

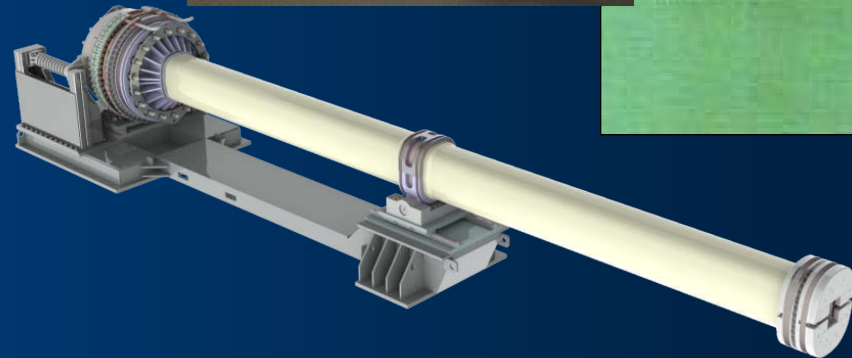
Electromagnetic Railgun, A Multi-Mission Weapon System

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Missile Systems Conference

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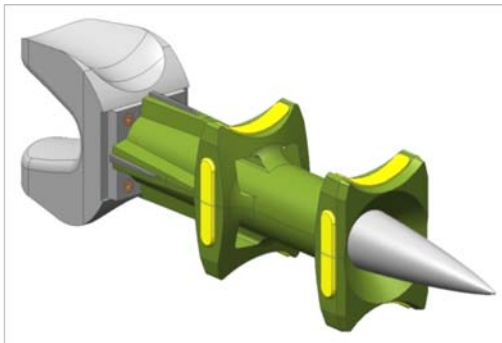
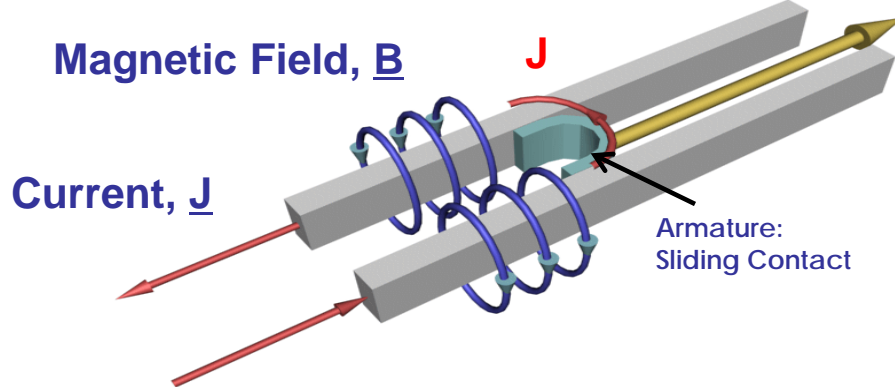
Briefing Outline

- Introduction to electromagnetic railguns
- General Atomics' role in ONR program
- Application of railguns to multiple missions
- Testing of Blitzer™ prototype system

