicle. With these two services, Arianespace can offer a wide range of affordable launch opportunities for small satellites and constellations.

Ten European countries contribute to Vega, which was developed by ESA, with the Italian Space Agency ASI as lead contributor and Avio (based in Colleferro, Italy) as the launcher prime contractor. Avio is in charge of all industrial operations up to liftoff. Vega has been part of the Arianespace launcher family since its first flight in 2012.

# Rocket Lab Integrating Twin Spacecraft for Mission to Mars for NASA

Rocket Lab USA, Inc. a global leader in launch services and space systems announced that the two spacecraft the Company is building for NASA's Escape and Plasma Acceleration and Dynamics Explorers (ESCAPADE) mission have entered the system integration phase in preparation for a planned launch in 2024.

The ESCAPADE mission, led by Dr. Rob Lillis at the University of California, Berkeley's (UCB) Space Sciences Laboratory (SSL), is a twin-spacecraft science mission that will orbit Mars to investigate the structure, composition, variability, and dynamics of Mars' unique hybrid magnetosphere. The mission will explore how the solar wind strips atmosphere away from Mars to better understand how its climate has changed over time. Each spacecraft will carry an instrument suite that includes a magnetometer for measuring magnetic field, an electrostatic analyzer to measure ions and electrons, and a Langmuir probe for measuring plasma density and solar extreme ultraviolet flux.

To ensure that the two spacecraft are ready for the harsh environment of space and their roughly 230-million-mile journey to the red planet, the Rocket Lab Space Systems team has successfully passed System Integration Review (SIR) and is proceeding with integration of the flight hardware in preparation for launch. Integration includes both the spacecraft bus with Rocket Lab-manufactured solar arrays, reaction wheels, star trackers, separation systems, radios, and flight software and the flight instruments being delivered from UCB and other mission partners. In addition to a battery of functional tests to verify performance, the spacecraft are undergoing a full environmental test campaign, including vibration, thermal vacuum, and electromagnetic compatibility testing. The Company has also concluded RF compatibility testing with NASA's Deep Space Network (DSN), which will communicate with Rocket Lab's Frontier-X radios on both spacecraft and provide navigation services to the mission.

"Reaching the flight integration phase for a new spacecraft is a significant milestone, especially for a complex interplanetary mission like this," said Rocket Lab founder and CEO Peter Beck. "Building on the successful delivery of a spacecraft to lunar orbit for NASA last year, it's a privilege to be developing a spacecraft headed for deep space to perform Decadal-class science with our partners at UC Berkeley."



The ESCAPADE spacecraft integration and test is taking place at Rocket Lab's advanced spacecraft development and manufacturing complex within the Company's Long Beach headquarters. The facility includes a 12,000 sq. ft. cleanroom and 40,000 sq. ft. of production & test facilities designed to support constellation class manufacturing and satellite assembly, integration and test for commercial, civil and national security customers.

ESCAPADE is being developed under NASA's Small Innovative Missions for Planetary Exploration (SIMPLEX) program in the Science Mission Directorate (SMD) and is the first Heliophysics mission to another planet. The mission is led by the University of California, Berkeley's (UCB) Space Sciences Laboratory (SSL) with spacecraft provided by Rocket Lab. The two spacecraft are planned for launch in 2024 to low Earth orbit aboard a Blue Origin New Glenn launch vehicle provided by NASA. Rocket Lab's spacecraft will then perform the Mars transfer from Earth orbit, 11-month cruise to Mars, and Mars orbit insertion before achieving a "string of pearls" orbit formation in advance of the science phase beginning in 2026.

## General Atomics Acquires EO Vista, LLC

General Atomics announced that it has acquired EO Vista, LLC, a leader in the development of advanced space-based and airborne electro-optical payloads, based in Acton, MA. Its business will be integrated into the General Atomics Electromagnetic Systems (GA-EMS) group.

"EO Vista has a proven track record of rapid innovation that set new standards for performance and affordability in electro-optical payload designs," said Scott Forney, president of GA-EMS. "We look forward to bringing EO Vista's unique capabilities on board as we continue to expand our weather and science programs and our growing portfolio of sensor system payload designs to support a wide range of customer requirements, including Intelligence, Surveillance, and Reconnaissance missions."

EO Vista is currently providing the advanced Electro-Optical Infrared (EO/IR) weather sensor payload to GA-EMS under their contract with the U.S. Space Force, Space Systems Command, to deliver an EO/IR Weather System (EWS) satellite to support the transition from the Defense Meteorological Support Program (DMSP) on-orbit systems to a new generation of affordable, high performance, small weather satellites. "The EO Vista team is excited to join General Atomics, a company whose commitment to delivering innovative solutions in support of the national interest strongly aligns with our legacy," said Dr. Steven Wein, president of EO Vista.



# NASA's Voyager Team Focuses on Software Patch, Thrusters

Engineers for NASA's Voyager mission are taking steps to help make sure both spacecraft, launched in 1977, continue to explore interstellar space for years to come. One effort addresses fuel residue that seems to be accumulating inside narrow tubes in some of the thrusters on the spacecraft. The thrusters are used to keep each spacecraft's antenna pointed at Earth. This type of buildup has been observed in a handful of other spacecraft. The team is also uploading a software patch to prevent the recurrence of a glitch that arose on Voyager 1 last year. Engineers resolved the glitch, and the patch is intended to prevent the issue from occurring again in Voyager 1 or arising in its twin, Voyager 2.

## THRUSTER BUILDUP

The thrusters on Voyager 1 and Voyager 2 are primarily used to keep the spacecraft antennas pointed at Earth in order to communicate. Spacecraft can rotate in three directions – up and down, to the left and right, and around the central axis, like a wheel. As they do this, the thrusters automatically fire and reorient the spacecraft to keep their antennas pointed at Earth.

Propellant flows to the thrusters via fuel lines and then passes through smaller lines inside the thrusters called propellant inlet tubes that are 25 times narrower than the external fuel lines. Each thruster firing adds tiny amounts of propellant residue, leading to gradual buildup of material over decades. In some of the propellant inlet tubes, the buildup is becoming significant. To slow that buildup, the mission has begun letting the two spacecraft rotate slightly farther in each direction before firing the thrusters. This will reduce the frequency of thruster firings.

The adjustments to the thruster rotation range were made by commands sent in September and October, and they allow the spacecraft to move almost 1 degree farther in each direction than in the past. The mission is also performing fewer, longer firings, which will further reduce the total number of firings done on each spacecraft.

The adjustments have been carefully devised to ensure minimal impact on the mission. While more rotating by the spacecraft could mean bits of science data are occasionally lost – akin to being on a phone call where the person on the other end cuts



out occasionally – the team concluded the plan will enable the Voyagers to return more data over time. Engineers can't know for sure when the thruster propellant inlet tubes will become completely clogged, but they expect that with these precautions, that won't happen for at least five more years, possibly much longer. The team can take additional steps in the coming years to extend the lifetime of the thrusters even more.

"This far into the mission, the engineering team is being faced with a lot of challenges for which we just don't have a playbook," said Linda Spilker, project scientist for the mission as NASA's Jet Propulsion Laboratory in Southern California. "But they continue to come up with creative solutions."

## PATCHING THINGS UP

In 2022, the onboard computer that orients the Voyager 1 spacecraft with Earth began to send back garbled status reports, despite otherwise continuing to operate normally. It took mission engineers months to pinpoint the issue. The attitude articulation and control system (AACS) was misdirecting commands, writing them into the computer memory instead of carrying them out. One of those missed commands wound up garbling the AACS status report before it could reach engineers on the ground.

The team determined the AACS had entered into

an incorrect mode; however, they couldn't determine the cause and thus aren't sure if the issue could arise again. The software patch should prevent that.

"This patch is like an insurance policy that will protect us in the future and help us keep these probes going as long as possible," said JPL's Suzanne Dodd, Voyager project manager. "These are the only spacecraft to ever operate in interstellar space, so the data they're sending back is uniquely valuable to our understanding of our local universe."

Voyager 1 and Voyager 2 have traveled more than 15 billion and 12 billion miles from Earth, respectively. At those distances, the patch instructions will take over 18 hours to travel to the spacecraft. Because of the spacecraft's age and the communication lag time, there's some risk the patch could overwrite essential code or have other unintended effects on the spacecraft. To reduce those risks, the team has spent months writing, reviewing, and checking the code. As an added safety precaution, Voyager 2 will receive the patch first and serve as a testbed for its twin. Voyager 1 is farther from Earth than any other spacecraft, making its data more valuable.

