



SPACE ODYSSEYS



“We look down on our scientists if they
engage in outside consultation.
We implicitly promote the ivory tower.”

Dr Vikram Ambalal Sarabhai



The Universe is magical as the power of infinity. The myth of space is unveiled to us only 1 per cent. With the advanced technology developed through time have the capability to discover that is yet to be found or believed to exist. We are not alone, and our space continuously reminds us of this fact.

Our space-age was set back in the early 1960s. Thumba got Dr Sarabhai's attention as it is close to the Earth's Magnetic Equator and was the best place to launch the first Sounding Rockets as its location was ideal for scientific reasons.

The Bishop and the people of Thumba agreed to dedicate the Church for this mission. After this Dr Sarabhai and other scientists including Dr A P J Abdul Kalam and Homi Baba prepared for the launch and it was a successful one. With this launch, India had successfully put its first signature on Space. The Thumba Equatorial Rocket Launching Station [TERLS] in Thiruvananthapuram for launching rockets for Upper Atmospheric Research was a miraculously destined event in the history of India.

St Mary Magdelene Church in the fishing village of Thumba in Thiruvananthapuram, Kerala served as the main office for scientists in the early stages of India's Space Programme. The church is now preserved in its full glory even today, and it houses an impressive space museum.

In the book, "Ignited Minds: Unleashing The Power Within India" Dr A P J Abdul Kalam has beautifully described this iconic event.

Welcome to the Space Club

Establishment of Space Science & Technology Centre (SSTC) in Thumba in the year 1965 and Satellite Telecommunication Earth Station set up at Ahmedabad in 1967 began the journey of becoming a spacefaring nation. Dr Sarabhai

recognised the potential of the country to be a spacefaring nation like USSR after it launched Sputnik-1. The countdown for India to enter into space began with the establishment of Indian Space Research Organisation [ISRO] in 1969.

India joined the Space Club and since then has effectively been successful in developing various space technology for the rapid growth and development of the nation.

One of the main characteristics of Indian Space Programme is collaborating and cooperating with other international spacefaring nations of the Space Club.

Major ISRO Centres Vikram Sarabhai Space Centre (VSSC)

Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram, is one of the lead centres of ISRO responsible for the design and development of launch vehicle technology. The significant programmes at VSSC include Rohini Sounding Rockets, Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV) as well as the development of Geosynchronous Satellite Launch Vehicle (LVM3), Reusable Launch Vehicles, Advanced Technology Vehicles, Air-breathing Propulsion and critical technologies towards human spaceflight.

The Centre pursues active research and development in the fields of Aeronautics, Avionics, Materials, Mechanisms, Vehicle Integration,





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Chemicals, Propulsion, Space Ordnance, Structures, Space Physics and Systems Reliability.

Liquid Propulsion Systems Centre (LPSC)

Liquid Propulsion Systems Centre (LPSC) is the centre for design, development and realisation of Liquid & Cryo Propulsion stages for ISRO's Launch Vehicles. LPSC activities and facilities spread across its two campuses:

LPSC, Valiamala, Thiruvananthapuram

LPSC, Valiamala is responsible for Research and Development, System Design/Engineering and Project Management functions of all Liquid & Cryo stages related to PSLV, GSLV and LVM 3.

LPSC, Bengaluru, Karnataka LPSC, Bengaluru is responsible for the design and realisation of propulsion systems for Remote Sensing and Communication Satellites and other scientific missions.

ISRO Propulsion Complex (IPRC)

ISRO Propulsion Complex (IPRC), Mahendragiri is equipped with the state-of-the-art facilities necessary for realising the cutting edge propulsion technology products for the Indian Space Programme. The centre houses a number of test stands and storage facilities for ground testing of Liquid, Semi-cryo and Cryo Stages. IPRC is also responsible for the supply of Storable Liquid & Cryo Propellants for ISRO's Launch Vehicles and Satellite Programmes.

