A Space Explore Edition...

spacepreneur

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Mr. Sravan Varma Datla
Navars Edutech Pvt Ltd (Pg. 24)

Mr. P Radhakrishnan
ISRO (Pg. 18)

Mr. Rajesh Muneshwar
VIHAAN SPACETECH (Pg. 32

Mr.Suyash Singh
Galaxeye (Pg. 30)

Mr. GOVIND YADAV
Vyomika Space (Pg. 35)

Mr. Abhigna Yerramreddikalva
Galaxeye (Pg. 42)

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FIND INSIDE spacepreneur

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
kartikeya@futureaviation.in

Hello my dear readers,

With this edition spacepreneur magazines completes 1 Year. Our entire team is so happy to be a part of India's space Journey. 2023 is a landmark year for ISRO & Entire Nation. "The Government of India has declared August 23 of every year as 'National Space Day'.

Being the New Year I take great pleasure in introducing Dr. (Hon).M.R.K Menon an acknowledged Expert in the field of Aerospace Education. He has significant training and experience in the field of Magazine Publishing from New York and will prove to be a great asset our growing organization. His unique style of interviewing achievers in the field of Aerospace will add great depth to our coverage.

Regular dosage of Global news, launches, fund raise you can flip through the magazine. We have interacted with Mr. Rajesh Muneshwar Founder of VIHAAN SPACETECH & other conversation Mr.Suyash Singh Co- Founder of Galaxeye feels recent steps from the Govt are very supportive of the private space ecosystem.

As a regular space tutors interaction with Mr. Sravan Varma Datla, CEO & Co-Founder - Navars Edutech Pvt Ltd says India's space industry encounters challenges in funding, tech advancement, and global competition. Vyomika Space is all set to installing around 170 Space Labs in over 40 Districts of India to empower more than 22000 rural students says Mr. GOVIND YADAV, Founder & CEO - Vyomika Space.

Our Contributing Editor Dr.(Hon) MRK Menon interacted with Industry veteran Mr. P Radhakrishnan, Retd. Deputy Director (Systems Reliability & Quality Assurance) ISRO & Experimental Rocketry Space kid conversation with Mr. Abhigna Yerramreddikalva feels the main challenge that he faces as he build rockets in India is a lack of government regulations and just a lack of information on how to safely engage in the hobby.

We always strive to bring up pertinent business challenges and highlight critical aspects of the astronomy sector's expansion. One Such issue is Space Education & Skilled Manpower. Spacepreneur is launching national Space Competition for Schools & Colleges. More details will be published in the next edition.

There is a saying which I would like to end by vote of thanks to our beloved and devoted readers. There is no wrong time to do the right thing.

Happy New Year wishes to all.

"We always strive to bring up pertinent business challenges and highlight critical aspects of the astronomy sector's expansion."

spacepreneur

Team

B. Kartikeya
EDITOR-IN-CHIEF & PUBLISHER

EDITORIAL

Special Editor
Prof D.Vivekananda

Contributing Editor
Dr (Hon) MRK Menon

SPACEPRENEUR CORRESPONDENTS
Rohith Reddy

Marketing

Head Marketing
Ms. Naheda Imtiyaz
+91 9492938822

Manager, Marketing (North & West)
Rohith Reddy

ART & DESIGN

Creative Head & Art Director
Swati Sharma (Design Garage)

PHOTOGRAPHER
Krishanth

INTERNATIONAL

For Europe Advertisements
Jubin Josepsh
+33 758933925,
jubin.joseph@bluespacegroup.com

SUBSCRIPTION

Sony

HOW TO REACH US

Hyderabad
No Villa No. 105,
Nakshatra Society, Siddanthi,
Shamshabad, Hyderabad,
Telangana 501218, INDIA

For all magazine related enquires

E-mail
kartikeya@futureaviation.in

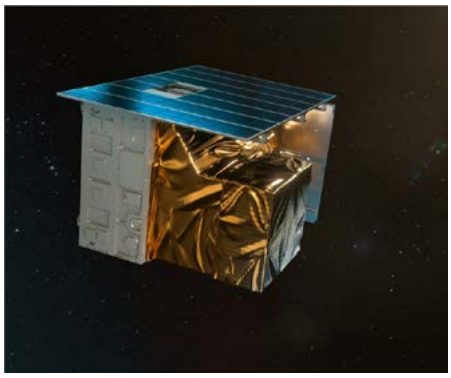
Turn to page 45

LM Technology Demo to Showcase Faster On-Orbit Sensor Calibration

Lockheed Martin will soon launch a unique wideband Electronically Steerable Antenna (ESA) payload demonstrator to show the company's investment in advanced technology to perform missions faster once on orbit.

Based on an innovative, proprietary design, Lockheed Martin expects to calibrate this new ESA sensor in a fraction of the time it takes to operationalize traditional on-orbit sensors, which historically can take months to be powered on, fully calibrated and ready to perform their mission.

The payload demonstrator, which will launch aboard Firefly Aerospace's Alpha rocket, extends Lockheed Martin's significant investment in scalable wideband ESA technology development to showcasing an actual on-orbit capability. This technology is critical to future remote sensing architectures.



"Our customers' mission needs and operational tempo have increased dramatically," said Maria Demaree, vice president and general manager of National Security Space at Lockheed Martin Space. "We designed this technology to showcase how a highly producible ESA antenna could be built, launched, and quickly calibrated and fielded on orbit, in support of 21st Century Security."

The ESA payload is built on a novel, scalable design, using highly reliable commercial parts for quick, mass-producibility. For this demonstration, it was integrated on a Terran Orbital Nebula small satellite bus.

The payload, nicknamed Tantrum, was developed in Lockheed Martin Space's Ignite organization, a new team established to target three main missions: exploratory research and development, accelerating the pace of technology development and, lastly, introducing new product innovations.

"Within the Ignite construct, the payload was developed from early architecture to flight-ready product in 24 months on an accelerated schedule piloting many streamlined agile processes," said Sonia Phares, vice president of Ignite at Lockheed Martin Space. "For this demonstration, Lockheed Martin has invested its own resources and is embracing more calculated risks from initial development through on-orbit operations to bring new technologies to the forefront of space faster and to keep our customers ahead of ready."

Airbus Awarded UKSA Grant to Develop Space Catalyst in Stevenage

Airbus Defence and Space in the UK has been awarded £3.9 million from the UK Space Agency (UKSA) to create a space and connectivity catalyst at its headquarters in Stevenage. Airbus will create a range of facilities at its 14 acre site available to new and existing space players to encourage growth in the wider space ecosystem. The new Space Catalyst will be part of Airbus' Community for Space Prosperity (CUSP) programme which aims to grow the activity of the UK space supply chain, research and outreach activities.

Ben Bridge, Chairman of Airbus Defence and Space UK said: "We have always been committed to encouraging new entrants into the UK's vibrant space economy, and this award will enable us to take it to the next level. By building dedicated facilities at our Stevenage headquarters, new and existing space players will be able to take advantage of the laboratories, test facilities and existing infrastructure and tap into the expertise of the 1,200 skilled workforce based on site, further strengthening the UK's sovereign space capability."

Dr Paul Bate, Chief Executive of the UK Space Agency, said: "This is an exciting opportunity for Airbus to create a range of new space facilities in Stevenage to support the wider sector, as part of its Community for Space Prosperity (CUSP) programme. Infrastructure like this will help ensure the UK stays at the forefront of international space missions and fosters advanced capabilities, generating more opportunities for business, suppliers and researchers, and inspiring the future workforce.

"The Space Clusters Infrastructure Fund highlights the government's commitment to space and will help deliver the goal set out in the National Space Strategy to build one of the most innovative and attractive space economies in the world, developing new skills and creating jobs."

Hughes JUPITER 3 Satellite Begins Over the Air Testing with the Ground System

Hughes Network Systems, an EchoStar company announced its JUPITER™ 3 ultra-high-density satellite has successfully deployed its solar arrays and antennas, and the spacecraft has passed readiness testing by the manufacturer, Maxar Space Systems. Hughes is now testing the satellite communications with ground equipment, which is the final step before initiating broadband services for customers such as airlines, corporations, governments, and consumers of its popular HughesNet service. The JUPITER 3 satellite will bring over 500 Gbps of additional broadband capacity across North and South America.

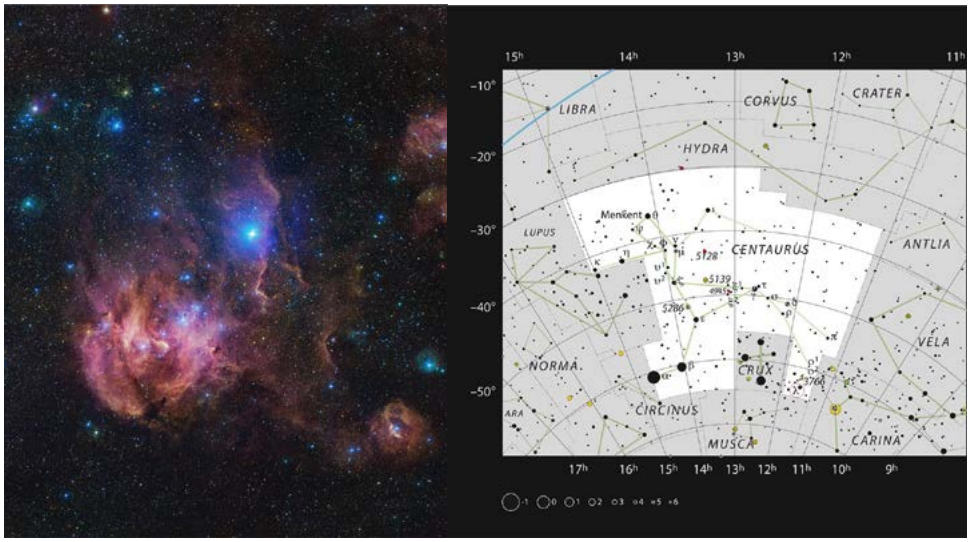
"Reaching this milestone demonstrates the engineering excellence and innovation our team infused into this satellite," said Hamid Akhavan, CEO, EchoStar. "As the largest commercial satellite ever built, JUPITER 3 will double the capacity of our fleet serving more customers who live beyond the reach of cable and fiber internet by providing ubiquitous connectivity throughout the Americas. This achievement is a testament to the strength of our JUPITER System technology, the de facto standard for satellite connectivity."

The increased capacity of JUPITER 3 will power new HughesNet® satellite internet plans, including innovative HughesNet Fusion® Plans that use multipath technology to reduce latency for a more responsive internet experience.

JUPITER 3 will support the efforts by Hughes to bridge the digital divide and provide internet access to rural customers across the Americas, as well as applications such as in-flight Wi-Fi for airline passengers, enterprise networking, and cellular backhaul for mobile network operators (MNOs).

The JUPITER 3 orbital position is 22,236 miles (35,786 kilometers) above the equator at 95 degrees west.

New 1.5-billion-pixel ESO Image Shows Running Chicken Nebula in Unprecedented Detail



While many holiday traditions involve feasts of turkey, soba noodles, latkes or Pan de Pascua, this year, the European Southern Observatory (ESO) is bringing you a holiday chicken. The so-called Running Chicken Nebula, home to young stars in the making, is revealed in spectacular detail in this 1.5-billion-pixel image captured by the VLT Survey Telescope (VST), hosted at ESO's Paranal site in Chile.

This vast stellar nursery is located in the constellation Centaurus (the Centaur), at about 6500 light-years from Earth. Young stars within this nebula emit intense radiation that makes the surrounding hydrogen gas glow in shades of pink.

The Running Chicken Nebula actually comprises several regions, all of which we can see in this vast image that spans an area in the sky of about 25 full Moons. The brightest region within the nebula is called IC 2948, where some people see the chicken's head and others its rear end. The wispy pastel contours are ethereal plumes of gas and dust. Towards the centre of the image, marked by the bright, vertical, almost pillar-like, structure, is IC 2944. The brightest twinkle in this particular region is Lambda Centauri, a star visible to the naked eye that is much closer to us than the nebula itself.

There are, however, many young stars within IC 2948 and IC 2944 themselves – and while they might be bright, they're most certainly not merry. As they spit out vast amounts of radiation, they carve up their environment much like, well, a chicken. Some regions of the nebula, known as Bok globules, can withstand the fierce bombardment from the ultraviolet radiation pervading this region. If you zoom in to the image, you might see them: small, dark, and dense pockets of dust and gas dotted across the nebula.

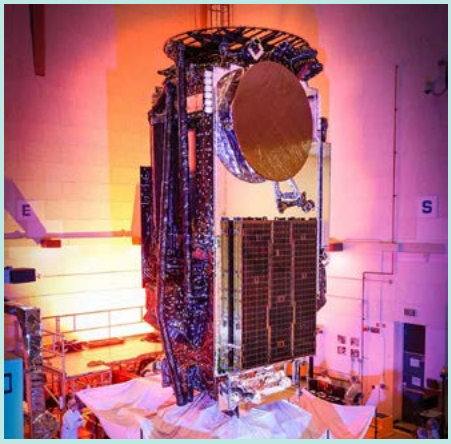
Other regions pictured here include, to the upper right, Gum 39 and 40, and to the lower right, Gum 41. Aside from nebulae, there are countless orange, white and blue stars, like fireworks in the sky. Overall in this image, there are more wonders than can be described – zoom in and pan across, and you'll have a feast for the eyes.

This image is a large mosaic comprising hundreds of separate frames carefully stitched together. The individual images were taken through filters that let through light of different colours, which were then combined into the final result presented here. The observations were conducted with the wide-field camera OmegaCAM on the VST, a telescope owned by the National Institute for Astrophysics in Italy (INAF) and hosted by ESO at its Paranal site in Chile's Atacama Desert that is ideally suited for mapping the southern sky in visible light. The data that went into making this mosaic were taken as part of the VST Photometric Hα Survey of the Southern Galactic Plane and Bulge (VPHAS+), a project aimed at better understanding the life cycle of stars.

L3Harris Space Reflectors Successfully Deploy on the Largest Commercial Satellite

L3Harris Technologies successfully deployed reflectors onboard the Hughes JUPITER™ 3 ultra high-density satellite to provide HughesNet® internet access across the Americas and to support enterprise networks, in-flight Wi-Fi, cellular backhaul and community Wi-Fi solutions.

"L3Harris designed and delivered four reflectors for the largest commercial communications satellite ever built," said Ed Zoiss, President, Space and Airborne Systems, L3Harris. "In the fast-paced, complex world of satellite communications, customers need solutions that decrease mission risk and cost while answering the call to deliver data at higher speeds in the most remote locations. Our space antennas do exactly that."



L3Harris is a supplier of large reflector apertures and deployable mesh reflector-feed antenna systems for UHF-Band through K-Band and all orbital regimes. The reflectors also feature a mesh-reflective surface that maximizes antenna gain and provides improved performance required for mobile media services.

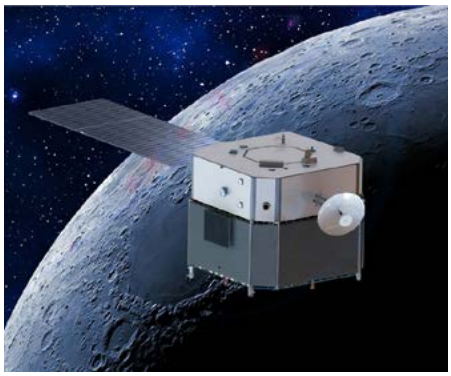
L3Harris built JUPITER 3's reflectors in Palm Bay, Florida. L3Harris has delivered more than 100 large deployable reflectors and continues to push the boundaries of space antenna technology.

Thales Alenia Space to Provide Communication Transponder for Turkey's 1st Lunar Mission

Thales Alenia Space (joint venture between Thales, 67%, and Leonardo, 33%) has signed a contract with TÜBITAK Space Technologies Research Institute (TÜBITAK UZAY) to provide a Communication Transponder for AYAP-1, Turkey's first lunar mission.

The Lunar Research Program (AYAP) is an integral part of the National Space Program led by the Turkish Space Agency, with TÜBITAK UZAY in charge of the design, development, integration, test, launch and operations of the AYAP-1 spacecraft. With this project, Turkey aims to successfully carry out its first lunar mission and become one of the few countries that can conduct activities on the Moon with its own capabilities.

Thales Alenia Space will provide an S-Band TT&C (Tracking, Telemetry and Command) Transponder for the AYAP-1 spacecraft, a key unit to establish a communication link between the spacecraft and the ground station. The TT&C transponder is in charge of receiving the commands sent by the ground station to control the spacecraft, and sending back the telemetry with the vital information on the status of the spacecraft. The TT&C link is also instrumental to monitor the position of the spacecraft by measuring the distance to the ground station.



Stéphane Terranova, CEO of Thales Alenia Space in Spain said: "At Thales Alenia Space we are honoured by the confidence of TÜBITAK UZAY to provide the Communication Transponder for AYAP-1 spacecraft, a key element for the success of Turkey's first mission to the Moon. We're excited to contribute in the renewed ambition of humanity to explore the Earth's natural satellite."

