MISSION PRARAMBH:

INDIA'S FIRST PRIVATELY BUILT ROCKET VIKRAM-S SUCCESSFULLY LIFTS-OFF

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On November 18, 2022, at 11:30 AM, the Indian Space Research Organization (ISRO) successfully launched Vikram-S, India's first rocket built by a private company. The launch took place at the sounding rocket complex in Srihari Kota. The rocket, named Vikram-S, pays tribute to Vikram Sarabhai, the pioneer of India's space program. The mission for the rocket launch has been named as 'Prarambh', that means beginning. Vikram-S was a suborbital technology demonstration mission. Around 140 seconds after lift-off, the rocket soared to an altitude of 89.5 km (Vs. expected 81.5 km). Thereafter at about 291 seconds the rocket splashed down into the Bay of Bengal at around 115.6 km away from Sriharikota. Hyderabad-based space startup Skyroot Aerospace developed the Vikram-S rocket, which was launched with assistance from ISRO and IN-SPACe. With the successful debut flight of Vikram-S, Skyroot Aerospace has achieved the milestone of being the first Indian private company to enter outer space.

Keywords: Vikram-S, Prarambh, Suborbital, Single-stage, Spin-stabilised, Solid propellant, rocket, launch vehicle, Skyroot Aerospace, ISRO, IN-SPACe

The successful launch of Vikram-S, India's first rocket developed by a private company. rocket, Mission Prarambh from Sriharikota on November 18, 2022, marks the dawn of a new era for private participation in the Indian space endeavor.

Vikram-S and payloads

Vikram-S is a solid propellant rocket with a single stage that is spin-stabilized and HTPB based. Vikram-S features a body mass of 545 kg, measures 6 meters in length, and has a diameter of 0.375 meters and is among the most affordable rockets in its class worldwide. The rocket is fitted with systems for telemetry, monitoring, GPS navigation, an integrated camera, data collection, and power management. It is built on upgradeable architecture with light weight carbon composite materials with an all-carbon fibre core structure and four 3D-printed motors. The engine, 'Kalam-80' used in this launch vehicle commemorates former President Dr. APJ Abdul Kalam.. The first of the three Vikram rockets in the series, the Vikram-S is a small-lift launch vehicle. Three other versions of the Vikram rocket series—Vikram-I, II, and III—are being developed by Skyroot. The Vikram-II can lift off 595 kilograms of mass, whereas the Vikram-I can deliver 480 kilograms of payload to Low Earth Orbit. With a low inclination orbit, Vikram-III can launch an 815 kg mass up to 500 kilometers. While Vikram-I will have three solid stages and a liquid upper stage, Vikram-II and Vikram-III will have cryogenic upper stages with additional boosters to enhance the uplift capacity. Vikram rockets could be easily assembled and launched in less than 72 hours. The launch of Vikram-I is planned during next year.

The rocket had carried three PCB based non-deployable payloads in space with a total mass of 83 kg. Of the three payloads, two were for Indian customers, and one was for a foreign client.

1. FunSAT was developed by a Chennai-based aerospace startup, Space Kidz India with global collaboration of children from the U.S., Indonesia, Singapore, and India.

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2. N Space Tech India Pvt. Ltd., Tenali, Andhra Pradesh
3. BazoomQ Space Research Lab., Armenia.

All these payloads were equipped with sensors for the measurement of acceleration, pressure, etc. In addition, it had carried 300 Hallo Cards with good wishes from Skyroot, ISRO and IN-SPACe officials.

VIKRAM-S: VITAL STATS
Mass: 545 Kg
Length: 6 meters
Diameter: 0.375 meters
Peak thrust: 7 tons
Peak velocity: > Mach 5 (Hypersonic)
Peak combustion pressure: 90 bar
Payload capacity: 83 kg to 00 km altitude

VIKRAM-S: CUSTOMER PAYLOADS
Space Kidz India
N-Space Tech India
Bazoomq Armenia

The Vikram-S, which was created by a team of 200 engineers from Skyroot Aerospace in a record-breaking two years, is propelled by Kalam-80 solid fueled propulsion, advanced avionics, a carbon fiber core structure, and engine parts that were 3D printed. Three clients' payloads were transported by it: BazoomQ Space Research Lab., Armenia; N Space Tech India; and Space Kidz India.

Why is this launch a big deal?

When India already has reliable heavy lift rockets like PSLV and GSLV, successfully sent satellites to Moon and Mars, and is advancing towards launching human spaceflight, what is a big deal in launching such a small suborbital rocket? Let us critically examine this aspect.

