Mission to Mars: ISRO Plans

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Subsequent to the announcement of the first Moon mission 'Chandrayaan-1', the Indian Space Research Organisation (ISRO) has chalked out a road map for planetary exploration through the year 2020. This includes an orbiter to Mars, around 2016.

The basic science questions concerning Mars are its accretion and evolution, and the plausible presence of life on Mars. These aspects can be understood through chemical and isotopic investigations of the surface rocks and following water on Mars. Another important aspect of Mars is to understand the origin and evolution of its atmosphere and the climate of Mars.

Several Mars missions in the past have addressed to some of these questions through orbiters and surface rovers and a number of new missions are in the offing. The knowledge gained from these past missions, as well as the further questions raised by their findings are taken into account in the plans of a future Mars orbiter mission by ISRO. The prime focus of ISROs orbiter mission is to study Mars aeronomy using radio occultation, laser altimeter, neutral and ion mass spectrometers and a magnetometer, in addition to geologic mapping and chemical mapping of the Mars surface through optical and γ-spectrometry respectively, as some possible payloads.

Several missions have been sent to Mars but no good model of Mars upper atmosphere is available. This is mainly because of scarcity of data on the Mars upper atmospheric composition. Measurements of constituents in Martian upper atmosphere are basic requirement for understanding the Martian ionosphere, its variability, and its interaction with the solar wind. Also to quantity the dynamics, chemistry and variability of upper atmospheric processes, variability in atmospheric composition as a function of latitude, longitude, solar activity and season is required. Since the length of day and night on Mars is similar to that on Earth, diurnal variation in the constituents of the Martian upper atmosphere is of utmost importance since there can be large horizontal transport from dayside to night side on Mars. To understand the evolution of Mars atmosphere and its history, the information on isotopic ratios $^{13}C/^{12}C$, D/H, $^{18}O/^{16}O$, $^{38}Ar/^{36}Ar$, $^{15}N/^{14}N$, would be very useful.

Radio occultation provides a measure of the vertical structure and an averaged large-scale electron density profile of the planetary ionosphere as a function of height and planetary latitude at each occultation point. A laser altimeter in a Lidar mode can provide information on Martian clouds and dust, in particular the dust storms on Mars, which are the largest dust storms in the Solar System. The Mars Global Surveyor has made magnetic survey of Mars to establish the existence of crustal magnetic field more than 30 times stronger than that of Earth (1500 nT at the spacecraft altitude of ~ 110 km). These crustal magnetic fields are a mystery, since they are arranged in east west bands of alternating polarity, extending for over

1000 km north to south like bar code across the planet's surface. It is still not known what materials produce this strong crustal field and why it occurs in alternate bands. It is envisaged that an improved magnetic field mapping of Mars is important for understanding of the early history of Mars and its thermal evolution. The planned Mars orbiter of ISRO will focus on the above scientific aspects, and the plans in the offing will be discussed in this talk.