Laser beams on submarines can knock out enemy missiles

by Charles B. Stevens

New developments in the use of lasers to communicate with submerged submarines will soon make it possible to upgrade the effectiveness of U.S. submarine-launched ballistic missiles (SLBMs), while also allowing the near-term deployment of "pop-up" missile-defense systems from submarines.

Strategic Defense Initiative chief Lt. Gen. James A. Abrahamson, in testimony before the Senate Armed Services Strategic and Theater Forces Subcommittee the second week in March, reported that the HOE missile-defense system demonstrated by the U.S. Army last June could be used as a post-boost intercept system deployed from forward-based submarines. "It is important to recognize that we have already demonstrated the practicality of several layers of strategic defense," he concluded.

An essential, though not widely reported, contribution to this effort is the work of Dr. Lowell Wood, Lawrence Livermore National Laboratory's leading beam-weapon scientist. Working in collaboration with Dr. John Marling, he developed a new means of detecting low-power laser light, so that a small, space-based xenon-chloride laser developed by Northrop will be able to communicate with submerged submarines. When combined with the Navstar guidance satellites, this new communication system will vastly improve the fighting capabilities of ballistic-missile submarines, through the kind of defensive deployment implied by General Abrahamson, and by raising U.S. nuclear offensive capabilities to a level more commensurate with that of the U.S.S.R.

Ballistic missiles and communications

At the present time, land-based intercontinental ballistic missiles (ICBMs) are far more militarily effective than SLBMs, because they are far more accurate and easily commanded through secure communication systems. The very elusiveness which makes submerged submarines relatively invulnerable, also makes it more difficult for them to communicate and determine their exact location at any given time. Therefore, only ICBMs currently offer a versatile means, through rapid retargeting, of destroying hardened military targets in a dynamic military engagement. SLBMs represent primarily a long-response, retaliatory force, which could at most pin down a defender's missiles until the more accurate ICBMs arrived. Therefore, it is evident that the current U.S. strategic nuclear force, which is dominated by SLBM warheads, is primarily designed as a retaliatory force, whereas the U.S.S.R. has a predominance of ICBMs in its nuclear inventory.

The United States is now developing the new Trident SLBM, which in conjunction with the Navstar satellite system will bring SLBM accuracy up to the level of land-based ICBMs. Navstar satellites are being deployed at the present time. Signals from several of these satellites provide the means for blind-launched SLBMs to get a fix on their own location and that of their targets, with an accuracy of less than a meter. The SLBM determines its location when it emerges from the ocean and receives the Navstar satellites' signals. It then can zero in on pre-programmed targets with an accuracy equaling that of land-based ICBMs.

But to make SLBMs the equal of ICBMs in dynamic warfighting, it is essential that there be a secure means to communicate which will not make the subs open to easy detection. One method which was being pursued for several years was that of utilizing extremely long wavelength electromagnetic waves, which could penetrate the earth and ocean. But this system is highly vulnerable to attack, since it relies on a massive antenna. Its communication data-rate is very small.

For a long time it has been recognized that lasers could provide the means for reliable and high data-rate submarine communication. Tuned to the proper blue-green wavelength, laser light pulses can penetrate the atmosphere, clouds, and a significant depth of ocean. Originally, the idea that was pursued was to utilize an extremely high-power, ground- or air-based laser, which would have its beam relayed to a submerged submarine by a space-based orbiting mirror. But this system was abandoned when it was realized that it would be highly vulnerable and costly; the Navy returned to the long wavelength electromagnetic antenna approach.

Then in the late 1970s, Dr. Wood proposed that by utilizing a new method of laser light detection, small space-based lasers could achieve submarine communication at low costs and with a high degree of reliability. Dr. Wood is the "young scientist" Dr. Edward Teller has referred to as the one who convinced him that beam-weapon defense against ballistic missiles was feasible. Dr. Wood has made major contributions to laser fusion and x-ray laser development, and heads the most outstanding group of scientists currently researching the means to make offensive nuclear weapons obsolete.

A laser filter system

The key to making cheap, invulnerable laser-submarine communication possible was developed by Dr. Marling and consists of a light filter system. Dr. Marling developed his concept while working at Livermore with Dr. Wood. It is based on the fact that cesium atoms are highly responsive to particular wavelengths of light. By combing a series of light filters with cesium gas, Dr. Marling realized the scientific basis for developing an extremely sensitive atomic resonance laser light detector.

The detector consists of a blue filter through which light passes, permitting only the desired blue-green-range wavelength to enter. This filtered light then passes through a cesium gas cell. The cesium absorbs only the .459 micron laser wavelength radiation. It re-emits this absorbed radiation in the infrared wavelength range. Since infrared wavelengths had been filtered out by the first blue filter, the only infrared radiation within the cell would derive from absorbed laser light. Therefore, by placing an infrared filter at the exit of the cell, all of the blue-green wavelength range would be filtered out, leaving just the infrared signal wavelength deriving from the cesium atoms which had been excited by the .459 micron laser light.

The result is that a deeply submerged submarine is able to detect a faint modulated signal from an orbiting, moderate-power laser, despite bright sunlight, turbid waters, or heavy cloud cover.

Besides encouraging Dr. Marling and collaborating with him, Dr. Wood mounted a campaign on Capitol Hill to generate congressional support for the idea, at a time when Navy officials were extremely skeptical.

According to the Jan. 21 issue of *Aviation Week and Space Technology,* Lockheed Missiles & Space Co., teamed with Northrop, has been selected to design a xenon-chloride .459 micron laser that is space-qualifiable. The communication system could be deployed by 1990.

Communications and defense

The requirements for quick-response communications are far greater for defending against ballistic missiles then for the offense. Rapid re-targeting and launch commands are essential to successful interception of barages of offensive missiles and warheads. The HOE system is based on utilizing a small interceptor rocket, which is deployed by a ballistic missile. The interceptor rocket contains homing devices and guidance computers; it destroys the offensive missile by colliding with it. Quick-response, Navstar-redirected SLBMs provide the means for achieving pop-up interception of ICBM warheads as they travel through space.

More signficantly, the same SLBMs could deploy pop-up nuclear powered x-ray lasers, which could destroy offensive missiles in their boost phase. Each x-ray laser module could destroy scores of missiles, each of which carries many warheads, before they leave the territory of the Soviet Union.