Space programme in India so far has been under the sole domain of the Indian Space

Research Organisation (ISRO). ISRO has developed several public sector and private industries as supply chain partners in the realization of launch vehicles and satellites. But their contribution was limited to the supply of subsystems. While all the major space agencies in the world (e.g., NASA, ESA, Roscosmos, JAXA, CSA) primarily act as enablers and regulators. Elsewhere leading innovations, research work, manufacturing and testing activities of the space systems are undertaken by universities, institutes, public, and private enterprises. Space-X, Blue Origin, Lockheed Martin, Boeing, Virgin Galactic, United Launch Alliance, Orbital Science Corp., and Bigelow Aerospace are some of the leading players aggressively contributing in building low-cost spacecraft, and rockets.

Global Space economy is estimated around $447 billion, and it is expected to grow by over 8% during 2022-2027. Despite ISRO's remarkable abilities, India's contribution to the global space sector is estimated at approximately $7 billion, accounting for under 2%. Keeping in view the growing business in space across the globe and to harness the huge untapped potential across the country, the government of India in June 2020 announced reforms in the space sector. The space activities were opened to the private sector. The Department of Space set up the Indian National Space Promotion and Authorization Center (IN-SPACe), an independent organization that acts as an intermediary between ISRO and private industry. IN-SPACe facilitates the entry of private enterprises into the Indian space industry and establishes favorable conditions for reasonably priced satellite launch services.

Mission Prarambh

After opening the space sector to the private sector, 150 startups have sent applications to foray into space. ISRO is encouraging them to utilize their facilities and expertise. A group of retired ISRO experts who help companies grow their space operations. On October 11, 2021, Hon. Prime Minister Shri Narendra Modi established the Indian Space Association (ISpA), a non-profit industrial organization dedicated to the successful growth, cooperation, and exploration of India's public and private space industries. It aimed to make India technologically sophisticated, self-sufficient, and a major force in the world of space exploration.

A new era has begun with the Prarambh mission, in which the private sector is taking over a portion of the government agency's workload. The development will also demonstrate that the private sector, which was previously reliant on governmental funds, is capable of not only creating and building the launch vehicles but also drawing in clients from around the world and investments. Additionally, this work plan will allow ISRO to focus on interplanetary mission exploration and high-end space research and development for strategic applications. At the moment, ordinary operations take up far too much of ISRO's resources and frequently cause it to miss its strategic goals.

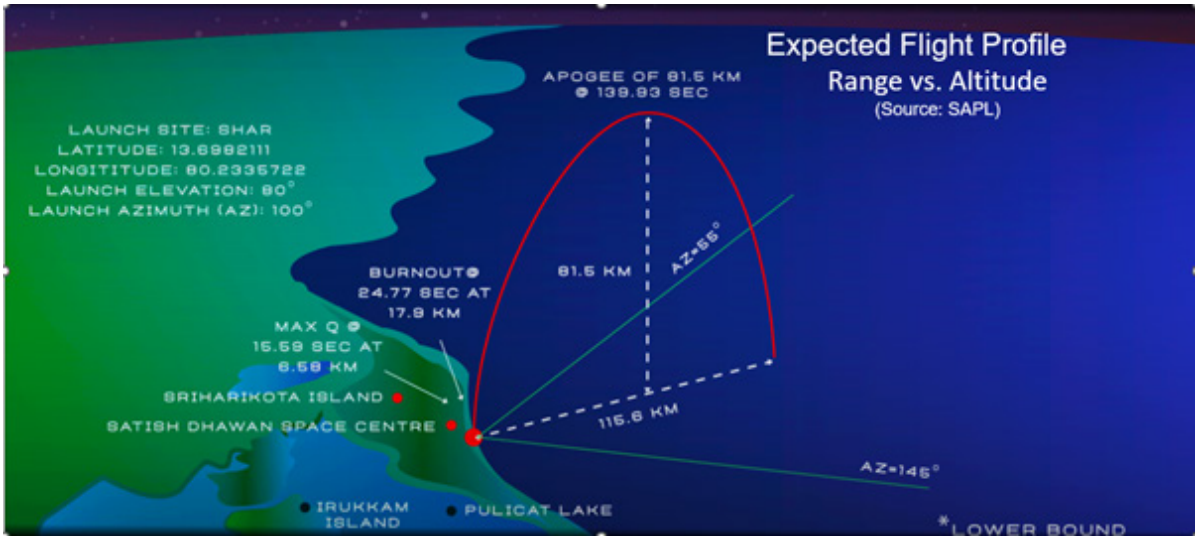
From a technical perspective, the Prarambh mission will aid in testing and validating technologies for the orbital class of Vikram series launch vehicles. This comprises numerous technologies and subsystems (such as telemetry, tracking, GPS, onboard cameras, data gathering, thermal, structures, power systems, etc.) that will be put to the test during the launch's pre-lift-off and post-lift-off stages. In addition to providing tailored, dedicated, and ride-share solutions to meet the diverse needs of small satellite customers, this development may also provide unique capabilities including multi-orbit insertion and interplanetary missions.

