

## Planetary Exploration: Indian perspective

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The Moon has been a focus of exploration for over half a century but still there are many basic unresolved problems related to its origin and early evolution. To understand some of these aspects, a program for planetary exploration was initiated by Indian Space Research Organization about a decade ago. The Moon was chosen as the first destination and **Chandrayaan-1** polar orbiter mission, equipped with a dozen instruments, was successfully carried out during 2008-2009. The mission was launched using the Indian Polar Satellite Launch vehicle. The instruments included a stereo camera for terrain mapping, a radar, two X-ray cameras, three mineral cameras, a radiation monitor and a solar wind analyser. The main scientific results obtained from this mission are: presence of OH and H<sub>2</sub>O on the lunar polar regions, crystalline feldspars in lunar highlands, a new spinel rich rock type on the lunar far side, abundance of Mg, Al, Si, Ca and Fe and possibly Na in surface rocks of the southern lunar highlands, unexpectedly high reflected solar wind hydrogen signal from sun lit side, a small mini magnetic field at anti Crisium point and identification of molecules with Mass 1,18 (water) and 44 (Carbon di oxide) in lunar south polar environment. Besides, Chandrayaan-1 obtained high resolution global map of the moon. Additionally new evidence for recent lava activity, and lava tubes, suitable for habitation have been identified. The mission opened up opportunities of international cooperation and collaboration in instrumentation and observation in which a dozen countries participated.

The next mission, **Chandrayaan-2** is proposed to be an orbiter- Lander-Rover mission, presently scheduled for 2014. The orbiter will have six instruments including a Terrain Mapping Camera, an Imaging visible-near infra red Spectrometer, a X-ray Spectrometer together with a Solar X ray monitor and a mass spectrometer for Atmospheric Composition. An important addition is a Dual Band Synthetic Aperture Radar. The Rover, capable of examining a few kilometer surface of the moon around the lander site will be equipped with two instruments, a Laser Induced Break Down Spectroscope and a Alpha Particle Induced X-ray Spectroscope for chemical analyses.

Simultaneously a Mars orbiter, **Mangalyaan-1**, is being planned. It is proposed to have a highly elliptic orbit passing through the upper atmosphere and ionosphere of Mars to study depth variations of several atmospheric constituents. Many instruments are being considered including a methane sensor, a D/H photometer, Thermal Imaging spectrometer and a composition analyser to study the neutrals in the martian Exosphere. A camera will also be included.

The results obtained and expected from these missions will be discussed in the global context.