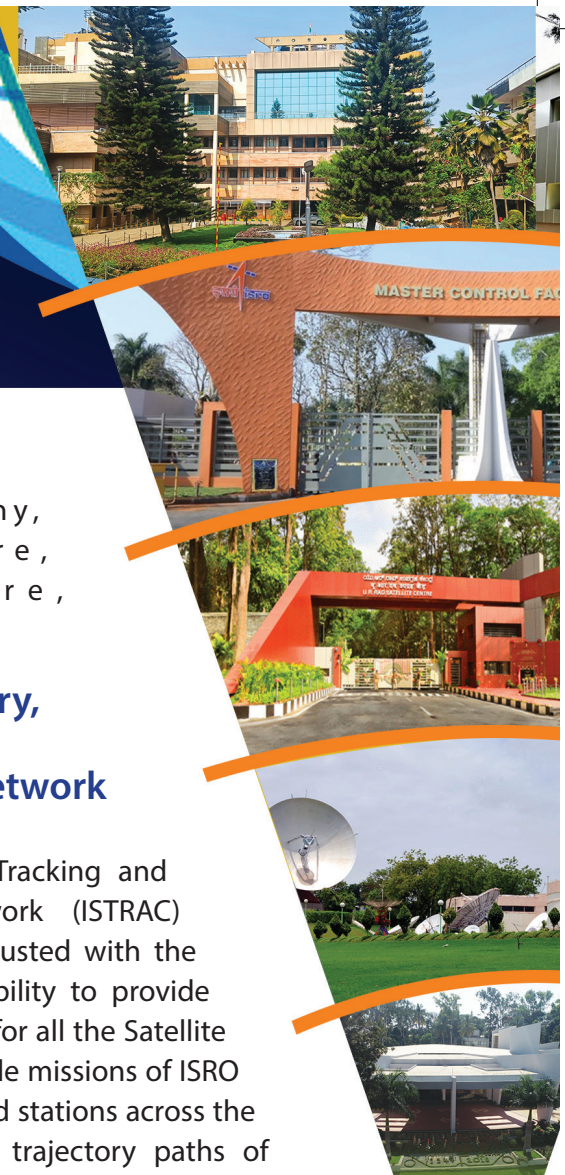
Satish Dhawan Space Centre (SDSC) SHAR

Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota, the Spaceport of India, is responsible

for providing Launch Base Infrastructure for the Indian Space Programme. SDSC SHAR has two launch pads from where the rocket launching operations of PSLV and GSLV are carried out. The island has storage and servicing facilities of critical Liquid & Cryo propellants to the launch vehicle. The range is supported with ultra-modern support systems like CCTV, Timing, Communication and Computer Networks. The centre has Asia's largest Solid Propellant Processing facilities for producing and Ground Testing Solid Propellant stages for PSLV and GSLV. The launch complex has Assembly & Integration facilities where different systems and assemblies received from work centres will get integrated into launch vehicle stages and transported to launch pad for final assembly. The Range Comprises of multiple tracking radars which can track launch vehicle upto thousands of kilometers and weather radars to assess the weather conditions during the launch window on hourly basis, Telemetry systems, remote Checkout Systems and Launch & Mission Control Centres. SDSC SHAR has a separate launch pad for launching sounding rockets.

ISRO Inertial Systems Unit (IISU)

ISRO Inertial Systems Unit (IISU), Thiruvananthapuram is responsible for the design and development of Inertial Systems for Launch Vehicles and Spacecraft programmes of ISRO. Major systems like Inertial Navigation Systems based on Mechanical Gyros and Optical Gyros, Attitude Reference Systems, Rate Gyro Packages and Accelerometer Packages, Sensors and NGC packages are developed indigenously and used in various missions of ISRO. IISU also designs and develops Actuators and Mechanisms for Spacecraft and Allied Applications.



U R Rao Satellite Centre (URSC)

U R Rao Satellite Centre (URSC), Bengaluru, formerly known as ISRO Satellite Centre (ISAC) is the significant centre for building satellites and developing associated satellite technologies. These spacecraft are utilised for providing applications to various users in the area of Communication, Navigation, Meteorology, Remote Sensing, Space Science and Interplanetary Explorations. ISRO Satellite Integration and Test Establishment (SITE) with state-of-the-art clean room facilities for spacecraft integration and test facilities including a 6.5 Metre Thermo Vacuum Chamber, 29 Ton Vibration Facility, Compact Antenna Test Facility and Acoustic Test Facility under one roof. URSC has the distinction of building more than 100 satellites for various applications like Scientific, Communication, Navigation and Remote Sensing.

Space Applications Centre (SAC)

Space Applications Centre (SAC) at Ahmedabad contributes significantly in scientific and planetary missions of ISRO – Chandrayaan-1 and Mars Orbiter Mission. The government and the private sector utilize the Communication Transponders developed at this centre for Geosynchronous Satellite (GSAT) series of satellites for VSAT, DTH, Internet, Broadcasting, Telephones etc.

SAC designs and develops the Optical and Microwave Sensors for the Satellites, Different Antennas, Powerful Amplifiers including TWTA, Signal and Image Processing Software, GIS Software and many applications for Earth Observation (EO) Programme of ISRO. These applications are in diverse areas of Geosciences, Agriculture, Environment and Climate Change, Physical Oceanography, Biological

Oceanography, Atmosphere, Cryosphere, Hydrosphere, etc.