The team will upload the patch and do a readout of the AACS memory to make sure it's in the right place on Friday, Oct. 20. If no immediate issues arise, the team will issue a command on Saturday, Oct. 28, to see if the patch is operating as it should.

# NASA's Webb Captures an Ethereal View of NGC 346



One of the greatest strengths of NASA's James Webb Space Telescope is its ability to give astronomers detailed views of areas where new stars are being born. The latest example, showcased here in a new image from Webb's Mid-Infrared Instrument (MIRI), is NGC 346 – the brightest and largest star-forming region in the Small Magellanic Cloud.

The Small Magellanic Cloud (SMC) is a satellite galaxy of the Milky Way, visible to the unaided eye in the southern constellation Tucana. This small companion galaxy is more primeval than the Milky Way in that it possesses fewer heavy elements, which are forged in stars through nuclear fusion and supernova explosions, compared to our own galaxy. Since cosmic dust is formed from heavy elements like silicon and oxygen, scientists expected the SMC to lack significant amounts of dust. However the new MIRI image, as well as a previous image of NGC 346 from Webb's Near-Infrared Camera released in January, show ample dust within this region.

In this representative-color image, blue tendrils trace emission from material that includes dusty silicates and sooty chemical molecules known as polycyclic aromatic hydrocarbons, or PAHs. More diffuse red emission shines from warm dust heated by the brightest and most massive stars

in the heart of the region. An arc at the center left may be a reflection of light from the star near the arc's center. (Similar, fainter arcs appear associated with stars at lower left and upper right.) Lastly, bright patches and filaments mark areas with abundant numbers of protostars. The research team looked for the reddest stars, and found 1,001 pinpoint sources of light, most of them young stars still embedded in their dusty cocoons.

By combining Webb data in both the near-infrared and mid-infrared, astronomers are able to take a fuller census of the stars and protostars within this dynamic region. The results have implications for our understanding of galaxies that existed billions of years ago, during an era in the universe known as "cosmic noon," when star formation was at its peak and heavy element concentrations were lower, as seen in the SMC. The James Webb Space Telescope is the world's premier space science observatory.

Webb is solving mysteries in our solar system, looking beyond to distant worlds around other stars, and probing the mysterious structures and origins of our universe and our place in it. Webb is an international program led by NASA with its partners, ESA (European Space Agency) and the Canadian Space Agency.

## Webb Pinpoints a High-speed Jet Stream on Jupiter

Researchers using the NASA/ESA/CSA James Webb Space Telescope's NIRCams (Near-Infrared Camera) have discovered a high-speed jet stream sitting over Jupiter's equator, above the main cloud decks.

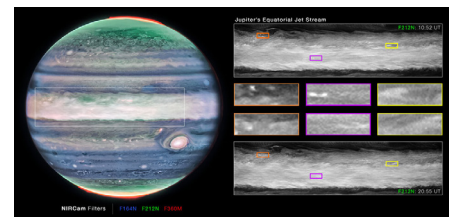
Researchers spotted several wind shears, or areas where wind speeds change with height or distance, which enabled them to track the jet. The jet is travelling at 515 km per hour and is located in Jupiter's lower stratosphere, just above the tropospheric hazes, next to the boundary between the troposphere and stratosphere layers.

This image highlights several of the features around Jupiter's equatorial zone that, during one rotation of the planet (10 hours), are very clearly disturbed by the motion of the jet stream. The discovery of this jet provides insight into how the layers of Jupiter's famously turbulent atmosphere interact with each other, and how Webb is uniquely capable of tracking those features. Researchers are looking forward to additional observations of Jupiter with Webb to determine if the jet's speed and altitude change over time.

These results were recently published in a paper in *Nature Astronomy*.

These findings may help inform ESA's Jupiter Icy Moons Explorer, *Juice*, which was launched on 14 April 2023. *Juice* will make detailed observations of the giant gas planet and its three large ocean-bearing moons – Ganymede, Callisto and Europa – with a suite of remote sensing, geophysical and in situ instruments.

*Juice* will focus on unveiling Jupiter's atmosphere upwards from the cloud tops. It will probe how temperatures, wind patterns and chemistry are changing in Jupiter's atmosphere to answer questions such as: What is the weather and climate like on Jupiter? How does an atmosphere work when there is no solid surface?





## Astronomers Detect Most Distant Fast Radio Burst to Date

An international team has spotted a remote blast of cosmic radio waves lasting less than a millisecond. This 'fast radio burst' (FRB) is the most distant ever detected. Its source was pinned down by the European Southern Observatory's (ESO) Very Large Telescope (VLT) in a galaxy so far away that its light took eight billion years to reach us. The FRB is also one of the most energetic ever observed; in a tiny fraction of a second it released the equivalent of our Sun's total emission over 30 years.

The discovery of the burst, named FRB 20220610A, was made in June last year by the ASKAP radio telescope in Australia and it smashed the team's previous distance record by 50 percent.

"Using ASKAP's array of dishes, we were able to determine precisely where the burst came from," says Stuart Ryder, an astronomer from Macquarie University in Australia and the co-lead author of the study published today in *Science*. "Then we used [ESO's VLT] in Chile to search for the source galaxy, finding it to be older and further away than any other FRB source found to date and likely within a small group of merging galaxies."

The discovery confirms that FRBs can be used to measure the 'missing' matter between galaxies, providing a new way to 'weigh' the Universe.

Current methods of estimating the mass of the Universe are giving conflicting answers and challenging the standard model of cosmology. "If we count up the amount of normal matter in the Universe — the atoms that we are all made of — we find that more than half of what should be there today is missing," says Ryan Shannon, a professor at the Swinburne University of Technology in Australia, who also co-led the study. "We think that the missing matter is hiding in the space

between galaxies, but it may just be so hot and diffuse that it's impossible to see using normal techniques."

"Fast radio bursts sense this ionised material. Even in space that is nearly perfectly empty they can 'see' all the electrons, and that allows us to measure how much stuff is between the galaxies," Shannon says.

Finding distant FRBs is key to accurately measuring the Universe's missing matter, as shown by the late Australian astronomer Jean-Pierre ('J-P') Macquart in 2020. "J-P showed that the further away a fast radio burst is, the more diffuse gas it reveals between the galaxies. This is now known as the Macquart relation. Some recent fast radio bursts appeared to break this relationship. Our measurements confirm the Macquart relation holds out to beyond half the known Universe," says Ryder.

"While we still don't know what causes these massive bursts of energy, the paper confirms that fast radio bursts are common events in the cosmos and that we will be able to use them to detect matter between galaxies, and better understand the structure of the Universe," says Shannon.

The result represents the limit of what is achievable with telescopes today, although astronomers will soon have the tools to detect even older and more distant bursts, pin down their source galaxies and measure the Universe's missing matter. The international Square Kilometre Array Observatory is currently building two radio telescopes in South Africa and Australia that will be capable of finding thousands of FRBs, including very distant ones that cannot be detected with current facilities. ESO's Extremely Large Telescope, a 39-metre telescope under construction in the Chilean Atacama Desert, will be one of the few telescopes able to study the source galaxies of bursts even further away than FRB 20220610A.

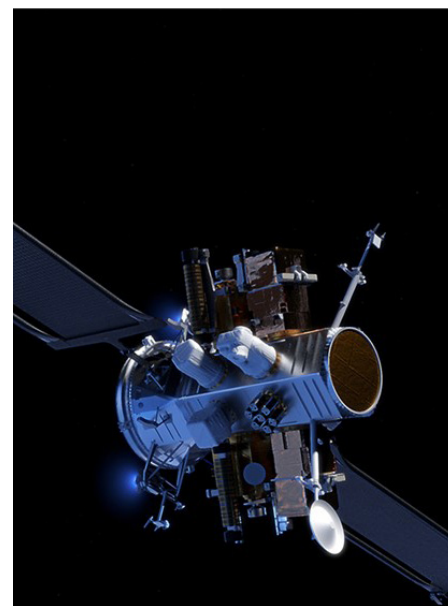
## Blue Origin Unveils Multi-Mission, Multi-Orbit Space Mobility Platform

Expanding upon its mission to build a road to space for the benefit of Earth, Blue Origin has unveiled Blue Ring, a spacecraft platform focused on providing in-space logistics and delivery.

