Lunar Topography by Lunar Laser Ranging Instrument – Chandrayaan-1

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Introduction: Lunar Laser Ranging Instrument (LLRI) is one of the eleven scientific instruments flown on board India's first lunar mission Chandrayaan-1. LLRI measures the absolute range from Chandrayaan-1's orbit of about 100 Kilometers using the time-of-flight technique with an accuracy of better than 5 meters. Being an active instrument, ranging was possible from both the near and far side of the lunar surface. Several million shots have interrogated the moon's surface providing valuable lunar scientific data hitherto not available to the Indian scientific community.

Instrument Configuration: LLRI consists of a Nd:YAG laser transmitter generating 10 mJ at 10 Hz repetition rate. The laser footprint on the lunar surface from a nominal 100 km orbit is typically 32 m. The LLRI receiver configuration is based on a 20 cm Dall-Kirkham telescope and Si Avalanche photodiode detector. The processing electronics included front-end amplifiers, constant fraction discriminators and time-of-flight electronics for range computation.

Lunar Topography Measurements: LLRI was successfully turned ON during the 84^{th} orbit on 16^{th} November, 2008 at 03:47:03:088 (UT). The instrument continued to be ON till the 1963^{rd} orbit (April, 2009) before it was turned OFF. During this period more than 24 lakh valid range returns were available for lunar topography generation. Nearly 80% of polar regions (above $\pm$ 75^0) and around 70% of equatorial region has been covered during the period of operation.

LLRI Data Products: Higher-level data products from LLRI data viz. graphs, contours, 3D-profile and maps were generated by using user-friendly software, called LAMPS-*Lunar Altimetry Mapping Software* developed in Matlab environment at LEOS. Grid maps of complete Lunar topography has been generated with 0.5^0 resolution as shown in Figure.1.

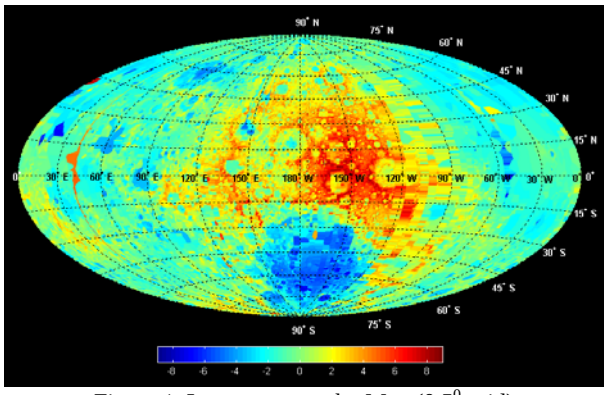

Figure.1. Lunar topography Map (0.5^0 grid)

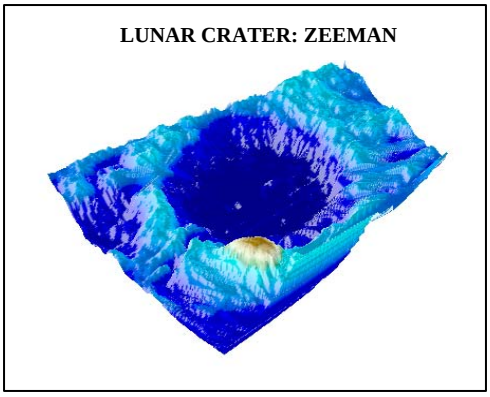

Figure.2: 3-D visualization of Zeeman Crater

Also, several lunar craters could be identified with great detail and Figure.2 shows a 3-D visualization of one of the lunar crater Zeeman, located on the lunar far-side (southern hemisphere).The topography maps generated from LLRI is very invaluable for identifying potential landing sites for forthcoming lunar missions and better understanding the geophysics of the moon.

Details regarding Lunar Laser Ranging Instrument (LLRI) and its data products can be discussed in depth during this presentation.