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Navy's futuristic railgun shows potential in test

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The Navy has begun developing a futuristic “hypercannon” that could someday hit a target more than 200 miles away, using technology that may be more familiar to students of science fiction than modern naval weaponry.

Known as an electromagnetic railgun, the weapon uses electricity instead of gunpowder to fire projectiles.

In a dramatic first step, the Office of Naval Research said yesterday that it fired the electromagnetic gun using an unprecedented pulse of energy in a test held Thursday in Dahlgren, Va.

During the test, the gun almost instantaneously propelled an aluminum slug weighing slightly more than 7 pounds to Mach 7 – or more than seven times the speed of sound.

The railgun has the potential to fire a projectile 230 miles, a trajectory that would take just seven minutes. By contrast, a standard 5-inch naval gun battery can fire a shell 20 miles.

With such technology, a warship off the coast of San Diego could fire a projectile as far as Bakersfield, or almost two-thirds the distance to Phoenix.

After watching Thursday's demonstration, the chief of naval operations, Adm. Gary Roughead, called the concept a “revolutionary approach to naval warfare.”

The arc of the projectile's trajectory would send it nearly 95 miles high, well above the Earth's atmosphere. The projectile would use a satellite-based guidance system to adjust its re-entry, using something like movable fins to calibrate the final descent to its target.

Even if development proceeds as planned, however, it will take 15 years before a Navy warship could be equipped with such a weapon, said Elizabeth D'Andrea, the railgun program manager for the Office of Naval Research. She heads a government-industry consortium that includes San Diego-based General Atomics and SAIC.

The term “railgun” was derived from its basic components.

The bore consists of two highly conductive parallel rails, one carrying a positive electric current, the other a negative current. The projectile, which sits on a conductive device, is placed between these two rails so it



A high-speed Navy video image showed a projectile as it was shot from an electromagnetic railgun at Mach 7 in a test Thursday in Dahlgren, Va.

completes the electric circuit. This allows the current to flow, which creates a magnetic field and a force that launches the projectile out of the barrel.

The first phase of the program began in 2005 and is expected to continue through 2011 at a cost of \$237 million, D'Andrea said. The next phase, including installation of a high-power prototype aboard a ship, depends on developing components and materials that can withstand the tremendous heat energy and other forces generated by the railgun.

“This is a laboratory launcher, which means it's not meant to go into the field,” D'Andrea said.

Yet Navy officials view the technology as tantalizing.

Among other things, it could dramatically improve safety aboard ships because no explosives are required to fire the projectile and no explosive rounds would be stored in the ship's magazine.

The projectiles fired by the railgun would be inert metal slugs or canisters full of metal pellets, akin to a shotgun shell. But they would impact at such high velocity, about Mach 5, that they would destroy whatever they hit, making the railgun what the military calls a “kinetic energy” weapon.

Because a projectile is basically a hypersonic bullet and not a high-explosive warhead, Navy officials say that there is no associated blast and that the impact is more focused. So a railgun would likely minimize collateral damage near a target.

In addition, the rechargeable railgun would be theoretically capable of firing multiple rounds per minute.

“Because we can shoot six to 10 rounds per minute, we could support more than one engagement at sea,” D'Andrea said. The railgun's range of 230 miles (or 200 nautical miles) means a warship could engage targets as far as 400 nautical miles apart, she said.

Some experts think railguns could be used to target and destroy incoming nuclear ballistic missiles.

Thursday's test at the Naval Surface Warfare Center set a record because the electromagnetic gun fired the projectile at more than 10.6 megajoules, D'Andrea said. (A joule is the measure of energy needed to produce one watt for one second. A megajoule is 1 million joules.)

The previous railgun record, 9 megajoules, was set in 1993 by the Center for Electromagnetic Materials and Devices at the University of Texas.

“Nine megajoules was the limit of their capability, but that's where we're starting,” said Roger Ellis, technical director of the railgun program.

The muzzle velocity of the swallow-tailed aluminum projectile was 5,600 mph – in excess of Mach 7. It traveled about 100 feet before hitting a sand-filled metal box in a bunker, Ellis said.

The slug vaporized the face of the metal box and hit the sand with such force that the box split open, he said.



U.S. Navy

High-speed images showed the slug fired by the electromagnetic railgun Thursday as it vaporized the face of a sand-filled metal box in a bunker 100 feet away.



In high-speed images released by the Navy, a fireball trailed the projectile – making it appear like a fiery rocket propellant. D'Andrea said the heat energy generated within the railgun is intense enough to ignite aluminum particles and gases.

“One of the things we're trying to do is identify materials that can live in a very high-temperature environment,” D'Andrea said.

The next step in the program is to upgrade the railgun's power capacity to 16 megajoules, using electric capacitors supplied by San Diego's General Atomics, a key program contractor that is developing a final design.

“All of the technology that comes out of this program will be usable in other high-energy, high-power applications,” said Scott Forney, vice president of General Atomics' Electromagnetics Systems Division. The company is developing electromagnetic aircraft launcher technology for aircraft carriers and mag-lev technology for public transit.

But the railgun has only one purpose, Forney said.

Another San Diego defense contractor, Science Applications International Corp., has been working with British defense giant BAE Systems on the development of a rival railgun design.




U.S. Navy

The chief of naval operations, Adm. Gary Roughead (left), toured facilities at the Naval Surface Warfare Center in Dahlgren, Va. After watching the railgun test, he called the concept a "revolutionary approach to naval warfare."

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