Blue Ring serves commercial and government customers and can support a variety of missions in medium Earth orbit out to the cislunar region and beyond. The platform provides end-to-end services that span hosting, transportation, refueling, data relay, and logistics, including an "in-space" cloud computing capability. Blue Ring can host payloads of more than 3,000 kg and provides unprecedented delta-V capabilities and mission flexibility.

"Blue Ring addresses two of the most difficult challenges in spaceflight today: growing space infrastructure and increasing mobility on-orbit," said Paul Ebertz, Senior Vice President of Blue Origin's In-Space Systems. "We're offering our customers the ability to easily access and maneuver through a variety of orbits cost-effectively while having access to critical data to ensure a successful mission," Ebertz added.

Blue Ring is part of a newly formed Blue Origin business unit called In-Space Systems.



## Virgin Galactic Completes 6th Successful Spaceflight in 6 Months

Virgin Galactic Holdings, Inc announced the completion of its sixth space mission in six months and tenth to date. The 'Galactic 05' mission saw Virgin Galactic's spaceship converted into a suborbital lab for space-based scientific research for the second time.

Michael Colglazier, CEO of Virgin Galactic, said: "Providing researchers with reliable and repeatable access to a high-quality microgravity environment is vital to our mission of expanding human knowledge and enabling scientific discoveries. We are proud to support the work of the Southwest Research Institute and International Institute for Astronautical Sciences with today's flight, and we will use insights from the mission to enhance the research capabilities of our future Delta-class spaceships. We look forward to playing an increasingly important role in space research in the years ahead." Onboard 'Galactic 05':

### ASTRONAUT 020

Dr. Alan Stern, U.S. Planetary Scientist and Associate Vice President in Southwest Research Institute's (SwRI) Space Sector

### ASTRONAUT 021

Kellie Gerardi, U.S. Payload Specialist and Bioastronautics Researcher for the International Institute for Astronautical Sciences (IIAS)

### ASTRONAUT 022

Ketty Pucci-Sisti Maisonrouge, Private Astronaut

Dr. Stern flew with two human-tended experiments, including a biomedical harness to collect physiological data related to human spaceflight. He also conducted practice routines and procedures in preparation for a future NASA-funded suborbital research flight.

Dr. Alan Stern, U.S. Planetary Scientist and Associate Vice President in Southwest Research Institute's (SwRI) Space Sector, said: "The success of this mission is another important step in the development of the scientific and educational use cases for commercial suborbital vehicles. The potential here is literally astronomical."

Gerardi flew with three payloads, two of which evaluated novel healthcare technologies in microgravity conditions through the collection of biometric data. The third payload examined how confined fluid behaves to inform future healthcare technologies in space.

Kellie Gerardi, U.S. Payload Specialist and Bioastronautics Researcher for the International Institute for Astronautical Sciences (IIAS), said: "The suborbital science potential for Institutes like ours is unprecedented and I'm also struck by the broader societal impact of commercial human spaceflight — after today's mission, Virgin Galactic is now responsible for producing 10% of the world's female astronauts, and I look forward to seeing that number soar for my daughter's generation."



## NGC Selected to Deliver Nearly 40 More Data Transport Satellites for SDA's NextGen Low-Earth Orbit Constellation of Connectivity

The Space Development Agency (SDA) awarded Northrop Grumman Corporation an agreement with a total potential value of approximately \$732 million to design and build 38 data transport satellites. These satellites will support Tranche 2 Transport Layer - Alpha (T2TL-Alpha), the latest iteration of SDA's low-Earth orbit Proliferated Warfighter Space Architecture (PWSA).

- This Alpha announcement follows an August 2023 award to Northrop Grumman of 36 satellites as part of Tranche 2 Transport Layer - Beta (T2TL-Beta); Alpha and Beta satellites are designed to interoperate on orbit.
- This contract includes supporting ground elements and five years of operations and sustainment with the satellites scheduled to launch starting December 2026.
- Northrop Grumman was also awarded a contract for Tranche 1 Transport Layer 1 (T1TL), which similarly provide low latency, high volume data transport supporting U.S. military missions around the world.
- Northrop Grumman's approach to the PWSA contracts is to combine our satellite technology and mission experience with strategic commercial partnerships to move at the pace the environment demands.

### EXPERT:

Blake Bullock, vice president, communication systems, Northrop Grumman: "Northrop Grumman, in partnership with our industry teammates, is fully committed to the Space Development Agency's vision of fielding a next-generation, low-Earth orbit architecture connecting and protecting our warfighters wherever they serve. Our Northrop Grumman team is bringing our deep Military SATCOM experience to this mission, and we're executing on our commitments."

### DETAILS ON THE PROLIFERATED WARFIGHTER SPACE NETWORK:

Northrop Grumman provides both space vehicles and ground systems for the SDA's PWSA, a next-generation constellation in low-Earth orbit. PWSA has two major lines of effort:

- The Transport Layer: Designed to provide low-latency, high volume data connectivity supporting U.S. military missions around the world.
- The Tracking Layer: Designed to detect, track and ultimately target hypersonic and ballistic missiles.

Both layers are designed to interoperate in space using a common data standard allowing satellites made by various manufacturers to communicate seamlessly with one another. Taken together, these satellites are designed to connect elements of an integrated sensing architecture, and the network they create will deliver persistent, secure connectivity, serving as a critical element for Joint All Domain Command Control.

To date, SDA has announced awards to Northrop Grumman of 132 satellites.

## European Service Module for Artemis II Connected to Orion Vehicle



Just over two years ago, on 14 October 2021, the second European Service Module (ESM-2) arrived at Kennedy Space Center in Florida. Technicians have been busy preparing the spacecraft for Artemis II, which will bring its four-person crew around the Moon and back.

### TESTING THE LIMITS

ESM-2 was first connected to the Crew Module Adapter to form the complete Orion service module. From then, the service module endured a variety of tests to ensure all equipment functions correctly, communicates with each other, and will withstand the intense conditions of the launch. Two important tests include the Thermal Cycle Test which assessed how well the spacecraft will withstand the extremes of temperature, and the Direct Field Acoustic Test (DFAT), which assessed how well the spacecraft will withstand the vibrations of its launch to the Moon.

### CONNECTING THE PIECES

Now, the crew and service modules have been connected to form the Orion vehicle for Artemis II. Mechanically, these two main sections are connected at six points around the crew capsule's heat shield. Data and power connections and pipes for fluids between the sections are routed to go around the heat shield instead of crossing it.

Marco Arcioni, assembly integration and testing team leader for the European Service Module at ESA, states: "Now that the Crew and Service Modules are joined as one, we can power up the Orion vehicle and check whether all parts work together correctly. Understandably, this is a crucial step in the process; it allows the European and US teams to validate that all systems communicate with each other."

### NEXT STEPS

Next year will be a busy time for the Orion teams. The installation of the solar wings will complete the spacecraft, after which it will be transferred to NASA's Exploration Ground Systems team, where the tanks will be filled with propellant. From there, Orion will be connected to the launch abort system, and then with the mega Moon rocket, SLS, in preparation for the Artemis II launch.

The European Service Module is part of the ESA Terra Nova exploration programme leading Europe's human journey into the Solar system.

## Terran Orbital Awarded \$4.7M Contract by European Space Agency



Terran Orbital Corporation a global leader in satellite-based solutions primarily serving the aerospace and defense industries announced its wholly-owned international subsidiary, Tyvak International s.r.l., has been chosen as a prime contractor under a \$4.7 million or €4.5 million contract by the European Space Agency (ESA) for a proximity operations and in-orbit servicing mission that will deploy a nanosatellite spacecraft from Space Rider, the European uncrewed robotic laboratory.

The deployed nanosatellite will perform proximity operations maneuvers around Space Rider, demonstrating unprecedented in-orbit servicing capabilities. Space Rider will allow technology demonstration, and benefit research in pharmaceuticals, biomedicine, biology, and physical science. At the end of its mission, Space Rider will return to Earth with its payloads and land on a runway to be unloaded and refurbished for another flight. Tyvak International develops the nanosatellite to be onboarded and deployed at any time during the experimental Phase in orbit, on one of the ESA's Space Rider flight missions, paving the way for future recurring servicing missions.

