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Teller confirms laser breakthrough

by Charles B. Stevens

Contrary to much misinformation and disinformation, emanating from various liberal and Moscow circles, the United States *and the Soviet Union* are indeed very close to realizing the sort of technology to make nuclear-tipped missiles "impotent and obsolete," as President Reagan had called for when he announced his Strategic Defense Initiative (SDI)—the so-called "Star Wars"—program on March 23, 1983. This was detailed by Dr. Edward Teller in his May 9, 1986 testimony, on behalf of the newly formed Science and Engineering Committee for a Secure World, to the Senate Defense Appropriations Subcommittee.

In particular, Teller, during the question and answer period following his formal testimony, explained that U.S. experiments have shown that the nuclear explosive powered x-ray laser, whose principle "is established," can be designed to send a beam a thousand miles with a spread of no more than five feet. This degree of focusing, which is thousands of times better than what SDI critics have claimed to be physically possible, means that *a single x-ray laser device could destroy upwards of tens of thousands of nuclear warheads and missiles at any stage of their trajectory.*

This stunning level of firepower would completely undermine the military credibility of any type of massive salvo-type surprise first strike. In fact, whoever struck the first blow in a nuclear war could find themselves in the embarrassing position of being virtually "disarmed," while the victim maintains its full range of offensive firepower—that is, the opposite result of that intended. An x-ray laser device could be popped up into space above the Arctic ice by a submarine any time during the 20 minutes it takes Soviet ICBM warheads to travel from Russia to North America. If one x-ray laser device could destroy 10 times the existing Soviet warhead inventory, hundreds or thousands of such defensive systems could readily defend against any conceivable surprise first-strike.

Ominously, Teller confirmed SDI Director Lt.-Gen. James Abrahamson's report that the Soviet Union is two to five years ahead of the United States in x-ray laser development.

Almost one year ago, in a front page *New York Times* article, William Broad reported that California-based Lawrence Livermore National Lab scientists had demonstrated focusing of x-ray laser beams in an underground nuclear test on March 23, 1985. The test completely disproved the public contention by Soviet scientists and U.S. SDI critics that it was physically impossible to develop x-ray laser optics for beam focusing. That had been baldly asserted in the 1984 Congressional Office of Technology Assessment report on SDI, chiefly authored by Ashton Carter of MIT, though later endorsed by such leading scientists as Dr. Charles Townes of Stanford University.

The basic concept was originally pointed out as a possibility by the Fusion Energy Foundation and Dr. F. Winterberg of the University of Nevada in 1982 and 1983 reports, books, and articles. The idea is to use a plasma (an ionized, high temperature gas) as a "lens" for focusing x-ray laser beams.

In the fall of 1985 and then later in the winter, various publications, such as the *Los Angles Times* and *Science* magazine, claimed that Livermore scientists had misrepresented their x-ray laser tests. Based on leaks of top-secret reports, these publications maintained a campaign of calumny and slander against the Livermore tests and such SDI advocates as Dr. Teller and Dr. Lowell Wood.

More recently, Prof. Hans Bethe of Cornell University has been reported to have been passing on disparaging reports on the top secret Livermore results. In particular, Bethe has been quoted as stating that the Livermore experimental diagnostic measurements are not capable of distinguishing between a laser beam output and simple "superfluorescence."

Teller sets record straight

Since this original controversy, a further x-ray laser test has been reported to have been carried out at the beginning of 1986. The May 9 Teller testimony, stating that the principle "is established" together with the detailed projection of "beam divergence," is the first official statement since that test. It is a clear and direct refutation of the reported statements of Professor Bethe and the *Los Angeles Times* and *Science* articles. In fact, one leading government scientist reports that a recent review by the General Accounting Office of the Livermore nuclear x-ray laser program has given it very high marks. It is also indicated that Bethe has not raised his questions about "superfluorescence" during any of the classified reviews.

