INDIAN MISSION TO MARS. J. N. Goswami[1,2] and K. Radhakrishnan[2], [1]Physical Research Laboratory, Ahmedabad – 380009, India (goswami@prl.res.in), [2]Indian Space Research Organization, Bangalore- 560231, India.

Introduction: The successful Chandrayaan-1 mission with international participation marked the beginning of the Indian planetary exploration programme in 2008 [1]. A road map for further missions during the current deacde, focusing on the inner solar system objects was also drawn up. Spadework for two planetary missions, one to Moon and another to Mars at the earliest possible opportunity, was initiated. The next lunar mission, Chandrayaan-2, having an orbiter-lander-rover configuration for exploring a high latitude region on the moon is planned to be carried out with Russian collaboration. The possibility of using the proven PSLV-XL launch vehicle for a Mars mission during the 2013 and 2018 launch opportunities led to the decision to have a mission to Mars in 2013. Preliminary studies of technical feasibility and development of sub-systems for the Mars mission were initiated and scientific goals and plausible payloads for such a mission were also finalized. Following a series of technical and scientific reviews of progress made, a formal approval for the 2013 Mars mission was announced on 15 August, 2011. The salient features of this mission, the technological challenges, scientific objectives, a brief outline of the payloads to be flown and the primary mission parameters are presented here. The mission will be launched using the flight proven PSLV-XL, during the period of late October to early November, 2013, from the Indian Launch site at Shriharikota. All activities related to the mission are progressing as per schedule to meet the launch deadline.

Science Objectives: Recent missions to Mars have provided direct evidence for the presence of hydrated minerals on the exposed surface and of water at subsurface regions. Possible presence of methane has been proposed based on limited observations. However whether such emission is sporadic and/or localized in nature as well as the plausible source(s) of martian methane are yet to be established. Quantification of the loss of martian atmosphere, and in particular, CO_2 and H_2O, is also essential for understanding the time evolution of martian atmosphere. Compositional studies of martian atmosphere with high sensitivity and over extended mass range is also needed for a better understanding of the martian evolution. The Indian Mars mission will include payloads to obtain data covering all the above important aspects that will advance our current understanding of the planet Mars.

Payloads: Close to a dozen payloads aimed at understanding the evolution of Mars were short-listed and based on available spacecraft resources five of these were selected for the mission. These are:

(i) Lyman Alpha Photometer (LAP) for estimation of D/H ratio based on absorption spectra of Lyman-α lines of D and H. LAP consists of an UV detector equipped with gas filled pure molecular hydrogen and deuterium cells with tungsten filaments that are located between an objective lens and a detector.

(ii) Methane Sensor for Mars (MSM): A Fabry-Perot Etalon sensor to measure CH_4 at several ppb level. The frequency of the spectral lines of the FP etalon and reference channel are chosen appropriately to meet the required sensitivity.

(iii) Thermal Infrared imaging Spectrometer (TIS): TIS will provide map of composition and mineralogy of the martian surface. It uses a 120×160 element bolometer array as detector and consist of fore optics, slit, collimating optics, grating and reimaging optics.

(iv) Mars Exospheric Neutral Composition Analyzer (MENCA): A quadrapole mass spectrometer covering the mass range 1-300 amu with mass resolution of 0.5amu and capability of detecting partial pressure up to ~10^{-14} torr wiil be employed to study the neutral composition of the martian upper atmosphere.

(v) Mars Colour Camera (MCC): Imaging of topography of the martian surface with a GIFOV of 25m and a frame size of ~50km×50km employing a multi-element lens assembly and a 2K×2K area array detector.

The flight model payloads are currently under fabrication and shall be ready by early April for integration with the spacecraft.

The Mission Elements: The mission will be implemented by using the PSLV-XL launch vehicle that is capable of placing a spacecraft of 1350 kg in an elliptic parking orbit with 250km perigee, 23000 km apogee and 18^{o} inclination with a suitable argument of perigee realized with coasting before injection. The

spacecraft with 500 kg drymass will make a ten month journey enroute before mars capture and will be placed in a (500×80000) km elliptic orbit around Mars. The anticipated on-orbit mission life is about 6-10 months. The spacecraft structure and propulsion hard hardware configurations are similar to Chandrayaan-1 with specific improvements and upgrade needed for a Mars specific mission.

References: [1] Goswami, J. N. and Annadurai M. (2009) *Current Science*, 96, 486-491.

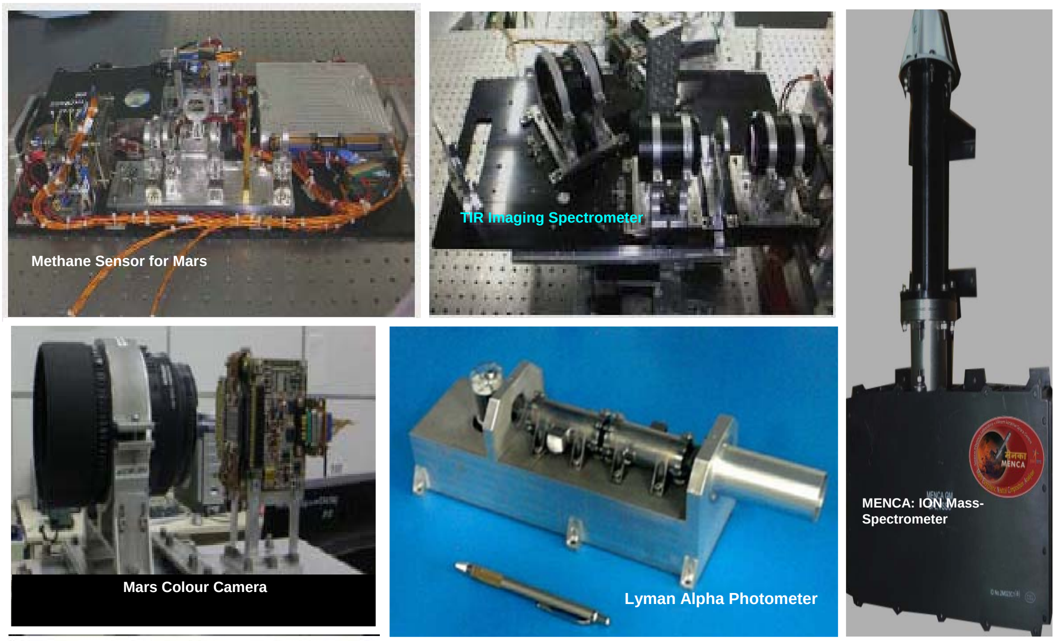

Fig.1 Proto-flight (verification) model of the payloads for Indian Mars Mission