The satellite will remain in a shallow orbit for about six months, Moore said. During that time, students will measure the Earth's atmospheric resistance by tracking the satellite's decay. Software that supplies the math for STARSHINE calculations is posted on STARSHINE's own Web site at www.azinet.com/starshine.

STARSHINE will be carried aloft by space shuttle mission STS-96 and released from a Hitchhiker canister into an orbit of 250 nautical miles above the Earth. The mission is scheduled for Dec. 10.

The satellite's mirrors will produce intermittent flashes of light visible to the naked eye as it passes overhead in the night sky, making it possible to observe the spacecraft without telescopes.

"As the satellite slips closer to the atmosphere, students will be able to use the degradation data to calculate the density of the atmosphere," Moore said. "The satellite will appear at sunset. Students will mark the time the satellite goes by a star they recognize, using a hand-held GPS [global positioning system] device for precise time.

"They will determine where the satellite is [in relationship to the known star], take a time hack, and dump the data on the Internet, and use each other's data."

Solar flare effects

They'll also have to factor in the effects of solar flares on the satellite's orbit. "Sunspots cause big magnetic whirlpools in the Earth's atmosphere," Moore said. "More air molecules will get in the way. The orbit will change during periods of sun spots."

As part of their project, he said, "students can count sun spots and then go out at night and see the orbit change faster because of the sun spots."

Moore retired in 1996 from the academy's faculty where for three years he held the Gen. Bernard A. Schriever chair of space systems engineering in the department of astronautics. Before that, he taught physics at Utah State University and was a general manager of a division of Thiokol.

"We started out to do it [STARSHINE] in Utah, but interest in the project exploded," he said. "Now it's throughout the United States because that's where the digital computers and GPS all are."

Until the 1986 Challenger space shuttle disaster, he said, NASA accommodated student projects on its various space shots. After the Challenger accident, he said, "NASA refused to carry student satellites."

Moore used personal persuasion with the NASA administrator to relax the policy. "I kept pounding away at him," Moore said, laughing. "He relented, as long as there are no moving parts."

After that, STARSHINE sponsors were easy to find. They include the Rocky Mountain Space Grant Consortium, Utah Department of Education, the U.S. Space and Rocket Center, NASA, Air Force Research Laboratory, and the Optics and Photonics Lab at Hill Air Force Base, Utah.

The Utah State Space Dynamics Laboratory designed the satellite. Technology students at Bridger-land Area Technology Center at Logan, Utah, constructed the basic shape.

"We just got our first batch of 200 [unpolished] mirrors," Moore said. "In fact, you just caught me polishing the edges of the glass for the backing plate."


Click here for caption

Moore and his wife, Phyllis, work in their home shop in Monument, Colo., preparing the polishing kits. "We have to cut all the stuff, and make the kits. We're doing this full time," he said, adding cheerfully, "I'm retired now. I have nothing but time."

Opticians at the White Sands Missile Range designed the mirror polishing kit especially for middle-school students. "The kits are self-contained," Moore said. "Everything that's needed is there." A school's science students can order a kit from STARSHINE's Internet address.

Each mirror, he said, will go into space bearing "the names of all the people who participated in polishing them. We'll photograph the lists and shrink them to a microdot and put them on the back of the mirrors."

Moore had a few mirrors left, but they were going fast. He added encouragingly, "If they don't make it on this space shuttle, they can catch the next one. We're going to do this every year."

Lightweight satellite

Moore explained that the weight of STARSHINE was kept light so the sphere would fly and fall within a school year.

"If we made it very dense, it would stay up a long time," Moore explained, "but it would not provide a good measurement of atmospheric drag."

The STARSHINE mirrors will be sent to the Air Force Optics and Photonics Lab at Hill for special treatment, once the students have polished them, said Lorin C. Peck, chief of Hill AFB's Image Quality Testing Facility. The mirrors will be examined for flatness and coating, he said, then forwarded to Utah State University, which will build the satellite.

"The first thing we're going to do is check the mirrors out, to make sure they are performing correctly optically, for flatness and reflection," said Jay E. Broadhead, a specialist in optical coating at the lab. "And if they're not performing, we're going to correct them."

Each mirror, he said, will be coated with a very thin layer of pure aluminum, and then silicon dioxide to halt oxidation.

The idea for a student project like STARSHINE, Moore said, occurred to him when he was part of a network tracking Sputnik.

"Back then, I thought it would be a cool thing to do," he said. "Technology has now made it possible. Now kids can do this with PCs just as powerful as computers were then, and the Internet allows us to take data anywhere in the world, free."

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