This contract is in partnership with a consortium of Italian industries and research institutions, including Polytechnic University of Turin, the University of Padova, and StellarProject SRL.

"Terran Orbital is honored to be selected once again for a prime contract with the European Space Agency," said Marc Bell, Terran Orbital Co-Founder, Chairman, and Chief Executive Officer. "Using space technology for research in areas, such as proximity operations and in-orbit servicing, will be a huge benefit for our partners and the protection of precious and strategic orbital assets. I am excited to see Tyvak International s.r.l. in the forefront."



## Successful Launch Sequence Test of Ariane 6 on its Launch Pad



**D**uring the night of 23 to 24 October at the Guiana Space Centre, teams completed a full-scale 36-hour long test consisting in the execution of a full launch chronology enriched by multiple qualification tests on several launch system functions. Operators spent nine hours on a countdown to liftoff, performed once again the ignition of the Vulcain 2.1 combustion chamber and stopped as planned just before ignition of the Vulcain 2.1 engine.

This time, operations were performed at night to ensure a cooler ambient temperature. Ariane 6 tanks hold 180 tonnes of cryogenic propellant (liquid oxygen and hydrogen), so fueling takes hours from start to finish to fill the four tanks (two for the core stage and two for the upper stage). During the process, engineers are constantly adapting flow rate and monitoring temperatures (liquid hydrogen is at  $-253^{\circ}\text{C}$ ) both for the launcher and the ground installations.

The full and lengthy chronology ended after the performance of the emergency draining of the main stage tanks via the engine for validation of the procedure and final reconditioning of the launcher. One more step towards inaugural flight has been successfully performed !

## Rocket Lab Receives FAA Authorization to Resume Launches



**R**ocket Lab USA, Inc. a global leader in launch services and space systems announced it has received authorization from the Federal Aviation Administration (FAA) to resume Electron launches from Launch Complex 1.

The authorization comes after Rocket Lab experienced an in-flight anomaly on September 19th during the Company's 41st Electron launch. The FAA, the federal licensing body for U.S. launch vehicles, has now confirmed that Rocket Lab's launch license remains active, which is the first step to enable launches to resume. Rocket Lab is now finalizing a meticulous review into the anomaly's root cause, a process that involves working through an extensive fault tree to exhaust all potential causes for the anomaly, as well as completing a comprehensive test campaign to recreate the issue on the ground. The FAA is providing oversight of Rocket Lab's mishap investigation to ensure Rocket Lab complies with its FAA-approved mishap investigation plan and other regulatory requirements. In addition, the National Transportation Safety Board (NTSB) was granted official observer status to the investigation. The full review is expected to be completed in the coming weeks, with Rocket Lab currently anticipating a return to flight later this quarter with corrective measures in place.

During the September 19th mission, Electron completed a successful lift-off, first stage burn and stage separation as planned, before an issue was experienced at around two and a half minutes into flight shortly after second stage engine ignition. Flight data shows Electron's first stage performed as expected during the mission and did not contribute to the anomaly.

"After more than 40 launches, Electron is a proven, mature design with a well-established manufacturing process behind it, so we knew the fault was going to be something complex and extremely rare that hasn't presented in testing or flight before," said Rocket Lab founder and CEO Peter Beck. "Our investigation team with FAA oversight has worked around the clock since the moment of the anomaly to uncover all possible root causes, replicate them in test, and determine a path for corrective actions to avoid similar failure modes in future. We look forward to sharing the details of the review once it is fully complete ahead of returning to flight."

Electron is the second most frequently launched U.S. launch vehicle annually, relied upon by government and commercial satellite operators globally. Prior to the September 19 mission, Electron had completed 20 consecutive successful orbital launches and 37 successful missions total, deploying 171 satellites to orbit.

# India's Space and Geospatial Policies: Unlocking New Horizons



**Dr Y Nithiyandam,**  
Professor & Head of Geospatial Research  
Programme, Takshashila Institution

*ISRO has made moderate-resolution satellite remote sensing data up to 5m spatial resolution available for free to Indian citizens, which is even more than what NASA and ESA offer. This is in line with India's new Space Policy, approved in April 2023, which aims to expand India's space capabilities, open remote sensing data, and create international partnerships. The policy encourages private businesses to participate in the space economy. Another part of this development is the National Geospatial Policy, which focuses on spatial technologies and aims to achieve significant progress by 2035. This includes conducting a comprehensive survey of India's land and water resources. Many government departments are involved in this policy, and it emphasizes the link between Space and Spatial Sciences, which plays a crucial role in resource management and national development. Both policies are intended to drive India's progress in space and geospatial sectors.*



## Part I

ISRO has given us another big update this year. It's not about Chandrayan. We are still excited about Chandrayan -3 and Aditya L1 missions. But now, ISRO has a new surprise. For the first time, satellite remote sensing datasets are made available for free to the people of India. Satellite images up to five meters, which is very good. This is better than NASA's Landsat and the European Space Agency's Sentinel programs. ISRO could have done this much earlier; however, it is open today since it was one of the action points of ISRO envisaged in India's new space policy.

Now, we will discuss the great things envisaged in India's two recent attractive policies: Geospatial and space. These policies will help us do amazing things in the future.

The space policy was approved on April 6, 2023. With an ambitious vision, India aims to enhance its space capabilities, fostering a robust commercial presence in outer space. This initiative seeks to leverage space technology to catalyse technological and developmental progress, benefiting related sectors. Additionally, the vision encompasses forging international partnerships and nurturing an ecosystem conducive to effectively applying space technologies. These efforts contribute to the nation's social and economic advancement, environmental protection, and security while promoting peaceful space exploration, stimulating public awareness, and encouraging scientific curiosity.

Different strategies are envisaged in the space policy to achieve its vision. One of the keys is to include private businesses in all parts of the space economy. This means anyone can buy space technology or

services from any company, whether private or public. To do this, the government will focus on research and development in the state sector. It will use space technology for critical national projects and make rules that help private companies in the space sector. InSpace (Indian National Space Promotion & Authorisation Centre), India's new space promotion centre will help with this. The government also wants to promote education and new ideas in the space sector. They will support startups and use space to help develop new technology. They want people to be more interested in science and know more about it. Different plans have been made for non-governmental entities and InSpace. The roles of the Indian Space Research Organization and New Space Limited are also deliberated in detail, as is the Department of Space.

As we embrace the era of open-source data, it's crucial to acknowledge the National Geospatial Policy, unveiled on December 28, 2022, after Cabinet approval on December 16, 2022. This policy, focusing on the crucial aspects of spatial technologies, including Open Data Policy, aims to revolutionise various sectors with a citizen-centric approach. It builds on the February 2021 guidelines by the Department of Science and Technology, which liberalised geospatial data acquisition and services. This policy sets an overarching framework, targeting India's leadership in the global space sector, fostering innovation, and developing a national framework to transition to a digital economy. It emphasises making publicly funded geospatial data accessible to businesses and the public, aiming to cultivate a vibrant geospatial industry with significant private enterprise involvement.

Geospatial policy, in contrast to space policy, involves the intricate coordination of multiple government departments, which is a complex task. It sets ambitious milestones for significant achievements by 2025, 2030, and 2035, aiming to comprehensively survey the nation's land, water, and sub-aquatic resources by 2035. This will lead to a robust digital and geospatial infrastructure. The policy incorporates strategies and initiatives like Atmanirbhar Bharat and the Integrated



Geospatial Information Framework. It outlines detailed plans for enhancing geospatial infrastructure, including data and mapping infrastructure, roles of organisations like Survey of India, private sector engagement, and developing a National Digital Twin. The policy also emphasises the importance of surveyor registration and certification, geospatial education, and skill development. A key element is forming a committee to promote geospatial data, with specific roles for stakeholders in different thematic areas. This comprehensive approach, with clear timelines, makes it a detailed and nuanced policy compared to the Space Policy.

Space and Spatial Sciences synergy is integral, with each field heavily relying on and enhancing the other. Both Space and Spatial Sciences play a crucial role in resource management and catering to the needs of India's population. The policies governing these sectors aim to improve the lives of Indian citizens through better data availability, fostering business development, academic research, and scientific progress. They encourage innovation, particularly indigenous

innovation, and are focused on building necessary capacities in these fields. Both policies are meticulously designed to achieve specific goals and visions within set timelines, emphasising the importance of their collaborative nature in driving forward India's development.