Introduction to Physics of Railguns

Railgun: Electromagnetic Force drives projectile

Lorentz Force,
 $\underline{J} \times \underline{B}$

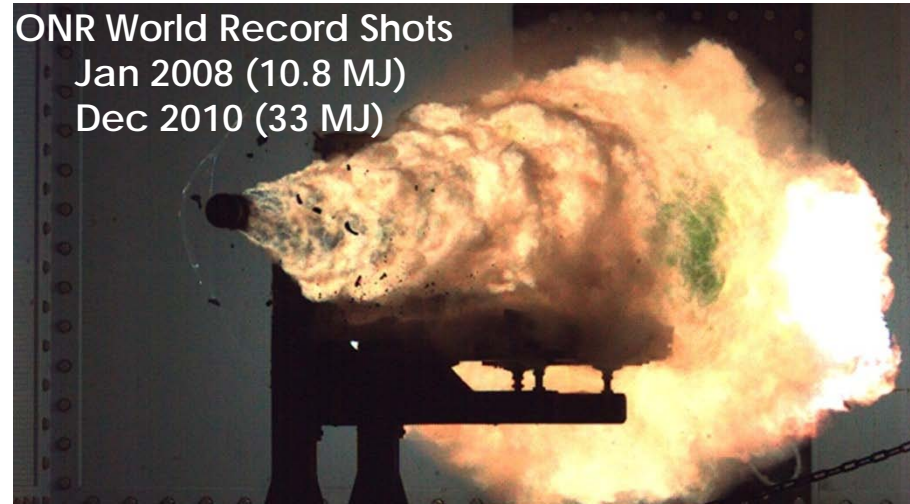
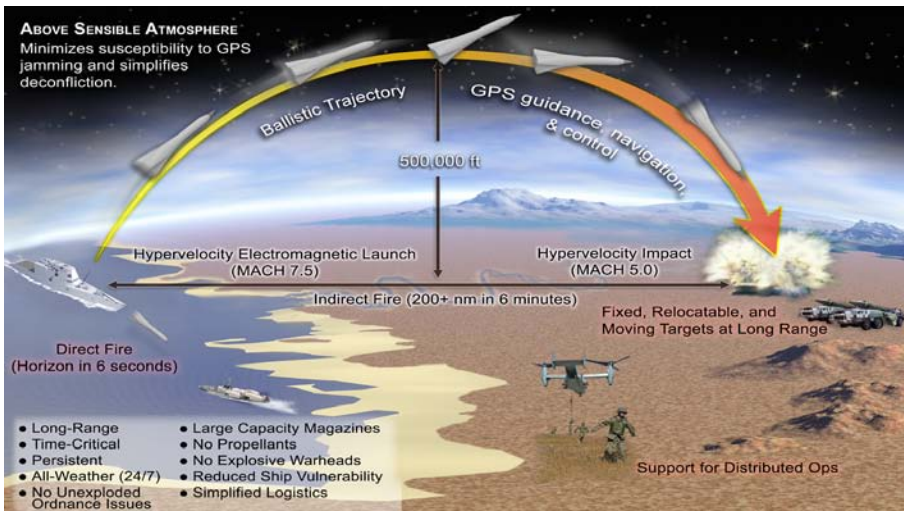


Launch Package

- Armature
- Sabot with
- Bore riders
- Flight body

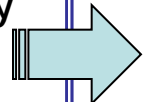
- MJ of electrical energy stored in capacitors instead of propellant
 - Propulsion from Mega-Ampere level currents discharged through rails in milli-seconds
 - Acceleration 20 – 100 k-gee
- High muzzle velocity: 2–2.5 km/sec (Mach 6-7.5)
 - Long range
 - Extends inner tier of ship defense to horizon
 - Mostly exo-atmospheric flight for indirect fire missions
 - Fast time to target
 - 7 seconds to horizon at sea level
 - 30-40 seconds from sea level to 100,000 feet
 - High Lethality from kinetic energy
- No onboard propellant
 - Simplifies logistics
 - Improves ship survivability

GA is Providing Tactical Launcher Development and Pulsed Power for ONR's Railgun Program



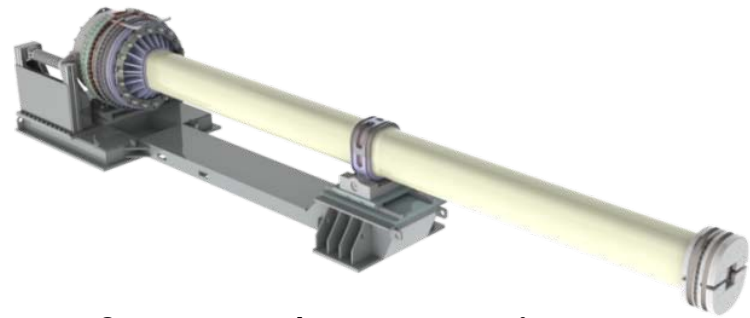
GA Pulsed Power for NSWCCD Railgun Facility