Lunar communications expertise Thales Alenia Space site in Madrid (Spain) is a centre of excellence in space communications. With 35 years of experience in the design and production of satellite communication systems, payloads and equipment for all type of space missions - from Earth orbit to deep space, - it has participated in more than 650 satellites from space agencies and satellite operators worldwide and delivered 4,500 units. Building on their comprehensive heritage and expertise, Thales Alenia Space teams in Madrid are currently involved in 9 missions to the Moon providing lunar communications systems and equipment in S and X frequency bands for 4 lunar orbiters, 3 lunar landers, 1 lunar rover and the space station Lunar Gateway.

Among these missions are KARI's Danuri orbiter (KPLO, Korea Pathfinder Lunar Orbiter), in orbit since 2022, the first step in South Korea's lunar exploration program; NASA's VIPER rover (Volatiles Investigating Polar Exploration Rover), which will explore the South Pole of the Moon in search of water ice - a vital resource for establishing a sustainable human presence on the Moon; the ESPRIT module of the Lunar Gateway (European System Providing Refuelling Infrastructure and Telecommunication), a contribution of the European Space Agency (ESA) to the Artemis program led by Thales Alenia Space as prime contractor; and the lunar landers NOVA-C and Griffin in the frame of NASA's CLPS program (Commercial Lunar Payload Services), to bring experiments to the surface of the Moon.

MetOp 2nd Generation Weather Satellite Pair Show Off

Having satellites in different types of orbit is essential to delivering data to forecast the weather accurately. With the first Meteosat Third Generation Imager satellite safely in geostationary orbit since December 2022, it's also time to focus on its polar-orbiting cousin, the MetOp Second Generation mission. And now, for the first time, two MetOp Second Generation satellites have been brought together to stand side-by-side for testing. As its name suggests, the MetOp Second Generation mission, or MetOp-SG for short, will follow-on from the first series of MetOp satellites, which currently provide meteorological observations from polar orbit, and which have had the biggest impact on the accuracy of numerical weather prediction. The Meteosat satellites, which hover 36 000 km above the equator in geostationary orbit, can monitor rapidly evolving events for now-casting and short-term weather prediction. However, being fixed above the equator means and that some parts of Earth are never viewed.

The MetOp satellites, on the other hand, orbit Earth from pole to pole and much lower down at an altitude of 832 km, allowing them to achieve global coverage every few days and make more detailed observations. The complementarity of having satellites in both geostationary and polar orbits is key to accurate weather forecasting. Comprising six satellites in total, the new MetOp-SG mission is based on a pair of satellites, type-A and type-B, that carry different instruments. The series is set to deliver a wealth of meteorological information for over 20 years.

The main reason why MetOp Second Generation has been designed to work as a pair is because the instruments needed are so large that it takes two satellites to accommodate them. Each pair of satellites carries a total of ten instruments. The instruments are either significantly improved versions of those on the first generation or completely new, to provide measurements of unprecedented accuracy – not only for numerical weather prediction, but also for nowcasting at high latitudes, climate monitoring, atmospheric chemistry, oceanology, hydrology, and land applications. The first MetOp-SG-A satellite has been at Airbus' facilities in Toulouse, France, for about a year now, but it was recently joined by the first MetOp-SG-B satellite for a series of tests.

> *"Having the first MetOp-SG-A and MetOp-SG-B in the same cleanroom is a unique opportunity to admire both satellites and their range of instruments, all of which have been developed and manufactured in Europe."*
>
> **-Marc Loiselet,**
> ***ESA's MetOp-SG Project Manager***

ESA's MetOp-SG Project Manager, Marc Loiselet, said, "The A-type satellite carries instruments that image in the ultraviolet, visible and infrared wavelengths, and atmospheric sounders that work in the infrared and microwave frequencies."

The METimage instrument, provided by the DLR German Aerospace Center, will provide very accurate 2D images of clouds sensed in infrared and visible bands. IASI-NG, provided by the CNES French Space Agency, is an infrared sounder to provide 3D maps of atmospheric temperature and humidity as well as a spectrum of many different chemicals. In addition, the Microwave Sounder will provide 3D maps of atmospheric temperature and humidity by taking observations in the microwave frequency range. The 3MI instrument will be used to assess the impact of the aerosols on meteorology. An instrument called Radio Occultation, which by tracking satellite navigation systems including Galileo, will provide very accurate vertical profiles of temperature and humidity. This instrument is accommodated on both A-type and B-type satellites. The A-type satellite also carries the Copernicus Sentinel-5 mission to monitor air pollution and atmospheric ozone.

"The B-type satellites will provide images in the microwave and makes observations of ocean-surface winds and soil moisture," added Marc Loiselet.

The Microwave Imager will provide images of precipitation and clouds as well as profiles of water vapour. The Ice Cloud Imager will, for the first time, provide images of ice clouds, which impact Earth's radiation budget and so far not yet accounted for. The scatterometer will provide ocean surface wind vectors and soil moisture. The final payload is the ARGOS-4 data collection system to collect data from various transmitters on Earth's surface, in the sea and in the air. The MetOp-SG mission is a cooperation between Eumetsat and ESA. ESA is responsible the development of the first two satellites and, on behalf of Eumetsat for the procurement of the four recurrent satellites. Eumetsat defines the overall system and user requirements, develops the ground systems, procures the launch services, operates the satellites, and makes the data available to users. The mission is also the European component of the Joint Polar System – a collaboration between Eumetsat and the U.S. National Oceanic and Atmospheric Administration.

Both organisations' polar-orbiting satellites bring benefits to weather forecasting and climate monitoring all over the world. With Airbus as prime contractor, more than 110 companies in 17 countries are involved in building the MetOp-SG satellites. The first satellite-A and satellite-B will both be ready for launch in 2025, although the actual dates for liftoff are yet to be confirmed. The MetOp-SG satellites are also the first European satellites designed for a controlled reentry at the end of their life in orbit. This was initiated ahead of the implementation space debris mitigation regulation.

NASA's 3D-printed Rotating Detonation Rocket Engine Test a Success

NASA has achieved a new benchmark in developing an innovative propulsion system called the Rotating Detonation Rocket Engine (RDRE). Engineers at NASA's Marshall Space Flight Center in Huntsville, Alabama, successfully tested a novel, 3D-printed RDRE for 251 seconds (or longer than four minutes), producing more than 5,800 pounds of thrust.

That kind of sustained burn emulates typical requirements for a lander touchdown or a deep-space burn that could set a spacecraft on course from the Moon to Mars, said Marshall combustion devices engineer Thomas Teasley, who leads the RDRE test effort at the center.

RDRE's first hot fire test was performed at Marshall in the summer of 2022 in partnership with In Space LLC and Purdue University, both of Lafayette, Indiana. That test produced more than 4,000 pounds of thrust for nearly a minute. The primary goal of the latest test,

Teasley noted, is to better understand how to scale the combustor to different thrust classes, supporting engine systems of all types and maximizing the variety of missions it could serve, from landers to upper stage engines to supersonic retropropulsion, a deceleration technique that could land larger payloads – or even humans – on the surface of Mars.

"The RDRE enables a huge leap in design efficiency," he said. "It demonstrates we are closer to making lightweight propulsion systems that will allow us to send more mass and payload further into deep space, a critical component to NASA's Moon to Mars vision."

Engineers at NASA's Glenn Research Center in Cleveland and researchers at Venus Aerospace of Houston, Texas, are working with NASA Marshall to identify how to scale the technology for higher performance. RDRE is managed and funded by the Game Changing Development Program within NASA's Space Technology Mission Directorate.

Green Hydrogen for Ariane 6 and More

Ariane 6 uses liquid hydrogen and liquid oxygen as fuel for its main and upper stages. Hydrogen in its gaseous form (H2) is rarely found on Earth, and so is currently produced in French Guiana from steam reforming of methanol (CH3OH).

Other processes are far more sustainable and so ESA and France's space agency CNES wish to switch to solar-powered electrolysis of water which can reduce by five the amount of carbon dioxide emitted for hydrogen production. ESA and CNES are determined to reduce the footprint of rocket launches and ground operations at Europe's Spaceport in French Guiana, and are aiming to deliver low-carbon hydrogen generated by solar-powered electrolysis of water by 2026.

Project Hyguane – a portmanteau of the French words for hydrogen, French Guiana and the local Iguanas – is a €40.5M investment in a solar farm and distribution systems and is being designed to be allowed to easily expand in the future.

The Hyguane facility could save over 3000 tonnes of equivalent carbon dioxide emissions a year when operational, while supplying up to 12% of Ariane 6

needs based on nine launches per year. The project does not stop at the space sector, by supplying hydrogen fuel cells it will allow low-carbon vehicles and hydrogen electricity generators to operate in French Guiana. The project will ease the transition to hydrogen vehicles and demonstrate that fuel cells can replace diesel-engine generators.

A hydrogen refuelling station designed and operated by SARA and a Hydrogen Competence Centre operated by MT-Aerospace are key factors in developing low-carbon transport in French Guiana as they allow for vehicle fuelling and maintenance.

The project is a large contribution to CNES and ESA's sustainability efforts to make 90% of Europe's Spaceport run on renewable energy by 2030.

Teddy Peponnet, head of the project for ESA, said "this novel facility will be a shining example of carbon-free production of hydrogen when it opens and we aim to set an example for a more sustainable future."

After three years of studies, the project started on 13 December with the signing of the consortium agreement between the parties involved: four companies – Air Liquide, SARA, MT-Aerospace and BEBLUE; three universities – Université de Guyane, Université de Liège, Université Libre de Bruxelles and two institutions – ESA and CNES. ADEME, the french agency in charge of ecology transition is as well part of the project, is financially supporting Hyguane with €10M.

Planned for completion in 2026, the project could be extended to double the production of hydrogen and supply additional hydrogen vehicles (such as coaches, buses, and trucks) and hydrogen electricity generators. Teddy Peponnet adds "Green hydrogen is ready to fly! The technical revolution is on its way."

RTX to Track UK Space Assets With LEO Observation System

Raytheon NORSS UK-based space domain awareness specialist – has been awarded a contract to provide the UK Space Agency with Space Surveillance and Tracking Services Data (SST) in low-Earth orbit (LEO) for Resident Space Objects (RSO). Increased international deployment of Raytheon NORSS' LOCI will provide the UK Space Agency with a wider, more comprehensive picture of objects in LEO.

Under this contract, Raytheon NORSS will use its ground-based Low-Earth Orbit Camera Installation sensors, known as LOCI, to routinely collect observation data on objects in LEO, including space debris, defence assets and commercial satellites. This data will help expand and improve the UK's sovereign space domain awareness capabilities and enhance the UK Space Agency's ability to keep assets in orbit safe from possible dangers, such as collision or fragmentation events.

Raytheon NORSS has recently increased the international deployment of LOCI in order to provide a wider, more comprehensive picture of objects in LEO. The LOCI sensor network will be operated out of multiple locations in the UK, U.S. and Australia.

"As the number of objects in LEO continues to increase, it's vital that our customers know what is happening with and around not only their assets, but also in the space environment," said Sean Goldsbrough, head of Raytheon NORSS. "Our recent international expansion of LOCI will provide the UK Space Agency and MOD with the high-quality, timely and assured SST data they need."

This announcement comes following news that Raytheon NORSS has been selected, alongside intandem, to produce a 10-year strategy for the UK Space Agency's National Space Operations Centre (NSpOC). A key objective of the centre, which is set to open in April 2024, is to enable the UK to deliver on its space domain awareness responsibilities.

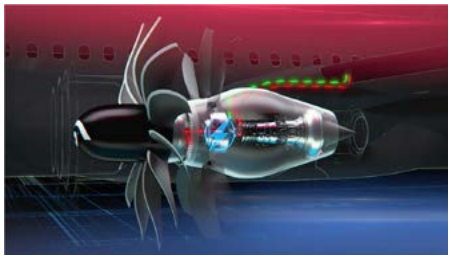
GE Aerospace Awarded NASA Contract for Next Phase of Advanced Engine Compact Core Development

NASA has awarded GE Aerospace a contract for Phase 2 of the Hybrid Thermally Efficient Core (HyTEC) program, supporting continued technology development for the next-generation of commercial aircraft engines with the aim to significantly improve fuel efficiency and reduce emissions compared to engines today.

The new contract builds on work completed in Phase 1 of HyTEC for high-pressure compressor and high-pressure turbine advanced aerodynamics, as well as the combustor.

"We are grateful and proud to collaborate with NASA to invent the future of flight. With the HyTEC program, GE Aerospace looks to further advance aircraft engine core technologies beyond our current industry-leading propulsion systems for a once-in-a-generation improvement in fuel efficiency," said Mohamed Ali, vice president of engineering for GE Aerospace.

Phase 2 will mature technologies for a core



demonstrator test later this decade. Testing will also expand to include 100% Sustainable Aviation Fuel (SAF) combustion evaluation.

Additionally, GE Aerospace will further advance the state-of-the-art for engine integration of hybrid electric systems. Hybrid electric testing under HyTEC Phase 2 builds on GE Aerospace's ongoing efforts to develop more electric engines, including the previously awarded NASA Turbofan Engine Power Extraction Demonstration under the first phase of HyTEC.

GE Aerospace and NASA have partnered for more than 50 years to accelerate the introduction of new innovations to the aviation industry. HyTEC Phase 2 is a major demonstration within NASA's Sustainable Flight National Partnership portfolio that will contribute to the U.S. goal of net-zero greenhouse gas emissions by 2050.

Currently, GE Aerospace is executing one of the most comprehensive technology demonstration roadmaps in the industry. More than 100 tests have been completed as part of CFM International's RISE* (Revolutionary Innovation for Sustainable Engines) program. The RISE program encompasses a suite of new aviation engine technology developments to increase propulsive and thermal efficiency, including open fan engine architecture and engine compact core work supported through HyTEC. The RISE program targets more than 20% improved fuel efficiency and 20% fewer CO2 emissions by the mid-2030s compared to the most efficient engines today.

Sidus Space's AI-Enhanced LizzieSat Completes Vibration Testing Ahead of Upcoming Mission

Sidus Space a multi-faceted Space and Data-as-a-Service company announced that it has completed environmental testing of LizzieSat ahead of its upcoming launch on SpaceX's Transporter-10 mission.

Environmental testing was completed by NTS Orlando where the LizzieSat Flight Unit underwent random vibration testing. The LizzieSat satellite for this mission is currently being prepared for shipment to the launch site and focus is now on mission operations in anticipation of launch.

The upcoming LizzieSat launch is a catalyst to the execution of Sidus Space's high-margin revenue Data-as-a-Service offering. Customers for this launch include NASA, Mission Helios, Automatic Identification Systems (AIS) data customers, and multispectral imagery consumers for detection of methane gas and vegetative stress.

"We expect the launch of LizzieSat will provide us with the opportunity to continue to expand our high-margin revenue streams, driven by the sale of both data and payloads on future missions. We anticipate the enhanced capabilities of these satellites will provide space infrastructure, as well as critical data, to create a high margin, rapidly scalable business model," said Carol Craig, Sidus' CEO and Founder. "The Company is continuously working to secure agreements to provide additional annual recurring revenue while on orbit."

1st Segments of the World's Largest Telescope Mirror Shipped to Chile

The construction of the European Southern Observatory's Extremely Large Telescope (ESO's ELT) has reached an important milestone with the delivery to ESO and shipment to Chile of the first 18 segments of the telescope's main mirror (M1). Once they arrive in Chile, the segments will be transported to the ELT Technical Facility, at ESO's Paranal Observatory in the country's Atacama Desert, where they will be coated in preparation for their future installation on the telescope main structure. Unable to be physically made in one piece, M1 will consist of 798 individual segments arranged in a large hexagonal pattern, with an additional 133 being produced to facilitate the recoating of segments. With a diameter of more than 39 metres, it will be the largest telescope mirror in the world.

The final stage in the production process of M1 segments – polishing – was carried out by world-leading optical systems manufacturer Safran Reosc near Poitiers, central France, at a building completely refurbished to work on this delicate task. As part of the process, Safran Reosc developed new automation workflows and measurement techniques to ensure that the polishing met the high standards required for ESO's ELT. The surface irregularities of the mirror are less than 10 nanometres (less than one thousandth of the width of a human hair). To reach this level of performance, Safran Reosc used a technique called ion-beam figuring, in which a beam of ions sweeps the mirror surface and removes irregularities atom by atom.

While only 18 segments have been shipped thus far, many more will soon be delivered by Safran Reosc to ESO. On 1 November 2023, the 100th segment went out of the production line and entered into the extensive inspection phase that takes place before final delivery. Furthermore, Safran Reosc has achieved a production rate in excess of four segments per week, with a target of five a week expected soon, a remarkable achievement for the series production of incredibly high-accuracy optics.