India's Geospatial and Space policies share many common goals, yet the Geospatial Policy stands out due to its detailed approach to outlining roles, timelines, and future directions. In contrast, while delineating roles and visions, the Space Policy lacks specific timelines for achieving its goals. This difference makes tracking progress and measuring achievements more challenging for the Space Policy. Over time, observing how these policies are realised and whether respective government organisations can meet the detailed expectations set by the Geospatial Policy will be intriguing.

The Geospatial Policy, released a year earlier as a draft after considerable deliberation, is yet to significantly impact by reaching its key milestones. However, the Space Policy has already achieved a notable milestone, notably opening up new opportunities for private enterprises. This shift allows private players to utilise open data geospatially and access available satellite imagery, a significant advantage for Indian researchers who traditionally rely on foreign data sets for their scientific work. This change is expected to spur a surge in scientific research and publications based on these data sets. The availability of such data is crucial for a deeper understanding of the Indian subcontinent. It opens up numerous possibilities for business analytics, enhancing resource management, urban planning, and improving overall living conditions. The impact of these policies extends beyond scientific research, offering tangible benefits in managing resources and improving people's lives across Indian cities.

In the upcoming issues, we will explore the synergistic aspects of these two policies in detail, providing a more comprehensive understanding of their implications and benefits. Stay tuned for a deeper dive into how these policies reshape India's space and geospatial sciences approach.

# Thaicom Contracts Airbus for an OneSat Flexible Telecommunications Satellite

**T**haicom Public Company Limited, a leading Asian satellite operator and space technology company, has selected Airbus for its new generation software-defined high throughput satellite.



Airbus will provide one of its latest designed satellites - a fully reconfigurable OneSat. This Thaicom satellite will provide extended connectivity in Ku-band over the Asia-Pacific region for millions of users. Thaicom has launched and operated eight geostationary satellites. This is Thaicom's first flexible satellite, allowing for more adaptability on coverage, frequency and capacity which is crucial in such a dynamic region.

of software-defined high throughput satellite (HTS). As the world's leading satellite technology provider, we trust that Airbus will be our best choice for building our new satellite at the strategic location of 119.5 degrees East. It will allow flexibility and instant reconfiguration to adapt dynamically to the service areas and will provide a significant confidence boost for Thaicom's valued customers and partners throughout Asia Pacific. This is a significant milestone for Thaicom as we forge ahead to further grow our broadband satellite business in the region."

Positioned in orbit at 119.5° East, this state-of-the-art satellite will enable Thaicom to propose to other partner operators a share of its satellite's payload capacity, lowering their costs and still ensuring they have separate control of their individual payload capacity and flexibility.

Airbus will design and manufacture the satellite, and also provide ground control segment components. Airbus plans to deliver the satellite in 2027.

Airbus OneSat can be fully reconfigured in orbit, capable of adjusting the coverage area, capacity and frequency "on the fly" to meet evolving mission scenarios. It builds on the heritage of Airbus' ultra-reliable Eurostar geostationary telecommunication satellites and the company's constellation expertise with OneWeb. Development of the OneSat programme is supported by ESA, as well as the French Space Agency (CNES), and the UK Space Agency.

# Arianespace Signs Agreement with Intelsat for Launch of IS-45

**A**rianespace announced a contract with Intelsat to launch the IS-45 payload with Ariane 6. IS-45 will fly aboard an Ariane 6 (in its heavy version Ariane 64, shared with co-passengers). The launch target is first half of 2026.

This year marks the fourth decade since Arianespace began its storied relationship with Intelsat. Arianespace launched Intelsat 507 aboard an Ariane 1 from French Guiana in October 1983, initiating a partnership that has stood the test of time, and five different variants of the Ariane rocket. IS-45 will be the third Intelsat payload awarded to Ariane 6 after IS-41 and IS-44.

"Arianespace is honored of its four-decade long partnership with the world leading satellite company, Intelsat, said Stéphane Israël, CEO of Arianespace. In 1983, Arianespace launched the first of what would become scores of satellites for Intelsat. We are delighted to build on a heritage of trust to launch IS-45 aboard an Ariane 64 in 2026."

"Following decades of successful launches with Arianespace, we are confident that the Ariane 6 will deliver the efficiency and flexibility needed for our future missions," said Jean-Luc Froeliger, Intelsat senior VP of space systems.

IS-45 weighs about 1 metric ton at launch and is designed and built by SWISSto12, based on the company's innovative HummingSat platform.



*"This significant contract with leading satellite operator Thaicom, is the ninth order for our pioneering OneSat product line which is fully reconfigurable in orbit and provides unrivalled flexibility. This collaboration with Thaicom is a first, and we look forward to further building our relationship in the future."*

**-Jean-Marc Nasr,  
Head of Airbus Space Systems**

Patompob (Nile) Suwansiri, Thaicom's Chief Executive Officer, commented: "I am delighted that we have selected Airbus to build our new generation

# U.S. Space Force Awards Viasat Contract for Proliferated Low Earth Orbit Satellite Services

Viasat, Inc. a global leader in satellite communications announced that Inmarsat Government, now part of Viasat, was awarded a Proliferated Low Earth Orbit (PLEO) Satellite-Based Services (SBS) contract by the U.S. Defense Information Systems Agency (DISA) on behalf of the U.S. Space Force's (USSF) Space Systems Command (SSC). Inmarsat Government is one of 16 companies selected for the \$900 million ceiling, 10-year Indefinite Delivery, Indefinite Quantity (IDIQ) contract.

As the United States and its mission partners become increasingly reliant on space-based capabilities for national security, it is critical to have resilient constellations that include satellites in geostationary (GEO) and non-geostationary orbits (NGSO). Proliferated LEO (pLEO) constellations are part of a Department of Defense (DoD) strategy to provide additional resilience for satellite communications (SATCOM), remote sensing and other capabilities by diversifying orbits.

Under this contract, Viasat plans to leverage small satellite technology, reduced costs and increased launch service competition, facilitating the ability for pLEO constellations to provide persistent, global coverage with reduced transmission latency. The company will provide a suite of fully-managed pLEO satellite-based services and capabilities, to include space relay services, supplemented by GEO and NGSO satellites, supporting all

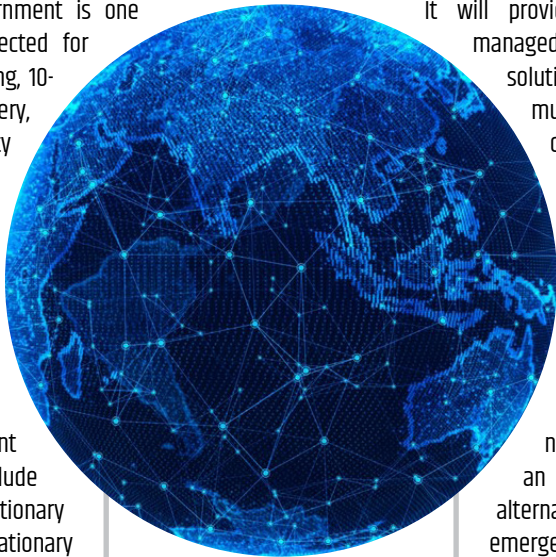
domains - space, air, land, maritime and cyber.

Viasat will aim to achieve this with a reliable, resilient low latency global pLEO offering that flexibly supports the needs of combatant commands, defense agencies, other federal government organizations and international coalition partners.

It will provide a comprehensive managed end-to-end SATCOM solution via a multi-band, multi-orbit constellation of satellites.

Furthermore, its new, hyper-intelligent software-defined wide area network (SD-WAN) is designed to orchestrate and provide priority routing across mixed networks, enabling an automated primary, alternate, contingency and emergency (PACE) solution to deliver the flexibility and responsiveness required to meet customers' needs today and in the future.

"Our team is committed to developing innovative, mission-focused solutions through our existing partnerships with satellite operators and extending opportunities with new partners. We eagerly look forward to using both our technologies and deep problem solving expertise to deliver resilient, robust and secure SATCOM capabilities to service members around the



*"Viasat has a proud history of providing integrated SATCOM solutions and service offerings across multiple bands and orbits to support government customers' unique needs."*

**-Susan Miller,  
President, Viasat  
Government**

world," said Susan Miller.

