



Development of a Projectile Muzzle Exit Sensor



Motivation



- Trigger cameras, flash x-ray, and radar
- Measure weapon system performance
- Get data for modeling and simulation
- Infrared (IR) sensors affected by blow-by gas from projectile, trigger prematurely



Sensor Design



- Magneto hydrodynamic Generator (MHD)
- Uses high-strength, permanent magnet
- Ionic, conductive gas layer from projectile exits gun at right angle to the magnetic field of the magnet
- Electrical charge is generated at right angle to magnetic field
- External excitation (ie battery) **NOT** required
- Attach to muzzle of gun
- US patent applied for by Contractor



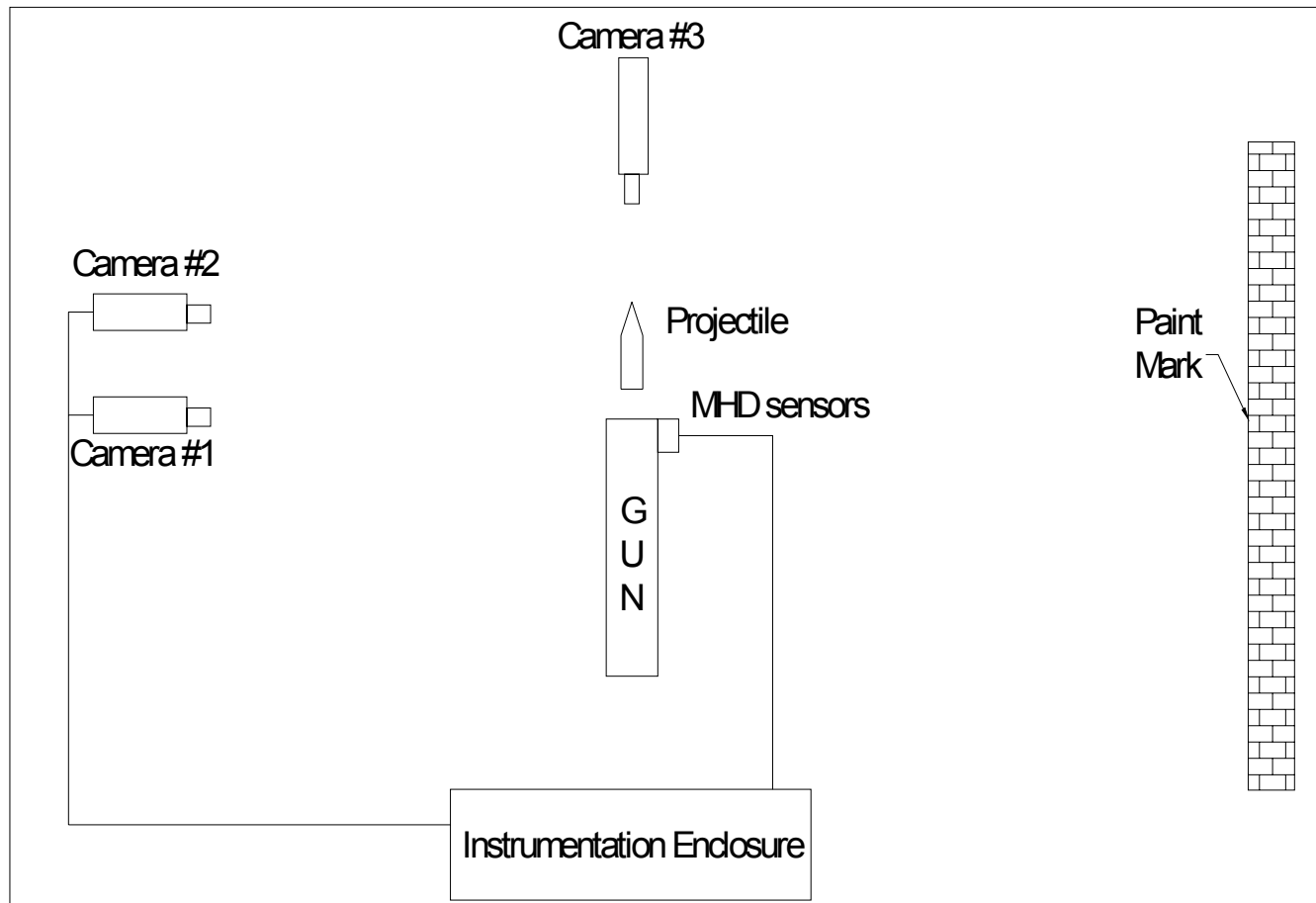
Prototype Test at ATC



- Sensors were attached to muzzle of M256, 120 mm diameter cannon, which had a severely eroded barrel
- Fifteen M865 rounds fired
- Sensor output triggered cameras which recorded high-speed images of projectile

