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PSLV-C60 carrying SpaDeX and its payloads lifts off, as part of Isro's key Space Docking Experiment, in Sriharikota on Monday. PTI

Isro launches critical space docking mission

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NEW DELHI: The Indian Space Research Organisation (Isro) on Monday night launched its workhorse PSLV rocket with several satellites, including two that will carry out an ambitious autonomous orbital rendezvous and docking experiment that only a handful of space agencies have mastered.

The Space Docking Experiment (SpaDeX), ascending aboard the PSLV-C60 rocket from the windswept launch pad at Sriharikota at 10pm, achieved its most important milestone precisely 910 seconds after lift-off. At that moment, two spacecraft, each a marvel of precision engineering weighing 220kg, were delivered into an eastward orbit 476km above Earth's surface.

In a precisely orchestrated sequence revealed through Isro's live transmission, SDX02 (SpaDeXB) emerged first from its berth, followed by its twin SpaDeXA three seconds later.

Isro chief S Somnath, speaking of the successful launch, explained the path ahead: "The two spacecraft will gain some more distance before they begin their measured convergence for docking. We anticipate this celestial rendezvous around January 7."

M Sankaran, director of UR Rao Satellite Centre (URSC), unveiled the meticulous choreography that would unfold over the next eight days: "The calculated delay between satellite deployments ensures they will steadily drift apart in their orbital paths. By tomorrow evening, we expect a separation of 20

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kilometre."

At this juncture, one satellite will assume the role of "chaser," its propulsion system precisely modulated to arrest the drift. "We must then await four days for the Sun's position to align optimally. Only then will we initiate the careful reduction of distance," Sankaran elaborated, describing how three distinct algorithms would govern this automated minuet.

The final act of this space ballet will occur when the satellites draw within three meters of each other, executing what engineers term "capture, retraction, and rigidization" – a technical description that belies the breath-taking precision required for two objects to embrace while hurtling through space at 7.6km per second.

This capability, once mastered, unlocks a universe of possibilities: in-orbit refueling, space station assembly, satellite rehabilitation, and even the construction of vehicles destined for deep space. For India, it represents not merely a reinforcement of its space-faring prowess but a crucial stepping stone toward more ambitious celestial ventures.

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Only a handful of nations have mastered orbital docking, a capability first demonstrated during the space race. The Soviet Union achieved this in 1967 with Cosmos 186 and 188, while the US achieved crewed docking in 1966 during the Gemini program.

In the 21st century, China joined this elite group by achieving autonomous docking in 2011 with its Shenzhou 8 spacecraft and Tiangong-1 space station. Japan and the European Space Agency have demonstrated autonomous rendezvous capabilities, though both rely on the station's robotic arm for final capture rather than direct docking.

More recently, SpaceX's autonomous docking demonstrations with the International Space Station.

It is in the same club that India hopes to break into. "SPADEX is a monumental step towards self-reliance. By mastering the critical capabilities of spacecraft rendezvous and docking, we are not only enabling satellite servicing and extending the life of on-orbit assets but also laying the foundation for executing more complex missions like space stations and interplanetary exploration," said Gaurav Seth, chief executive and co-founder of PierSight, a satellite-tech company that had one of its spacecraft as the payloads on the mission.

According to Isro's documentation, SPADEX spacecraft will rely on an intricate suite of instruments: laser range finders probe the void between them, rendezvous sensors track their relative positions, and proximity sensors guide their final approach. An Inter Satellite Link is designed to maintain a constant dialogue between the pair, sharing vital navigation parameters as one assumes the role of active "chaser" while the other becomes the passive "target."

The complexity of the mission began with the PSLV-C60's launch sequence precisely calibrated. Following the primary deployment, the rocket's fourth stage — after ejecting the SPADEX satellites — executed planned restarts to descend to a 350-kilometer orbit.

There it metamorphosed into POEM (PSLV Orbital Experimental Module), a floating laboratory hosting 19 diverse experiments from both ISRO and external organisations, from space debris capture mechanisms to studies of plant growth in the embrace of microgravity.

This orbital platform, drawing power from solar panels generating 528W, employs a sophisticated ballet of its own through reaction wheels, magnetic torquers, and thrusters, ISRO detailed in its release.

Beyond their historic docking attempt, the SPADEX satellites carry their own scientific mandate. Spacecraft A bears a high-resolution Camera, while its twin hosts a Miniature Multispectral payload and a Radiation Monitor – tools that will peer down at Earth for resource monitoring and vegetation studies while measuring the harsh radiation environment of their orbit.

The mission also showcases India's burgeoning private space sector. PierSight's contribution, the Varuna satellite, aims to demonstrate Synthetic Aperture Radar capabilities in a compact CubeSat format. "This mission will elevate our technology to the highest readiness level," Seth explained, describing Varuna as the vanguard of a planned constellation for persistent maritime surveillance.