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# RESEARCH SUCCESS MARKS RECENT DAYS FOR 'STAR WARS'

**By PHILIP M. BOFFEY, SPECIAL TO THE NEW YORK TIMES**

If a beam of green laser light flashes up from Hawaii to the space shuttle Discovery as scheduled on Wednesday, it will be the most prominent experiment yet conducted as part of President Reagan's Strategic Defense Initiative program to develop a defensive shield against nuclear missile attacks.

The experiment is the latest milestone in a series of tests aimed at learning how to send a laser beam through the turbulent atmosphere with great precision, a matter of critical importance if some of the most visionary "Star Wars" weapons are to succeed.

But the experiment also symbolizes dozens of rapid advances being made in a broad range of technologies that will be needed if the United States is ever to build a defensive system that could knock down incoming enemy missiles at various points along their flight paths toward this country.

Top Government scientists say that experiments completed or reported in recent months, and new ideas emerging from the nation's laboratories, have made them increasingly confident that the United States will ultimately be able to develop at least some of key weapons, sensors, materials and other technologies needed for a workable defensive system.

"There has been progress in all of these areas over the last six months or so," Dr. Gerold Yonas, chief scientist for the Strategic Defense Initiative Organization, which manages the "Star Wars" program for the Pentagon, said recently.

"The technology is rolling faster than some of us were really aware," George A. Keyworth 2d, the White House science adviser, said in an interview.

"We're about five years ahead of what we would have predicted" in developing such weapons as short wavelength lasers and neutral particle beams, and techniques for overcoming the distorting effects of the atmosphere on laser weapons, added Lieut. Col. Michael Havey, the "Star Wars" specialist for the White House science office.

How important these advances are is not yet clear. Most of the emerging technologies are very far from reaching the performance levels needed for eventual deployment, and much of the work was occurring even without the "Star Wars" program, which has only been functioning for less than a year. Moreover, military classification makes it difficult for outsiders to gauge whether the claimed advances are all that they seem.

Dr. Keyworth said he considers the ability to destroy Soviet missiles in the boost phase, shortly after they have lifted off the ground and before they can deploy their warheads and decoys, the most critical technical challenge facing the "Star Wars" program. Pointing to recent advances in lasers and particle beams, he said: "We now feel quite confident that within three to five years we can put doubts to rest on the feasibility of boost phase intercept."

But critics of the program discount the importance of the recent achievements. "They're certainly making progress," said John Pike, space analyst for the Federation of American Scientists, "but it's like the fusion energy program where they've been making very steady progress for 30 years now and they still don't have anything usable out of it. They're going to need breakthrough after breakthrough for several decades to get gadgets that are workable, and even then the system as a whole would not work reliably from a military or political point of view."

Richard Garwin, an International Business Machines Corporation physicist and a leading critic of the President's Strategic Defense Initiative program, told the annual meeting of the American Association for the Advancement of Science last month that whatever technical advances are made toward developing a "Star Wars" defense can easily be nullified by technical advances designed to overcome such a defense. "No matter how optimistic you are, how much of a technology fan, you cannot conclude that the "Star Wars" program will succeed," he said, "because technology is useful in defeating the system as well."

Important Test of Ground Laser

The experiment scheduled for the shuttle is the latest in a series designed to demonstrate that laser beams can be shot through the atmosphere with great precision despite the distorting effects of atmospheric turbulence.

The issue is of critical importance in determining whether a "Star Wars" defense could use lasers placed on the ground, where they could be as large as needed and would be easy to maintain and fuel and defend, instead of on space satellites, where they would have to be very

compact and need no maintenance.

One plan under study would use lasers on mountain tops to shoot beams up to mirrors in space, which would redirect the beams, at the speed of light, to the target missiles. That will only work if the beam can be aimed precisely through the atmosphere.

Scientists have already performed some tests in which they succeeded in compensating for atmospheric distortion. In experiments completed last winter, they shot a low-power laser beam from the top of a 10,000-foot mountain on the island of Maui, Hawaii, to an aircraft flying at an altitude of about 20,000 feet, measured the distortion caused by the atmosphere and then adjusted the beam of a second laser to overcome the distortion and land precisely on target, according to Dr. Louis Marquet, head of the directed energy office of the Strategic Defense Initiative. Later this summer, similar experiments will be conducted between the ground and sounding rockets that will rise far above the turbulent atmosphere to a height of about 360 miles.