What is Skyroot Aerospace?

With its headquarters located in Hyderabad, Skyroot aircraft Private Limited (SAPL) is a private aircraft manufacturer and provider of commercial launch services in IndiaThe company aims to design and launch a series of small-lift vehicles specifically for the small satellite sector. Founded in July 2018 with initial funding from Myntra co-founder Mukesh Bansal, it was established by former ISRO engineers Pawan Kumar Chandana (CEO, an IIT Kharagpur graduate) and Naga Bharath Daka (CTO, an IIT Madras graduate).

It became the first private enterprise in India to successfully test-fire a liquid propulsion engine and launch a solid fuel rocket in less than two years. In September of this year, the business raised USD 51 million through a Series-B financing deal. In July of last year, it raised $11 million through Series-A capital raising. In 2021, Skyroot Aerospace and ISRO signed a Memorandum of Understanding to use ISRO's resources and knowledge to develop the rockets.

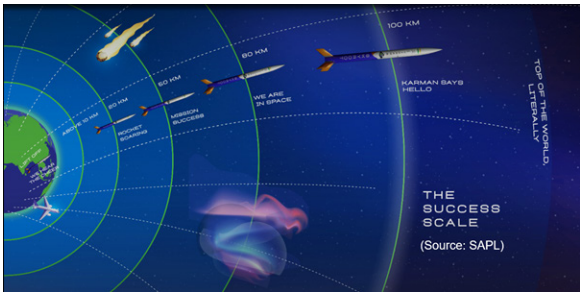
Skyroot Aerospace, a two-time national award-winning space startup establishment took place in June 2018 by Mr. Pawan Kumar Chandana and Mr. Naga Bharath Daka, former ISRO scientists. With ₹526 crore in funding raised so far, it is the most financially supported private space venture in India.
The first Indian startup to receive authorization to launch a rocket for the Indian space program is Skyroot Aerospace. The business is actively interacting with consumers worldwide and has already begun bookings for launches beginning at the end of 2022.



What are suborbital missions? Why do we need them?

A satellite is said to be in an orbit when its momentum completely opposes Earth's gravity, causing it to follow a curving route that tilts it toward the planet continuously but never gets close. In order to create enough momentum to maintain its orbit, an orbiting spacecraft must first launch vertically before tilting and gaining horizontal speed as it moves through the dense atmosphere. The altitude determines the horizontal speed needed to stay in orbit, which is about 27,400 km/h for a 240 km low-Earth orbit. This indicates that a velocity of nearly 8 km/sec is required to maintain orbital motion.

Lower altitudes are the target of sub-orbital flights. The velocity of these missions is insufficient for escape into orbit. When a spacecraft reaches outer space during a sub-orbital trip, its trajectory crosses the gravitational body's atmosphere, and it returns without completing one orbital round. A sub-orbital spaceflight is defined as one that reaches a height of more than 100 kilometers above sea level. The Federation Aeronautique Internationale selected this altitude, also referred to as the Karman line, since a vehicle must travel faster than orbital speed at this point in order to sustain itself using aerodynamic lift from the Earth's atmosphere. However, NASA and the U.S. military define outer space as being 80 kilometers or above, from which one can feel weightlessness.



A few sub-orbital test flights are thought to be essential prior to a spacecraft being sent into real orbit. Prior to being sent on more costly orbital or deep-space missions, these flights may also be a less expensive means to test out spaceflight experiments or technology. Additionally, sub-orbital flights provide research chances to examine phenomena like sedimentation or coagulation of solid particles in fluids that are overshadowed by the effects of gravity. The sub-orbital flights offer great chances to maintain successful space tourism enterprises. Even though it is brief, the passengers still get to enjoy the exhilaration of weightlessness and an incredible perspective of Earth.

Dr. Jitendra Singh, Minister of State for Science and Technology, saw this historic mission at the launch facility. The launch of the Vikram-S represents a "important milestone" in the history of India's private space industry, according to Prime Minister Narendra Modi.

Conclusion

It is noteworthy that the first privately constructed Vikram-S rocket was successfully launched in June 2020, following the declaration of recent space reforms by the Indian government. Indian space startups are entering a new era as a result of the collaboration between government organizations and business partners ISRO, IN-SPACe, and ISpA. India still has a long way to go before it can catch up to the rest of the world in terms of commercial engagement in space programs, even if the launch of Vikram-S marks a major step in the country's space exploration. This positive development might mark a sea change in the Indian private sector's involvement in the world's growing space industry.