The construction of ESO's ELT has required the close involvement of multiple companies in Europe and Chile with ESO's teams, highlighting how the telescope is a true international endeavour. The mirror segments were cast by the German company SCHOTT at their facility in Mainz, Germany, before being delivered to Safran Reosc in France for polishing. Other companies involved in the work done on the segment assemblies include: Dutch company VDL ETG Projects BV who produced the delicate segment supports, German-French FAMES consortium who developed and manufactured the 4500 nanometric-accuracy sensors monitoring the relative position of each segment, and German company Physik Instrumente who designed and manufactured the 2500 actuators able to position the segment to nanometric precision. The delicate task of transporting the segments was assigned to Danish company DSV.

Having left France last week, the 18 polished mirror segments are now on their journey of over 10 000 km to the ELT's construction site in the Atacama Desert. From there, ESO's ELT will tackle the biggest astronomical challenges of our time and make yet unimaginable discoveries once it starts operating later this decade.

Artemis II Booster Surges Ahead at NASA's Kennedy Space Center

Inside the Rotation, Processing and Surge Facility at NASA's Kennedy Space Center in Florida, engineers and technicians process the right forward center segment of the SLS (Space Launch System) rocket on Nov. 28, 2023. The ongoing processing of the segments is the first step before stacking operations begin and the segments will form the twin solid rocket boosters for the SLS rocket that will power NASA's Artemis II mission. After arriving via rail in September, the team has been inspecting each segment one-by-one and lifting them to a vertical position to ensure the solid propellant and segment are ready for integration and launch.

Once processing is complete for all 10 segments, they will be moved one at a time to the Vehicle Assembly Building for stacking atop the mobile launcher. Standing 17 stories tall and burning approximately six tons of propellant every second, each booster generates more thrust than 14 four-engine jumbo commercial airliners. Together, the twin boosters provide more than 75 percent of the total SLS thrust at launch.

The Artemis II mission will send four astronauts around the Moon as part of the agency's effort to establish a long-term science and exploration presence at the Moon, and eventually Mars.

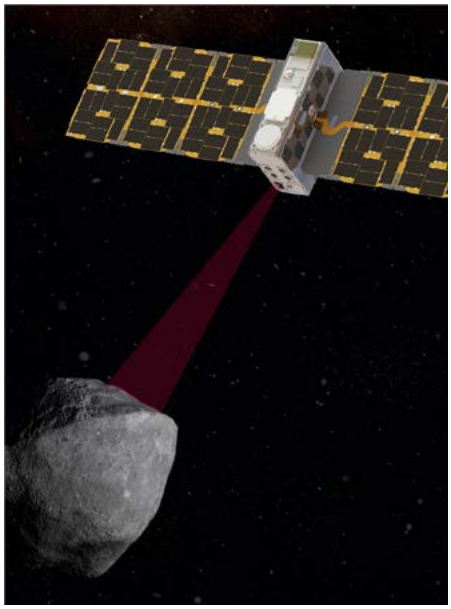
Tyvak International Completes Test Readiness Review of the Milani Nano Satellite

Tyvak International, European leader in small satellite solutions announced together with its project partners the successful achievement of Test Readiness Review of the Milani spacecraft. A critical component of the Hera planetary defense mission, Milani will be the European Space Agency's (ESA) first deep-space nanosatellite. Milani will also be the first nanosatellite ever to orbit an asteroid. Tyvak International is responsible for Milani's design, build, and mission operations. In this exploration, Tyvak International is joined by an excellent consortium of European industries and research centers from Finland, Czech Republic, and Italy.

As part of the world's first test of asteroid deflection, following the successful impact of NASA's DART spacecraft on asteroid Dimorphos, Hera will perform a detailed post-impact survey turning the experiment into a well-understood and repeatable planetary defense technique. To achieve its objectives Hera will be utilizing new technologies from autonomous navigation around an asteroid to low-gravity proximity operations. Hera will be humankind's first probe to rendezvous with a binary asteroid system and Europe's flagship Planetary Defender.

Milani, named after Professor Andrea Milani, the pioneer of asteroid risk analysis who came up with the original double-spacecraft Don Quijote mission concept from which the DART-Hera missions were derived, is a companion nanosatellite of Hera, carried by the mothercraft along the journey to Didymos, and ultimately released in its proximity. Milani's instruments are the ASPECT hyperspectral imager (by VTT, Finland), the VISTA (Volatile In-Situ Thermogravimetre Analyser) dust detector, and the Navigation Camera developed by Tyvak International with the collaboration of Politecnico di Milano for Image Processing algorithms. Finally, laser reflectors (by INFN, Italy) will enable unprecedented gravity field measurements of the asteroid coupled with Hera's laser range finder.

Tyvak International is part of the Terran Orbital Corporation (NYSE: LLAP) ("Terran Orbital" or the "Company"), a global leader in satellite-based



solutions primarily serving the aerospace and defense industries. "Terran Orbital is proud of Tyvak International's successful achievement of the Test Readiness Review," said Terran Orbital Co-Founder, Chairman, and Chief Executive Officer Marc Bell. "We are honored by the trust placed in Tyvak International by ESA, and we look forward to continuing to design, build, deliver, and operate cutting-edge satellite solutions for missions, like Hera Mission.

"We've always been proud to be part of such a challenging mission and the Test Readiness Review is a crucial milestone for the program" said Tyvak International's VP of Programs and Milani Program Manager Margherita Cardi. "In the last months we assembled the satellite and saw it taking shape day after day; It was a very exciting and emotional phase for me and the whole team".

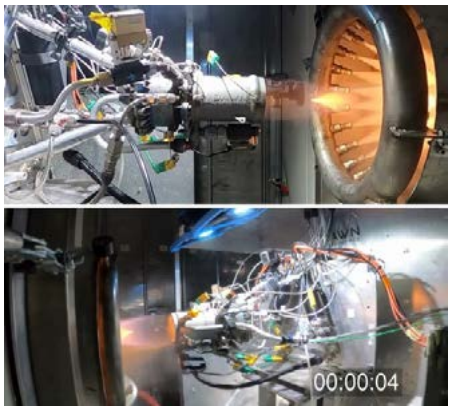
"Admiring the Milani spacecraft fully integrated brings lots of emotions that pay off the tens of thousands of hours of cutting edge engineering efforts," said ESA Hera Project Manager Ian Carnelli. "Tyvak International has proved unprecedented commitment to bring this project from blueprints to reality, we can't wait for the environmental test campaign to be completed and start testing with the Hera spacecraft. One step closer to Didymos."

Dawn Aerospace Achieves Key Rocket Engine Milestone

Dawn Aerospace has successfully completed a full-duration, bi-propellant test of the Mk-II Aurora spaceplane's rocket engine. The Mk-IIA engine was fired for 112 seconds at their test facility in Christchurch, New Zealand. This engine will be fitted to the Mk-II Aurora, a subscale technology demonstrator for the Mk-III – Dawn's two-stage to orbit solution for scalable and sustainable space access.

The Mk-II Aurora has already completed 50 test flights, 47 with jet engines and 3 under rocket power in March 2023. Dawn's propulsion team have been working on improvements in preparation for the next set of flight tests, set to take the vehicle to supersonic speeds and above 20km altitude in early 2024 to complete the test campaign of the Mk-IIA.

The rocket engine utilizes HTP and kerosene as propellants, rather than the more commonly used liquid oxygen, due to their storability and deep throttling capabilities. These are crucial factors



as Dawn builds towards having a global fleet of spaceplanes with aircraft-like operations.

Ralph Huijsman, Lead Propulsion Engineer, commented: "While HTP is the right long-term choice for the spaceplane, it led to some interesting challenges in the development of the engine. The available information is extremely limited and is often outdated or walled off. This meant we ran into some fundamental challenges along the way that were difficult to engineer our way out of. That makes this achievement even more special. It is exciting to see everything come together and work flawlessly."

CEO of Dawn Aerospace, Stefan Powell said: "The team has put in significant work to reach this milestone. We're excited about our future flights where we'll fly MUCH higher and faster than ever before."

The next phase in the development roadmap for the Mk-IIA is to test critical aspects of operating the vehicle such as high-altitude operations and BVLOS flights (beyond visual line of sight).

The Mk-IIB will incorporate all the learnings from the Mk-IIA to achieve an optimised vehicle for flights to 100 km. In doing so, it will be the first vehicle to fly to space twice in a day. The Mk-IIB will be a uniquely capable vehicle with commercial applications in atmospheric, microgravity, and high-speed flight research as well as earth observation.

Thales Alenia Space has Selected the UK's National Satellite Test Facility for FLEX Satellite 1st Test Campaign

Thales Alenia Space, a joint-venture between Thales (67%) and Leonardo (33%), has selected the UK's National Satellite Test Facility (NSTF), at RAL Space in Oxfordshire, for the first comprehensive assembly, integration and test campaign of the European Space Agency's FLEX (Fluorescence Explorer) satellite.

FLEX satellite will be used to map the fluorescence of the Earth's vegetation, which will provide a better understanding of the Earth's state of health and vegetation productivity on a global scale. As prime contractor, Thales Alenia Space will lead the satellite platform assembly, integration and test campaign planned in 2025, following the receipt of the FLORIS (Fluorescence Imaging Spectrometer) innovative instrument. Developed by Leonardo, this high-resolution imaging spectrometer will map the Earth's vegetation fluorescence to quantify photosynthetic activity.

"We are delighted to lead the first test campaign for ESA's FLEX satellite in the National Satellite Test Facility. This activity builds upon our recent successful completion of the assembly, integration

and test campaign of the MicroCarb Satellite. The AIT of MicroCarb was carried out on behalf of the UK and French Space Agencies and will be Europe's first carbon monitoring mission" commented Andrew Stanniland CEO of Thales Alenia Space in the UK.

Matt Fletcher, Head of Environmental Test at National Satellite Test Facility, RAL Space, added : "FLEX is a fascinating satellite and we're delighted to be supporting Thales Alenia Space and ESA with its assembly and testing. The National Satellite Test Facility was purpose-build for just this sort of ambitious project, and we're looking forward to putting FLEX through its paces and preparing it for the rigours of space."

Information from FLEX will improve our understanding of how carbon moves between plants and the atmosphere and how photosynthesis affects the carbon and water cycles. In addition, information from FLEX will give us a better insight into plant health. This is especially important today since the Earth's growing population is placing increasing demands on the production of food and animal feed. It is estimated that there will have to be more than a 50% increase in agricultural production by 2050 to meet demand. Understanding plant health and productivity is therefore essential to managing resources.

The FLEX satellite will orbit in tandem with one of the Sentinel-3 satellites (part of Europe's Copernicus program), also built by Thales Alenia Space. It will take advantage of Sentinel-3's optical and thermal sensors to provide an integrated package of measurements to assess plant health.

SPAINSAT NG: Start of Final Acceptance Testing of Satellite and Active Antennas

SpainSat NG 1 satellite is in its final testing phase with most critical components already integrated on the spacecraft and major systems having been validated in preparation for launch in 2024.

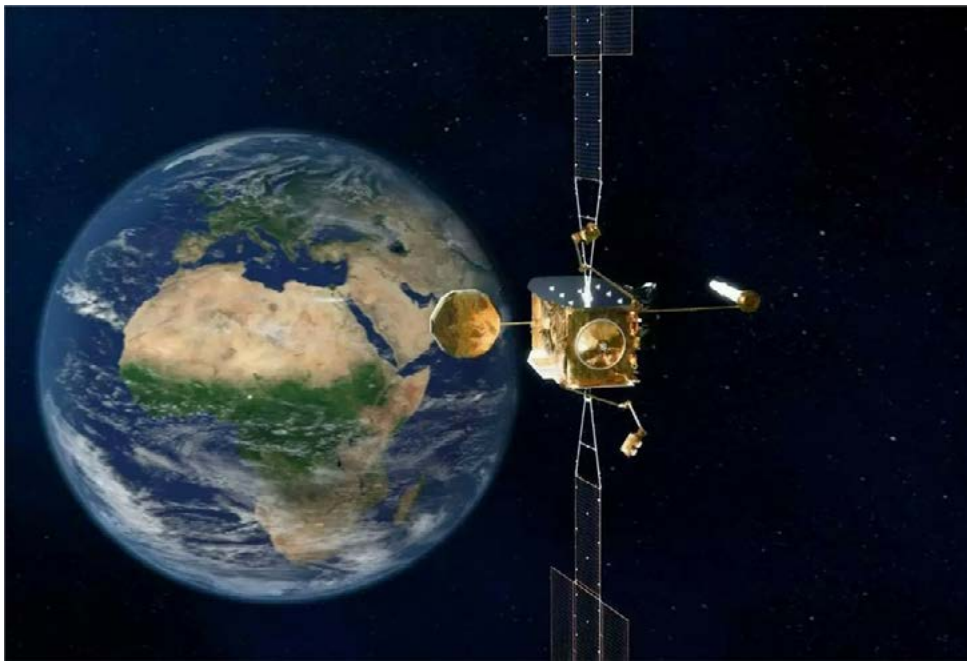
Military satellite communications play an increasingly important role in operating effectively in multiple domains whether in military operations or in humanitarian relief and rescue missions. This is why the Spanish Ministry of Defence (MoD) is upgrading its satellite communications capabilities. The Spanish Government satellite operator and service provider, Hisdesat, is developing the SPAINSAT NG Programme for the Spanish MoD through a Public Private Partnership, and selected Airbus DS System as prime contractor for the space segment.

The programme consists of a set of twin satellites, SpainSat NG I and SpainSat NG II, which aim to provide secure and reliable communications for military operations, as well as supporting humanitarian and disaster relief efforts. They will serve the Spanish Armed Forces and other national and allied government agencies.

The SPAINSAT NG programme is perhaps the most advanced there is currently in secure satellite communications in Europe, and it is being carried out mainly in Spain. The programme development had to overcome difficult challenges including: the pandemic, the Filomena snowstorm, heavy supply chain tensions, and the war in Ukraine, but despite these, it is on track for entering into service in 2025.

Technological advances : SpainSat NG satellites are equipped with the most advanced technology available on the market today.

At the heart of the spacecraft is the state-of-the-art transmit and receive active antenna system built by Airbus Defence and Space in Spain, which is a fundamental component of the satellites' mission. This cutting-edge system enables the antenna's coverage and performance to be dynamically adapted to the needs of the mission using sophisticated software processing. This cutting-edge direct radiating array (DRA) system also incorporates advanced features such as the ability to switch between different coverage zones thousands of times per second, the capability to adapt the coverage zones to reduce unwelcomed signals and the ability to locate terrestrial emitters of known or unknown origin with high accuracy.



These features are possible thanks to key technological building blocks such as the gallium nitride (GaN) solid-state amplifier technology providing superior power efficiency and linearity than the legacy Gallium arsenide (GaAs) technology. In addition, the tailor-made beamforming networks based on high-density X-band hybrid radio frequency modules which now integrate hundreds of phase and amplitude control nodes in a small footprint, enable the implementation of up to 16 independent beams on each active antenna in order to serve the most demanding missions. Moreover, their transparent digital processor on board makes them "software-defined satellites".

Programme Status : The SPAINSAT NG programme passed the critical design review in December 2021 and is now in the final testing phase. The prime contractor is Airbus Defence and Space. Airbus in Spain is also responsible for the X-band equipment and Thales Alenia Space España for the UHF and military Ka-band equipment.

The SpainSat NG I satellite is scheduled for entering into service in 2025, and will provide coverage to Europe, Africa and America from geostationary orbit.

The development and integration of innovative satellite payload elements, such as reconfigurable transmit and receive X-band active antennas, and the deployable pallet with individually steerable Ka-band antennas, have been supported by ESA's Pacis 3 partnership project. This partnership project, thanks to ESA funding, takes the risk out of the partners' investments when responding to market needs.

NGC Successfully Tests a New Solid Rocket Motor Developed in Less Than a Year

Northrop Grumman Corporation successfully conducted a full-scale static test fire of a new solid rocket motor that was developed in less than a year as part of its Solid Motor Annual Rocket Technology Demonstrator (SMART Demo).

The SMART Demo successfully demonstrated several innovative technologies, alternate manufacturing materials and processes to reduce lead times by 75 percent, including:

Several advanced, long-lead tooling products as well as components of the solid rocket motor's nozzle structure, constructed with additive manufacturing techniques

A new cost-effective solid rocket motor propellant capable of operating at cold temperatures

Alternative suppliers and new materials that could supplement or replace other long-lead materials experiencing challenged supply chains

Expert: Wendy Williams, vice president, propulsion systems, Northrop Grumman: "We are designing and building the world's largest and most advanced solid rocket motors, and we're proving we can do so with shorter lead times, an expanded supply chain and increased agility for our customers."

Details on SMART Demo: SMART Demo shows the effective implementation of new solid rocket motor technologies, materials, and processes to reduce development time and costs and improve motor performance. The efforts include the design, development, build and test of a new solid rocket motor and associated tooling.

