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WHAT TIME IS IT ON THE MOON?

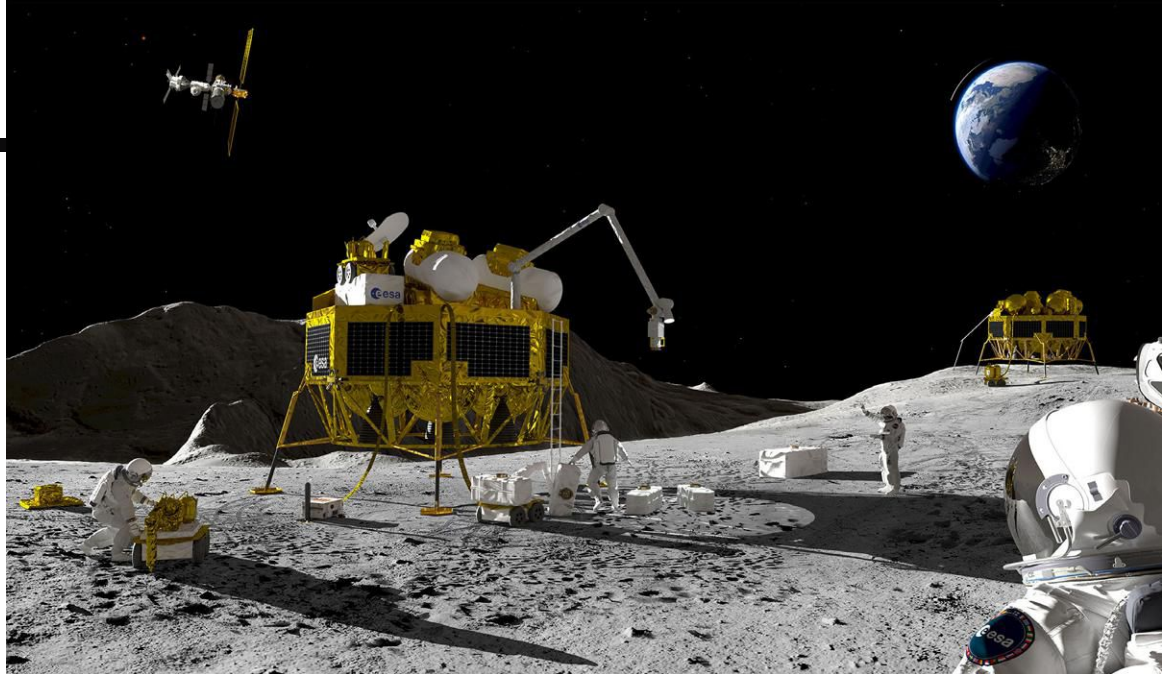


If all goes to plan, by the end of this decade, the Moon will be bustling with activity from dozens of explorers — both human and robotic. But as this new space race heats up, scientists have just begun working out a key question: What time is it on the Moon?

This simple query has a complicated answer. So far, lunar missions have functioned on the time of their respective home countries. But early last year the European Space Agency (ESA) deemed this unsustainable for the upcoming swell of Moon missions.

On April 2, over a year after ESA identified the issue, the White House directed NASA to set up a new standardized lunar time by the end of 2026. This Coordinated Lunar Time (LTC) is a necessity for the “safety and accuracy” of future Moon missions, Steve Welby, the deputy director for national security at the White House Office of Science and Technology Policy, said in a statement.

Without a standard time for the Moon, “there’s a risk that something could go horribly wrong,” says Catherine Heymans, an astrophysicist at Edinburgh University in the U.K. “This clock does need to be defined.” Multiple spacecraft from different countries are expected to be on or around the Moon at the same time, underscoring the need for a common lunar time — and by extension



SCALING UP. The Moon is set to become a hive of activity in the next decade, as depicted in this artist's impression of NASA and ESA lunar operations. ESA-ATG

a navigation system — that would facilitate real-time communications, avoid collisions, and carry out joint operations, per ESA.

“The White House intervention is very helpful because it really puts the foot on the accelerator to get this to happen ahead of the planned Artemis landing by the end of 2026,” says Heymans.

TIME IS RELATIVE

According to relativity, clocks placed in different gravitational fields tick at different rates. This means time moves just a tad faster on the Moon, by about one second every 50 years.

That minuscule difference wouldn't be a bother if there was only one crew working on the Moon, in which case these changes could be easily accounted for, says Heymans. Given the surge of interest from multiple nations, however, “accurate time measurement becomes even more imperative.”

NASA's proposed LTC is “a system that, while independent, maintains traceability to Earth's Coordinated Universal Time (UTC) to facilitate seamless time conversion,” says Julian Coltre, public

affairs officer in NASA's Space Operations Mission Directorate.

Space agencies also hope by 2030 to launch a small constellation of satellites to the Moon to provide position tracking and navigation — effectively a lunar equivalent to Earth's GPS. This will also require a consistent lunar time, says Welby.

LUNAR TIMEKEEPERS

Many technical details are



STANDARD TIME. Atomic clocks, like this one housed at the National Institute of Standards and Technology in Boulder, Colorado, are used to track time — one second per 9,192,631,770 energy transitions within a cesium atom.

NIST

yet to be worked out. One is whether Moon time should be maintained by atomic clocks on the Moon or stay synchronized with those on Earth, in which case a relay system would need to continuously communicate with our planet to register the time and convey that to lunar habitants.

Perhaps the most unconventional idea is to maintain time by the flashes of light from pulsars, the immensely magnetized remnants of massive stars. As they rotate, pulsars blast electromagnetic radiation from their poles; if directed toward Earth, we receive a flash like a lighthouse beacon — a predictable “pulse” that astronomers observe regularly with radio telescopes. Although pulsars offer significantly lower precision than atomic clocks, the stars wouldn't demand constant calibration like degrading clocks would, thus offering centuries-long stability.

One thing a lunar time-keeping system likely won't have is multiple time zones. A day on the Moon lasts for two Earth weeks, rendering different time zones unnecessary, says Heymans. —S.K.