- 81 MJ Laboratory Modular Capacitor Bank
- All units delivered and operating reliably



GA Advanced Containment Launcher

Develop and demonstrate tactically relevant launcher at full muzzle velocity and half muzzle energy (32 MJ)

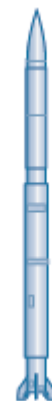


- System under construction for testing 1st Qtr of CY12

Railguns Have Potential to Dramatically Improve Ship Defense Against Emerging Air and Surface Threats

Problem: Rapid proliferation of low cost cruise & ballistic missiles

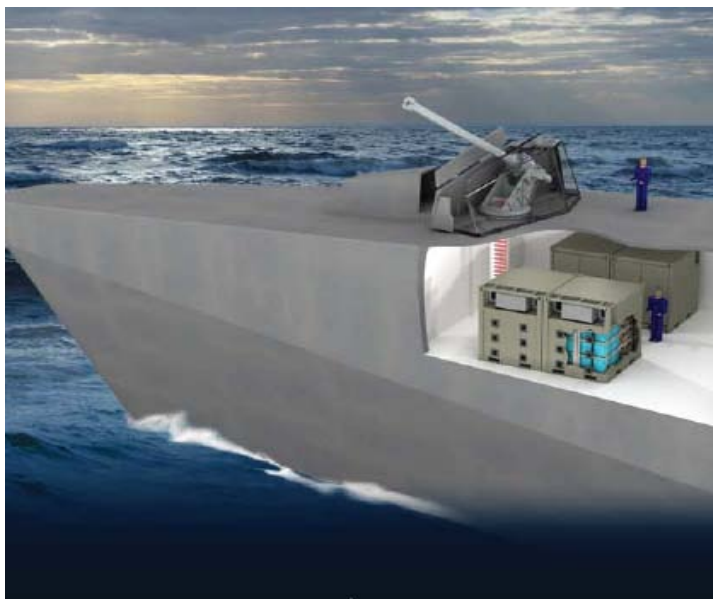
- Overwhelm our ship defense system through swarm attack
- Denies access to key regions
- Cost to defeat threat many times higher than threat cost



Ballistic Missile



Supersonic sea skimming cruise missiles can travel at Mach 3 (1 km/sec)



High Performance, Low Cost Solution: Multi-Mission Blitzer Railgun

- > 2x muzzle velocity of current guns
- Faster time to target
- Greater range
- Higher lethality at range
- No onboard propellant
- Smaller rounds, deeper magazines

Blitzer Railgun System: Developed to Demonstrate Technical Maturity and Practicality of a Smaller Scale Railgun System



System was built for testing in a Proving Grounds environment

Blitzer Testing at Dugway Proving Grounds Provides a Significant Demonstration of Railgun Maturation