Northrop Grumman plans to execute SMART Demo's annually as the company continues to invest and advance in solid rocket motor development and propulsion. SMART Demo expands and strengthens Northrop Grumman's supplier base by streamlining the test and qualification of new materials, processes and alternate suppliers who manufacture critical materials that use faster and more efficient processes.

Northrop Grumman is also developing five new motors concurrently for the first time. As the company anticipates significantly expanding and increasing motor production count by 2030, it is constructing 11 new buildings and modifying 16 more to support new and existing programs.

Sierra Space Secures DARPA Contract for Lunar Oxygen Extraction Framework for LunA-10 Capability Study

Sierra Space, a leading pureplay commercial space company building the first end-to-end business and technology platform in space, announced today that it secured a significant contract with the Defense Advanced Research Projects Agency (DARPA).

Under this contract, Sierra Space will embark on a groundbreaking research and development initiative, the 10-Year Lunar Architecture (LunA-10) capability study. Sierra Space will focus on integrating oxygen extraction, electrical storage and hydrogen-oxygen engine technology into an architecture for a commercial lunar infrastructure concept.

Sierra Space has already demonstrated its prowess in carbothermal oxygen production from lunar soil, or "regolith." In a significant precursor to this agreement, in April, NASA achieved a groundbreaking milestone by successfully extracting oxygen from simulated lunar soil using Sierra Space technology. The team harnessed a high-powered laser to replicate the heat generated

by a solar energy concentrator, melting lunar soil simulant within a carbothermal reactor developed in-house by Sierra Space. This breakthrough occurred within a thermal vacuum chamber simulating the lunar environment, setting the stage for future resource utilization on the moon, known as in-situ resource utilization (ISRU).

"At Sierra Space we recognize that to enable humanity's extended exploration of space there is a critical need for ISRU oxygen technology on the lunar surface, given its strategic importance in terms of mobility, life support systems and potential commercial applications," said Tom Vice, CEO, Sierra Space. "This formative work with DARPA is of paramount importance to Sierra Space's efforts to both shape the future of extended human missions to space and also to broaden access to space by removing the high costs associated with transporting oxygen propellant to the lunar surface."

Sierra Space envisions using carbothermal technology to manufacture oxygen on the lunar surface, contributing to the development of a self-sustaining lunar economy. This collaboration with DARPA will enable Sierra Space to conduct a system concept review and establish quantitative requirements for future endeavors. The ultimate goal is to optimize lunar architecture, reduce launch mass and foster a vibrant translunar economy.

As part of this agreement, DARPA will maintain continuous involvement with Sierra Space, including access to research results and certain rights in patents and data.

Airbus Starts Galileo 2nd Generation Satellite Production

Full production has begun on the six Galileo Second Generation (G2) satellites at Airbus' site in Friedrichshafen, Germany, with the arrival of the first satellite Flight Model structure from Beyond Gravity in Zurich. After initial preparation the panels will be dispatched to other Airbus sites before final integration and testing at Friedrichshafen. The Galileo G2 satellites are scheduled for launch in the coming years to support the initial deployment and validation of the G2 System.

Jean-Marc Nasr, Head of Space Systems at Airbus, said: "After the successful design phase we are now kicking off production in earnest of the state-of-the-art Galileo G2 satellites. Our teams in Friedrichshafen are working with engineers across Europe to meet the challenging schedule and finalise these sophisticated satellites which will further improve the global Galileo system opening up even more opportunities for services on Earth."

To meet the demanding schedule to deliver all six satellites in less than two years, Airbus has developed a coordinated production programme to leverage the spacecraft manufacturing, integration, and testing expertise across Airbus sites including Backnang (near Stuttgart), Friedrichshafen, Madrid, Ottobrunn (near Munich) and Toulouse. The second satellite structure is due to arrive in early 2024 and the third towards the end of next year. Airbus' modular approach to the manufacturing of the G2 satellites will see three spacecraft being produced in parallel at any one time.

The G2 satellites will incorporate enhanced navigation antennas which will help improve accuracy of the flagship European Global Navigation Satellite System. The spacecraft, equipped with electric propulsion for the first time and higher-strength navigation antennas, will also feature fully digital payloads which will be easily reconfigured in orbit, enabling them to actively respond to the evolving needs of users with novel signals and services.

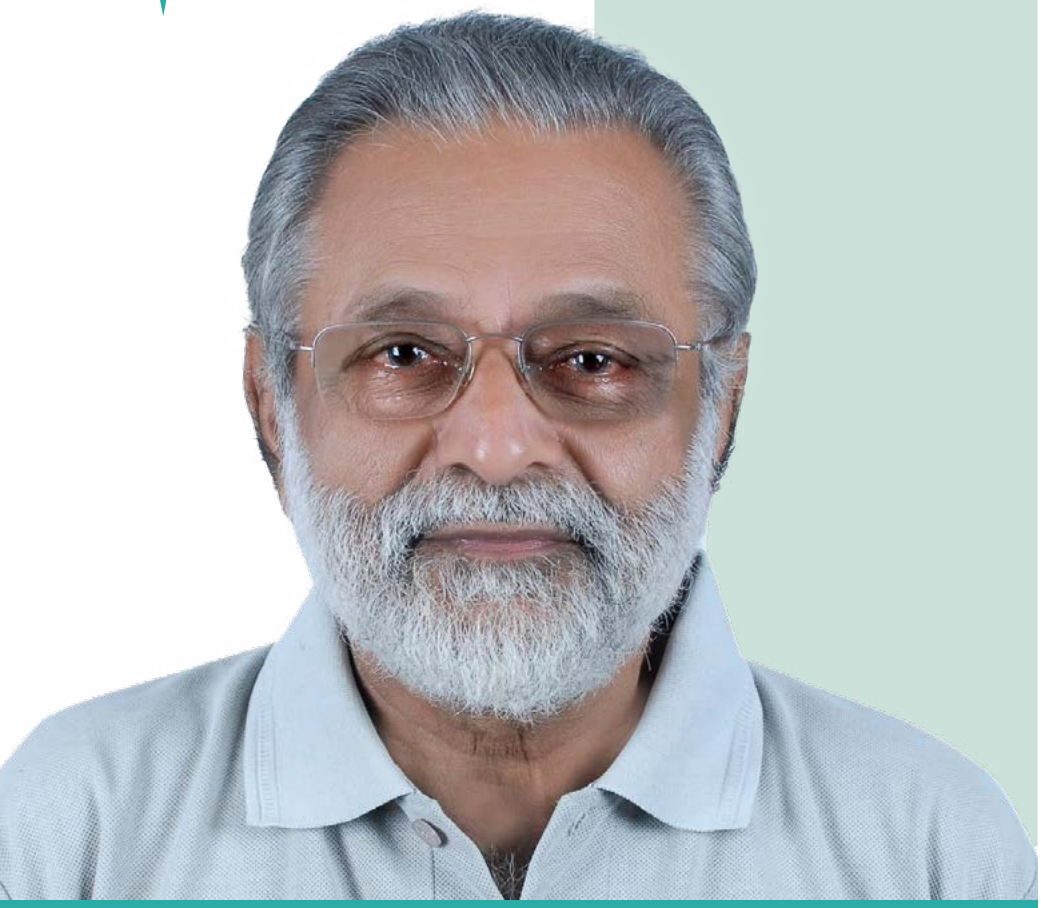
The above 2 tons satellites, which benefit from Airbus' heritage of the highly reliable Eurostar series of telecommunications satellites, will also incorporate six (rather than four) enhanced atomic clocks as well as inter-satellite links, enabling them to communicate and cross-check with one another. This is intended to offer decimetre-scale precision positioning for users around the world. They will be controllable with an increased data rate to and from the ground and equipped with advanced jamming and spoofing protection mechanisms to safeguard Galileo signals. The spacecraft will operate in orbit for 15 years.

The future of navigation on Earth lies in space. The Galileo navigation satellite system is moving to the next level – guiding billions of people, bringing enhanced services, more robust and more precise

The Full Operational Capability phase of the Galileo programme is managed and funded by the European Union. The European Commission and ESA have signed an agreement by which ESA acts as design authority and system development prime on behalf of the Commission. The views expressed in this Press Release can in no way be taken to reflect the opinion of the European Union and/or ESA. "Galileo" is registered as a trademark in the database of the European Union Intellectual Property Office.

This new milestone is a testament to the capabilities and dedication of the European industry and reaffirms ESA's commitment to redefine the boundaries of satellite navigation. I cannot wait to see the many parts come together to bring to life an even better performing Galileo system, so this EU programme can continue serving European and world citizens.

-Javier Benedicto, *ESA's Director of Navigation*



Spacepreneur Contributing Editor Dr. (Hon) M R K Menon In conversation with

Mr. P Radhakrishnan

He was responsible for the power systems for Aryabhata, India's first satellite, launched in 1975. In 1985, he was selected and trained as an austronaut to fly in the US Space Shuttle the next year. But the programme was called off following the tragic Challenger disaster in January 1986. He retired as Deputy Director (Systems Reliability & Quality Assurance) from LPSC in 2003.

Q What is high point of your career with ISRO?

A Over 50 years ago, early in my career, I had the opportunity for working for the first Indian satellite, Aryabhata, launched in 1975. I was responsible for its Power System.

Afterwards I worked in various fields such as Electronics, Reliability & Quality, and Project Management. I've been with ISRO for 37 years.

I've often thought that 37 years of my life with ISRO has spoilt me in the sense that I can't thrive in any other organization!

Briefly in my early forties, I flirted with the hope of a space flight in the US Space Shuttle. Selected and trained, while waiting for the D-day in September 1986, my dreams blew up along with the Challenger spacecraft in January 1986. More tragically, the disaster cost 7 heroic lives!

This was at once the high and low point in my career!

Q Who is one person who has influenced you in life and how?

A I can't possibly point to one single person and say, "He/she shaped my life" There are a handful of people who influenced my life and attitude. In the beginning my parents, then some of my teachers at various levels and certain relations, old enough to be grandparents who shone the way to new areas of interest outside my curriculum that stayed with me all through my life. All these were during my student days.

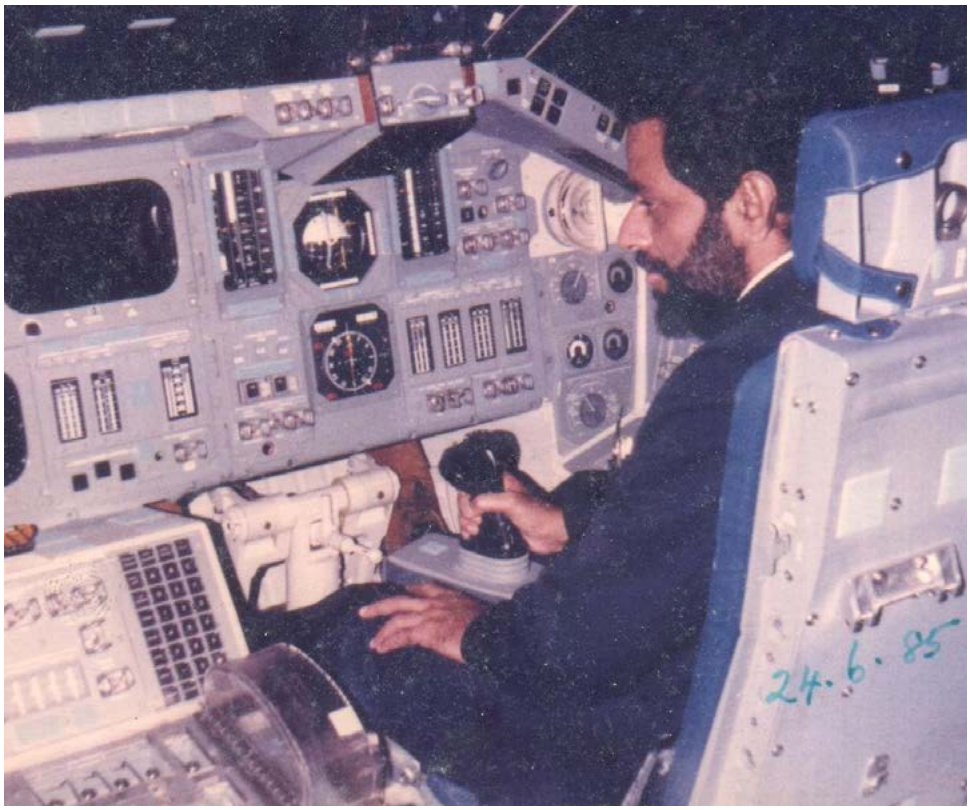
When I entered ISRO, I was fortunate enough to be closely associated with or able observe from close quarters certain eminent persons. First and foremost, Dr. Vikram Sarabhai (the founding father of space in India) himself who was briefly present during my first interview. Then there is my first boss, Shri Pramode Kale, based in Pune, still intellectually active. I was struck by the breadth and depth of his erudition, though only 3 years older than me! Soon there came into my radar other distinguished personages such as Prof. Satish Dhawan, Chairman/ISRO, Dr. Brahm Prakash, the first Director of the Vikram Sarabhai Space Center (VSSC), and, of course, the legendary Dr. APJA Kalam who was the Project Director of SLV-3, our very first (though a midget!) Satellite Launch Vehicle. These individuals were not only great experts in their chosen field but were the best among human beings! Observing them taught me that the best way to assess the character and quality of individuals is to observe how they treat people who can do nothing for them!

Their magnanimity is beyond compare! One incident is adequate as a typical example. Way back in 1979, when the first experimental launch of SLV-3 failed, a a pall of gloom descended over

Sriharikota. Within a short while there was a Press Conference. Prof. Dhawan, then Chairman of ISRO, stood in front of the Project Director, Dr. Kalam, and faced the barrage from the Press. A year later, when the second launch of SLV-3 was a spectacular success, the same Prof, Dhawan took the back seat and let Dr. Kalam take all the laurels from the Press! Could we expect such nobility from lesser human beings? We have heard from Dr. Kalam himself that he could pull through the agonizing period that followed the first failure only by deriving strength from the reassuring support from both Prof. Dhawan and Dr. Brahm Prakash. These three formed a superb troika!

Association with these individuals and incidents involving them afforded me the best schooling outside the formal school!

Pardon me this lengthy answer, I can't economize on my words while thinking of such memorable individuals.



Q How did you get the role of propagating Space Technology in India in the 1960's on a NASA outreach project?

A Soon after I joined TERLS (Thumba Equatorial Rocket Launching Station) in 1966 (there was no ISRO then) there arose the need for a lecturer for NASA-INCOSPAR (the forerunner of ISRO) Spacemobile campaign to popularize the nascent space activities that started with the launch, in 1957, of the first ever artificial satellite, Sputnik, by the then Soviet Union. Those were the days before man set foot on the Moon! It was my good fortune that I was selected as a lecturer along with another, RC Khattar from Bhabha Atomic Research Center. NASA had supplied a small truck full of plaster of paris scale models of rockets and spacecraft, posters and audiovisual aids. Two lecturers, one person for administrative chores, and the driver formed the crew. We travelled by road all over India for 10 months according to a prearranged schedule and gave lecture-cum-demonstration followed by films at a large number of universities, colleges and schools as well as certain public institutions. On an average there were three lectures a day. I'd faced at times audience numbering a thousand in open air.

Not only did Spacemobile gave me, a novice of 22, a broad exposure to space science & technology, but afforded me an instructive Bharat Darshan!

Q Do you foresee a bright future for private space agencies in India?

A Certainly yes! We have successful models existing elsewhere. I'm convinced that what Government Agencies can do, the Private Sector can do just as well. In matters of Space or Atomic Energy, however, the Government should have strict regulatory authority, or else, the nation's security is compromised. There could be a balanced mix of private enterprise contained within the compass of regulation by the Government.

Q Are you surprised to see a magazine devoted to Space Technology and Exploration in India?

A Agreeably surprised, to be sure! I'm reminded of a monthly science magazine, "Science Today" in my youth. The contents of the magazine were contributed by knowledgeable authors. Somewhere along the way, the magazine just disappeared leaving no successor!

Q What are the three elements that characterize the soul or culture of ISRO?

A If you ask for one attribute, I'd say in a lighter vein, "ISRO is ISRO" (Plagiarizing "Honda is Honda")

Now more seriously, the basic strength of ISRO lies in its open culture. Its seeds were sowed by Dr. Vikram Sarabhai who managed at once Atomic Energy and Space in addition to his own considerable private business. He knew the inner workings of both Government and Private enterprise. From an Open Culture everything else follows. For best results, Science & Technology can't tolerate dictatorship!

A natural offshoot of open culture is a fierce review system - Review is all pervasive through various levels of a Project starting from the Concept, progressing through the distinct stages of Design, and then finally

rigorous evaluation of results of exacting tests. These tests are conducted at subsystem and system levels. This kind of reviews and tests apply equally to software packages ending with simulations.

All reviews are conducted in an uninhibited atmosphere without undue regard to hierarchy but, of course, keeping within limits of decency and decorum. ISRO allows everyone participating in a review to say, "I disagree with you, Sir", not without the responsibility to reason out the disagreement. This engenders a sense of involvement and purpose among the participating employees.