ISRO Telemetry, Tracking and Command Network (ISTRAC)

ISRO Telemetry, Tracking and Command Network (ISTRAC) Bengaluru is entrusted with the primary responsibility to provide tracking support for all the Satellite and Launch Vehicle missions of ISRO using their ground stations across the world along the trajectory paths of PSLV and GSLV. The vital objectives of the centre are:

- Carrying out mission operations of all operational Remote Sensing and Scientific Satellites and providing Telemetry Tracking & Command (TTC) Services from launch vehicle lift-off till the injection of the satellite into orbit
- To estimate its preliminary orbit in space
- Hardware and Software Developmental activities that enhance the capabilities of ISTRAC for providing flawless TTC and Mission Operations Services.

Master Control Facility (MCF)

Master Control Facility (MCF) at Hassan in Karnataka and Bhopal in Madhya Pradesh monitors and controls all the Geostationary / Geosynchronous satellites of ISRO – INSAT, GSAT, Kalpana and IRNSS series of satellites. MCF is responsible for orbit raising of satellites, In-orbit payload testing, and On-orbit operations all through the life of these satellites.



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MCF activities include round-the-clock Tracking Telemetry & Commanding (TTC) operations, and special operations like Eclipse Management, Station-keeping Manoeuvres and Recovery Actions in case of contingencies.

National Remote Sensing Centre (NRSC)

National Remote Sensing Centre (NRSC) at Hyderabad is responsible for Remote Sensing Satellite Data Acquisition and Processing, Data Dissemination, Aerial Remote Sensing and Decision Support for Disaster Management. NRSC Ground Station at Shadnagar acquires Earth Observation Data from Indian Remote Sensing Satellites as well as from different foreign satellites.

NRSC is also engaged in executing Remote Sensing Application Projects in collaboration with the users. The Aerial Services and Digital Mapping (ASDM) Area provides end-to-end Aerial Remote Sensing Services and value-added solutions for various large scale applications like Aerial Photography and Digital Mapping, Infrastructure Planning, Scanner Surveys, Aeromagnetic Surveys, Large Scale Base Map, Topographic and Cadastral Level Mapping, etc.

Human Space Flight Centre (HSFC)

HSFC was formed on January 30, 2019. As a lead Centre for human space flight activities, HSFC will undertake multi-disciplinary R&D activities in new domains of human science and technology while conforming to high standards of reliability and human safety. HSFC is currently concentrating on Gaganyaan mission with thrust on areas like end-to-end mission planning, development of Orbital Module (OM), development of Life support systems, selection

and training of astronauts, development of various Training simulators, co-ordination in Recovery and rehabilitation of astronauts, collaboration with National and International agencies/institutions for multi-directional growth to act as a technology aggregator.

Apart from Gaganyaan, HSFC will focus in the future on new areas of technology development, significant amongst them includes nurturing and creating new expertise in the domains of Bioastronautics, Human space sciences, and Space habitat systems. The Centre will develop the necessary expertise to sustain the human space flight activities in the country, including the capability to build Orbiting space station and become active partners in collaborative interplanetary manned missions to Moon/Mars and near-Earth Asteroids.

Laboratory for Electro-Optics Systems (LEOS)

LEOS is responsible for the design, development and realization of state-of-the-art attitude and navigation sensors, high performance optics and special-purpose science instruments. These sensors and optical systems have been successfully flown in various missions of the Indian Space Programme. Demand-driven indigenous developments include star sensors, earth sensors, sun sensors, magnetometers, large-area high-precision telescope mirrors, multi-band matched opto-mechanical lens assemblies, thin-film and special purpose coatings, fiber optic gyroscopes, laser and fiber optics-based navigation sensors, MEMS devices, specialty detectors, ground and on-board software. LEOS houses a spectrum of in-house metrology instruments that are developed or procured and ground-calibrated for this purpose. The multitude of sensors, optics and photonic devices developed at



LEOS are embedded into various aspects of satellite attitude determination, remote sensing, meteorological applications, scientific exploration, interplanetary missions, etc.

Indian Institute of Remote Sensing (IIRS)

IIRS is a premier institute with a primary aim to build capacity in Remote Sensing and Geoinformatics and their applications through education and training programmes at postgraduate level. Formerly known as Indian Photo-Interpretation Institute (IPI), founded in 1966, the Institute is first of its kind in entire South-East Asia. While nurturing its primary endeavor to build capacity among the user community by training mid-career professionals since its founding in 1966, the Institute has enhanced its capability and evolved many training and education programmes that are tuned to meet the requirements of various stakeholders, ranging from fresh graduates to policy makers including academia, industry and NGOs.

