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Apollo 11 anniversary: Lick Observatory scientists recall landmark experiment 40 years ago

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Forty years ago, Lick Observatory scientists helped make history when they teamed up with Apollo 11 astronauts to determine the distance from Earth to the moon with unprecedented accuracy.

Using a powerful laser installed at the observatory and a sophisticated reflector placed on the moon, Lick astronomers were able to time the round trip of a beam of light and calculate the distance.

"It was astonishing," recalled Joseph Miller, professor emeritus of astronomy,

who was one of a handful of scientists inside the dome of Lick Observatory on July 20, 1969.

The experiment atop Mount Hamilton outside of San Jose was the culmination of many months of preparation that included excavating a major pit under the 120-inch telescope inside the observatory. The team installed two lasers and optical equipment to shoot a beam of light up through the telescope, as well as light-detecting equipment and an advanced timer to record the precise instant when the beam returned to earth.

"At the beginning, we thought it was a bit iffy whether we'd get a return signal," said Miller, describing events on that hot summer day atop Mount Hamilton. "Until we actually got that return signal, we were nervous."

After some trial and error--astronomers joke that locating the moon through a telescope is harder than finding a galaxy five billion light years away, said Miller--the first signals beamed back to earth on August 1, completing the round trip of 245,000 miles in about three seconds. "It was an exciting time," said Miller, who retired in 2005 as director of UCO/Lick Observatory.

Miller was busy fielding questions from television and newspaper reporters who'd gathered at the observatory for the historic moon landing. Ironically, he was not allowed to answer the question on every reporter's mind because of national security concerns.

"The Russians knew very accurately the distance between Russian cities and between cities within the United States, but they didn't know the distance between the U.S. and Russia," explained Joe Wampler, professor emeritus of astronomy, who coordinated the experiment for the observatory. "Having an accurate measure of the distance to the moon at a moment in time would've given them that information. I was kind of upset about that, because we went into this as a scientific experiment. We weren't doing it for national security."

In the weeks before the lunar landing, Wampler prepared the telescope to accept the laser beam. On July 20, he calculated the precise position on the moon where the laser would be aimed, based on information from NASA about the location of the astronauts.



Lloyd Robinson, left, and Joseph Wampler helped make history after astronauts landed on the moon. Photo by Carolyn Lagattuta.

Astronomer Lloyd Robinson was particularly anxious in the hours before the lasers were first fired. Described as the genius behind the computer interface with the telescope, Robinson had been hired by the observatory just six weeks before the moon landing. Robinson, a research physicist, teamed up with Wampler on the critical task of developing the electronics and computer software to measure and display the time it took the beam of light to travel to the moon and back.

"NASA wanted to be sure they weren't scooped by the Russians or the French, because the Russians had bigger telescopes, and the French had better lasers," recalled Robinson. "They came to Lick and said, 'Can you help us?' There was considerable monetary support. Anything I asked for, I got. That turned out to be the only time in my career that was the case."

Although Robinson considers the feat a highlight of his career, and his children and grandchildren are familiar with his role in history, his attention that day was focused on the technical details. "You don't think about the significance of what you're doing as much as, 'I want this thing to work,'" said Robinson. "There was barely time to test the stuff."

But the best was yet to come, as the laser continued to fire every few seconds, generating reams of data that created the most detailed picture ever of the moon's path in the night sky. "The one-time measurement was a great technical achievement, but the real scientific payoff came later," said Miller. "We were measuring so accurately that we could see the distance to the moon change within minutes."

Although the Earth and moon orbit around one another, the gravitational effects of the moon on the Earth aren't simple, explained Miller. By following the moon closely, Lick researchers propelled scientific understanding of geologic processes on earth, including continental drift. "At the time, a lot of people still didn't believe in continental drift," noted Wampler.

The experiment contributed a grand new chapter to a story that goes back thousands of years, noted Wampler. "The moon has been used for a very long time in cosmology," he said. "The Greeks in 300 B.C. knew the distance to the moon with about 5 percent accuracy." The moon figured prominently in the development of Isaac Newton's theory of gravity, as well as in Einstein's theories about cosmology.

Other details of July 20, 1969, were more frivolous, including a visit to the observatory by a tarantula. "I remember some graduate students from the East Coast had never seen a tarantula before, and Joe (Wampler) had to shoo it out," recalled Robinson. Miller recalled the landing of a fly on the telescope just as the laser fired. "It was a spectacular explosion," he said. "The fly was vaporized instantly."

After Lick researchers detected the return signal, they moved on to other projects. But NASA continued the work, and the reflector on the moon remains in service today—the only experiment from the Apollo missions that is still active, said Wampler. "Once we proved we could get return signals, then other observatories could take over," he said, adding that today's instruments generate measurements that are accurate to within about a quarter-inch.

Ultimately, the development of new technology and the success of the project helped establish Lick Observatory as a leader in the dawning of a new era of advanced astronomy, said Miller.

"In a sense, we were doing a service to NASA and the country, but the technology Lloyd developed was the stimulus that positioned us to become world leaders in the use of computers and electronics in advanced astronomical research," said Miller. "You could say that was the incredibly powerful fallout of this project."

In 2007, research astronomer Remington Stone wrote a first-person account of the project, which is available online in the UCO News and Events section, under "Apollo 11 Anniversary." To read a *Santa Cruz Sentinel* story about the experiment, [click here](#).

