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## Conference Report

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# U.S. tests the x-ray laser while scientists meet nearby

by Charles B. Stevens

On Dec. 5, as over 400 scientists were meeting in nearby Las Vegas at the Lasers '85 conference sponsored by the Society for Optical and Quantum Electronics, the U.S. Department of Energy (DOE) announced that an underground nuclear test was carried out at the Nevada nuclear weapons test range. According to informed sources and recent articles in *Science* magazine and the *Los Angeles Times*, this test may be part of a series begun in March to demonstrate nuclear-bomb-powered x-ray lasers and optics for defense against mass ballistic missile attacks.

The international Las Vegas conference, which constituted one of the largest gatherings of laser scientists held this year, had attendees from more than 20 countries, including the People's Republic of China, Japan, Iraq, West Germany, Italy, Great Britain, India, and the Soviet Union. While the meeting primarily dealt with the present status of laser technology and its applications, including a session organized by the Fusion Energy Foundation on "Lasing in Biophysics," several conference plenary sessions were devoted to discussing the policy implications of President Reagan's Strategic Defense Initiative (SDI) program for developing defenses against nuclear-armed ballistic missiles. These sessions heard presentations by leading scientists and government spokesmen, such as the President's science advisor, Dr. George "Jay" Keyworth, SDIO Chief Scientist Dr. Gerold Yonas, and Dr. Edward Teller.

### Teller: 'Soviets have x-ray laser'

Two days before the DOE Nevada test, Dr. Edward Teller made the startling announcement that the U.S.S.R. has also probably developed the x-ray laser. Teller began his Dec. 3 plenary session presentation by reporting that despite the recent proliferation of "confused press reports. . . . the Excaliber . . . x-ray laser does exist. . . ." Teller went on to report that this x-ray laser, designed by Lawrence Livermore National Laboratory, was based on scientific concepts first developed by Soviet scientists.

Furthermore, Teller reported, new evidence has recently appeared which strongly indicates that the Soviet Union has

successfully demonstrated an x-ray laser. Therefore, Teller concluded that Russia is seeking a monopoly in missile defense, while maintaining a vast lead in offensive nuclear forces.

In light of this, Teller emphasized, "The SDI is far more urgent than previously thought."

### 'Astounding progress'

A week before the Las Vegas conference, Lt.-Gen. James Abrahamson, the director of the SDI Office, announced at a special Pentagon news briefing that "astounding progress" had been made in the development of directed-energy weapons, and free-electron lasers in particular.

The hundreds of scientific papers presented to the Lasers '85 conference documented Abrahamson's claims:

- Dr. D. Mathews reported on continuing work with the Livermore Nova laser for demonstrating laboratory scale x-ray lasers.
- Dr. S. Suckewer presented the latest results from the Princeton University magnetic plasma, recombination x-ray laser.
- Prof. H. Kuroda of the University of Tokyo reviewed the current status of the Japanese x-ray laser program.
- Drs. H.M. Peng and S. Y. Luo detailed the results of the Chinese x-ray and gamma-ray laser research programs.
- Prof. Charles Rhodes of the University of Illinois detailed the experimental results on the non-linear absorption physics achieved with intense excimer laser beams. Rhodes showed how this will lead to x-ray lasers millions of times more efficient than existing models.
- Dr. Charles Brau of Los Alamos reviewed the "startling" progress made in the last year with free electron lasers (FEL). As Presidential Science Advisor Keyworth emphasized in his keynote address to the conference, in March 1983 when the President first proposed the SDI, the FEL was only a scientific concept. Today, the technology has approached the point where a full-scale prototype, ground-based system can be built. Based on existing experimental results, it is possible to conceive of a single FEL being capable of destroy-

ing the entire Soviet ballistic missile fleet.

- More than 20 papers reviewed progress in laser-beam propagation through the atmosphere, including presentations by Dr. Gerold Yonas, SDI chief scientist, and Dr. O. A. Vokovitsky of the U.S.S.R. Obninsk Institute of Experimental Meteorology.

- Major advances in remote sensing were reported in over a score of presentations. Dr. Yonas reported that a million element photo-diode infrared telescope had been demonstrated for detecting small objects in space or on the ground over distances of thousands of miles. Dr. Louis Marquet, SDI Directed Energy Weapons Division leader, reported that techniques for utilizing particle beams as warhead detectors had been demonstrated.

