Editorial

Astrosat: India's Unique Space Observatory

The launch of our first space observatory, the Astrosat, by the Indian Space Research Organization (ISRO) has placed India in the elite club of four advanced countries of the world that have their own space observatories, for probing heavenly objects from the space-orbit into the open space. It is almost a unique feat because, unlike similar missions by Europe and the U.S., it is a multi-wavelength platform which affords a simultaneous observation of celestial objects across different wavelengths, giving it a total perspective.

ISRO's most trusted rocket and workhorse launch vehicle, the PSLV-C30 carried this satellite in the space to place it into a 650-km orbit following its takeoff from the Satish Dhawan Space Centre, Shriharikota at 10 am on Sept 28, 2015. The Astrosat is a major space-science feat of the ISRO and its mission envisages an earth-orbiting scientific satellite with payloads capable of simultaneously observing the universe in the visible, ultraviolet and X-ray regions of the electromagnetic spectrum. The satellite is a multi-wavelength space observatory , which makes it unique in the world in space research. It carries five payloads including Ultraviolet Imaging Telescope- UVIT, Large Area Xenon Proportional Counter–LAXPC Soft X-ray Telescope, Cadmium Zinc Telluride Imager and Scanning Sky Monitor SSM.

Hitherto, the Indian astronomers have had to rely on alien resources for X-ray and ultraviolet data for want of our own space observatory. But, now with the launch of the ASTROSAT-telescope, it would provide a shot in the arm of the Indian astronomers for such space observations. It is all the more rejoicing for us in India, as the ASTROSAT-telescope is quite unique. Unlike most other telescopes, the five instruments (payloads) of ASTROSAT can observe a wider variety of wavelengths—from visible light to the ultraviolet and X-ray bands. Even in the X-ray band as well, it can study both low and high energy X-ray regions of the electromagnetic spectrum, while most other satellites are capable of observing only a narrow range of wavelength band. Besides, the capability to cover the full spectrum of wavelength simultaneously is another unique feature of the ASTROSAT.

Though it has taken nearly 20 years in the making, since the day the idea of such a satellite was put forward, and about 15 years since the idea was given a concrete shape, the final realization of what promises to be a true astronomical observatory in the sky is almost so unique in its concept and operation that it is expected to make a significant and niche contribution to the important field of X-ray astronomy and the study of the X-ray universe. The Astrosat is a well dedicated astronomy satellite and a miniature version of the Hubble, the US-European joint space observatory that has discovered new galaxies and improved our understanding of the universe. The Astrosat is the fourth in space, after the Hubble, Russia's Spektr R and Suzaku of Japan. It was initially planned for 2005 but it got delayed by a decade. However, our scientific community has struggled hard to build it up to date with utmost precision which such instruments need for such operations. So, delay does not matter.

The Astrosat is meant for studying objects in the deep sky. It can make observations in ultraviolet, optical, visible, low and X-ray wavelengths simultaneously. It will study stars, quasars, pulsars, supernova remnants, black holes and active galactic nuclei. The instruments on board and spreading across ultraviolet and X-ray wavelengths, will be capable of studying black holes, neutron stars, quasars, white dwarfs and pulsars in space.

The Indian Space Research Organization (ISRO) has also achieved a significant milestone in commercial satellites launch segment as its trusted workhorse launch vehicle PSLV-C30 launched not only the Astrosat, but, along with that, six other foreign satellites have also been put into space from SHAR Range on September 28.

With this launch, ISRO would be crossing the half-century mark in terms of launch of commercial satellites ever since it launched the first ever satellite for a foreign customer on May 26, 1999 by using the PSLV-C2. It is for the first time that India has launched a US satellite. The US satellites are the first from that country to be launched from India since the two countries signed a technology safeguards agreement in 2009. The scientific objectives of ASTROSAT mission are:

(i) To understand high energy processes in binary star systems containing neutron stars and black holes.

(ii) To estimate magnetic fields of neutron stars.

(iii) To study star birth regions and high energy processes in star systems lying beyond our galaxy.

(iv) To detect new briefly bright X-ray sources in the sky.

(v) To perform a limited deep field survey of the Universe in the Ultraviolet region.

The five payloads of ASTROSAT are chosen to facilitate a deeper insight into the various astrophysical processes occurring in the various types of astronomical objects constituting our universe. These payloads rely on the visible, Ultraviolet and X-rays coming from distant celestial sources.

✍• The Ultraviolet Imaging Telescope (UVIT, capable of observing the sky in the Visible, Near Ultraviolet and Far Ultraviolet regions of the electromagnetic spectrum

✍• Large Area X-ray Proportional Counter (LAXPC, is designed for studying the variations in the emission of X-rays from sources like X-ray binaries, Active Galactic Nuclei and other cosmic sources.

✍• Soft X-ray Telescope (SXT) is designed for studying how the X-ray spectrum of 0.3-8 keV range coming from distant celestial bodies varies with time.

✍• Cadmium Zinc Telluride Imager (CZTI), functioning in the X-ray region, extends the capability of the satellite to sense X-rays of high energy in 10-100 keV range.

✍• Scanning Sky Monitor (SSM) is intended to scan the sky for long term monitoring of bright X-ray sources in binary stars, and for the detection and location of sources that become bright in X-rays for a short duration of time.

Moreover, the Astrosat is a truly multi-institutional project, invoking collaborations even with foreign institutions and agencies. Apart from ISRO, four other Indian institutions involved in payload development are: Tata Institute of Fundamental Research (TIFR), Indian Institute of Astrophysics (IIA), Inter-University Centre for Astronomy and Astrophysics (IUCAA) and Raman Research Institute (RRI). Two of the payloads were developed in collaboration with the Canadian Space Agency (CSA) and University of Leiscester (UoL), UK. The International customer satellites that have gone piggyback, along with the Astrosat, are the LAPAN-A2 - a microsatellite from National Institute of Aeronautics and Space-LAPAN, Indonesia. LAPAN-A2 is meant for providing maritime surveillance using Automatic Identification System (AIS), supporting Indonesian radio amateur communities for disaster mitigation and carrying out Earth surveillance using video and digital camera. The Second one, NLS-14 (Ev9) is a Nan satellite from Space Flight Laboratory, University of Toronto Institute for Advanced Studies (SFL, UTIAS), Canada. It is a maritime monitoring Nan satellite using the next generation Automatic Identification System (AIS). Four LEMUR nano satellites from Spire Global, Inc. (San Francisco, CA), USA, are non-visual remote sensing satellites, focusing primarily on global maritime intelligence through vessel tracking via the Automatic Identification System (AIS), and high fidelity weather forecasting using GPS Radio Occultation technology.

The Rs 178-crore Astrosat has been hurled into space at lowest cost. It is a miracle that barely a year has passed since its first interplanetary mission, Mangalyaan, entered the orbit of Mars, and ISRO has crossed yet another important milestone. Scientifically the ASTROSAT is a very different mission for ISRO from its other major missions and will add a new dimension to its scientific capabilities. There are several advantages in having a sky observatory. The atmosphere around the earth interferes with the signals from space and changes their characteristics. So, what the instruments at earth observatories receive are modified signals. These have to be adjusted to bring in accuracy. But this space observatory would give us a truer picture.

(Prof. Bhagwati Prakash Sharma)

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