As a leading satellite network integrator, Viasat has worked with trusted satellite owners/operators to provide the bandwidth government customers require at a cost-effective price point.

## RTX to Begin International Deployment of Ground-Based Low Earth Orbit Observation System

Raytheon's UK-based space domain awareness specialist - announced the international deployment of its Low Earth Orbit Optical Camera Installation, called LOCI, that was built and developed in the United Kingdom. Raytheon is an RTX (NYSE: RTX) business.

This ground-based space domain awareness sensor system is being deployed in the Sierra Mountains, California, in the United States and has been tailored to tackle the challenges of low-Earth orbit optical observation. LOCI provides critical observation data on objects in low-Earth orbit, including space debris, defence assets and commercial spacecraft.

"By deploying LOCI, we are expanding our existing sensor network internationally to improve our coverage and, ultimately, our awareness of what is occurring on orbit," explained Sean Goldsbrough, head of Raytheon NORSS. "These intelligently selected locations will increase the quantity and quality of data we're collecting and allow our customers deeper insights into what is happening with and around their assets of interest and the overall space environment."

The Sierra Mountains are an ideal location for deployment given their minimal light pollution and cloud coverage, allowing LOCI to capture high quality images with limited environmental interference. Further international locations are already under discussion as the Raytheon NORSS team looks to expand its capabilities in coming years.

"The space domain already shapes our way of life, and our ability to monitor and support assets in orbit is critical to ensuring space continues to yield the technological benefits we associate with it," Goldsbrough said. "With the global deployment of LOCI, a technology that places Raytheon at the forefront of space-based technologies, we can provide our partners with a more comprehensive picture of what is taking place in low Earth orbit."

LOCI was developed by Raytheon NORSS in Northumberland, UK using internal research and development funding.

## CORRECTING and REPLACING NASA's Psyche— Maxar Space Systems' First Deep Space Spacecraft— Performing Well After Launch



**N**ASA's longest mission to use commercial solar electric propulsion (SEP) is underway after launch earlier. Maxar Space Systems, provider of comprehensive space technologies, built the unique spacecraft chassis based on the Maxar 1300™ series bus, the world's most trusted space platform. The Maxar Space Systems-built Psyche chassis spread its two solar arrays and successfully started maneuvers toward the asteroid belt.

This Maxar 1300 spacecraft is one of the lightest and smallest ever, showing the versatility of the platform. Despite its small size, Psyche packs a powerful propulsion system for a one-way journey that will travel 2.2 billion miles (3.6 billion kilometers) throughout the life of the mission. In fact, it carries the largest load of Xenon ever aboard a spacecraft to help power its thrusters. The thrusters will use electromagnetic fields to accelerate and expel charged atoms, or ions, of that xenon. Expelling those ions will create the necessary thrust to move Psyche through space.

"Psyche will break records for deep space travel using SEP," said Chris Johnson, CEO for Maxar Space Systems. "Maxar leads the industry in propulsion systems that use the Sun's energy to keep a mission moving. Psyche's propulsion system is three times as powerful as SEP systems on more than 40 spacecraft we've built, and we're producing a more powerful version for the Power and Propulsion Element of NASA's Gateway space station."

Maxar was selected to provide the spacecraft platform for the Psyche mission under a firm-fixed-price contract. The Psyche spacecraft will travel beyond Mars to study a metal-rich asteroid in 2029, where it will spend 26 months orbiting and collecting data from its 140-mile-wide target. The Psyche mission is led by Arizona State University. NASA's Jet Propulsion Laboratory, a division of Caltech in Pasadena, California, is responsible for the mission's overall management, system engineering, integration and test, and mission operations.

In addition to Psyche, NASA will use the Maxar 1300 platform and SEP technology for the NASA Gateway Power and Propulsion Element under the Artemis Program. NASA's other missions that use this platform include the OSAM-1 mission and the spacecraft that hosts the Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument.

## Relativity Space and Intelsat Sign Multi-Launch Agreement for Terran R



**R**elativity Space, the preeminent 3D printed rocket company, announced that it has signed a multi-year, multi-launch Launch Services Agreement (LSA) with Intelsat, operator of the largest integrated space and terrestrial network in the world. Under the agreement, Relativity will launch Intelsat satellites on Terran R as early as 2026.

As a medium-to-heavy-lift, reusable launch vehicle made for growing satellite launch demand and eventually multiplanetary transport, Terran R provides both government and commercial customer's affordable access to space, in LEO, MEO, GEO and beyond. Relativity has a total of nine signed customers for Terran R, including multiple launches and totaling more than \$1.8 billion in backlog.

"We are honored to be working with Intelsat to launch future spacecraft into their industry leading satellite fleet," said Tim Ellis, Co-Founder and CEO of Relativity Space. "They have an incredible company and team as a world leader in content connectivity with nearly 60 satellites already in orbit. The space industry clearly requires more commercially competitive, diversified, and disruptive launch capacity. Relativity is developing Terran R as a customer-focused reusable launch vehicle to solve this need. We look forward to planning, executing, and successfully launching these missions together with Intelsat."

"After 60 years of commercial satellite launches, Intelsat and our customers have come to expect reliability, efficiency and flexibility from our launch providers," said Jean-Luc Froeliger, Intelsat Senior Vice President of Space Systems. "Relativity has developed an innovative design and production process for the Terran R, which will deliver benefits to Intelsat for years to come."

Terran R was developed to accommodate the growing demand for large constellation launch services. With a payload fairing that offers the right market fit to meet a variety of needs, Terran R supports use cases from dedicated payload deployments of constellation customers or single geosynchronous satellites to rideshare configurations for multiple customers per launch. Putting customers first, Relativity is designing and manufacturing rockets that offer high performance and reliability, while costing less to produce and fly.

Terran R is designed and manufactured at Relativity's headquarters in Long Beach, CA, which is home to its fourth generation Stargate metal 3D printers. Stage and engine testing is conducted at NASA's Stennis Space Center in Mississippi and Terran R will launch Intelsat missions from Space Launch Complex 16, Relativity's orbital launch site at Cape Canaveral Space Force Station in Florida.

## UKSA and JAXA Confirm Bilateral Collaboration for Viasat and MHI to Develop Inrange Satellite-Based Launch Telemetry System for Japanese H3 Launch Vehicle

The UK Space Agency (UKSA) and Japan Aerospace Exploration Agency (JAXA) have agreed to start bilateral collaboration to develop an in-orbit telemetry relay service, called "InRange", which will be demonstrated on the H3 launch vehicle.

The bilateral collaboration for InRange builds upon the Memorandum of Cooperation (MoC) signed between both space agencies in 2021. Under this framework, InRange is jointly funded through UKSA's International Bilateral Fund for the development of a new in-orbit telemetry relay service for space launch vehicles using Inmarsat-Viasat's global L-band network in geosynchronous orbit by Viasat and through JAXA for the transmitter and antenna development for the H3 launch vehicle by Mitsubishi Heavy Industries, Ltd. (MHI).

The UKSA contract announced today for Viasat is valued at £17M.

Viasat's InRange service will reduce the dependency of launch providers on traditional ground-based infrastructure by providing a global in-orbit telemetry solution, using Viasat's geostationary ELERA L-band satellite network.

By using the InRange service for the H3 Launch vehicle, launch trajectories can be optimized by removing reliance of line-of-sight coverage with ground stations during critical stages of the launch. In some cases, this will also reduce the fuel required to deliver spacecraft into orbit which will increase the mass available for the launch customer's payload.

Viasat and MHI will work in collaboration to validate the InRange service and demonstrate the capability on an H3 launch. Japanese company NEC Space Technologies, Ltd. will also take part in this project, focusing on the L-band transmitter design which will be integrated into the H3 launch vehicle by MHI. JAXA will collaborate with the parties and play a technical role in integrating InRange into the ground infrastructure.

Dr Paul Bate, Chief Executive of the UK Space Agency, said: "the InRange service will be transformative for launch capabilities around the world, helping to make launch more sustainable by reducing both fuel needs and pressure on ground-based systems, so that spacecraft can take off on their journeys more efficiently.