I've often thought that 37 years of my life with ISRO has spoilt me in the sense that I can't thrive in any other organization!

Q Have you interacted with Dr Vikram Sarabhai or with Abdul Kalam Sir? Some find recollections?

A I'm proud that that Dr. Sarabhai knew me by name. Once in Ahmedabad, he attended my Spacemobile presentation. At the end, he called me aside and said, "You, no doubt, speak well and clearly. But be more Indian". Instantly I knew that I've got to temper my language style to suit the common audience in various parts of India. It was a valuable advice that served me all through my life. He made me realize that I must speak not to please myself but to make myself intelligible to everyone in the audience.

I've certainly interacted closely with Dr. Kalam. Even after he left ISRO to join Defence R&D, he used to invite me at times to his Establishment in Hyderabad for some meetings and discussions. Needless to say, he was a famous chronic bachelor. He always lived in a small room, no matter what his position was, which was invariably cluttered with all sorts of things ranging from books to musical instruments. He was an avid reader of all kinds of books - not only technical but art, history, philosophy including Hindu philosophy...

What struck me mostly as to everyone who met him was his disarming humility and unpretentiousness. After his tenure as the President of India, he spent his time exclusively on speaking to students. What can be more fortunate and appropriate than that his end should come when he collapsed while engaged in his favorite pastime – speaking to students!

Q What is one incident during your training at NASA that you remember the most?

A I don't have to think a bit to answer that question. Date: January 28, 1986. Time about 9 am. We were at Ford Aerospace Corporation in San Francisco. We were watching on the TV the launch of the Space Shuttle, Challenger with bated breath. A little over a minute after

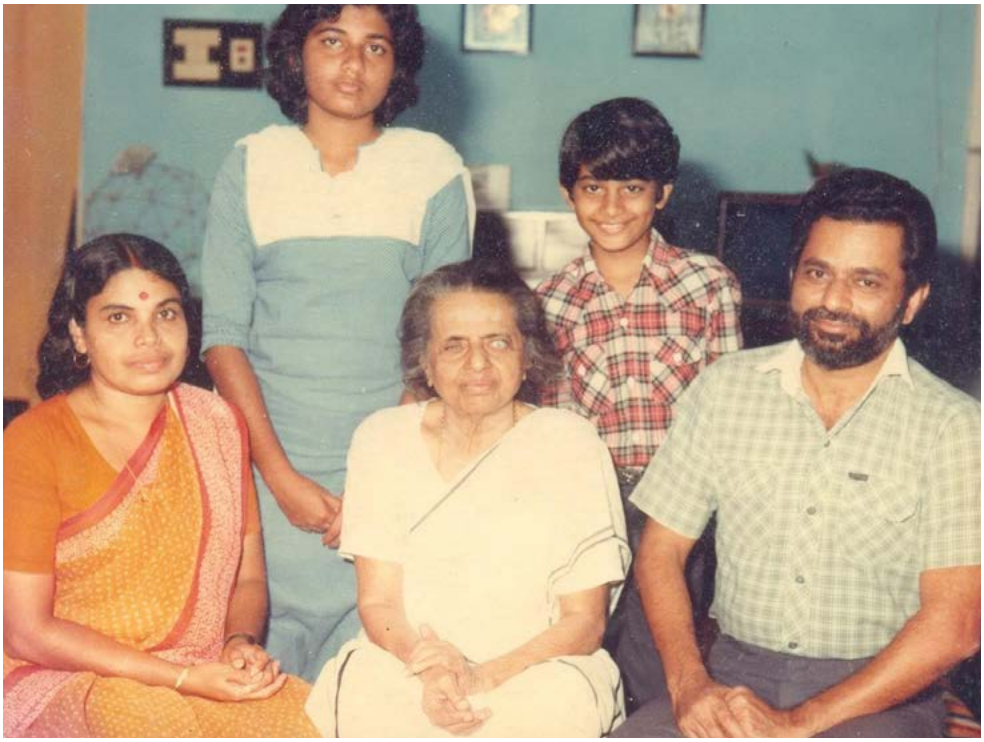

PHOTO: MANOJ CHEMANCHERI

lift-off, the TV screen was filled with a ball of fire and smoke. Just as swiftly as my hope for something to tell my grandchildren had soared, all my dreams fell around me ashes. At that moment I realized with a shock that I've become a still-born astronaut!

Q Would you recommend a career in Space Technology to the youth of India? What is your message for them?

A Without a doubt, I'd say that ISRO is still the best-run Government Department. I use the word "still" because an organization is pretty much like a living organism having different stages like birth, infancy, youth, middle age, and finally old age! ISRO is roughly 60 years old. I've no doubt, however, that the current team at the helm of affairs has the vision to delay the onset of old age.

I'm indeed proud that I belonged to ISRO once.



Skyrora and Spirit to Enhance Future UK Launch Capability

Skyrora and Spirit AeroSystems have announced a collaboration on orbital launch capability. The companies celebrated the announcement on the conference's opening day in Belfast, home to Spirit's largest UK manufacturing facility. UK-based, launch-vehicle manufacturer, Skyrora is developing an agile, end-to-end, launch service to provide access to space for small satellites globally. Having conducted a test launch of the suborbital Skylark L vehicle in October 2022, as part of the company's incremental learning approach to launch, Skyrora is well on track to become the first UK company to vertically launch satellites from the UK, expecting to conduct up to 16 launches per year once operating at scale.

"This alliance is a real testament to the strides Skyrora has made, and continues to make, towards our mission of being the first British company to launch from UK soil. It will allow us to renew our focus on localising our supply chain as much as possible, which is a key part of our mission to create a responsible and sustainable approach to orbital launch," said Volodymyr Levykin, CEO and Founder, Skyrora.

"By collaborating with innovative partners like Spirit, Skyrora will be able to access manufacturing and testing capacity right here in the UK. Historically, space has not been an environmentally friendly industry, but we are committed to being a responsible player that continues to foster talent and skills nationally as the ambitious new space economy goes from strength to strength," Mr Levykin added.

Spirit's presence in UK space is growing. Its broad offering of highly adaptive manufacturing and testing solutions in metallics and composites, at both its Scotland and Northern Ireland facilities, brings significant industrial capacity to Skyrora's launch proposition. Leveraging Spirit's aerostructures expertise, the companies will explore opportunities to transition Skyrora's orbital launch vehicles from development to full-scale production.

> *Through our support of innovative, sustainable, space technologies and clusters, we can add real value to building UK launch capability. Spirit's role will be to fully industrialise Skyrora's future production requirements, ensuring a smooth path from development to manufacture.*
>
> **-Sir Michael J Ryan CBE, *Vice President, European Space and Defence, Spirit AeroSystems***

"The UK Space Conference provides a fantastic platform for companies like ours to cement relationships enabling commercial success within the sector including, importantly, UK launch activity," Sir Michael added.

The UK Government has made orbital launch a key priority, with the National Space Strategy outlining plans to secure an increased portion of a global space economy expected to be worth £490 billion by 2030. "This collaboration between Skyrora and Spirit clearly demonstrates the attractiveness of the UK's thriving launch sector and the growing interest from both UK-based and international companies," said Matt Archer, Director of Launch, UK Space Agency.

"Relationships such as this will not only build our domestic spaceflight capability but also help deliver Government's ambition for the UK to be Europe's leading provider of small satellite launch by 2030, creating highly skilled jobs and local opportunities across the UK," Mr Archer added.

Collaborative goals also include the research of space technologies, particularly in additive manufacturing. Skyrora will provide Spirit with access to Skyprint 2, the largest in-house hybrid 3D printer of its kind in Europe. Located in Skyrora's manufacturing facility just outside Glasgow, research enabled by Skyprint 2 has the potential to unlock a localised supply chain to reduce costs and lead times for Spirit, bolster industrial cooperation, and promote growth within the UK space sector.

GLOBAL NEWS

ESA Validates Preliminary Design of Ariel Exoplanet Spacecraft Built by Airbus

Airbus has successfully passed the Preliminary Design Review (PDR) of Ariel, the Atmospheric Remote-sensing Infrared Exoplanet Large-survey spacecraft. This European Space Agency (ESA) mission will study the composition of exoplanets, how they formed and how they evolve, by surveying a diverse sample of about 1000 extrasolar planets in visible and infrared wavelengths.

Development and testing of equipment and sub-systems can now continue to ensure the spacecraft moves ahead on schedule under the lead of Airbus, prime contractor of this around €200M contract. Airbus will also provide expertise and support to ESA for the development of the payload module.

"Observations of these worlds will give us insights into the early stages of planetary and atmospheric formation, and their subsequent evolution. This will in turn contribute to the understanding of our own Solar

System and could help us find out whether there is life elsewhere in our Universe and if there is another planet like Earth!" said Christophe Gabilan, Ariel project manager at Airbus.

More than 5,000 exoplanets have been identified since the first observation in 1995, notably by the ESA mission Gaia, also designed and built by Airbus. Another Airbus-built ESA mission, CHEOPS, launched in December 2019, is characterising exoplanets orbiting nearby stars, observing these known planets in the size range between Earth and Neptune and precisely measuring their radii to determine density and composition.

Yet little is known about the chemical composition of their atmospheres. The recent discovery by the Webb Telescope, notably thanks to the NIRSpec instrument, built by Airbus, of methane and carbon dioxide in the atmosphere of K2-18b, an exoplanet 8.6 times bigger than Earth, shows there is still a lot to uncover in the search for habitable environments.

After its launch, in 2029 on an Ariane 6 launcher, Ariel will be injected onto a direct transfer trajectory to the second Lagrangian point (L2). Thanks to its very stable thermal and mechanical design, the spacecraft will be able to carry out long term observations of the same planet/star system for a duration of between 10 hours and up to three days. Its mission will last four years with a possible extension of at least two years.

FUND RISE

Armada Raises More Than $55M to Bridge the Digital Divide

Armada, an edge computing pioneer redefining the future of connectivity, compute and AI exited stealth. The company marks this milestone with a significant capital raise exceeding $55M, led by Founders Fund, Lux Capital, Shield Capital and 8090 Industries, with participation from Felicis, Contrary, Valor Equity Partners, Marlinspike, 137 Ventures, Koch Real Estate Investments, 8VC and a cohort of other strategic investors. This funding will propel Armada forward in its mission to bridge the global digital divide, empowering businesses and communities to leverage all of their data, regardless of where it's generated. Armada is dedicated to unlocking the potential of generative AI, edge computing and predictive models on a global scale.

Recent revolutions in IoT, AI and infrastructure have created a massive opportunity for an intelligent edge computing platform. With Gartner estimating that by 2025, 75% of enterprise data will originate at the edge, there's a clear demand for a decentralized approach to empower the fourth industrial revolution. Armada provides a full-stack infrastructure solution, deployable on both on-premise and cloud infrastructures, to deliver optimal edge computing and cutting edge satellite internet connectivity to the world's most

ARMADA

remote regions. This empowers companies to harness the power of generative AI and predictive models where they are most needed, enabling a range of industries – from utilities and infrastructure to military and mining – to dramatically enhance their real-time processing, analysis and decision-making capabilities, right where their data resides.

"Today, AI – including large language models, multimodal AI and predictive models – is revolutionizing every facet of our lives and work, but not everyone has the same opportunity. What's truly astounding is that vast swaths of the world still lack basic internet access, much less the ability to derive tangible value from their data," said Armada co-founder and CEO Dan Wright. "Armada's mission is to bridge the digital divide once and for all, giving our customers the ability to solve their biggest problems."

"Armada plays a vital role in addressing the growing compute needs of industrial IoT for manufacturing and industrial applications, a sector that has been vastly underserved but is crucial in today's landscape," said Justin Wilson, Managing Director at Koch Real Estate Investments.

"There is an impossibly large volume of data created at the edge, and regrettably, virtually nothing is done with it," said Armada co-founder and Chief Operating Officer Jon Runyan. "We're exceptionally fortunate to have the best talent in the world on our team, as well as the support of our incredible syndicate of investors and advisors. We are also thrilled to add Trae Stephens of Founders Fund and Anduril, Kerem Ozmen of 8090 Industries and our founding CTO, Pradeep Nair, to our Board of Directors as we tackle this enormous opportunity."

Armada is swiftly advancing with certifications and establishing partnerships to realize their ambitious vision of extending AI and remote connectivity to every corner of the world. The company has also created a marketplace, enabling partners to develop and distribute innovative applications, and has achieved SOC2 and ISO 27001 compliance.

"Armada has a best-in-class team building at the edge of what's technically possible right now," said Trae Stephens, Partner at Founders Fund and co-founder and Chairman at Anduril. "Armada's edge computing platform will fundamentally reshape entire industries."

spacepreneur | INTERVIEW

NAVARS EDUTECH

Spacepreneur Editor kartikeya in conversation with

Mr. Sravan Varma Datla

CEO & Co-Founder - Navars Edutech Pvt Ltd

Navars has effectively fulfilled Space Tutor's core objectives, imparting foundational knowledge and engagement to over 100,000 students in 1000+ schools across 13 countries within the last 3 years.

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

A In 2019, Navars took flight with a vision that aimed to bridge the gap between Academia and Industry, focusing on imparting Astronomy & Space education to K12 students. However, the onset of the Covid-19 pandemic necessitated a pivot towards online delivery methods. Surprisingly, the enthusiasm exhibited by young students not only validated our programs but also revealed the immense potential within this realm. As the world emerged from the pandemic, we redirected our efforts back to our initial plans, transitioning to an offline model centered around establishing Astronomy & Space labs within schools. These labs became invaluable conduits for experiential learning among students.

With a meticulously structured 7-year program implemented in schools, we've taken the initial steps, operationalizing our Labs in approximately 50 schools. The NASO Olympiad, a cornerstone of our initiatives, garnered substantial interest, witnessing annual participation from over 50,000 students. Simultaneously, our online programs catered to non-lab schools, catering to students eager to delve deeper into the realms of Astronomy & Space.

Our growth trajectory has been notable, expanding our team from an initial 5 members to a robust team of about 70 individuals. This growth was further bolstered by securing early rounds of investment from entities like Faad, AngelBay, JITO, Ivy League Ventures, among others. This influx of support and resources has propelled our mission, empowering us to continue expanding our reach and impact within the realm of space education.

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

A Our courses cater to both foundational learners (grades 2-12) and college students (professional and engineering tracks) who aspire to launch careers in the Space sector.

We bridge academic needs with industry-aligned STEM Space education through collaborative partnerships.

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

A Enrol directly on our website, www.navarsedutech.com, and discover tailored programs featuring objectives, learning outcomes, duration, and costs. Students receive personalized guidance from our team. Schools seeking Astronomy & Space Labs, Summer Camps, Workshops, or short courses can connect with us via our website or call our centre at 8885005533. Experience engaging educational opportunities designed to ignite curiosity and passion for space exploration.

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

A The space industry is set to become a trillion-dollar economy globally. India, with its 200+ space startups and growing expertise, has a big chance to lead this sector. To meet the rising demand, India needs to focus on developing a skilled workforce. Strengthening education and fostering collaborations between government, academia, and private sectors can bolster India's position in the global space economy.

India's space industry encounters challenges in funding, tech advancement, and global competition. Sustaining funding for missions and startups is critical, demanding continuous technological innovation to stay competitive. Balancing against global players,

developing a skilled workforce, and fostering collaborations are vital. Robust regulatory frameworks and enhanced infrastructure are needed. Overcoming these hurdles necessitates strategic investments, policy reforms, and stakeholder collaboration. Addressing funding stability, tech evolution, workforce development, global positioning, regulatory clarity, and infrastructure enhancement will bolster India's space sector on the international stage.

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

A To aspiring space enthusiasts: Choosing the space industry for your career is an incredible journey filled with boundless opportunities. Pursuing this path demands curiosity, resilience, and a thirst for discovery. Embrace STEM education, specialize in aerospace, engineering, or related fields. Stay updated with advancements, seek internships, and engage in projects. Cultivate problem-solving skills, innovation, and collaboration.

Dream big, aim for the stars, and know that your contributions can shape humanity's future beyond Earth. Your passion for exploration can fuel ground breaking discoveries. Believe in yourself, work hard, and embark on a thrilling career that reaches for the cosmos.