Teller said it is natural that the Soviets have shown no interest in President Reagan's proposal to share SDI technology with them in the future, because they are ahead of us in strategic defense, and probably know what we will discover in the next two years, perhaps the next five years. The Soviet Union has conducted expensive tests in large, underground tunnels, while the United States has only carried out much cheaper underground tests utilizing simple vertical bore-holes. Teller called for adding $200 million to the SDI program to pay for such tests.

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The use of expensive, evacuated tunnels indicates that the Soviets are carrying out actual weapon simulation tests. It is not necessary to test x-ray lasers in space to demonstrate and develop full scale anti-missile and anti-satellite applications. In fact, this author has found no expert who could otherwise detail a means whereby the deployment of pop-up x-ray laser weapons could be detected. Even x-ray laser predeployment in satellites would be difficult, if not impossible to detect, because of their extremely low radioactive signature.

Abrahamson backed on Soviet lead

On March 25, Lieutenant-General Abrahamson testified that the United States had obtained intelligence data showing that the Soviets were as much as five years ahead of the U.S. in developing x-ray lasers. In particular, Abrahamson noted that the Soviets had conducted an x-ray laser underground test in 1982—probably one of the tunnel tests referred to by Teller—which the U.S. will not be able to carry out until 1987.

Besides the Teller testimony backing up this assessment by Abrahamson, a new newsletter, *Tech Trends International,* which has as one of its managing editors the former *Aviation Week and Space Technology* reporter, Clarence A. Robinson, who is famous for his articles dating back to the mid-1970s on the Soviet SDI program, carried a detailed report on the advanced status of the Soviet x-ray laser program.

Tech Trends of May 12, 1986 (Vol. 1, No. 1) reports that the Russians are carrying out "an energetic developmental program for nuclear-pumped x-ray laser devices at its secret Degalin Valley underground test site." Apparently, this is part of the Chelyabinsk complex near the Ural Mountains. The report goes on to state, "X-ray lasers . . . have been high priority development programs in the U.S.S.R. for at least a decade, with increased activity and funding in the past several years."

Tech Trends states: "The effort . . . involves tens of thousands of scientists, engineers, and technicians, according to the Defense Department and intelligence community officials. . . . Space-based sensors have observed numerous tests at the Degalin x-ray laser test site with as many as 40 trailers containing diagnostic equipment with line of sight from the surface to the x-ray test area underground." *Tech Trends* contrasts this with the U.S. practice of seldom using more than "five or six" such diagnostic trailers during tests at its Nevada range.

Other sites devoted to supporting the Soviet program according to *Tech Trends* are Kasli, 60 miles northwest of Chelyabinsk, and Sarova, a nuclear weapons research insti-

Brightness and firepower

The numbers given by Dr. Edward Teller in his Congressional testimony, a beam diameter of 5 feet over a distance of 1,000 miles, confirm reports that the x-ray laser plasma-focusing lenses demonstrated in underground tests have obtained a brightness 1 trillion times that of the hydrogen bomb. For directed energy weapons, beam brightness is a direct measure of firepower. It is directly proportional to the number of missiles and/or warheads that can be destroyed. It is also proportional to the square root of the weapon's maximum effective range. That is, if we reduce the number of targets that the beam weapon is to engage by half, it will have a fourfold increase in effective range.

Brightness is usually measured in terms of energy or power per unit solid angle—steradians. The solid angle is roughly given by the square of the beam divergence angle measured in radians. Therefore, the brightness is inversely proportional to the square of the beam divergence. The figures given by Teller roughly indicate a beam divergence of one-millionth of a radian, a microradian. This is a factor about 1,000 times smaller than that presented by Soviet and U.S. scientific critics of SDI as being the minimal that the laws of physics would permit. Given the inverse square relationship, it also means that the x-ray laser is one million times brighter than these critics derived. This would mean that the device could either have a thousandfold increase in effective range, or alternatively, destroy 1 million times more targets.

The plasma lens focusing system provides the means for both readily dividing the x-ray laser output into tens of thousands of individual beams, and electromagnetically pointing toward separate targets. This large number of beams opens up entirely new types of firing strategies for x-ray lasers, particularly against massive missile salvos.