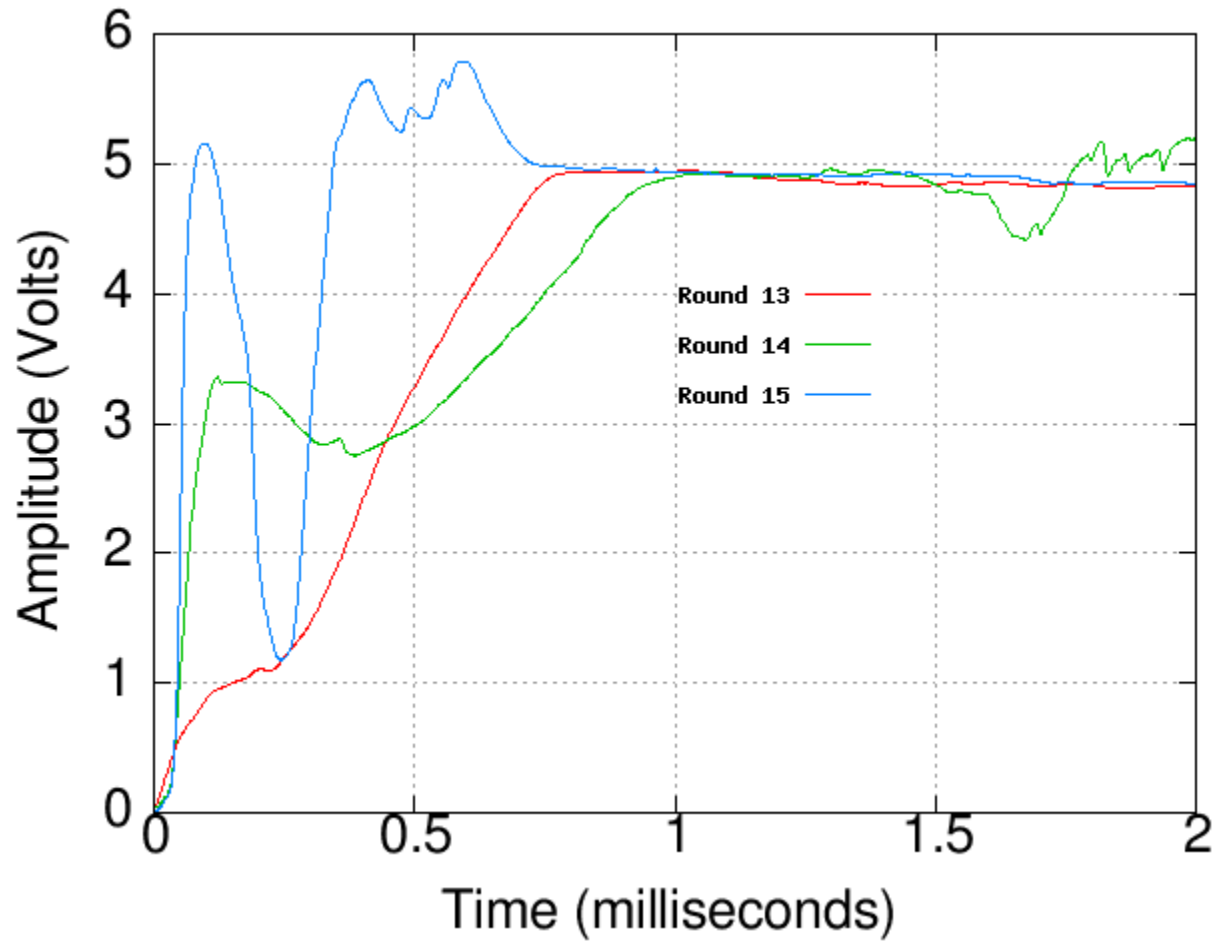


Range Test System Diagram



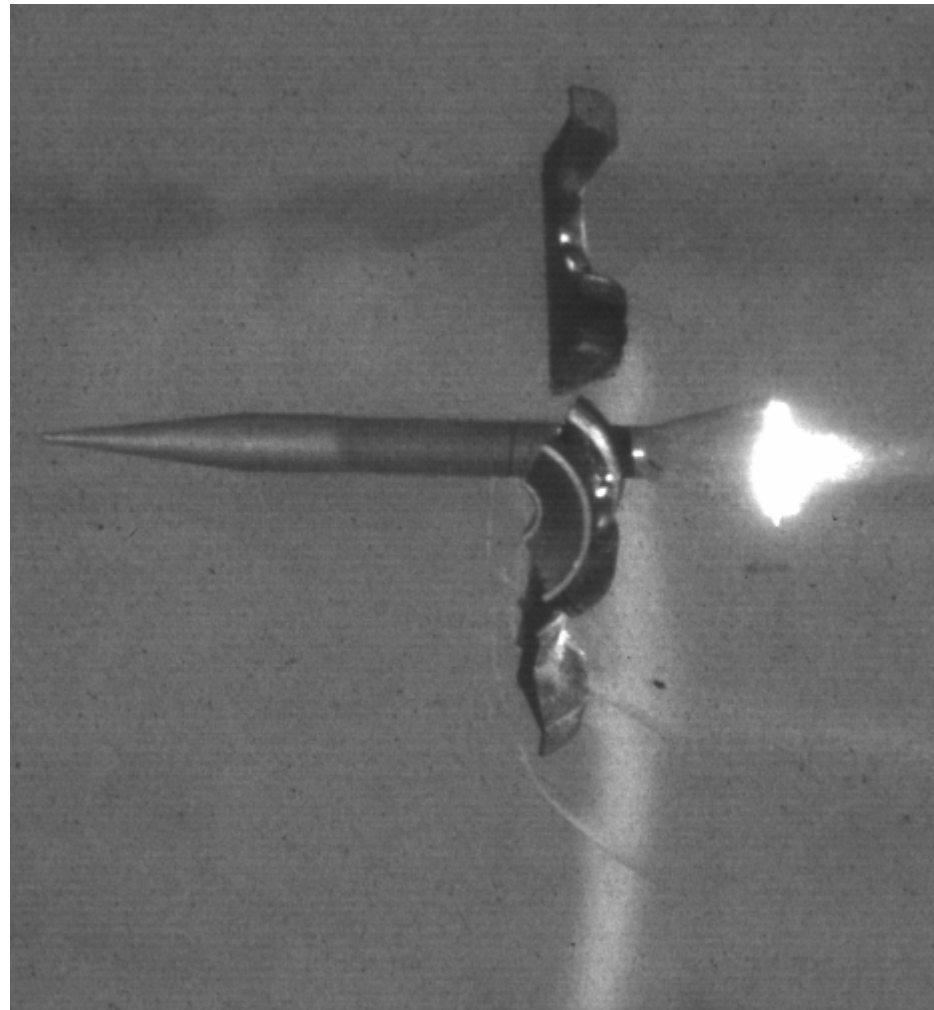


Amplitude vs Time for One MHD Sensor At The Same