The ABL demonstrator could be the forerunner of a system that can shoot down ballistic missiles.

The Airborne Laser

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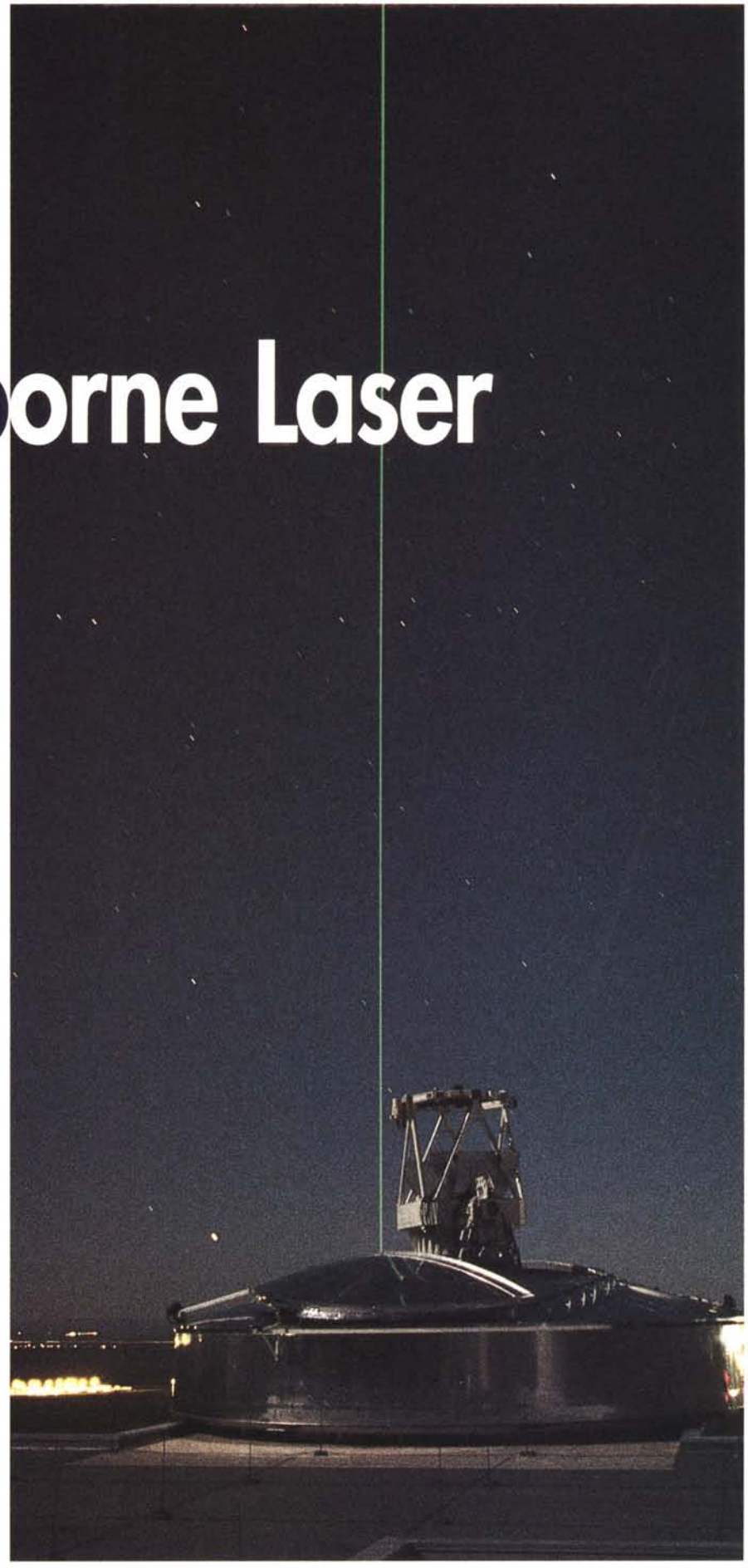

Photo by Ray Nelson

IT IS nighttime on a hilltop in New Mexico, and the sky is clear and crowded with stars. Suddenly, two green shafts of light shoot out overhead. The beams converge, appearing to extend infinitely into space.

It is not a scene from the next episode of "The X Files." It is a demonstration of one of the major technologies—adaptive optics—that may enable USAF to develop a prac-

Scientists must be able to correct for atmospheric distortions in order to make airborne lasers accurate enough to down missiles in their boost phase. USAF's Starfire Optical Range helped solve this problem with its adaptive optics technology, which employs lasers and a computerized deformable mirror to detect and compensate for atmospheric "jitter."

tical airborne laser (ABL) weapon system. The service invited the press to accompany Air Force Secretary Sheila E. Widnall to Kirtland AFB, N. M., home of Phillips Laboratory, to learn more about a program that, in her view, "revolutionizes our operational concepts, tactics, and strategies."