"The UK Space Agency's commitment to this project with ViaSat, Mitsubishi Heavy Industries and our counterparts at JAXA, through our International Bilateral Fund, puts into practice our firm belief that space is a team sport and that working together with organisations



around the world is what enables us to break the barriers of space technology."

Gary Lay, Vice President of Viasat's Global Government department, said: "we are delighted to be chosen as a flagship project that demonstrates the deepening ties between the UK and Japan's respective space industries. We believe Viasat are ideally positioned to provide a reliable, responsive and cost-effective global telemetry system using our unique L-band ELERA network for Japan's sovereign launch capability."

Masashi Okada, Project Manager, H3 Project Team, Space Transportation Technology Directorate of JAXA, said: "JAXA remains delighted to announce the launch of the InRange project. We would like to thank the UK Space Agency for selecting the InRange project as a project that will contribute to strengthening the economic and strategic relations between the UK and Japan in space. The InRange service will increase the flexibility of the H3's flight trajectories, and that will enable the H3 to meet the diverse needs of the launch customers than before. We will step up our efforts so as to successfully deliver the second test flight and will continue to promote the development of the H3 by realizing this project."

Atsutoshi Tamura, Vice President and Senior General Manager of Space Systems at MHI said: "MHI is delighted to work with Viasat on this innovative project, InRange. During planning of a launch vehicle's flight trajectories, we sometimes experience constraints due to limited visibility of the launch vehicle from ground stations. We believe that InRange is a solution that reduces such constraints and it will help us to continue to provide flexible launch services to a wide range of customers, for example commercial satellite operators and those planning planetary missions. We hope that this project will promote further collaboration between the UK and Japan in the space development industry."

## THEOS-2 Airbus-built satellite for Thailand successfully launched

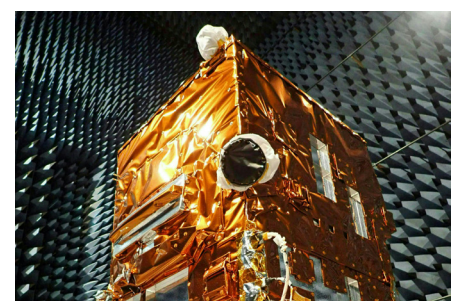
The Airbus-built THEOS-2 Earth observation satellite has been successfully launched on a Vega rocket from Kourou, Europe's spaceport in French Guiana. The Geo-Informatics and Space Technology Development Agency of Thailand (GISTDA) selected Airbus as partner for its next-generation national geo-information system in 2018.

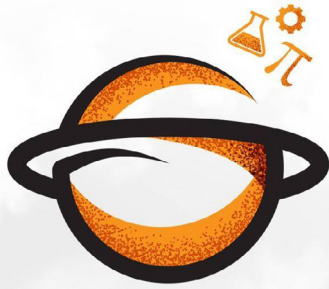
Jean-Marc Nasr, Head of Space Systems at Airbus, said: "This successful launch of THEOS-2, with its 50cm imagery, confirms Thailand's position in the small circle of nations with sovereign access to high resolution geostrategic information. We will continue to support GISTDA's ambitions to establish an all-encompassing geo-information system for the benefit of the Kingdom of Thailand."

THEOS-2 follows the Airbus-built THEOS-1 satellite launched in 2008, which still continues to deliver imagery well beyond its 10-year operational lifetime. In the frame of THEOS-2 programme, GISTDA's geo-information system benefits from satellite imagery collected by the Airbus constellation of optical and radar Earth observation satellites such as Pléiades and TerraSAR-X.

The contract also includes a second Earth observation satellite - THEOS-2 SmallSAT - from Airbus' subsidiary SSTL, combined with a comprehensive capacity building programme involving Thai engineers in the development of applications, ground segment and the SmallSAT spacecraft itself. THEOS-2 SmallSAT is based on SSTL's CARBONITE series of Earth observation spacecraft and has been delivered to Thailand.

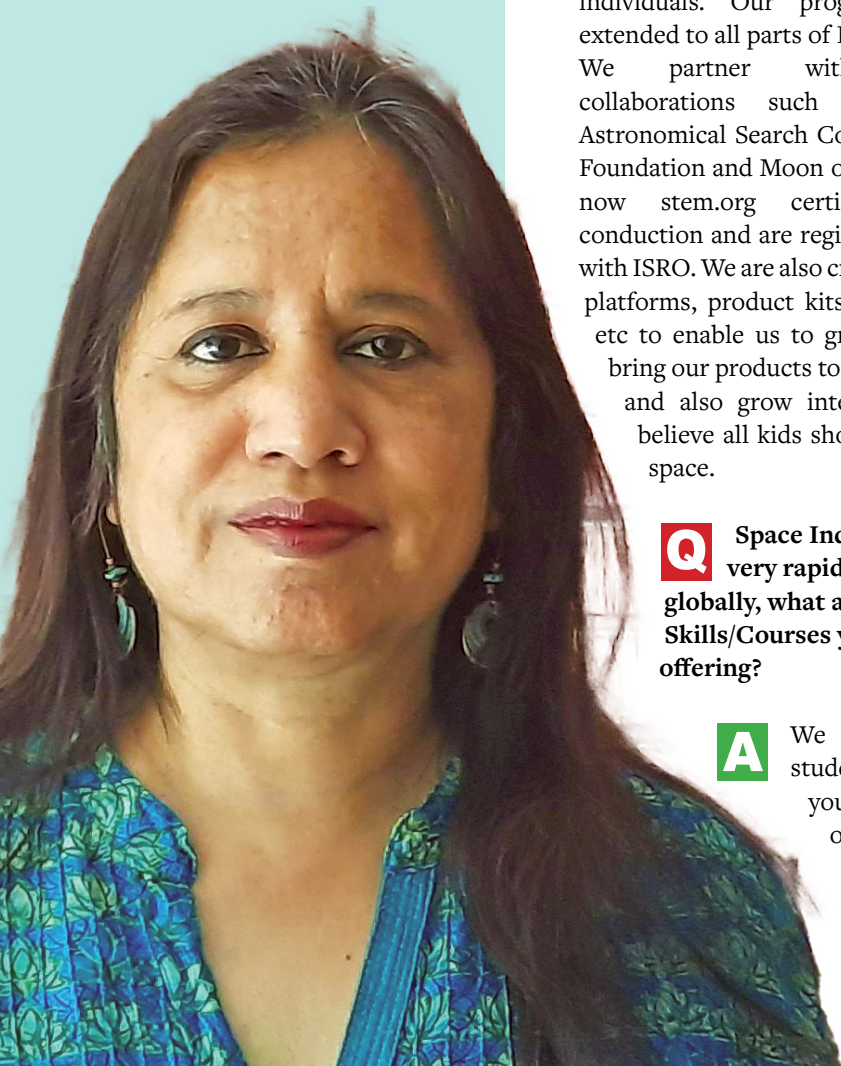
SSTL also proposes a training programme for GISTDA to enable Thai engineers to design, manufacture, integrate and test similar small satellites in Thailand in the future. The images from THEOS-2 programme will be key for GISTDA's future Thai Earth observation system which will be used for supporting various aspects, including but not limited to, social and security management, city and economic corridor management, natural resource and ecosystem management, water management, disaster management and agricultural management.





**STEM & SPACE**

Spacepreneur  
Editor kartikeya in  
conversation with  
**Dr. Mila Mitra**  
Co Founder, STEM  
& SPACE , Former  
NASA Scientist



**Q** Can you brief us about your journey to our readers?

**A** At STEM & Space, we recognize that STEM (Science Technology Engineering Math) is a unique and increasingly popular educational concept – STEM is interdisciplinary, investigative, hands on learning and is the way of the future. Space and Astronomy has always excited people, and as a subject it contains all aspects of STEM and hence is called the “Mother of all sciences”, hence it is the perfect platform to engage in STEM. It is essential to foster an interest in STEM at a young age. STEM & Space empowers schools, educators, and parents to engage young minds, ignite scientific curiosity, and foster a passion for space exploration through innovative programs, captivating platforms and engaging learning resources. With this concept, we started our journey about 5 years ago. With time, we have developed a bouquet of engaging products and platforms to interest schools as well as individuals. Our programs have now extended to all parts of India and also UAE. We partner with international collaborations such as International Astronomical Search Collaboration, Aldrin Foundation and Moon over Us, etc. We are now stem.org certified for STEM conduction and are registered space tutors with ISRO. We are also creating more online platforms, product kits, learning libraries etc to enable us to grown in scope and bring our products to all corners of India and also grow internationally as we believe all kids should have access to space.