2 MJ Blitzer EM Gun



Mobile Pulser



Testing at Dugway



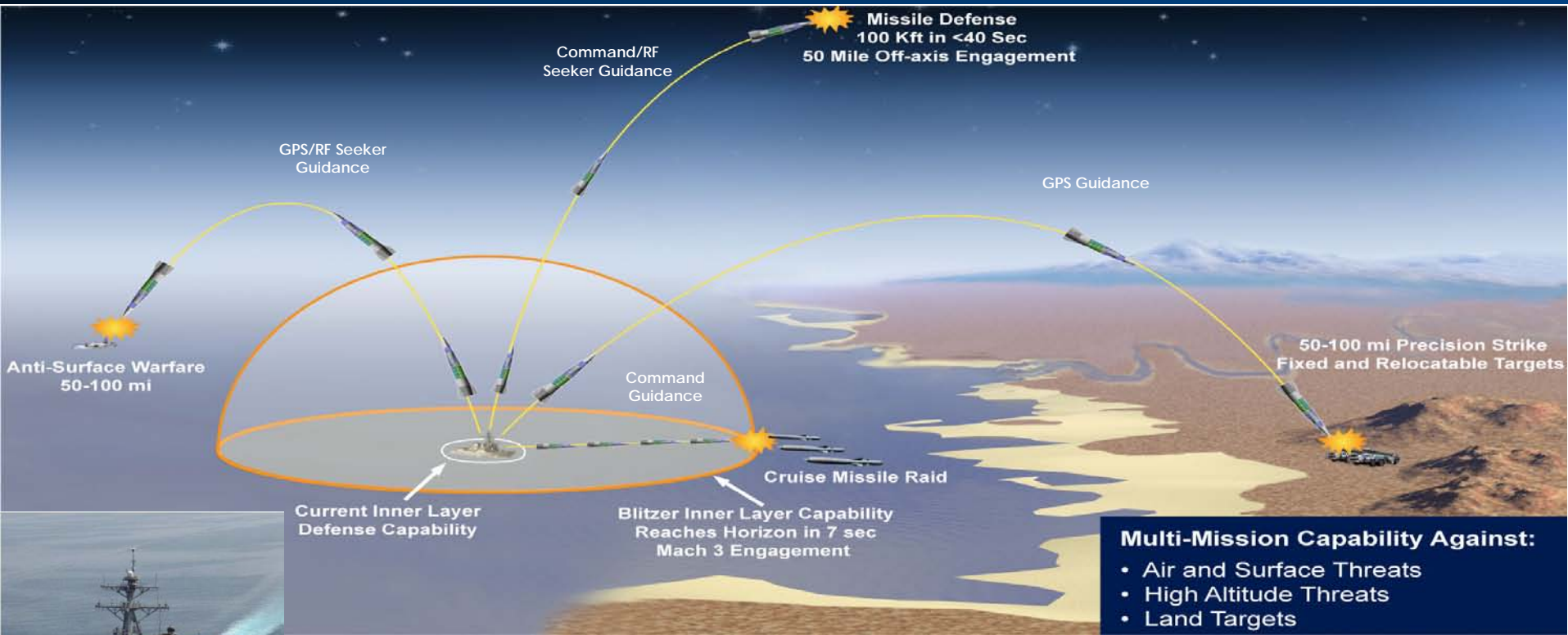
Launch Package in Flight

- Launcher and mobile pulsed power system developed on internal GA funds
- Testing on ONR funds provided through support from UT delegation
- 71 rounds fired to date (9 tests with $\frac{3}{4}$ scale aerodynamic projectile)
- Minimal bore wear; significant increase in state of the art

PEAK PERFORMANCE TO DATE	
Parameter	Performance
Velocity (km/sec)	2.0
Gun Energy (MJ)	1.8
Peak Current (MA)	2.12
Peak Voltage (kV)	2.8

Demonstration validates major elements of the Blitzer System

Blitzer Railgun Provides a Lower Cost, Deep Magazine, Multi-Mission Solution on Surface Combatant



- Replacement of Mk45 5" Gun
- Variable muzzle energy, lower for air defense targets requiring high firing rate (5 MJ); higher for Ballistic Missile Defense and Precision Strike (up to 20 MJ)
- Using battery energy storage, ship prime power requirement reduced to current available power

One launcher firing a family of projectiles to accomplish multiple missions

Excellent Progress Being Made on Railgun Development

- ONR program and GA's Blitzer™ efforts have significantly matured railgun technology
- Rapid advances in railgun technology motivate near term applications on surface combatants
- A 20 MJ Blitzer multi-mission railgun system on today's surface combatants appears viable
 - Using today's technology
 - Substantially improve defense of our fleet against rapidly emerging threats
- Navy leadership showing significant interest

The rapid pace of technology maturity and evolving threats are accelerating the drive toward railgun deployment