- Dr. James Ionson, SDI Innovative Science and Technology Division Director, detailed advances in gamma-ray laser research at Los Alamos and the University of Texas.

- Other sessions reviewed the applications of lasers to industry and medical research and treatment.

## Revolution in biology

The session organized by the Fusion Energy Foundation (FEF), "Lasing in Biophysics: Implications for Beam Science and Technology," featured presentations by Dr. F. A. Popp of the University of Kaiserslautern, Dr. James Fraser of the University of Texas Medical Center, and Dr. Phillip Callaghan of the U.S. Department of Agriculture. They detailed ground-breaking experiments in optical biophysics. Popp reviewed experiments in which the emission of "coherent" radiation from living cells was measured. The results indicate that this light emission could be an essential characteristic and controlling mechanism for living matter. Dr. James Fraser detailed the general frontiers of biological spectroscopy. And Dr. Callaghan detailed how "coherent lasing" of molecules is the basis for the operation of insect sensors.

The session chairman, Dr. Jonathan Tennenbaum, FEF European director, noted that the work represented in these invited talks was laying the basis for a revolution in biology.

The session attracted leading representatives from both industry and the scientific community.

## The x-ray laser test

In his conference presentation, Dr. Teller noted that recent, hostile news stories concerning the Livermore x-ray laser program were based on limited information, presented in a confused manner. Informed sources elaborated on this.

The *Los Angeles Times* and *Science* magazine had reported that Los Alamos National Laboratory scientists had discovered a major flaw in the Livermore x-ray laser experiments. In particular, these publications asserted that the instruments designed to measure the x-ray laser output had malfunctioned and, therefore, the claims of success for the Livermore x-ray laser were false.

But according to informed sources, what actually hap-

pened was exactly the opposite: "When designing an experiment, one must project a possible range of outputs and thereby calibrate one's instruments accordingly. The 'flaw' in the Cottage tests—if you want to call it that—was simply that the R Group had underestimated the upper limit on the x-ray laser brightness by many orders of magnitude. *Maybe, by as much as one million.* It's as though you were drilling a backyard water well and discovered instead the world's largest deposit of oil. Directed Energy Weapons' effectiveness against missiles is in general proportional to the brightness squared. I don't think demonstrating a laser which is a million times brighter than expected—and, therefore, potentially a trillion times more effective—could be considered a 'failure.' In any case, we are ready this time."

## International cooperation

As it turns out, the Las Vegas conference not only reverberated with the underground explosions, but also with news of a political earthquake within the Reagan administration. Within the week it was announced that Presidential Science Advisor George Keyworth, National Security Advisor Robert MacFarlane, and NASA Director James Beggs will all be leaving their positions. In this context, the conference presentation by Dr. Teller may be of added significance.

The primary point made by Dr. Teller was the need for international cooperation on SDI. Teller reported that no one, including even himself, has previously fully grasped the profound significance of President Reagan's proposals in this regard. Teller related that the President had held a special conference just before the Geneva summit where the need for international cooperation on SDI was reviewed. According to Teller, the President's proposal for "open laboratories" was not limited to bilateral U.S.-U.S.S.R. actions. We have always opposed the proliferation of nuclear weapons of mass destruction, he said. But defensive beam weapons are of a totally different nature. Their proliferation would be a good thing, because the more countries that are able to destroy ballistic missiles, the less likely that anyone could launch a pre-emptive first strike. Therefore, all countries and scientists should participate in developing SDI technology. According to Teller, this should begin immediately, with or without participation by the Soviet Union.

In this context, Teller presented a specific proposal for initiating such cooperation—an updated "Open Skys Proposal." Sensors are essential to successful missile defense. Teller proposed that the United States begin an open, crash program for the further perfection of sensors, including space-based ones. The full information procured by these sensors would be made immediately accessible to every country and any person in the world. Besides providing immediate benefits to all peaceful forms of economic activity and disaster prevention, such a joint, worldwide effort would provide everyone with the truth "concerning man-made dangers," i.e., what the Soviet Union is really up to.