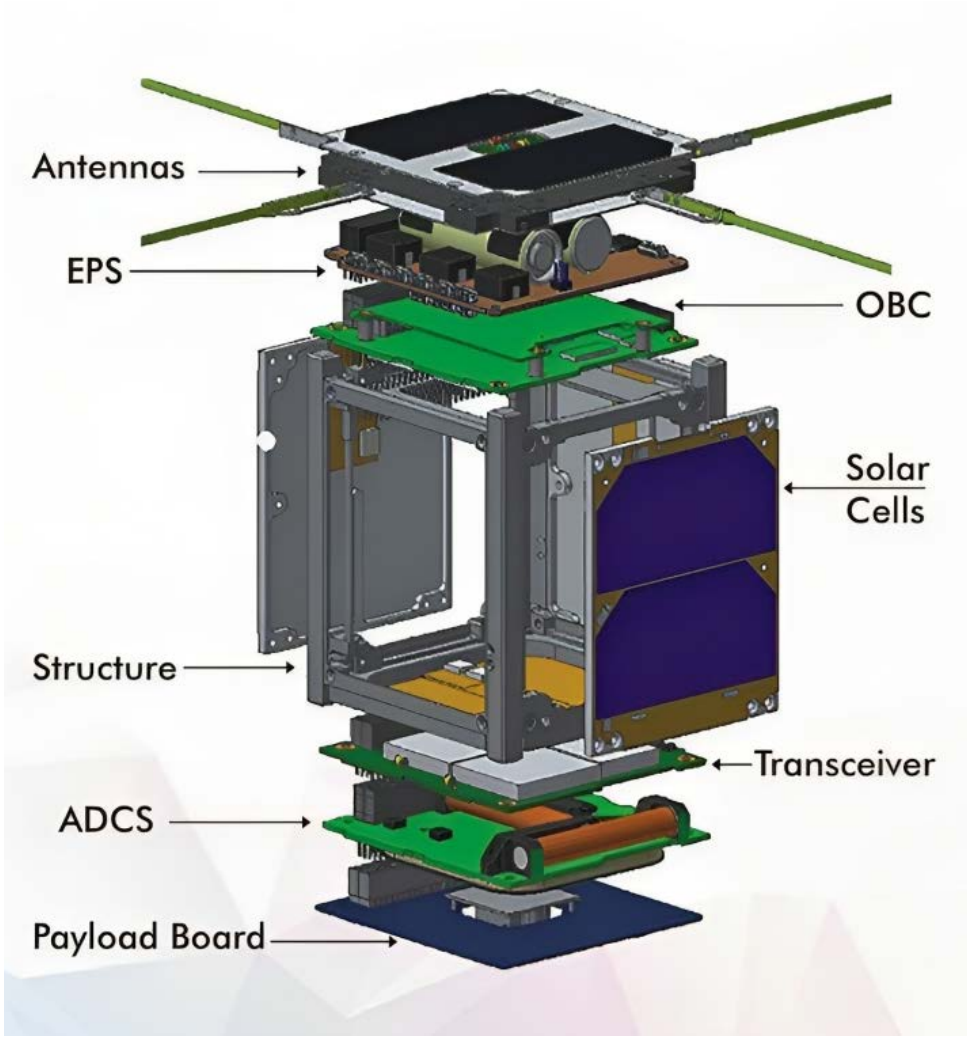
Q As a Space Tutor, what would you like to achieve in next 2 years? How ISRO is helping you & what kind of more implementations you expect from ISRO?

A Navars has effectively fulfilled Space Tutor's core objectives, imparting foundational knowledge and engagement to over 100,000 students in 1000+ schools across 13 countries within the last 3 years. Our aspiration now extends to reaching 1 million students through a comprehensive approach encompassing school programs, online education, and the Space Olympiad within the next 2-3 years.

In collaboration with ISRO, Navars champions space education by organizing workshops and competitions. The recent NSIC (National Space Innovation Challenge), held in partnership with AIM Niti Aayog & ISRO, drew participation from over 35,000 students nationwide. These collaborative initiatives by ISRO and Navars aim to cultivate student interest, providing tangible exposure and education in space sciences. Ultimately, the goal is to spark inspiration among the upcoming generation of Indian space enthusiasts, nurturing their passion and potential in this field.

Q You have raised Multiple funding's in space EduTech – How do you expand your business in 2024?

A Navars is committed to pioneering a dynamic and immersive approach to Space education in accordance with the objectives laid out in NEP2020. Our primary aim is to engage with and impact the lives of over 100,000 students by the year 2024 through our innovative Astronomy Lab program. Central to our mission is the establishment of Astronomy & Space Labs in approximately 250 schools, spanning both the vibrant landscape of India and diverse global markets. This initiative is designed to foster a hands-on, experiential learning environment, nurturing a new generation of passionate astronomers and space enthusiasts. By integrating cutting-edge technology and progressive pedagogy, we aim to ignite curiosity, inspire exploration, and cultivate a deep appreciation for the wonders of the cosmos among students world-wide.



Q If you could change one thing about Space Industry with a click of your fingers, what would it be and why?

A Although wishful thinking, I'd instantly make space travel and exploration more accessible and affordable for everyone. This change would democratize opportunities, fostering innovation and collaboration while accelerating scientific advancements and inspiring generations.

Ursa Major closes $138 million Series D and D-1 financings

Ursa Major, America's leading privately funded company focused solely on rocket propulsion, announced that it closed $138 million in its Series D and D-1 funding rounds. Investors include Explorer 1 Fund and Eclipse, RTX Ventures, funds and accounts managed by BlackRock, Exor Ventures, Mack & Co., XN, SV Pacific Ventures, and other institutional shareholders.

With this investment, Ursa Major will continue to develop Lynx, the company's innovative new solid rocket motor (SRM) program, while scaling production capacity and advancing multiple propulsion programs. While the initial Series D round was completed earlier in the year, Ursa Major extended fundraising to include a Series D-1 round due to strong interest in accelerating development on several future programs.

"In the year since our last funding round, Ursa Major has secured significant commercial and government customers, delivered dozens of flight-ready engines, introduced new engine concepts, and worked to address critical gaps in our nation's defense. This includes developing Lynx, a line of solid rocket motors that can deliver urgently needed capabilities," said Ursa Major CEO and founder Joe Laurienti. "This investment will support scaling our production capacity to meet strong market demand, as well as continued technology innovation for our medium- and heavy-weight propulsion systems."

Since its last round of funding, Ursa Major has responded to deficiencies in the nation's defense capabilities by introducing Draper, a revolutionary new storable liquid engine designed to defend against hypersonic weapons, and Lynx, a new solution for designing and manufacturing solid rocket motors for tactical applications.

Ursa Major has also redesigned and hot-fired the 50,000-pound-thrust Ripley engine, scaled production of the 5,000-pound-thrust Hadley engine to a rate of one per week, and qualified Hadley as the world's first and only rocket engine for space launch, in-space, and hypersonic missions.

"Ursa Major propulsion systems fill a critical gap in the defense industrial base today," said Greg Reichow, Partner at Eclipse and former Vice President of Production at Tesla. "For the U.S. and its allies, the ability to deter threats will depend on our ability to produce innovative solutions utilizing modern manufacturing methods that are not dependent on fragmented supply chains. Ursa Major's team possesses the technical prowess to deliver the high production rates, low cost, and advanced technology needed to help maintain national security."

Ursa Major's propulsion-only approach disrupts the existing vertically integrated launch industry by providing vehicle-agnostic engines for a variety of launch and hypersonic applications. This approach stands as a safeguard against the kind of consolidation and stagnation in launch technology that kept America dependent on Russian-made rocket engines in the past.

Reliable rocket propulsion is critical to maintaining the space supply chain and growing the space industry. Ursa Major's flexible rocket engines can be used for various Department of Defense (DOD) and non-DOD missions, from air launch to hypersonic flight and on-orbit missions. The company's customers get to launch faster and without the development cost of building engines in-house.

NorthStar Earth & Space closes CA$20 million Series D financing round to launch the world's first space based SSA commercial service

NorthStar Earth & Space Inc. has closed a CA$20 million Series D funding round with investments from Telesystem Space Inc., the government of Quebec (through its affiliate Investissement Québec), and the Luxembourg Future Fund – Co-Investments SA.

Funds will support the company's on-going operations to deploy the initial block of four satellites of NorthStar's constellation to monitor space from space, commence commercial Space Situational Awareness (SSA) services, and establish a data processing centre in Montreal that will process and deliver precision information to help track the location of satellites (over 11,000) and orbital debris (over 128 million).NorthStar is the first in the world to operate a satellite constellation dedicated to addressing the rapidly increasing challenges of managing space traffic and the risk of collisions from uncontrolled orbital debris. These objects range in size from a small chip of paint weighing grams to spent rocket stages weighing over 2 tonnes, both posing an immediate threat to hundreds of billions of dollars of assets in space that deliver essential services to our economy.

"Thanks to the unwavering support of the government of Quebec and our investors in North America and Luxembourg, NorthStar's unique space-based services will provide coverage of significant gaps that were previously inaccessible from ground-based systems. This represents a significant contribution to the sustainability of the space environment for future generations," said Stewart Bain, co-founder and CEO of NorthStar Earth & Space.

True Anomaly Raises $100 Million in Series B Funding to Further Accelerate Growth

True Anomaly, Inc., the technology company developing advanced hardware and software systems to ensure the sustainable security of space announced it has closed a $100M Series B equity raise. The round was led by Riot Ventures with participation from Eclipse, ACME Capital, Menlo Ventures, Narya, 645 Ventures, Rocketship.vc, Champion Hill Ventures, and FiveNine Ventures. This financing enables continued investment in people, products, and services to further advance True Anomaly's mission.

True Anomaly was founded in early 2022 by space operators and technologists who helped define the operational concepts for modern space security operations. The company builds solutions that address space domain awareness, security, and readiness challenges. This includes a differentiating combination of dynamic software applications as well as on-orbit spacecraft performing rendezvous and proximity operations (RPO) and non-Earth imaging (NEI). The company's products and services also offer solutions for space operator training, capabilities testing, and rapid response missions.

"A responsive and agile defense industrial base is essential to provide the tools for deterrence and global security," said Even Rogers, True Anomaly CEO and Co-Founder. "Space is the newest and most vulnerable theater of contemporary global competition, but the U.S. and its allies are ill-equipped for a conflict that begins in or extends into space. True Anomaly is solving this by building the technologies for a more secure, stable, sustainable, and transparent space environment. This Series B fundraise equips True Anomaly with the proceeds to maintain a deep focus on our mission, deliver incredible products, and continue to invest in the nation's next strategic offset."

In its first full year of operations, True Anomaly opened its GravityWorks spacecraft manufacturing facility in the Denver Tech Center and doubled its staff from 50 to more than 100 employees.

"We've had the unique privilege of working with True Anomaly since inception," said Will Coffield, Co-Founder and General Partner at Riot Ventures. "Doubling down in this round is a reflection of the exceptional execution we've witnessed over the last two years. The U.S. and its allies face intense national security challenges in the space domain, and we believe True Anomaly is going to be the company that delivers the core set of capabilities to offset those threats."

True Anomaly is also steadily expanding its Executive Leadership Team with industry expertise to help scale the business. Mark Seidel joined as Chief Financial Officer and Diana Lovati as Chief Information Security Officer in 2023.

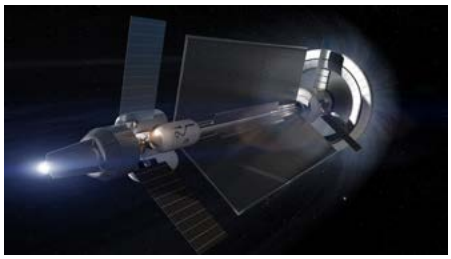
"True Anomaly's momentum across technology, product, and commercialization has been staggering in 2023," said Seth Winterroth, Partner at Eclipse. "This Series B not only validates True Anomaly's traction, but also illustrates the team's ability to scale, execute on product delivery, and ultimately, secure their incumbency in space security."

Helicity Space Raises $5M Seed Round

Helicity Space, a commercial space company developing in-space propulsion and power technology based on fusion power, announces $5 million in seed round funding from several new investors including Airbus Ventures, TRE Ventures, Voyager Space Holdings, E2MC Space, Urania Ventures and Gaingels.

Co-founded by Setthivoine You (former professor in plasma physics at the University of Tokyo and University of Washington) alongside Marta Calvo (formerly at Aerojet Rocketdyne with a background in chemical engineering) and Stephane Lintner (formerly at Goldman Sachs with a background in applied mathematics), the team at Helicity Space is dedicated to changing the game with fusion propulsion and its applications to advance exploration efforts, ultimately benefitting life on Earth.

"We are pleased to announce this latest round of funding for Helicity Space," said Dr. Stephane Lintner, Co-founder of Helicity Space. "Nuclear fusion



propulsion technology is the critical missing ingredient to fast, sustainable, and safe space exploration of our solar system. We thank our investors for not only understanding the impact this new technology will have, but also for believing in the entrepreneurial spirit that's required to expand the robust space economy from Earth's orbit and cislunar's operating grounds all the way to deep space."

Helicity Space's innovation is the culmination of more than 20 years of research by world-class scientists together to develop a novel approach to achieving fusion. The innovation leverages plectonemic plasma jets for confinement, magnetic reconnection for heating, and peristaltic magnetic compression for raising energy density. The successful close of this seed round further enables Helicity Space to advance their proprietary technology, the Helicity Drive, which consists of scalable fusion propulsion engines that should enable safer, faster, reusable, and more fuel-efficient travel into deep space.

"We're proud and excited to be on this journey with Helicity Space to bring the world's leading advances in plasma physics to space propulsion systems, and thereby set to bring the whole of our Solar System into Earth's reach. And on Earth, we see the benefit of bringing space-based and tested plasma fusion power to the speedier realization of executable plasma fusion applications to meet more of our planet's energy needs," remarks Lewis Pinault, Airbus Ventures Partner. "Helicity's highly talented global team is unlocking the value of a new breed of physics with a wealth of applications we stand ready to support."

Spacepreneur Editor kartikeya in conversation with **Mr.Suyash**

Co Founder - Galaxeye

Q Please brief us about the Journey from becoming an entrepreneur?

A I hold a Master's degree in aerospace engineering and have a background in developing deep tech systems, including the noteworthy Hyperloop project, which earned recognition as the sole Asian participant at Elon Musk's Hyperloop Contest hosted by SpaceX.

Inspired by our visit to SpaceX, where we witnessed the efficient assembly of rockets in limited spaces, our team, although deeply fascinated, initially refrained from entrepreneurial pursuits. Instead, we focused on specific problems that fueled our passion.

After completing my Master's, I joined the Industry R&D wing, where I utilized satellite imagery to address critical use cases. Identifying significant gaps in the satellite imagery domain, I founded GalaxEye to contribute to the advancement of this technology.

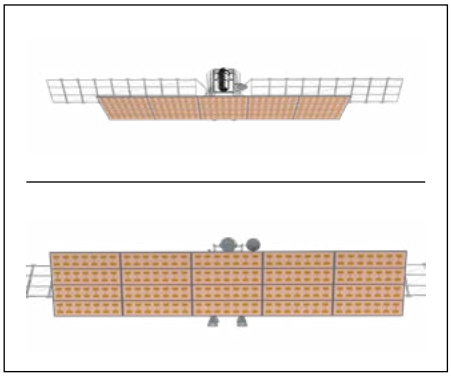
Q What are the Products & services currently offered by Galaxeye?

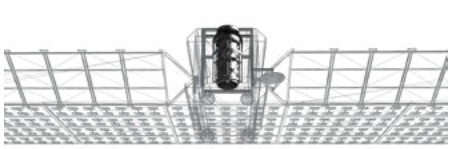
A We will be operating as Data as a Service Model providing Multi-Sensor Data Fusion dataset to the Users.

Q What are the challenges & opportunities you see in the Indian space Market?

A This is the best time to build in the space economy. Recent steps from the Govt are very supportive of the private space ecosystem. Chandrayaan-3 and many other missions by our Space agency is also a testament to what Indians can do.

> *Recent steps from the Govt are very supportive of the private space ecosystem. Chandrayaan-3 and many other missions by our Space agency is also a testament to what Indians can do.*





In terms of challenges, early stage companies' support system is still work in progress. Once that is done, we will be in a better position to accelerate further.

Q What are the leading space applications in all segments that you think can shape up the Indian space industry in coming years?

A Spatial Intelligence & location intelligence through Satellites.

Q Where do you see the Space industry by 2030 & how do you visualise GalaxEye by 2030?

A Space Industry by 2030 will be massive. Difficult for me to predict. GalaxEye will become Spatial Intelligence Powerhouse for the world solving problems across commercial & strategic markets.

Q What sets you apart from other competitors?

A Our Multi-Sensor Satellites are uniquely designed to provide comprehensive insights to the users, which sets us apart from the competition.

Q What is your suggestion to youngsters who wish to choose space as their careers?

A I would like to say go for it. Dont hesitate to, if you are space enthusiast, this is the golden period to be in space. There are a lot of design level and system level opportunities which can be found. Opportunities are limitless ranging from mechanical systems to electronics to AI.

Q What is your Wishlist for 2024?

A We want to launch our first Satellite as soon as possible.

Spacepreneur Editor kartikeya in conversation with

Mr. Rajesh Muneshwar

Co-founder & CTO – VIHAAN SPACETECH

Q Please brief us about the Journey from becoming an entrepreneur?

