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HOW WILL CHANDRAYAAN 2 STUDY THE MOON?

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The GSLV MkIII-M1 rocket being prepared for launch in Sriharikota. Photo: ISRO

The story so far: When Chandrayaan 1, India's first moon mission was launched on October 22, 2008, from Sriharikota, using the Polar Satellite Launch Vehicle (PSLV), India became the fourth country to plant its flag on the lunar surface. On the moon, the mission conclusively detected traces of water along with magnesium, aluminium and silicon. Now, close to a decade later, India will launch its second lunar mission, Chandrayaan 2, on July 15, 2019, again from Sriharikota, using the Geosynchronous Satellite Launch Vehicle (GSLV) Mark III rocket. The launch falls a day short of the 50th anniversary of the launch of the American mission Apollo 11 which took humans to the moon and back. The first moon landing occurred on July 20, 1969, on the Apollo 11 mission which was launched on July 16.

The GSLV Mark III rocket will first launch the spacecraft into an Earth Parking Orbit (170 km X 40,400 km). Then the height of the orbit will be enhanced until the spacecraft can reach out to the Lunar Transfer Trajectory. On entering the moon's sphere of influence, on-board thrusters will slow down the spacecraft, allowing it to be captured by the moon. Then it will be eased into a circular orbit (100 km X 100 km). From this orbit, the lander and rover will separate as a unit from the orbiter, and, through a series of braking mechanisms, the duo will "soft-land" on the moon, on September 6, 2019.

Chandrayaan 2 will be the first mission to reach and study the south pole of the moon. It is made up of an orbiter, a lander named 'Vikram', after Vikram A. Sarabhai, the founding father of space science research in India, and a rover named 'Pragyan', which means 'wisdom'. At about 3,877 kg, the spacecraft weighs nearly four times its predecessor, Chandrayaan 1. It will be launched by the GSLV Mark III, the Indian Space Research Organisation's (ISRO's) most powerful and massive launcher. While Chandrayaan 1 sent its lander crashing into the moon, Chandrayaan 2 will use rocket technology to soft land 'Vikram', carrying its 'Pragyan' rover in a suitable high plain on the lunar surface, between two craters, Manzinus-C and Simpelius N, at a latitude of about 70º South. This landing is scheduled for September 6 this year. The total cost of the project is about 978 crore. The lander-rover combo has an expected lifetime of 14 days, while the orbiter will continue for a year.

The time taken for the moon to complete one rotation on its axis is approximately equal to 29.5 earth days. This is also equal to the time it takes to complete one orbit around the earth. That is why the same side always faces the earth. But because it takes 29.5 earth days to complete one rotation, every point on its surface experiences daylight for about half the time, or a little more than 14 days at a stretch. Moon days are nearly 14 earth days long. Note that the landing is scheduled for September 6, when we will see the first quarter of the moon. This is a date when the lander will land at a point that is facing the earth and which has started receiving sunlight.

This point will receive light for nearly another fortnight which will match the expected lifetime of the lander-rover combo. Since the 'Vikram' lander and 'Pragyan' rover are powered by solar energy, they will be energised during this period by sunlight on the moon. Once night falls, this energy will not be available as they are plunged into a dark and cold -180º Celsius environment. If the lander-rover duo should kickstart after another half-rotation when day breaks once again, it will be a bonus for the ISRO.

The mission is not designed to survive this extreme cold, unlike some U.S. and Chinese

missions which survived on the “dark” side of the moon using special sources of warmth.

Using the Terrain Mapping Camera 2 which is on board the orbiter, the mission will produce images of the moon remotely from a 100 km lunar polar orbit. While the moon rotates about its axis, along its east-west direction, say, the lunar polar orbit will be in the perpendicular direction, along the lunar north-south direction. Thus, as the moon rotates, the orbiter gets a view of its entire surface from overhead. This data collected by the orbiter will be used to produce a 3D image of the moon’s terrain. This is just one of the eight instruments, or payloads, on board the orbiter. The lander carries three such payloads, some of which will measure the electron density and temperature near the lunar surface; the vertical temperature gradient, and seismicity around the landing site.

The rover will carry two instruments or payloads which will collect and test samples from the moon’s surface to identify what elements they contain. The rover moves on six wheels and once let down on the moon, can travel about 500 m from the lander.

There have been 38 attempts so far at “soft-landing” on the moon, with a success rate of 52% according to the ISRO website.

The moon offers a pristine environment to study. It is also closer than other celestial bodies. Understanding how it formed and evolved can help us better understand the solar system and even earth itself. With space travel taking shape and exoplanets being discovered everyday, learning more about earth’s celestial neighbour can help in advanced missions. Finally, it is a piece of the larger puzzle as to how the solar system and its planets have evolved.

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