Location On The Muzzle For Three Consecutive Shots





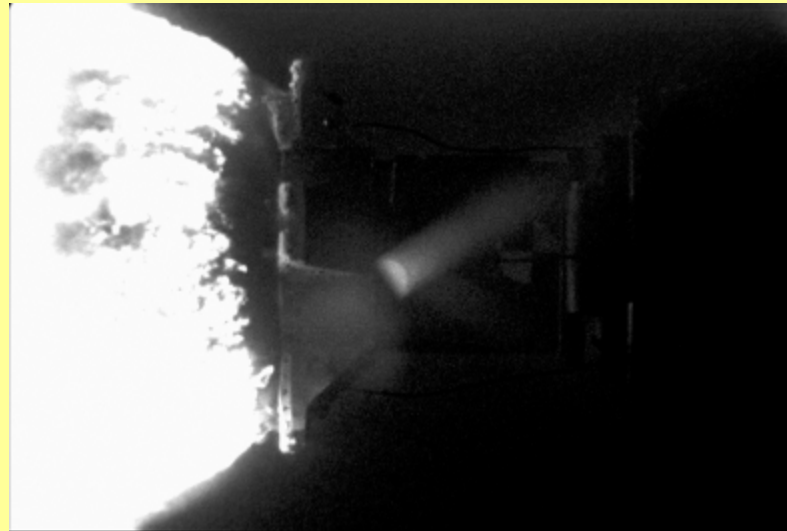
Using The MHD Sensor to Trigger a High-Speed Camera Image