Physical Research Laboratory (PRL)

PRL is mandated to conduct fundamental research in niche areas of sciences. Its research is organized in seven major science areas: Astronomy & Astrophysics, Solar Physics, Space and Atmospheric Sciences, Planetary Sciences, Geosciences, Atomic, Molecular and Optical Physics, and Theoretical Physics.

National Atmospheric Research Laboratory (NARL)

NARL is engaged in carrying out frontline research on atmospheric, ionospheric & space weather, and planetary ionospheric sciences through observations, technique/technology, instrument development, and simulation/modelling. NARL operates a large number of sophisticated

instruments, including high power radars and lidars, measuring various atmospheric and ionospheric parameters from Gadanki, two comprehensive off-campus observatories, one at Kolkata and the other at Hyderabad, and networks of GNSS receivers and airglow imagers. NARL also has a High-Performance Computing (HPC) system for carrying out sophisticated computation, simulation and modelling for atmospheric and ionospheric research. NARL provides weather forecasts and high-resolution upper air wind data for supporting the rocket launchings at SDSC-SHAR.

North Eastern Space Applications Centre (NESAC)

NESAC is an autonomous organization under the DOS that has dedicated more than 24 years of service to the eight states of the North Eastern Region (NER) of India through the application of space science and technology. The Centre's key objectives are: 1) to establish an operational remote sensing and geographic information system (GIS)-based natural resource information platform to support development, natural resource management, and infrastructure planning in the region; 2) to provide satellite communication services for education, healthcare, disaster management, and developmental communication; 3) to conduct research in space and atmospheric sciences and establish an instrumentation hub in collaboration with academic institutions in



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NER; 4) to provide integrated space-based support for disaster management; and 5) to develop regional infrastructure for capacity building in geospatial technology.

Indian Institute of Space Science and Technology (IIST)

IIST at Thiruvananthapuram, Kerala was established in 2007 to develop and discover possibilities of shaping manpower for Indian space programme. The institute has dynamically evolved and expanded as a centre of multidisciplinary learning and research that spans themes across the fields of Aerospace, Avionics, Chemistry, Earth and Space Sciences, Humanities, Mathematics and Physics. IIST offers undergraduate, postgraduate, doctoral and post-doctoral programmes with a synergetic emphasis on Space Science & Technology applications.

Antrix Corporation Limited (ACL)

ACL with its corporate office in Bengaluru is a wholly owned Government of India entity under the administrative control of Department of Space. ACL is engaged in providing space sector products and services worldwide ranging from supply of hardware and software, Earth observation and scientific missions, remote sensing data services, transponder lease services, mission support services and other allied services.

NewSpace India Limited (NSIL)

NSIL got incorporated in 2019, as a wholly-owned Government of India Undertaking/ Central Public Sector Enterprise (CPSE), under the administrative control of the DOS. NSIL mandate broadly covers (i) Owning satellites for Earth Observation and Communication applications;

(ii) Providing space-based Earth Observation and Communication services; (iii) Building satellites and launching them as per demand; (iv) Building launch vehicles through Indian Industry and launch as per requirements; (v) Providing launch services and (vi) Technology Transfer to Indian Industry.

