NASA’s Artemis II completes lunar flyby

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NASA reacquired contact with the Orion spacecraft at approximately 7:25 p.m. EDT Monday, restoring communications with the four Artemis II astronauts after a 41-minute blackout as the capsule passed behind the Moon. The crew of Reid Wiseman, Victor Glover, Christina Koch and Jeremy Hansen confirmed they were in good health preceding and following the blackout, which also included the mission’s closest approach to the Moon of 4,070 miles (6,550 kilometers) above the lunar surface.

The mission is now past its halfway point. And unlike the first trip to the Moon undertaken by the crew of Apollo 8 in 1968, which orbited 10 times before returning to Earth, Artemis II simply shot once around the Moon, using its gravity to head immediately back to Earth, performing no maneuvers there. It is expected to undergo reentry and splashdown on Friday.

The new aspects of spaceflight being probed by Artemis II largely concern the impacts of radiation on the spacecraft and the astronauts themselves. The dangers of radiation beyond Earth’s protective magnetic field, above all coming from our Sun, were poorly understood a half-century ago, and almost cost the lives of the crews of Apollo 16 and 17. Today, the different types of energy output from the Sun, broadly grouped under the term space weather, are far more studied, but the impacts they might have on humans traveling in deep space have only been theorized since no humans have traveled past low Earth orbit since 1972.

To that end, Orion carries six active Hybrid Electronic Radiation Assessors at various positions inside the crew module, supplemented by individual Crew Active Dosimeters worn by each astronaut, the same equipment used on the International Space Station. Germany’s DLR space agency contributed an updated version of its M-42 radiation sensor, the M-42 EXT, which is six times more sensitive than the version flown on Artemis I. Four of these sensors are affixed at points around the cabin. Together they will measure total radiation dose and distinguish between different types of energetic particles, including the heavy ions considered most hazardous to human tissue at the cellular level.

The mission is also serving as a live test of two forecasting models for space weather developed by researchers at the University of Michigan. One is a machine-learning system that uses satellite imagery of the solar corona to estimate the probability of a dangerous solar particle event up to 24 hours in advance. The second is a physics-based model designed to simulate particle acceleration in the Sun’s outer atmosphere itself and predict how particle storms will propagate toward Earth and the Moon.

These forecasting tools are being evaluated by NASA’s Space Radiation Analysis Group, and their performance during Artemis II will determine whether they are incorporated into mission planning for future flights.

The crew is also enrolled in three human health studies. The ARCHeR experiment uses wristband devices to monitor sleep patterns and movement throughout the flight, building a dataset on how deep space travel affects cognitive performance and stress, factors that are well documented in low-Earth orbit but never studied during lunar-distance missions. The AVATAR experiment uses organ-on-a-chip devices, roughly the size of a USB drive, seeded with cells derived from each astronaut’s own blood drawn before the mission, to create miniature stand-ins for their bone marrow. Bone marrow is particularly sensitive to radiation and plays a central role in immune function.

A third study tracks immune biomarkers through dry saliva samples—refrigeration being unavailable—collected in a pocket-sized booklet, before, during and after the flight.

NASA is also testing the Orion Artemis II Optical Communications System, a laser-based transmitter and receiver that has allowed for high definition video to be sent back to Earth. And while certain media reports are citing this system as new technology, it is not. NASA's LADEE mission in 2013 demonstrated laser communications from lunar distances, downlinking data at 622 megabits per second, more than twice the rate of the current mission.

And while the crew have taken numerous photos of the far side of the Moon, their contribution is dwarfed by the imagery taken by the Lunar Reconnaissance Orbiter, which has been mapping the Moon at high resolution since 2009, and by other orbiting surveyors launched by China and Japan.

Much has been also made of the communications blackout itself, which in a more scientifically and rationally planned mission would not be necessary. Communicating with any spacecraft is an inherently international effort. For any that travel beyond 30,000 km from Earth, it takes a minimum of three ground-based radio telescopes spread equally distant across the planet's surface. The original tracking stations were set up in 1958 when the Jet Propulsion Laboratory (JPL) sent one each to Nigeria, Singapore and California. More permanent facilities were constructed over the next five years in Madrid, Spain and Canberra, Australia, which, along with the telescope in Barstow, California (the Goldstone facility), constitute the modern Deep Space Network that was established in 1963 and has run continuously ever since.

The gaps in communications that do occur are caused when a spacecraft passes behind a planet or moon, as seen from Earth. Apollo 8 astronauts Jim Lovell, Frank Borman and Bill Anders were the first humans to experience this blackout in 1968 when they orbited the Moon 10 times as one of the critical flight tests of the entire 1960s space program, laying further groundwork for the Moon landing a year later during the Apollo 11 mission on July 20, 1969.

For current robotic missions, attempts have been made to overcome this limitation by using multiple spacecraft to get signals from different angles and relay them back to controllers on Earth. When the Mars rovers Curiosity and Perseverance landed, for example, NASA used the satellites orbiting the Red Planet, including the Mars Reconnaissance Orbiter, Mars Odyssey and MAVEN missions, along with the European Space Agency's Mars Express.

And at the Moon itself, the Chinese National Space Administration (CNSA) launched the Queqiao-1 satellite in 2018 and its companion Queqiao-2 in 2024 to provide telemetry for its Chang'e series of landers to have constant communications with Earth.

NASA was not unaware of this capability, and in 2019 the agency obtained formal approval to use the Queqiao satellite for relay purposes. That there was a blackout for Artemis II is much more an issue of geopolitical posturing from the Trump administration, which has insisted that the mission is an "American" triumph, rather than any lack of technical know-how.

More broadly, that attitude characterizes much of the Artemis II mission. Both Trump and NASA Administrator Isaacman, a fellow billionaire, have presented the Artemis program as the vanguard of a new era of lunar science. In reality, the drive to return humans to the Moon is above all an exercise in imperialist ambition in space and the preparation for the assertion of US claims over the water ice deposits concentrated in the permanently shadowed craters of the lunar south pole.

Control of those resources, a potential source of both drinking water and hydrogen fuel for spacecraft, is the underlying economic rationale for the billions of dollars being spent on a program that, technically, has so far only replicated what was accomplished in the 1960s.

Artemis II's reentry is scheduled for Friday. The heat shield problem carried over from Artemis I, in which portions of the char layer separated in fragments rather than ablating as designed, has not been fixed. NASA instead altered the reentry trajectory. The crews' safe return is dependent on how well that decision holds.