**Q** Space Industry is evolving very rapidly in India and globally, what are the current Skills/Courses you are currently offering?

**A** We aim to engage students from a very young age, grade 3 onwards and our products cater all the way to grade 10. Our products

aim to learn about different aspects of STEM through topics in the space domain. We touch on topics in physics, math, geography, remote sensing, earth sciences etc. We build skills in space and astronomy such as learning about telescopes, understanding the night sky, using virtual telescopes, astronomy software and data analysis. We also build skills which are very relevant in STEM such as experimentation, investigation, computing, engineering. Model making, solving problems etc.

**Some of our highlighted courses**

- Observing with telescopes and learning about the night sky
- Telescope making workshop
- Celebrating Chandrayaan – 3
- Light and Optics – Making a spectroscope
- How satellites communicate – Data digitization
- Topography
- Giant Mars and Moon maps – an award winning floor map

**Additionally, we engage students in project based learning**

- » **Asteroid Search Campaign:** A month long project in collaboration with IASC (International Asteroid Search Campaign) and Pan Starrs Observatory where students get access to real telescope data of the sky and use software to look for asteroids. Several students have made real discoveries of asteroids in this project
- » **Sally Ride EarthKAM** Students get the opportunity to participate in a program to select locations of geographical interest and request a camera onboard the International Space Station to get photographs of this location





## Special Engagements

### » Cosmic Kids Club

An online portal combining education and entertainment – videos, comics, live webinars

### » National Astronomy Challenge

A space based olympiad style challenge preceded by engagements and webinars by experts

### » School Portal

Sessions placed online as videos, presentations and demonstrations – School memberships would enable teachers to conduct it themselves with accompanying kits

**Q** Tell us something about the process of getting enrolled for Courses as Individuals & Schools?

**A** We announce upcoming projects and workshops to a large set of schools in our database and provide information about the projects. Schools reach out to students and get registrations done and give us the lists of participants.

For individuals, we conduct social media campaigns and mailers for projects such as Asteroid Search campaign.

We hold frequent webinars and engagements such as Kahoot bases quizzes and padlet challenges to attract the attention of students.

**Q** What are the challenges and opportunities you see in Indian space industry in next 5 Years?

**A** With the recent successes of missions such as Chandrayaan 3 and Aditya-L1, the space industry is poised to boom in India. The Prime Minister has also proposed a roadmap targeting an Indian based space station and

humans on the Moon. Correlated to this growth, we see possibilities of great interest in space education as space has caught the interest of students and the public.

This roadmap also indicates that the space economy in India will grow and career prospects in space and related industries will also see growth over the next 10 to 20 years. These future career possibilities will greatly interest the students of today and we believe there will be significant interest in gaining knowledge and acquiring skills which will make them ready for such futures.

**Q** What is your message to youngsters who wish to choose space industry as their Career?

**A** India's space industry is already at the threshold of tremendous growth. India has already achieved great stature internationally as a space power. The Prime Minister has proposed a roadmap whereby India will continue to grow rapidly in these fields, with several missions proposed including Gaganyaan, a mission to Venus, an Indian space station etc.

We encourage all students to join us to learn about this exciting domain and imbibe skills which will help them embark on career paths related to this industry which is going to soar.

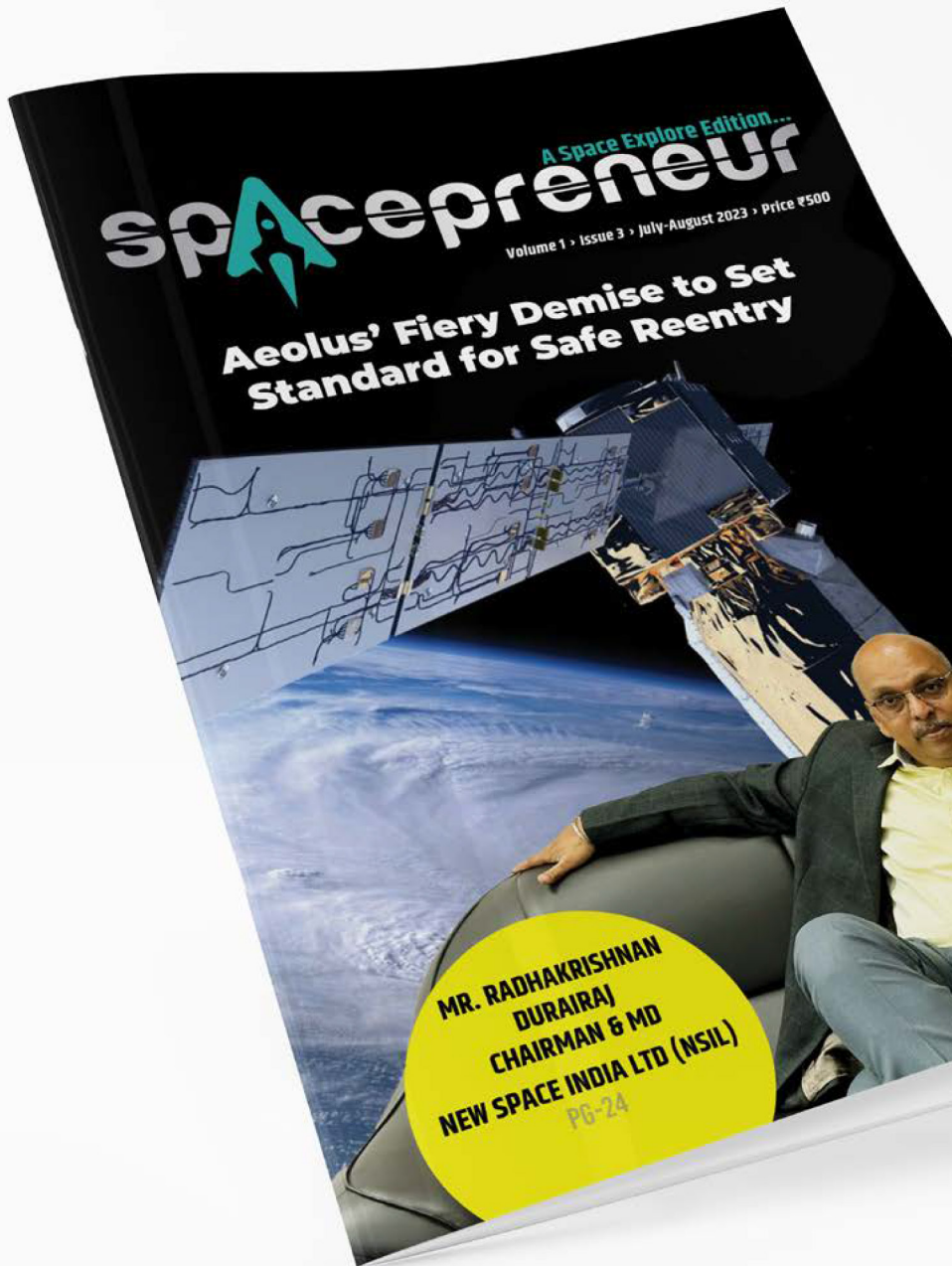
**Q** As a Space Tutor, what would you like to achieve in next 2 years? How ISRO is helping you & what kind of more implementations you expect from ISRO?

**A** As a space tutor, we are really looking forward to tapping into the enthusiasm that people in India have developed towards space in recent years. We feel this momentum is going to grow. We aim to foster this interest in students and teach them the skills and knowledge that will put them along the correct pathway towards such careers in the future.

As an ISRO tutor, we will continuously strive to build such future ready skills. We also aim to continue our efforts in science outreach so that students are aware of current and future space missions and achievements.

ISRO has been providing us with outreach and educational material related to upcoming missions and we hope ISRO will continue to provide us with educational material. ISRO has also been organizing competitions and quizzes to promote upcoming missions and we aim to spread this far and wide and engage students associated with us in such national level competitions. Occasionally, ISRO holds workshops in space topics which are suitable for universities and high schools and we would greatly appreciate if such workshops would also be held for middle schools.

We have ourselves taken some students to ISRO at Trivandrum and would like the possibility of field trips to ISRO centers.



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