Russia's Luna 25 could land on the moon days before Chandrayaan-3: How the two missions compare

The Russian mission was launched on August 10. It is likely to enter the moon's orbit by August 16 and attempt the soft landing by August 21 or 22. Here is why it is faster than Chandrayaan-3.

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Luna-25 (left) was launched earlier this week aboard its Soyuz rocket, almost a month after the launch of Chandrayaan-3 on July 14. (Photos: AP/@ISRO)

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Russia's mission to the moon, Luna 25, is generating interest in India too. This is because the Russian lander is likely to touch down close to the lunar South Pole a couple of days before India, taking away the title of the first country to soft-land close to the South Pole.

The Russian mission was launched on August 10. It is likely to enter the moon's orbit by August 16 and attempt the soft landing by August 21 or 22. India's mission to the moon cannot land before August 23, when it will be lunar dawn at the landing site.

Why is Russia reaching the moon earlier than India?

Although Luna-25 was launched earlier this week aboard its Soyuz rocket — almost a month after the launch of Chandrayaan-3 on July 14 — it will cover the 3.84-lakh-km journey within days. This is because the Russian mission was able to follow a more direct trajectory towards the moon, owing to its lighter payload and more fuel storage. The lift-off mass for Luna 25 is just 1,750 kg as compared with the 3,900 kg

of Chandrayaan-3. Chandrayaan's Lander-Rover alone weighs 1,752 kg, with the propulsion module weighing another 2,148 kg.

To make up for the lower fuel reserve available on the LVM3 vehicle that launched India's mission, a more circuitous route was taken. After being launched around the Earth, the orbit of the spacecraft was increased in a series of manoeuvres to help it gain velocity. The spacecraft was then slingshot towards the moon, reaching the lunar orbit nearly 22 days after it was launched. Over the next few days, Chandrayaan-3 will reduce its orbit and velocity around to the moon in preparation for the soft landing likely to be attempted on August 23.

Another reason Luna-25 can land a couple of days before India is because lunar dawn at its landing site will happen earlier. One lunar day is equal to 14 Earth days. With the payloads being powered by solar panels, landing at the beginning of a lunar day ensures that the experiments get the full 14 earth days.

How do the missions differ?

Apart from being lighter than the Indian mission, Luna-25 does not carry a rover. Chandrayaan-3 has a rover capable of moving around 500 metres. The Russian lander has eight payloads mainly to study the soil composition, dust particles in the polar exosphere, and most importantly, detect surface water.

The Indian mission also has scientific instruments to study the lunar soil as well as water-ice. The location near the southern pole was chosen because of the presence of craters that remain in permanent shadow, increasing the likelihood of finding water-ice.

The lander will carry four experiments on-board. The Radio Anatomy of Moon Bound Hypersensitive ionosphere and Atmosphere (RAMBHA) has a Langmuir probe used to study properties of electrons and ions such as temperature and density. It will study these properties near the surface of the moon and how they change over time.

The Chandra's Surface Thermo physical Experiment (ChaSTE) will study the thermal properties of the lunar surface near the polar region. The Instrument for Lunar Seismic Activity (ILSA) will measure the lunar quakes near the landing site and study the composition of the moon's crust and mantle.

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The LASER Retroreflector Array (LRA) is a passive experiment sent by NASA on-board the mission. LRAs are optical instruments that act as a target for lasers and can be used for very precise tracking by spacecrafts in the lunar orbit. As per the US space agency, such markers can also be used for precision autonomous navigation and landing of future missions.

There are two scientific experiments on the rover. The LASER Induced Breakdown Spectroscope (LIBS) will determine the chemical and mineral composition of the lunar surface. The Alpha Particle X-ray Spectrometer (APXS) will determine the composition of elements such as Magnesium, Aluminium, Silicon, Potassium, Calcium, Titanium, and Iron in the lunar soil and rocks.

The main difference, however, is that the India mission is built to last only one lunar day or 14 earth days. This is because it does not have a heating mechanism to keep the electronics safe from the extreme cold temperatures during the lunar night.

The Russian mission, on the other hand, will work for a year, meaning it has heating mechanism as well as a power source other than just solar panels.

Is India also in the race to land humans on moon?

It was the discovery of water molecules by India's Chandrayaan-1 mission in 2008 that has propelled another race to the moon. The United States and China now have plans to take humans to moon again; a first after the cold war era. To date, only 12 men aboard US' Apollo Missions have set foot on the lunar surface.

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Although India with its limited resources has been able to catch up with countries with more advanced and older space agencies, there is still a long way to go before humans can be sent to the moon.

"When it comes to sending humans to moon, the US and China are in the lead. The two countries — and even Russia during the cold war — have already succeeded not only in landing but also carrying out sample return missions. India is yet to announce a sample return mission, although planning for a fourth mission to moon with Japan as a partner is underway," said Ajay Lele, senior fellow at Manohar Parrikar Institute for Defence Studies and Analyses.

He said India is at par with countries such as Japan and Israel that are also attempting moon missions now.

Israel's Beresheet failed to land softly on the moon just a few months before Chandrayaan-2 in 2019. Since then, two more landers from Japan and UAE couldn't reach the lunar surface as the spacecraft carrying both failed in 2022.

At least four more lunar missions are in the offing this year from United States,

China, and Japan.

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Lele said India needs to first achieve human spaceflight before sending astronauts to the moon. He added, "With Isro carrying out more scientific missions, there is a need for the space agency to develop heavier launch vehicles. Currently, our heaviest launch vehicle has the capability of carrying only 4 tonnes of satellites to the geostationary Transfer Orbit."

In comparison, SpaceX' Falcon 9 can carry over 26 tonnes.

How have India and Russia collaborated on moon missions and other space activities?

Many have speculated whether Russia's launch was targeted for the same time as India's mission, but Lele dismissed this. He said India and Russia have been long-time collaborators, especially when it comes to space activities.

In fact, Russia was initially supposed to design the lander-rover for India's Chandrayaan-2 mission. However, it withdrew after the failure of its Fobos Grunt mission to one of Mars' moons. This then prompted India to develop the lander-rover independently. This is the reason there is a gap of 11 years between the Chandrayaan-1 and Chandrayaan-2 missions.

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Also, the predecessors of the LVM3 that launched Chandrayaan-3 were based on cryogenic engines sold to India by Russia. India later developed the technology on its own as Russia did not transfer the technology.

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