

and multidisciplinary to foster quality research and to generate comparable dataset so as to improve the image of data-deficient Himalayan region among the world community; (ii) overcoming the dearth of dedicated researchers to pursue research and need to devise strong incentive mechanism to boost the scenario; (iii) shift in approach to collect meaningful data through participatory research utilizing the force of students and other stakeholders; (iv) promote applied and

demand-driven research so that job opportunities of the researchers are ensured and (v) mountain-specific courses need to be designed and run in the institutions.

The workshop was attended by over 80 participants from 50 organizations consisting of eminent academicians, heads of leading research institutions, active researchers from universities, policy makers, NGOs, etc. actively engaged in mountain-specific research in the Himalayan region. The officials of MoEF and

DST took keen interest in the proceedings of the workshop and contributed immensely in terms of their intellectual inputs. This is a positive sign for improving research quality in the Himalayas.

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## Mars Orbiter Mission prepared to photograph Mars: some results from Earth Imaging Experiment

Mars Orbiter Mission (MOM), the interplanetary mission of ISRO, launched on 5 November 2013, is a maiden attempt towards sending orbiters to other planets of our solar system. It has many laurels to its credit in terms of cost-effectiveness, weight-budget, short period of realization, miniaturization of five heterogeneous science payloads, textbook precision of launch and post-launch manoeuvres. Mars Colour Camera (MCC) on-board MOM is among the five science payloads, having 16 different modes of exposure, aimed at imaging the surface of the Mars with moderate objectives like morphological/structural mapping, imaging dynamic events, viz. dust devils, polar ice cap variations and other opportunistic imaging.

Earth Imaging Experiments (EIEs) were conducted during the Earth Orbit



**Figure 1.** First image of the Earth taken by Mars Colour Camera on 19 November 2013.

Phase (EOP) in order to assess the application potential of MCC vis-à-vis the objectives envisaged. Three imaging sessions on two different dates, viz. two sessions on 19 November and one session on 23 November 2013 were conducted. These included imaging from varying altitudes, spatial resolution, illumination conditions, taking multiple snapshots of a given area of interest in order to view physiographic, morphologic and other geological details of our planet, so as to ascertain the expected results from highly elliptical Mars orbit. The imaging sessions were chosen to get favourable sun angle/spacecraft yaw axis/phase angle combination

The four major objectives of EIE are as follows:

- (i) To image India for outreach purpose.
- (ii) To image Earth from Mars apoaxis equivalent (about 60,000–70,000 km).
- (iii) To image from geo-stationary equivalent altitude (36,000 km).
- (iv) To image at a resolution of 1 km.

The altitude, spatial resolution and exposure mode required for selected science targets on Mars have been assessed, qualified and ascertained in terrestrial orbit.

The first photograph was taken on 19 November 2013 (0820 UT) from an altitude of 67,975 km with 3.5 km spatial resolution (Figure 1). It was the first MCC image showing parts of Asia and Africa, including India. The swath of the

image was about 7240 km and it was taken using 0.133 ms integration time. Three snapshots at one second interval were taken.

Most of the India could be covered with minimal cloud cover. The four major physiographic zones of India, viz. Himalayan range (white colour), the Indo-Gangetic Plain (grayish colour), the Thar desert (beige colour) and the southern peninsula (dark colour) were picked up distinctly with textbook precision by the maiden image taken by MCC. The *Helen* cyclone, off the eastern coast of India was picked up before its landfall. Additionally, the dispersal pattern of the suspended sediments discharged by rivers into the Gulf of Khambhat and Gulf of Kachchh is seen in light blue colour off the Gujarat coast. Lake Manas Sarovar is also visible amidst the Himalayan snow peaks. Other features in the image show parts of Sahara and Arabian deserts (bright colour), Trans-Himalayan Tibetan Plateau, fertile Indus Valley and a variety of cloud patterns.

The experiment has been successfully conducted and it has yielded fruitful results. MCC is expected to provide images of desired quality during rest of the mission. MCC on-board MOM is fully prepared to image Mars and send the first ever photograph of taken by an Indian payload in the Mars orbit.

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