A The journey started all the way down in 1999 when I built my first gunpowder rocket. It went to 300 meters but created long lasting, enduring zeal and gave a purpose of life. Later I completed by graduation in Rocket Engineering specialization in Design from National Aerospace University, "KhAI" Ukraine. For all four years we studied Rocket Launch Vehicle design, Space System Designing especially the Bipropellant Rocket engines, I was privileged for getting an opportunity to have been trained by great professors and engineers from Antonov Design Buro and SDO Yuzhnoe, Ukraine. Post this formal education in the discipline and professional training in Ukraine, we continued the development of Sounding rockets, Weather modification and Armament Rockets in Ukraine in close cooperation team of Ukrainian OEMs.

In India we started the Sounding Rocket Development activities for the professional training of the students. Back in 2012 The High-Power Rocketry in India was pioneered by us. So far more than 70 successful launches from almost all parts of India has been done. After the Russian invasion of Ukraine, our team had to get back to India and start our Private Space program from Indian Mainland. Vihaan Spacetech was established in 2023 in Nagpur.

Our mission and vision are to produce and give a reliable economical new generation Mid-Heavy Space Launch vehicle for LEO, GTO and Trans-Lunar Space missions. At present our team is focused on detailed design stage of the Tech-Demonstrator Space Launch Vehicle for - Very Low Earth Orbit mission.

> *Our mission and vision are to produce and give a reliable economical new generation Mid-Heavy Space Launch vehicle for LEO, GTO and Trans-Lunar Space missions.*

Q What are the challenges & opportunities you see in Indian Space Market?

A Indian Space Market and its ecosystem is at budding stage. With tremendous aspirations and potential of the young Start-Ups, it yet has to travel miles ahead. Challenges faced by them are multifaceted. The lack of clarity of the customer base, crunch of the development funding support and uncertainty of the sustainable business generation are the few primary challenges. These challenges despite the government's positive encouragement to the private industry, are aggravated when it comes to procurement by the PSUs and Direct Government sector. Availability of the material supply, its testing and Import permissions are the administrative issues need be resolved at governance level. Small competitive market, slow government processes and investment support are the key challenges the private industry needs to get into everyday.

Q What are the leading space applications in all segments that you think can shape up the Indian space industry in coming years?

A Space for Earth applications holds a high potential market that needs to be tapped by Indian space ecosystem. The Earth Observation, Remote sensing data for the urban development and defence reconnaissance holds high potential. Some typically ignored but unique space application which remained ignorant but has no competition in India are: Micro-gravity Space Manufacturing of Pharmaceutical, in space Additive manufacturing and Space based IOT applications holds a tremendous business potential by the private sector.

Q Where do you see the Space industry by 2030?

A By 2030 I see the space-based data business a great success and Indian market share in the space application becoming up to $ 15 Billion USD. Space Industry will become

more strategic. Both government and private sector investment will grow up 90$ of the space business. The industry by 2030 will certainly cross $ 738 billion Evaluation of the market. India's market share in the space industry can be expected to cross its 9% market share. The Space industry will grow with 7 % consistent annual growth rate. 90 % of the business will be in the downstream space application business, eg. IOT based satellites, Space based internet, in space manufacturing, etc.

Q What is your USP? What sets you apart from other competitors?

A A very fact that a pioneering space vision of India's alternate private space program makes us a part. Everybody has a product but we have a complete space program. This philosophy is manifested in all our orbital and space transportation products. Naming a few a development of a dedicated V-LEO space launch vehicle for reusable in space manufacturing orbital payload launch vehicle which is powered by Biomethane powered engines with Vertical Take-off and Horizontal Landing Concept makes our Launch Vehicle and its service makes us stand not just unique but distinguished.

Q What is your suggestion to youngsters who wish to choose space as their careers?

A My only suggestion is to opt for Design specialization in Propulsion system and Space orbital mechanics. Material, Propulsion, System engineering and Space Project Management would be a key area of specialization that would give them a competitive edge. It takes years of hands-on experience and supervision of more experienced technocrats to become a good design engineer. So, I strongly advice to organize into a student hands-on project group. Select an industry relevant project or problem statement from 4th semester in your undergraduate course and continue its development simultaneous to your formal studies of subject knowledge so that at the end of your graduation / postgraduation your project becomes a workable and sellable solution to the industry. This would increase the employability of the Space carrier aspirants and industry would require the fleet of highly competitive space engineering experts and space leaders.

Q What is your Wishlist for 2024?

A Well, we have a long Wishlist but speaking in terms of planned and scheduled work of 2024, we have priorities of Successful test demonstration of our Hall Effect Plasma Thrusters in LPSC facilities, Space shot to space with students and Mr. MRK Menon of Model rocketry society of India and Test Launches of our Sounding Rocket from VSSC facilities in Thumba. The validation of our Orbital Transfer Vehicle mission and V-LEO Launch Vehicle Simulation Validation at ISRO are on our top agenda list.

Need of a dedicated student built nonprofit space launcher for Student built and University research payloads.

India if needs to encapsulate the growing space career aspirations, the university space research and enthusiasm amongst the youth for space studies, we must be able to provide them a hands-on regular space participation. Indian Space Policy Makers must come out with an ISRO monitored dedicated Student Space program. In which student will build the rocket and launch it for a dedicated university built space payload and All India Intercollegiate Rocket Launch Competition.

Spacepreneur Editor kartikeya in conversation with **Mr. GOVIND YADAV**

Founder & CEO - Vyomika Space

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

A At Vyomika Space Academy, we are committed to promote Space Education in rural parts of India. In our beginning phase we have identified a great gap in the learning opportunities for the rural students in the northern states like Uttar Pradesh, Bihar, Punjab etc. We have started deploying multiple training programs in the targeted government schools by providing our short term physical and virtual training session on subjects such the need of rocket launches for India, satellite application for rural areas and Telescope based Astronomy to educate the rural students about the potential of Indian Space Programme and ISRO. In 2022 we got registered under the ISRO Space Tutor Programme and we launched our unique Rural Space Lab Platforms for the government schools in Uttar Pradesh and nearby states. Based on our good work dedicated to the rural students in the aspirational district Siddharth Nagar of Uttar Pradesh, on 17th April 2023 our Rural Space Lab project has received a national award from the President of India. At present Team Vyomika Space is all set to installing around 170 Space Labs in over 40 Districts of India to empower more than 22000 rural students.

> *At present Team Vyomika Space is all set to installing around 170 Space Labs in over 40 Districts of India to empower more than 22000 rural students.*

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

A As India is reaching moon, mars and beyond, it became a necessity to

educate our young generation to meet the needs of the Indian Space Industry. At Vyomika Space Labs we are offering low cost physical skill development courses and kits to an age group of 8-18 years old students. Our curriculum teaches subjects such as Astronomy through Telescopic Observation, Drone technology, Satellite based Remote Sensing Application for villages, Sounding rocket designing and other emerging technologies.

Q Tell us something about the process of setting up Space Labs in rural Places & what are the activities each space lab will have?

A To set a rural space lab, we sent our request proposal to the concerned district administration officials and village Sarpanch. After the approval of the project the education department or the Gram Panchayat provides us the suitable government school classroom and necessary fund to establish the proposed space education lab. The lab setup includes instruments such as telescope, drones, 3D Printer, RC Aircrafts, DIY Kits, Robots, Books, ISRO Rockets and Satellite exhibits and many more projects to run the space lab

curriculum. Also to achieve sustainability for the space lab operations we train the local government school teachers.

Under this training the attendee teachers learn to use and demonstrate all the given projects in the space lab.

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

A As Indian Space Industry is progressing with an amazing rate, we surely need a massive skilled workforce to serve the industry. But as India's major youth population is living in Rural regions, therefore we need a robust space education and awareness schemes for every rural student. Even with so many educational development plans, still we do not have good space science learning platforms for our government school attending students, especially in small population villages of northern states of India. With the promising space missions done by ISRO such as Chandrayaan 3 and Aditya L1 the entire rural student community is determined to build a career in the thriving Indian Space Industry and it is the duty of all the concerned institutions to provide the required support to the eligible students from every corner of the country.

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

A With its recent space missions ISRO have made it clear that Indian Space Industry is ready to lead the global space economy in the coming decades. And our youth possess a great opportunity in this new Indian space ecosystem. We are living in an amazing time where we can start a rocket and satellite manufacturing start-ups in the blink of an eye. Under the great supervision of ISRO it's capacity building programme office is reaching almost every young cosmic mind to help them craft their career in Indian Space Industry.

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 ISRO's space tutor programme enables, startups like us to reach all kind of young cosmic minds. We are getting many educational resources such as ISRO Jigyasa Portal and to run our curriculum and As a responsible space tutor Vyomika Space want to serve the most remote locations and villages of India to cultivate thousands of Abdul Kalams and Kalpana Chawlas to serve the scientific community of Bharat.

Q If you could change one thing about Space Industry with a click of your fingers, what would it be and why?

A If I could change one thing in global space industry then it would be its international collaboration regime. Sharing of findings and Research among leading space fearing nations would reduce down the cost of future space exploration missions. Humanity can't go interstellar or intergalactic civilization, without a planetary level cooperation.

Rocket Lab Signs Deal to Launch South Korean Satellite

KAIST's NeonSat-1 will launch as the primary payload on an Electron rideshare mission with NASA in the first half of 2024.

Long Beach, California. December 7, 2023 – Rocket Lab USA, Inc. (Nasdaq: RKLB) ("Rocket Lab" or "the Company"), a global leader in launch services and space systems, today announced it has signed a launch services agreement to launch an Earth observation satellite for the Korea Advanced Institute of Science and Technology (KAIST) on a rideshare mission in the first half of 2024.

KAIST's NeonSat-1 will be the primary payload on an Electron rideshare mission that will also deploy NASA's Advanced Composite Solar Sail System, or ACS3 satellite. The mission will lift-off from Rocket Lab Launch Complex 1 in New Zealand.

"2024 is shaping up to be our busiest launch year yet with a fully booked manifest of Electron

missions," said Rocket Lab founder and CEO, Peter Beck. "By combining this mission with the launch of NASA's ACS3 spacecraft, we've been able to provide KAIST with a launch opportunity on short notice to help them reach orbit faster. It's a privilege to be working with the KAIST team and we are thrilled to be providing them with timely and affordable launch services on Electron."

Jae-Hung Han, Director General of the Satellite Technology Research Center (SaTReC) at KAIST said: "We highly anticipate collaborating with Rocket Lab for a successful launch of our first satellite of the NEONSAT microsatellite constellation program."

NeonSat-1 is a high-resolution optical satellite that will be deployed as a technology demonstration for a planned future Earth observation constellation. KAIST is Korea's leading science and technology institution, having developed and operated Korea's very first satellite KAIST when it was successfully launched more than 30 years ago.

In addition to being launched by Electron, KAIST's NeonSat-1 will use Rocket Lab's MLB satellite separation system in the Company's latest demonstration of its vertically integrated space systems strategy.

Launch Vehicle Telemetry Expected to Become Commercially Available Faster as InRange Moves to Market

Viasat, Inc. a global leader in satellite communications, is working with Safran Data Systems to jointly bring InRange to market so launch providers and spaceports can relay launch vehicles' telemetry in flight throughout their trajectory - and without having to rely on ground networks.

InRange uses global L-band satellite fleet - which Viasat now operates following the acquisition of Inmarsat in May - to provide real-time telemetry data for launch missions. By using space-based communications, InRange will allow launch mission controllers to monitor the performance of missions beyond the line of sight, without the need for ground communications infrastructure. A global satellite communications network can also prevent so-called 'blackout zones' when a launch vehicle moves into an area not covered by Earth-based connectivity.

Under the MoU, Safran Data Systems will provide its telemetry antennas, onboard transmitters, and Cortex modems to support the InRange system for commercial launch systems virtually anywhere in the world. The companies will also explore different commercial models to

allow launchers to purchase and use the InRange system 'off the shelf'. The move will be another commercial milestone for InRange, following a recent European Space Agency joint contract to test the system on Skyrora's sub-orbital Skylark L launch vehicle next year.

InRange is part of Viasat's wider in-orbit communications services which are designed to enable real-time data transfer between satellites in different orbits, for uses like government communications, earth observation, or climate monitoring. This includes the IDRS space relay service, which enables operators to command and control Low Earth Orbit satellites whatever the mission.

Gary Lay, Vice President of Viasat's Strategic Programmes, said: "In the last 10 years we've seen the commercial launch industry really take off with many private launch providers coming to market. Accurate telemetry is a critical part of any launch mission, so global connectivity that provides accurate, real-time data could be game changing as we continue to see rapid growth."

"InRange is designed to give launch operators greater flexibility and reliability for their launch telemetry. This partnership with Safran is aiming to bring the service to market faster and help it become an indispensable tool for mission success."

Jean-Marie Bétermier, Safran Electronics & Defense Space Director, said "Meeting the new needs of launch operators is our main objective at Safran Data Systems. We have been anticipating them over the last few years and are proud of the progress made with this InRange service offered jointly with Viasat. This is a great recognition of our expertise in the field of advanced telemetry, as we can provide data in real time and continuously, whatever the position of the launch vehicle."

Virgin Galactic Completes 6th Successful Spaceflight in 6 Months

Virgin Galactic Holdings, 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."

USSF-52 Mission

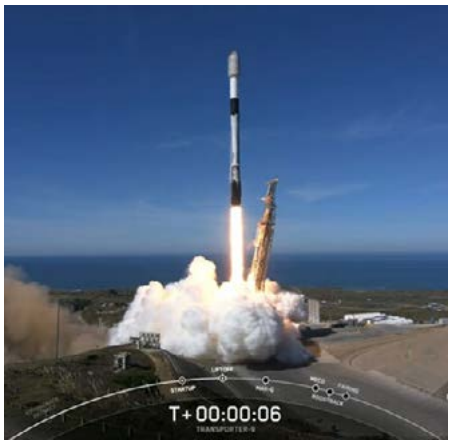
Falcon Heavy launched the USSF-52 mission to orbit from Launch Complex 39A (LC-39A) at Kennedy Space Center in Florida. This was the fifth launch and landing of these Falcon Heavy side boosters, which previously supported USSF-44, USSF-67, Hughes JUPTER 3, and NASA's Psyche mission.

Satellite With Saab Technology Launched by SpaceX

Ymir-1, a satellite equipped with technology from Saab, was launched into space on 11 November onboard SpaceX Falcon 9. This marks a new era within maritime communication.

Ymir-1 is a test satellite and part of the development of the next generation of the Automatic Identification System (AIS), a system used by ships to communicate position, speed, course, and other data. AIS is a requirement for all larger ships and boats in civilian traffic. Saab TransponderTech is a leading manufacturer of AIS transponders and has built the advanced transponder onboard the satellite.

"Saab's focus is innovation and to be at the forefront of technology. By using the space domain, we can strengthen and improve already existing products in our portfolio. The satellite launch is an important step in our investment



in space and demonstrates our ability to utilise available Saab technology to, together with our partners, create new, unique space applications," says Christian Hedelin, Chief Strategy Officer at Saab.

Due to the increasing number of ships at sea, AIS will be upgraded to a new technology known as VDES (VHF Data Exchange System). With VDES, capacity will significantly increase, and there will be the possibility of secure two-way communication via satellites, providing global coverage compared to today's systems which are limited to coastal communication.

In the long run, the new navigation and communication system, VDES, will link land, sea, air, and space by combining advanced transponders with modern software and satellites.

The Swedish-built satellite Ymir-1 is a tool for research and development, developed in collaboration between Saab, AAC Clyde Space, and ORBCOMM within the AOS consortium. The project will continue throughout 2024.

SES's 5th and 6th O3b mPOWER Satellites Successfully Launched

SES announced that two additional O3b mPOWER satellites were successfully launched into space by a SpaceX Falcon 9 rocket from Cape Canaveral Space Force Station in Florida, United States, at 4:08pm local time. With the fifth and sixth O3b mPOWER satellites launched, the system completes the six medium earth orbit (MEO) satellites required to offer high-performance network services delivering high throughput, predictable low latency, unique flexibility and service availability.

Last month, SES announced it will add to the constellation two more satellites built by Boeing, bringing the total number of O3b mPOWER satellites to 13. The additional investment is expected to be covered within SES's existing committed CapEx envelope. The first four O3b mPOWER satellites launched in the last year have arrived at their target orbital position and are undergoing in-orbit checks, including a series of system validation tests encompassing both

space and ground components.

In 2023 alone, SES has rolled out and tested more than 160 O3b mPOWER terminals over the existing O3b constellation to serve mobility, telecom, government, and enterprise customers.

"With the fifth and sixth O3b mPOWER satellites launched and going operational in the next few months, we are gearing up to deliver the high-performance connectivity services our customers need. By building resiliency into the network, we are confident our customers will be able to depend on us to deliver the reliable and secure connectivity required to run their operations," said Ruy Pinto, CEO of SES.

O3b mPOWER commercial service is expected to begin during the second quarter of 2024.

Blue Origin Successfully Completes 24th Mission to Space

Blue Origin successfully completed its 24th New Shepard flight and 13th payload mission from Launch Site One in West Texas.

