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Space

Planned moon landings could pelt orbiters with dusty debris

Jonathan O'Callaghan

FUTURE moon missions with large landers may stir up clouds of dust from the lunar surface, which could be dangerous for orbiters or even space stations.

Later this decade, NASA hopes to return humans to the surface of the moon with its Artemis programme. Two companies in the US, SpaceX and Blue Origin, have been contracted to develop landers that could take humans to the lunar surface by 2025 at the earliest.

However, Philip Metzger at the University of Central Florida says there may be a complication. An analysis he has done with James Mantovani at Kennedy Space Center in Florida shows that large landers on the moon could kick up huge amounts of dust as they touch down. Since, unlike Earth, the moon doesn't have a strong magnetic field or an atmosphere to trap dust, it could escape into space and damage passing spacecraft.

"As we begin more activity on the moon, the rocket exhaust from landings is going to be spraying more soil off the moon up into these orbital altitudes," says Metzger. "Within a few decades, I think this is going to be a very serious problem."

Using mathematical models, the pair studied how much dust would be stirred up by landers weighing more than 40 tonnes – eight times the mass of the Apollo landers – such as the SpaceX and Blue Origin lunar vehicles. He found they would kick up millions of pieces of dust that would easily reach the escape velocity of the moon, 2.4 kilometres per second, and escape its gravitational pull.

This dust could then travel through lunar orbit and hit any orbiters overhead, particularly any at less than 110 kilometres above the surface, with millions of impacts per square metre (arXiv, doi.org/gr9xxt).

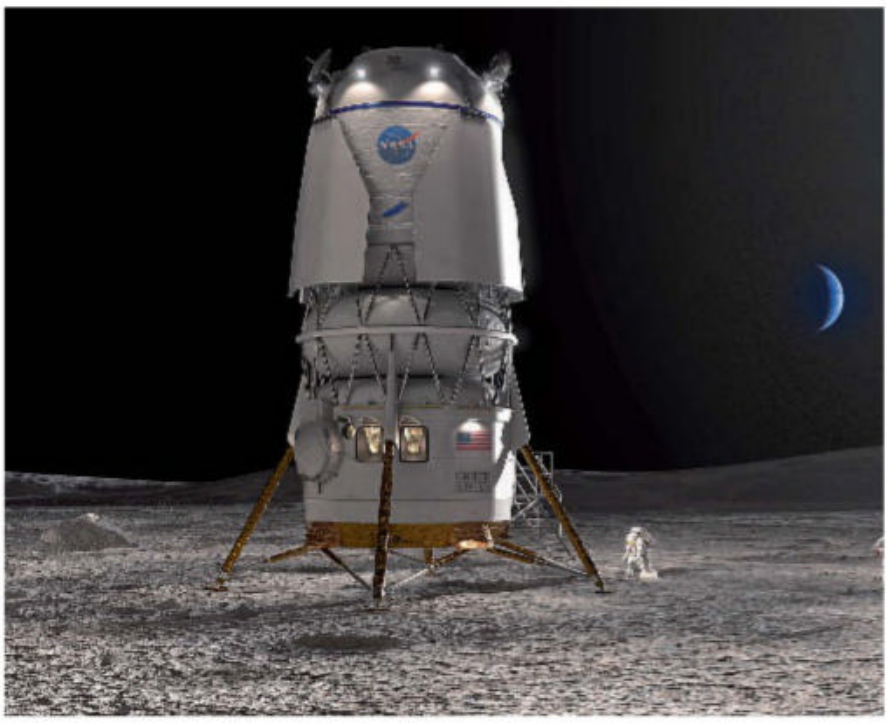
"The dust will be impacting at hypervelocity," says Metzger, meaning thousands of metres per second. While unlikely to destroy a spacecraft, this could degrade radiators, solar arrays or science instruments, he says.

Also of concern would be NASA's planned Lunar Gateway space station, which is designed to orbit between Earth and the moon and will frequently pass near the moon. "NASA's Gateway is going to be hit by many, many tiny particles," says Metzger, about 10,000 impacts per square metre every time it passes the moon. While not causing major damage, this may erode the station's exterior.

10,000

Estimated dust impacts per m² on NASA's lunar space station

Mihály Horányi at the University of Colorado Boulder, who worked on NASA's LADEE moon orbiter in 2013, says the dust shouldn't be an issue unless an orbiter is overhead when a lander touches down. "I don't believe this is a real hazard," he says.



BLUE ORIGIN

Artist's depiction of Blue Origin's Blue Moon lander

Ian Christensen at the Secure World Foundation in the US, however, says the study shows the need for coordination, because private companies and other nations such as China are also planning landings. "As the tempo of lunar activity increases, it will be necessary to find ways to mitigate the creation of debris," he says.

NASA and SpaceX didn't respond to a request for comment. Blue Origin declined to comment.

Metzger says a solution might be to reduce disturbance by having a lander's thrusters high on the vehicle, as is planned on SpaceX's Starship lander. Building landing pads for spacecraft to touch down on would also help, he says. ▮

Health

Octopus ink compound can target cancer cells

Kenna Hughes-Castleberry

A CHEMICAL found in octopus ink has been created artificially and used to kill cancer cells. The development could lead to new cancer treatments.

Octopuses release ink into water when attacked to help them escape from predators. Martín Samuel Hernández-Zazueta at the University of Sonora in Mexico and his colleagues had previously identified a compound called ozopromide that is found in the ink sac of common octopuses (*Octopus vulgaris*) as one of interest for its anti-cancer properties.

The researchers used a series of standard chemical reactions to create ozopromide artificially. Then, to explore its potential as a cancer treatment, they injected the compound into cancerous human breast, cervix, prostate and lung cells.

They found that the presence of ozopromide resulted in the death of a significant portion of the cancerous cells, with the highest proportion being a 50 per cent decrease in cancer growth in lung cells. The compound didn't affect the nearby non-cancerous cells.

Many current cancer treatments, including immunotherapy, can cause inflammation as an unwanted side effect. The team found that ozopromide actually reduced the production of inflammatory proteins around the cells, promoting better overall healing from the cell death (*Food and Chemical Toxicology*, doi.org/kc2f).

The researchers hope this indicates that the compound could eventually lead to a cancer treatment without inflammation as a side effect.

Charles Derby at Georgia State University in Atlanta says the work is a "big deal". However, it "is just the first step in a long series of steps to determine if this molecule will be useful in human medicine". ▮