**Science & Technology (Current)**

### CHECMATE vs. CHECKMATE

CHECMATE - Compact High Energy Capacitor Module Advanced Technology Experiment

**Laser and mirror experiments**



Technicians at the Naval Research Laboratory (NRL), work on the Low-powered Atmosphere Compensation Experiment (LACE) satellite.

The High Precision Tracking Experiment (HPTE), launched with the Space Shuttle Discovery on STS-51-G, was tested June 21, 1985 when a Hawaii-based low-power laser successfully tracked the experiment and bounced the laser off of the HPTE mirror.

The Relay mirror experiment (RME), launched in February 1990, demonstrated critical technologies for space-based relay mirrors that would be used with an SDI directed-energy weapon system. The experiment validated stabilization, tracking, and pointing concepts and proved that a laser could be relayed from the ground to a 60 cm mirror on an orbiting satellite and back to another ground station with a high degree of accuracy and for extended durations.[45]

Launched on the same rocket as the RME, the Low-power Atmospheric Compensation Experiment (LACE) satellite was built by the United States Naval Research Laboratory (NRL) to explore atmospheric distortion of lasers and real-time adaptive compensation for that distortion. The LACE satellite also included several other experiments to help develop and improve SDI sensors, including target discrimination using background radiation and tracking ballistic missiles using Ultra-Violet Plume Imaging (UVPI). LACE was also used to evaluate ground-based adaptive optics, a technique now used in civilian telescopes to remove atmospheric distortions.

### Hypervelocity Rail Gun (CHECMATE) vs. CHECKMATE

Research out of hypervelocity railgun technology was done to build an information base about rail guns so that SDI planners would know how to apply the technology to the proposed defense system. The SDI rail gun investigation, called the Compact High Energy Capacitor Module Advanced Technology Experiment (CHECMATE), had been able to fire two projectiles per day during the initiative. This represented a significant improvement over previous efforts, which were only able to achieve about one shot per month. Hypervelocity rail guns are, at least conceptually, an attractive alternative to a space-based defense system because of their envisioned ability to quickly shoot at many targets. Also, since only the projectile leaves the gun, a railgun system can potentially fire many times before needing to be resupplied.

A hypervelocity railgun works very much like a particle accelerator insofar as it converts electrical potential energy into kinetic energy imparted to the projectile. A conductive pellet (the projectile) is attracted down the rails by electric current flowing through a rail. Through the magnetic forces that this system achieves, a force is exerted on the projectile moving it down the rail. Railguns can generate muzzle-velocities in excess of 24 miles per second. At this velocity, even a rifle-bullet sized projectile will penetrate the front armor of a main battle tank, let alone a thinly protected missile guidance system.

Rail guns face a host of technical challenges before they will be ready for battlefield deployment. First, the rails guiding the projectile must carry very high power. Each firing of the railgun produces tremendous current flow (almost half a million amperes) through the rails, causing rapid erosion of the rail's surfaces (through ohmic heating, and even vaporization of the rail-surface.) Early prototypes were essentially single-use weapons, requiring complete replacement of the rails after each firing. Another challenge with the rail gun system is projectile survivability. The projectiles experience acceleration force in excess of 100,000 g. In order to be effective, the fired projectile must first survive the mechanical stress of firing, the thermal effects of a trip through the atmosphere at many times the speed of sound, and then the subsequent impact with the target. In-flight guidance, if implemented, would require the onboard guidance system to be built to the same standard of sturdiness as the main mass of the projectile.

In addition to being considered for destroying ballistic missile threats, rail guns were also being planned for service in space platform (sensor and battle station) defense. This potential role reflected defense planner expectations that the rail guns of the future would be capable of not only rapid fire, but also of multiple firings (on the order of tens to hundreds of shots).