In general, massive missile salvos lead to large numbers of warheads passing through relatively small "windows" in space. If these windows can be saturated

tute north of Moscow.

Implications

The nuclear bomb powered x-ray laser has a truly awesome firepower—a single device being capable of destroying the entire world's inventory of missiles and nuclear warheads. Utilized in conjunction with a surprise first strike, the x-ray laser could surgically remove all of the opponent's space-based assets and help suppress any deployment of offensive and defensive missiles. Because of its high firepower, the system necessitates the minimum of additional requirements such as target tracking, discrimination, and command and control.

But if both the United States and Soviets have it, it would be far more beneficial to the United States. The reason is that x-ray lasers are far more effectively deployed against offensive missile strikes. The reason for this is the same one that prevents the x-ray laser from being utilized as a weapon of mass destruction against targets on the surface of the Earth. Even highly focused x-ray laser beams can only penetrate part way through the Earth's atmosphere. And this ability to penetrate the atmosphere is much greater when it is fired in an upward direction, such as would be the case against incoming warheads passing through space.

Given this fact, and other advantages which naturally accrue to the defense, defensive x-ray lasers would have vast superiority over x-ray lasers deployed to protect and convoy an offensive missile strike. The military implications of the x-ray laser are asymmetrical because only the Soviet Union has engaged in building and deploying an increasingly effective surprise first strike capability. Even if both sides have the x-ray laser, it is most effective against the aggressor.

This can be seen from the simple fact that if a surprise, massive first strike is launched and completely fails, it would leave the intended victim in a vastly superior strategic position. The aggressor's offensive forces would have been depleted, while the victim's remain in reserve.

As Dr. Teller noted in the body of his testimony, while the present situation is ominous, the basis for much hope exists. The x-ray laser augers a new scientific and technological age. It will revolutionize every aspect of science and technology. With it, we will for the first time be able to probe the interior of atoms of living and non-living matter *2n situ*. Atomic scale pictures of living cells will be made for the first time. Biology, medicine, and materials science will be revolutionized overnight. Major advances in the fusion process itself will be obtained.

As Dr. Teller indicated in his testimony, the future holds great promise if we can overcome the scruples, screams, and cries of the treasonous liberal Luddites.

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with a sufficient density of lethal beams, all warheads and decoys could be destroyed without having to discriminate between them or target them individually. The result would be similar to that of grape shot and/or machine guns applied against massed infantry.

The idea here of utilizing a large number of tightly focused beams, instead of spreading the laser output evenly over a large area, is that with a sufficient density of beams—for example, warheads have an aerial cross section of one square meter or more; so, having one beam per square meter would be enough to ensure destruction of all targets in a given area—achieves the same aerial coverage at a greater range. The point being that the empty spaces between the beams represent an increase of least action for this particular firepower application. Given the variety of missile deployments and defensive fields of fire deployment, a wide range of options would be open to the defense beyond this simple model, such as some selective targeting and partial discrimination combined with multiple barrages from different directions against the same window.

An ordinary hydrogen bomb has an energy output on the order of 10^{15} joules (1,000 trillion joules). Given no focusing, this would be evenly distributed over a sphere which has a total of 4π steradians. Therefore, roughly, the brightness would be 10^{14} joules per steradian. At 1 trillion times this brightness, the x-ray laser would have 10^{26} joules per steradian. To destroy existing types of missile boosters, an energy density of about 1 million joules per square meter would be required. For the tougher warhead carrying re-entry vehicles (RVs), 1 trillion joules per square meter would be needed.

This gives a maximum range for the full output directed onto an individual target of 10 billion meters (about 6 million miles) against a rocket booster and 300 million meters (almost 200,000 miles) against an RV. Alternatively, if the output is broken up into 100,000 separately directed beams, the respective ranges would be 30 million meters (almost 20,000 miles) and 1 million meters (about 600 miles). In practice, the output would be divided to obtain lethal kills at a variety of ranges from the same device against multiple kinds of targets. For example, low power bursts at long ranges could be used to destroy decoys, leaving the real RVs more readily targetable.