The shuttle experiment is an intermediate, low-cost step designed to demonstrate that the equipment and plan for the high-cost sounding rocket tests are apt to work. A low-power beam will be sent up through the atmosphere from Maui to an eight-inch diameter retroreflector mirror mounted on a side hatch window of the shuttle. The mirror will reflect the beam back to the point of origin, where the amount of atmospheric distortion will be measured.

Scientists will then determine whether control equipment on the ground could have corrected the beam to overcome the distortion, but they will not actually send a corrected beam back up to the shuttle. That step will await the sounding rocket experiments.

All of these scheduled experiments are working with low-power lasers, Dr. Marquet notes. The next big issue will be to determine whether it is possible to control atmospheric distortion of high-power laser beams of the kind that might ultimately be used in a weapons system. Such high-power beams are distorted more drastically by the atmosphere.

Free Electron Lasers Tested

Meanwhile, in Government and industrial laboratories, significant advances are being made toward developing two kinds of lasers that are emerging as strong candidates to serve as "Star Wars" weapons, probably based on the ground.

One type is known as the free electron laser, which uses the motion of electrons through magnetic fields to generate laser light. Such lasers have the enormous advantage of being "tunable," that is, they can be designed to operate at whatever wavelengths can best pass through the atmosphere and disable the target.

The Lawrence Livermore National Laboratory in California reported this year that it had achieved a peak power output of 100 megawatts in a new free electron laser, a significant gain over past performance, for the very short time period of 15 billionths Vf a second. More important, the free electron laser worked as predicted by scientific models, and those models suggest that it should eventually be possible to make a free electron laser that will meet the much more demanding power and wavelength requirements of the "Star Wars" program, according to Donald Prosnitz, assistant program leader for free electron lasers at Livermore.

Other important work on free electron lasers has been carried out at Los Alamos National Laboratory in New Mexico, and in industry. "Just a few years ago free electron lasers were only a clever idea," said Dr. Keyworth, the President's science adviser. "Now there is little doubt as to whether free electron lasers will work. The question that remains is how big and how efficient and how economical they can be. But a dream theory has most certainly been turned into a reality."

Similar advances are reported to be occurring with excimer lasers, which fire an electron beam into a gas to produce unusual molecules, called excimers, which in turn break up into separate atoms and generate a brief, intense burst of laser light while doing so. The advances on excimer and free electron lasers led Dr. Keyworth to state: "I for one feel much more confident than I did at the outset in the concept of a ground-based laser. It's a very powerful option."

Other Achievements Noted

Scientists involved in the "Star Wars" program cite these other advances, mostly achieved over the past 6 to 12 months, as exemplifying the kind of progress being made:

* The University of Texas Center for Electromechanics has used an electromagnetic launcher to fire 20-gram projectiles repetitively at the rate of 5 shots in half a second, and to fire a plasma of vaporized metal at speeds approaching 25 miles per second. Both are considered important steps in the development of "rail guns" that would be able to fire homing projectiles at high speed to intercept enemy missiles.

* United Technologies Corporation has developed a composite material in which carbon silicide fibers are used to reinforce a brittle ceramic base. The resulting material is as strong as steel, light in weight and highly resistant to radiation, heat and laser attacks, making it potentially useful as a shielding material for "Star Wars" components in space.

* The Pennwalt Corporation has engineered a new molecule, not found in nature, that can be fabricated into capacitors capable of storing much larger amounts of energy per unit weight than is now attainable, a critical step on the road to storing the enormous amounts of energy required by space-based weapons.

* A large chemical laser at the White Sands Proving Ground has achieved a very powerful, very high quality beam that can be used for

atmospheric compensation tests but is still well below the power needed in a weapon.

* The Los Alamos National Laboratory has devised a very compact pre-accelerator that can accelerate a particle beam to 2 million volts, which is in the ballpark of what is needed for a "Star Wars" pre-accelerator. The new device is the size of a desk; its predecessors were the size of a house.

* Scientists at Lawrence Livermore National Laboratory were reportedly successful in a test three months ago of a new way to focus the X-rays generated by a nuclear explosion, thereby reducing one of the most critical technical problems standing in the way of development of the "nuclear bomb-pumped X-ray laser," another potential candidate as a "Star Wars" weapon.

* New infrared sensors, designed to detect and track enemy missiles in flight, have demonstrated 10 times greater resolving power than earlier models.

In addition, rocket-propelled projectiles have proved able to hit a target above the atmosphere and reach designated points within the atmosphere.