10

1.0

1.1

1.25

1.4

1.6

1.8

2.0

2.2

2.5

2.8

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Strategic defense initiatives at Los Alamos National Laboratory

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Abstract

This presentation reviews the Strategic Defense Initiative (SDI) programs at Los Alamos National Laboratory, noting especially the needs for and applications of optics and optical technologies. Table 1 lists the various activities at Los Alamos contributing to SDI programs. The principal, nonnuclear SDI programs are: 1) the free-electron laser, and 2) neutral particle beams. Both should be considered as potential long-range-kill systems, but still in the futuristic category.

Free-electron laser

In 1984 the free-electron laser (FEL) oscillator experiment at Los Alamos produced 6 kW of pulsed output, the highest FEL output power demonstrated to that date. Wavelength was tunable from 9 to 35 μm , and the beam quality was limited only by flaws in measurement optics. Based on these results, Los Alamos is pursuing a 100-kW-average-power demonstration facility for FY1988 to address scale-up issues for the FEL. The new laser will operate at 10 μm . A higher power demonstration facility is planned for FY1992 at White Sands Missile Range. It will integrate all components of a complete FEL weapons system and will operate at 0.5 μm .

Neutral particle beam

Los Alamos has a long history in particle accelerator technology that is now being applied toward the development of space-based neutral particle beam systems. Although neutral particle beam weapons are still a long way off, today's technology can have immediate application in detection and discrimination of incoming warheads during the exo-atmospheric phase of launch. Satellite-based neutral particle beams can "scan" all targets very rapidly. Only those targets having significant mass, i.e., true warheads, will stop the high energy particles, producing gamma rays and neutrons. Thus the true targets can be discerned from the decoys. The return signals can in turn be used by other satellites to direct hit to kill vehicles. It is somewhat ironic that the technological advance leading to lighter weight, compact accelerators for orbital systems is the radio-frequency quadrupole accelerator, invented by the Soviets in 1969 but developed here at Los Alamos.

Laser research and engineering

Other projects draw from the laboratory's vast experience in laser research, such as the development of short wavelength KrF lasers. Recent experiments demonstrated 11% intrinsic efficiency for the Los Alamos KrF laser - a record, to date, worldwide. We have observed an energy output of over 10 kJ, also a world record. Likewise, recent advances in image analysis technology have provided an order of magnitude improvement in our ability to align laser beams. This implies faster and more precise alignment for complex laser systems. The laboratory has also recently been designated as a national laser damage center. This program will develop an extensive data base for laser-induced damage in optical materials. By working closely with commercial manufacturers, the knowledge gained in understanding the fundamentals of laser damage phenomena will result in higher quality optical products having higher laser damage thresholds.

General observations on SDI

The Strategic Defense Initiative is an extremely demanding task, but the technology advances of the past fifty years are also quite impressive and bode well for future advances equal to the challenge. In pursuing this research effort it is essential that a balance be maintained between the relatively limited but near term defensive concepts and the more effective, but futuristic concepts receiving all the publicity. The Los Alamos SDI program is devoted to research on a wide variety of concepts with the objective of providing enough data to accurately assess the prospects of increased safety if fully operational SDI systems are deployed.

Table I. Los Alamos Activities Relevant to the Strategic Defense Initiative

Surveillance, acquisition, tracking and kill assessment
 - Sensor, laser, and electronic technology

System concepts, battle management
 - Concepts, strategy, policy and air s control analysis
 - Artificial intelligence research
 - Laser communication technology

Directed energy weapons
 * Neutral particle beam
 * Free-electron laser
 * Short-wavelength laser technology
 * Nuclear weapon directed energy
 - Microwave generators
 - Charged particle beam technology

Kinetic energy weapons
 - Projectile, pellet, and jet technology
 - Railgun launcher technology

Support programs
 * Laser, particle beam, and microwave lethality
 * Kinetic energy kill lethality
 - Countermeasure technology
 - Survivability technology
 - Space power
 - Foreign technology

*Major Programs