The Air Force believes that a workable ABL defense system could be used to destroy an enemy's theater ballistic missiles in their "boost phase," while they are still over enemy territory and before they have released any warheads.

The Starfire Optical Range, which provided the nighttime light show, developed the adaptive optics technology needed to maintain laser-beam integrity—to ensure that the beam will not be scattered as it travels through the atmosphere. Declassified in 1991, the technology was initially designed to improve image quality from telescopes but is equally applicable to laser beams.

On October 27, one day after the demonstration in New Mexico, Secretary Widnall told attendees at the Air Force Association National Symposium in Los Angeles that the service is 100 percent sold on the ABL program. The ABL "attacks at the speed of light, costs about $1,000 per shot, will kill chemical and biological weapons over enemy territory, and frees up many of our attack aircraft from 'Scud-hunting' duty for other warfighting requirements," she said.

Two Teams

The ABL program comprises the work of the Air Force and a pair of contractor teams. Rockwell International leads one team, which includes Hughes and E-Systems. The other is headed by Boeing and includes TRW and Lockheed Martin. Each contractor team received a $22 million contract in 1994. The Air Force plans to award a single demonstrator contract to one of the teams in Fiscal 1997.

For USAF, the concept of building airborne laser weapons is nothing new. The service conducted high-energy laser experiments in 1981 using the Airborne Laser Laboratory (ALL) aircraft. This older test system destroyed five AIM-9 Sidewinder air-to-air missiles and one BQM-34 cruise missile drone.

Today, USAF leaders and ABL team members believe they have within their grasp the technologies to build a practical antimissile system over the next several years. So convinced is the Air Force that it has put $700 million on the line to produce a demonstrator by 2002.

USAF plans call for using a Boeing 747 jumbo aircraft as the ABL platform. The service estimates that seven ABL-equipped aircraft would cost $450 million each. It expects the total program to cost $5 billion and plans a potential initial operational capability for three aircraft by 2006. All seven aircraft would be operational by 2008.

The development of several key technologies now appears to make the system a realistic project. One of these is today's more efficient laser.

Col. Dick Tebay, the ABL system program director, said the laser itself has come a long way since the ALL experiments of the early 1980s. The laser for today's ABL, he noted, is eight times more powerful than the one used in the ALL project but is one-thousandth as bright. Situated nearby as the Colonel spoke was a display of the remains of several Scud-type missiles that the ABL system had "killed."

The preferred system for the ABL is the high-powered chemical oxygen-iodine laser (COIL), first invented and patented in 1977 by the Air Force Weapons Laboratory, now part of Phillips. Since then, Phillips scientists have continued to develop COIL, which is based on chemical reactions between chlorine gas and a mixture of hydrogen peroxide and potassium hydroxide. It emits infrared light at a wavelength of 1.315 microns—the world's shortest known wavelength—and travels easily through the atmosphere, according to Phillips personnel.

Phillips scientists have also improved the COIL device by using plastic components to reduce the weight and by increasing its efficiency (making it more powerful with less brightness). The resulting Verti-COIL also enables the system to recycle the laser fuel, thus further reducing its weight.

Correcting Distortion

In early 1995, the Air Force conducted its Airborne Laser Extended Atmospheric Characterization Experiment (ABLE-ACE) to demonstrate how a laser beam's physical properties can be affected as it travels through the atmosphere and how adaptive optics technology can correct the distortion. Using a modified C-135E transport and a Gulfstream II jet, the ABLE-ACE team flew to various locations in the US and overseas, measuring the degree of atmospheric disturbance suffered by laser beams sent from the C-135E to the Gulfstream and the compensation necessary for the adaptive optics technology to correct the "jitter" in the beam. The distances between the two aircraft were similar to those over which an ABL beam would have to travel to destroy an ascending missile.

According to team members, the tests were successful, verifying that application of adaptive optics technology for the ABL is feasible.

The accurate tracking of missiles rising through turbulent atmosphere is seen as the most challenging aspect of the program, Colonel Tebay said. Even so, he termed it a low to moderate risk in the program and expects a fix by 1998, in time for the program design review.

The cost per shot of the ABL is relatively low. Under current plans, five ABL aircraft could arrive in theater within hours of notification and with sufficient fuel for 200 engagements. Each engagement, or shot, would use $1,000 worth of laser fuel.

The Air Force said that kinetic-kill vehicles, by contrast, would cost $1 million per shot.

Some reports have stated that the planned buy of seven ABL aircraft would not be able to handle the threats posed in more than one theater at a time, even though current national military strategy calls for forces that can fight and win two major regional conflicts at roughly the same time. However, according to Air Combat Command's Col. Patrick K. Garvey, chief of the Aerospace Control Division Directorate of Requirements, employment projections show that seven ABLs will provide sufficient coverage for two theaters.

He emphasized throughout his briefing, however, that the ABL is not a stand-alone solution to theater missile defense problems but would be one complementary part of a broader system. ■