The flight carried 33 payloads from NASA, academia, research institutions, and commercial companies, bringing the number of payloads flown on New Shepard to more than 150. Club for the Future, Blue Origin's nonprofit, flew 38,000 postcards as part of its Postcards to Space program. Each postcard will be returned to its creator stamped "Flown to Space." The Club recently added a digital method to create and send postcards, which can be found here. New Shepard's booster kicks up dust prior to landing on the pad in the West Texas desert. There are clouds in the sky and scrub brush in the foreground.

New Shepard's booster lands on the pad during NS-24 (December 19, 2023).

KEY MISSION STATISTICS

Official Launch Time: 10:42:28 AM CST / 16:42:28 UTC

Booster Apogee: 347,208 ft. AGL / 350,855 ft. MSL (106 km AGL / 107 km MSL)

Crew Capsule Apogee: 347,601 ft. AGL / 351,248 ft. MSL (106 km AGL / 107 km MSL)

Crew Capsule Landing Time: 10:52:41 AM CST / 16:52:41 UTC

Mission Elapsed Time: 10 min 13 sec

"A special thank you to all of our customers who flew important science today and the students who contributed postcards to advance our future of living and working in space for the benefit of Earth," said Phil Joyce, Senior Vice President, New Shepard. "Demand for New Shepard flights continues to grow and we're looking forward to increasing our flight cadence in 2024."

Lift-off for EIRSAT-1, Ireland's 1st Ever Satellite

Six years of hard work and dedication paid off in spectacular fashion as the Educational Irish Research Satellite, EIRSAT-1, successfully blasted off from Vandenberg Space Force Base, California. Hitching a ride on a Space-X Falcon-9 launcher, the tiny satellite – measuring just 10.7cm x 10.7cm x 22.7cm – has now made history as Ireland's first satellite!

EIRSAT-1 was designed, built, and tested by students from University College Dublin (UCD) participating in ESA Academy's Fly Your Satellite! programme, a hands-on initiative supporting university student teams to develop their own satellites according to professional standards. The launch opportunity itself was provided by ESA.

ESA experts have been on-hand throughout the satellite's development to offer training and guidance to dozens of UCD students. Their learning journey also included test campaigns at ESA Education's CubeSat Support Facility in Belgium, and dedicated spacecraft communications sessions both at ESA Academy's Training and Learning Centre and at the European Space Operations Centre in Darmstadt Germany, to learn Ireland's first spacecraft operations procedures.

"I would like to wholeheartedly congratulate the EIRSAT-1 team for this successful launch and the start of Ireland's first exciting adventure in orbit," said Josef Aschbacher, ESA Director General. I'd also like to thank UCD for joining forces with ESA towards a common educational objective: boosting the skills of the young generation," he continued. "It's only by building capacity that we can make our space ambitions become a reality, for Ireland and for Europe. With our Education programme we are nurturing generations of citizens who are learning to use space technology and space solutions in order to make a difference for our society, our planet and our future."

From low earth orbit EIRSAT-1 will carry out three main experiments, which were built from scratch by the students:

GMOD, a detector to study gamma ray bursts, which are the most luminous explosions in the universe and occur when a massive star dies or two stars collide.

EMOD, an experiment to see how a thermal treatment protects the surface of a satellite when in space.

WBC, an experiment to test a new method of using Earth's magnetic field to change a satellite's orientation in space.

Following EIRSAT-1's deployment to orbit, the student team is now working to establish contact with the satellite and start operations from their dedicated ground control facility, also entirely operated by students and located at UCD in Dublin.

"The team at ESA Education would like to join ESA DG in expressing their heartfelt congratulations to the EIRSAT-1 students for achieving their incredible goals," said Hugo Marée, Head of the ESA Education Office.

"Not only has EIRSAT-1 made history by being Ireland's first satellite, but it has also inspired a generation of Irish school students to grow their ambitions higher. This has been achieved thanks to the inspiration activities organized by ESERO Ireland (a collaboration between ESA and Science Foundation Ireland) around this mission," he continued. "I am proud of our Education programme which is able to inspire and engage different age groups towards a future career in STEM."

Spacepreneur Contributing Editor Dr. (Hon) M R K Menon In conversation with

Mr. Abhigna Yerramreddikalva

Q How did you get into Experimental Rocketry while still at school?

A I have been deeply fascinated with rockets and space for quite some time. My experimental rocketry endeavours started in the 6th grade during the first lockdown of the COVID-19 pandemic. I had a lot of free time and started learning more about how rockets work, I had also been watching a lot of YouTube videos of model rockets, so I thought of building a small model rocket with some electronics to measure the altitude. At that time I thought that it would be a short 3 month project, but here I am 3 years with a lot of skills under my belt and still really interested in experimental rockets!

I am leaning towards Electrical Engineering or Mechanical Engineering though, but again I am not 100% decided yet.

Q How have your Parents supported you during this period when studies are considered more important?

A My parents have been very supportive of my "outside-of-school" activities. They've provided me with the tools, parts, and opportunities necessary to pursue my passion. Until this point, I had been able to balance both my schoolwork as well as my projects. Now, however, as I am gearing up for my 10th-grade board exams I have had to focus a little more on my studies rather than rockets.

Q Have you received any Mentorship from any Individual as part of your learning curve? What is a Mentors role?

A I have not received much technical mentorship as such, and most of what I've learned has been through YouTube videos, iterative design, learning by doing, and a whole lot of failure. I believe that a mentor's role is not just to educate someone, but to inspire them, connect them with others, and help them grow. My mentors have been Mr Rajesh Muneshwar and AVM(Retd).Shri.Suresh Singh Sir of Vihaan Spacetech. They've graciously allowed me to use their launch site and manufacture the motors required to launch my rockets and have provided me with a lot of advice on how to improve my rocket-building techniques. My mentor has also been my father. He's the one who sparked my interest in space and technology and pushed me to seek professional mentorship, post my work online, and has just generally supported me throughout my journey

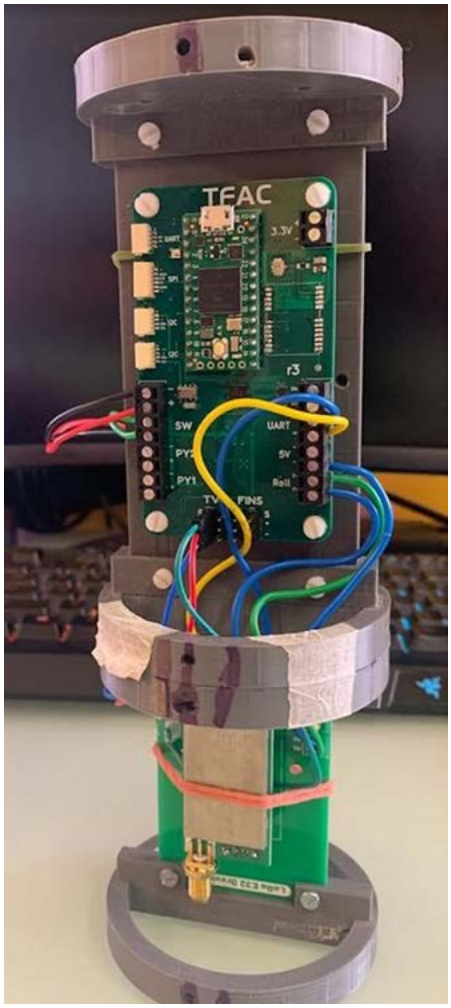
Q Describe your feelings when you made your first live, on stage presentation in front of University and ISRO officials?

A It was quite nerve-racking when I made my first on-stage presentation. I had never done public speaking until that point or even spoken to a crowd of that

many people before but as my presentation progressed I let go of that stage fright because I saw that several people in the audience were fascinated by my work. Then I realized that my presentation was effective in both showcasing the work that I've done and also in inspiring people to pursue what really fascinates them.

Q Tell us briefly about the development of the MK-1 Rocket you plan to launch later this year?

A Air MK1 is my first step into high-power rocketry and the first rocket I've built. I built Air MK1 to get my hands dirty with building rockets (as I had only worked on designing, building, and testing flight computers before that), and also to test out my flight computer TFAC. Air MK1 is around 1.15 meters long and has a dry mass of 1.4kg. It is built out of a 78mm diameter cardboard tube with a 3D printed nosecone at the top, and four plywood fins at the back. Air MK1 is made of two sections of cardboard tube joined by a coupler. The forward section is the sort-of payload section and will hold my avionics stack, and the aft section will hold the motor-mount assembly and the recovery devices. Air MK1 is designed to fly to an

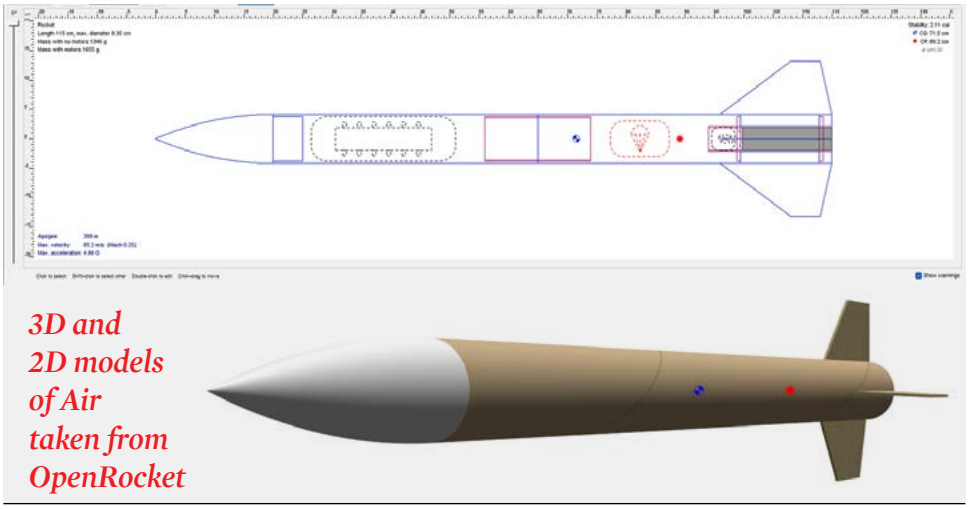


apogee of around 400m on a H73J equivalent rocket motor. The parachutes will be deployed by the motor's ejection charge, my flight computer is a passive payload and will be logging data to test out the software of my flight computer so it can be used to recover rockets later down the road.

Q Describe briefly the Specs of the Flight Controller you have designed and produced to guide your Model Rocket?

A My flight computer is called TFAC (Third Flyable Avionics Computer). It is the fourth flight computer I have designed and built and the only working flight computer I've made. At the heart of TFAC is a Teensy 4.0 microcontroller. TFAC has a 10DOF sensor suite with a BMI088 IMU, an MS5607 barometer, and a LIS3MDL magnetometer. Additionally, TFAC also has a uBlox NEO-M9N GNSS radio with a U.FL antenna. In terms of datalogging TFAC has two memory devices. A flash chip where data from all the devices is logged to in-flight and a Micro-SD Card slot where the data stored in the flash chip is dumped after the rocket has landed. The sensors communicate with the microcontroller via the I2C interface, and the memory devices use SPI. Additionally, TFAC has 2 load-switch-based Pyro-Technic channels, four servo outputs, an LED, and a buzzer along with a plethora of I/O such as power outputs and communication outputs. TFAC can be powered by a 2s or 2s LiPO battery for which it has a step-down buck converter. TFAC uses an Ebyte-E32 Transceiver for sending telemetry data to an identical receiver on the ground, data is displayed on a Ground Control UI written by me. More information on TFAC can be found here on my website: https://www.abhignay.com/documents

Q What are the challenges you are facing as you engage in this activity?



3D and 2D models of Air taken from OpenRocket

A The main challenge that I face as I build rockets in India is a lack of government regulations and just a lack of information on how to safely engage in the hobby. Before I met my mentor I had no way of launching my rockets, procuring parts, and making motors. Now that I am working with an aerospace company to launch my model rockets I have access to launch sites and rocket motors, but as a student, without those connections, I would have no way of flying my rockets.

Q What are your Career Plans?

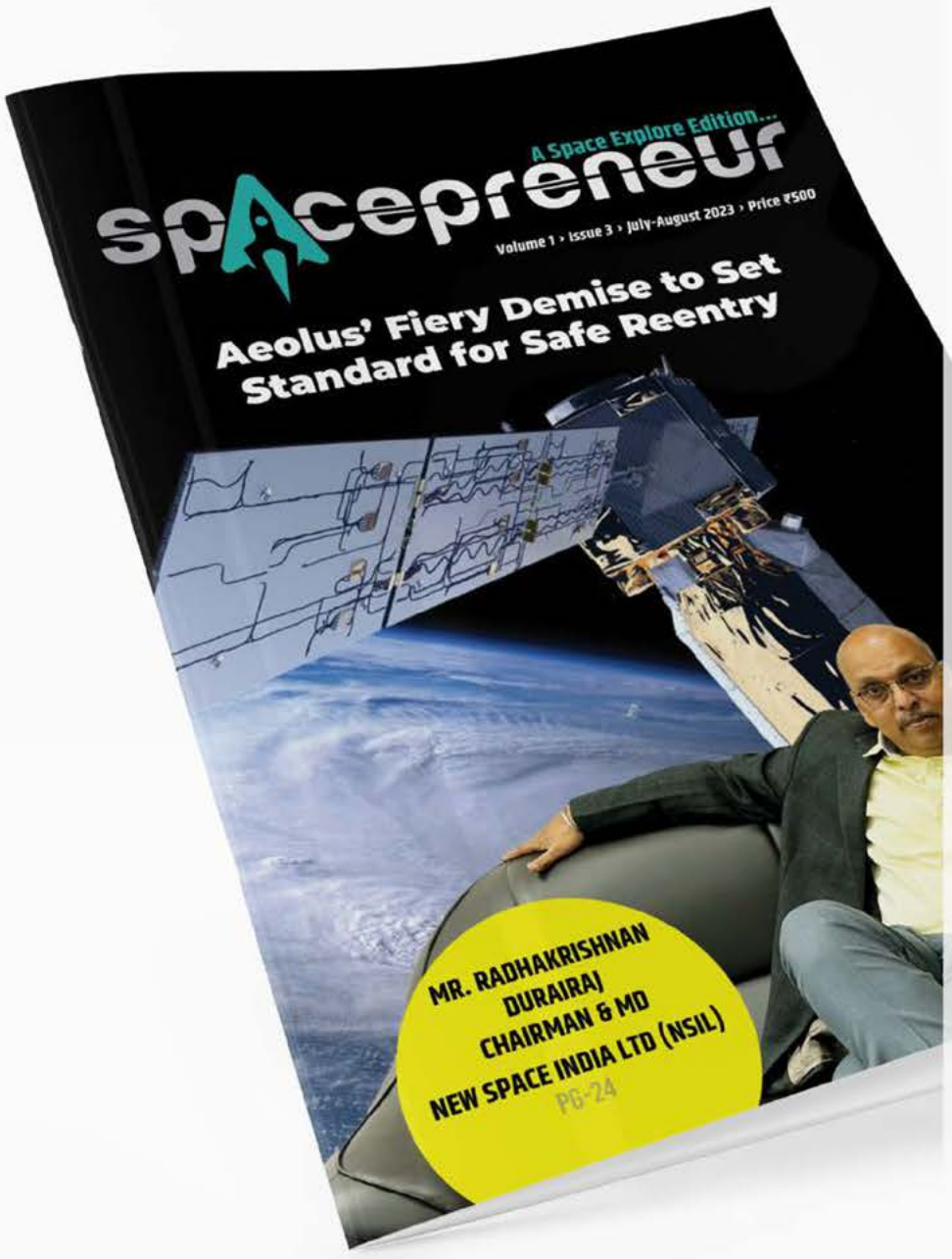
A As of now I am unsure of what exactly to pursue as my career. I do want to work on real rockets and satellites in the future, but I am undecided on the specifics. I am leaning towards Electrical Engineering or Mechanical Engineering though, but again I am not 100% decided yet.

Q Have you met school students who are engaged in Model Rocketry?

A I haven't met many school students who are engaged in model rocketry, but I know that quite a few are interested. I believe that this has to do with the scarce guidance that can be found online with regard to the hobby. The entry-barrier for model rocketry in India compared to other countries like the US is quite high and it can be quite daunting if you are not ready to go all in to model rocketry

Q What is your message for children interested in Aerospace as a Career?

A My message to students interested in Aerospace and Model rocketry is that if you really like aerospace you should start working on it right now! Experiment, fail, succeed, the learnings you get by constantly iterating, fine-tuning, and failing at your work are extremely valuable. I strongly feel that if you want to get into something you should go all-in and not be afraid of failing, but you should be ready to persevere because very rarely will things work on the first time. If you frame your failures and look at what went wrong you are learning about it in the best and most valuable way possible!



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www.spacepreneurmag.com
spacepreneurmag@gmail.com
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Ananth Info Park, Plot No.39,
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Fax:+91-40-6615 6531

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