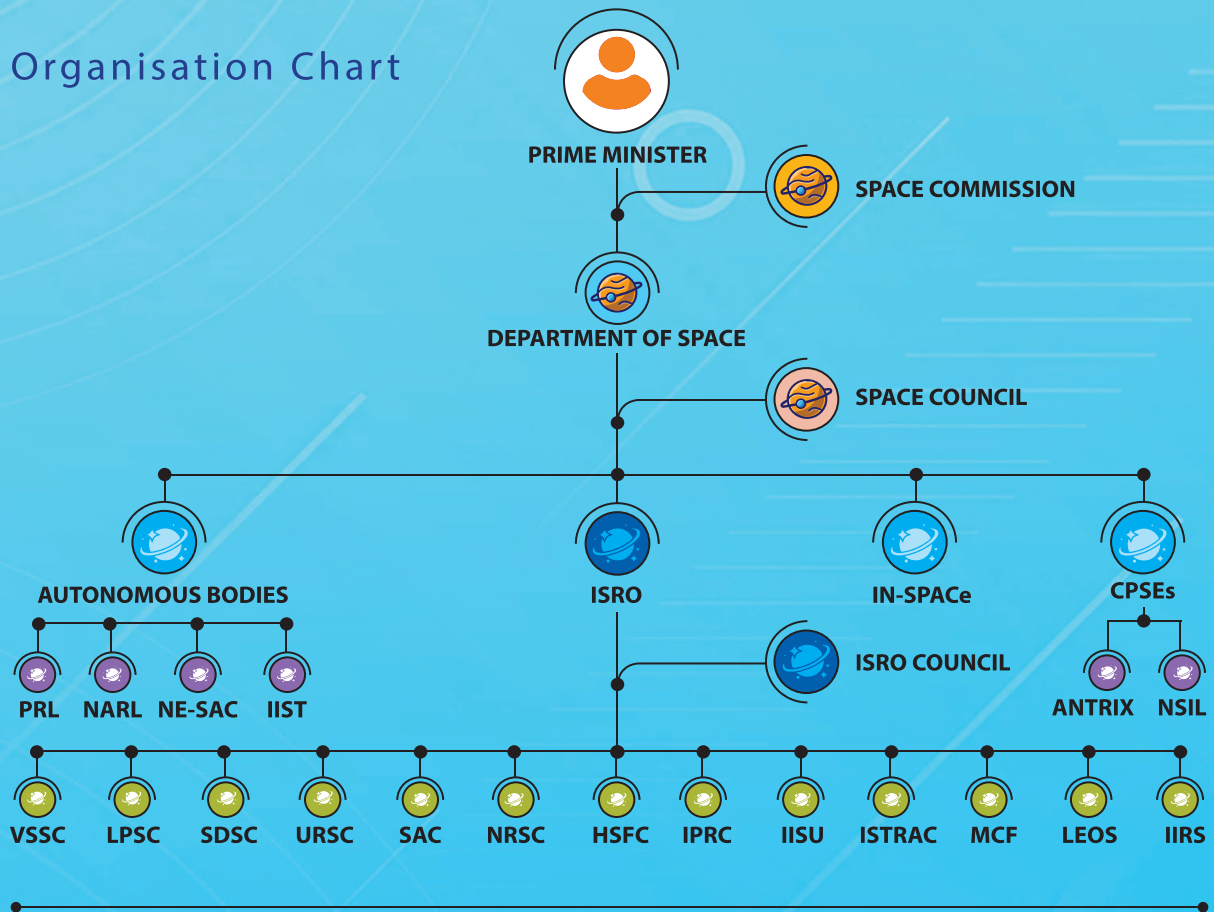
Indian National Space Promotion and Authorization Centre (IN-SPACe)

As the space sector was opened up to private enterprises and start-ups to undertake space activities to promote, handhold, regulate and authorise their activities, an autonomous nodal agency attached to DOS - the IN-SPACe was formed. This will enhance the diffusion of space technology and boost the space economy within the country. IN-SPACe will permit and oversee the activities of private enterprises and start-ups. It regulates space activities, including the building of launch vehicles and satellites and providing space-based services as per the definition of space activities. It permits the sharing of space infrastructure of ISRO and the establishment of temporary facilities within the premises of ISRO. It promotes the establishment of new space infrastructure and facilities, by Non-Government Entities (NGE), in pursuance of space activities based on safety norms and other statutory guidelines and necessary clearances. IN-SPACe governs the usage of spacecraft data and the rolling out of space-based services and all the associated infrastructure for the same.



अंतरिक्ष विभाग
DEPARTMENT OF
SPACE

Organisation Chart



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| ISRO Indian Space Research Organisation | SDSC Satish Dhawan Space Centre |
| INSPACE Indian National Space Promotion and Authorization Centre | URSC U R Rao Satellite Centre |
| CPSEs Central Public Sector Enterprises | SAC Space Applications Centre |
| PRL Physical Research Laboratory | NRSC National Remote Sensing Centre |
| NARL National Atmospheric Research Laboratory | HSFC Human Space Flight Centre |
| NE-SAC North Eastern Space Applications Centre | IPRC ISRO Propulsion Complex |
| IIST Indian Institute of Space Science and Technology | IISU ISRO Inertial Systems Unit |
| Antrix Antrix Corporation Limited | ISTRAC ISRO Telemetry, Tracking and Command Network |
| NSIL NewSpace India Limited | MCF Master Control Facility |
| VSSC Vikram Sarabhai Space Centre | LEOS Laboratory for Electro-Optics Systems |
| LPSC Liquid Propulsion Systems Centre | IIRS Indian Institute of Remote Sensing |



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