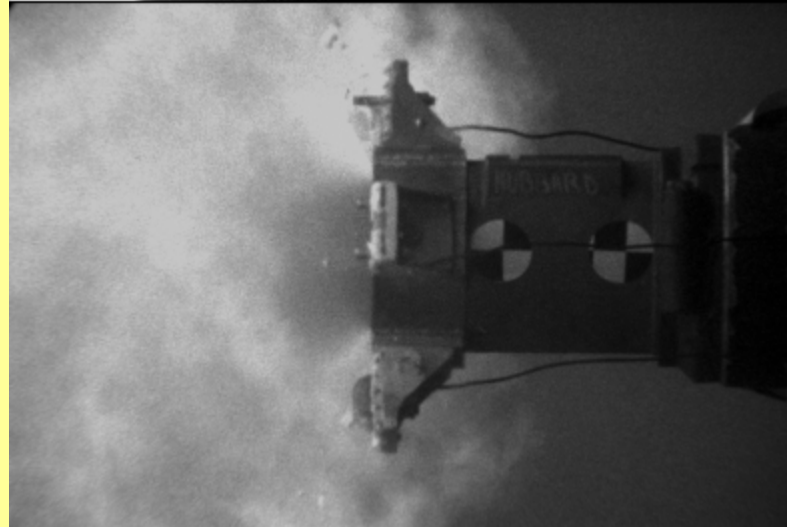
Muzzle Images During, and After Projectile Exiting the Cannon - Triggered by MHD Sensor

Projectile
exits the gun.



200 μ sec later.

Note distance gun
has recoiled.





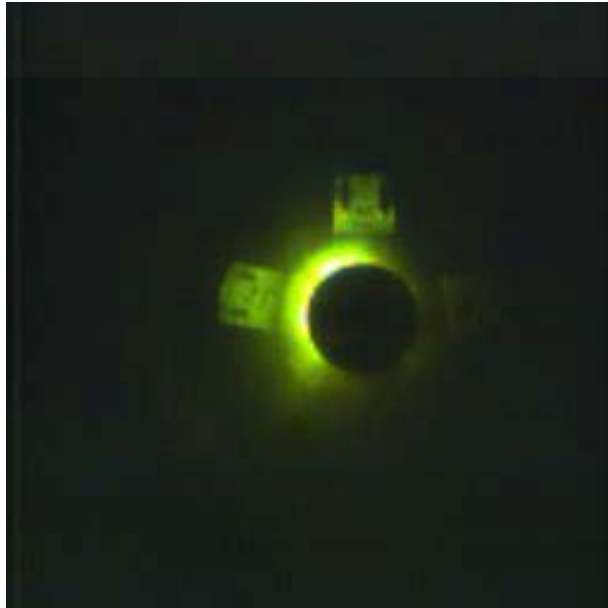
Two MHD Sensors Mounted on the Gun



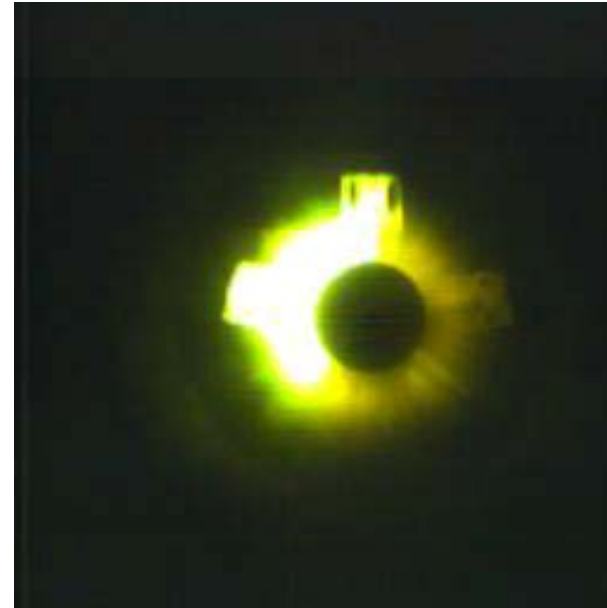


Down Bore Image of Round Exiting Gun

The small size of fireball indicates fast response of MHD sensor.



The small amount of light indicates that the round is just beginning to exit the gun.



A short time later, more light at the left of the gun indicates asymmetrical gas leakage, which may adversely affect the flight.



Future Efforts



- Obtain faster, more consistent rise time
- Eliminate movement of muzzle mount
- Increase durability so it lasts for “many” shots
- Build sixteen prototype sensors and two muzzle mounts and test them at ATC
- Design and build “production” sensor



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