



Navy Fuze S&T and Acquisition Strategy

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Outline



- **Navy Fuze Acquisition and S&T Overview**
- **Navy Fuze Efforts and NDIA Presentations**



Navy Weapon R&D



Chief of Naval Operations
ADM Jonathan Greenert



NAVAIR

NAWC-AD (Pax)
 • Test Wing Atlantic (Pax)
 • Training Systems (Orlando)

NAWC-WD (China Lake)
 • Test Wing (Pacific)

NAVSEA

NSWC

- Carderock
- Corona
- Crane
- Dahlgren
- Dam Neck

- EOD
- Indian Head
- Panama City
- Philadelphia
- Port Hueneme

NUWC

- Keyport
- Newport

SPAWAR

- SSC Pacific
- SSC Atlantic



Navy Surface Gun Fuzing Roadmap



155mm
Projectile



LRLAP: Long Range Land Attack Projectile
Electronic S&A and electro-mechanical ISD

5" Fuze



MK437 Mod 0: Multi-Option Fuze Navy

Railgun/5"
Subcaliber
Projectile



ONR Future Naval Capability Project

HVP: Hyper Velocity Projectile
Height of Burst Sensor Development
MEMS S&A Development

57mm
Fixed
Ammunition



MK442 Mod0/1: 3P (Prefragmented, Programmable, Proximity) Fuze

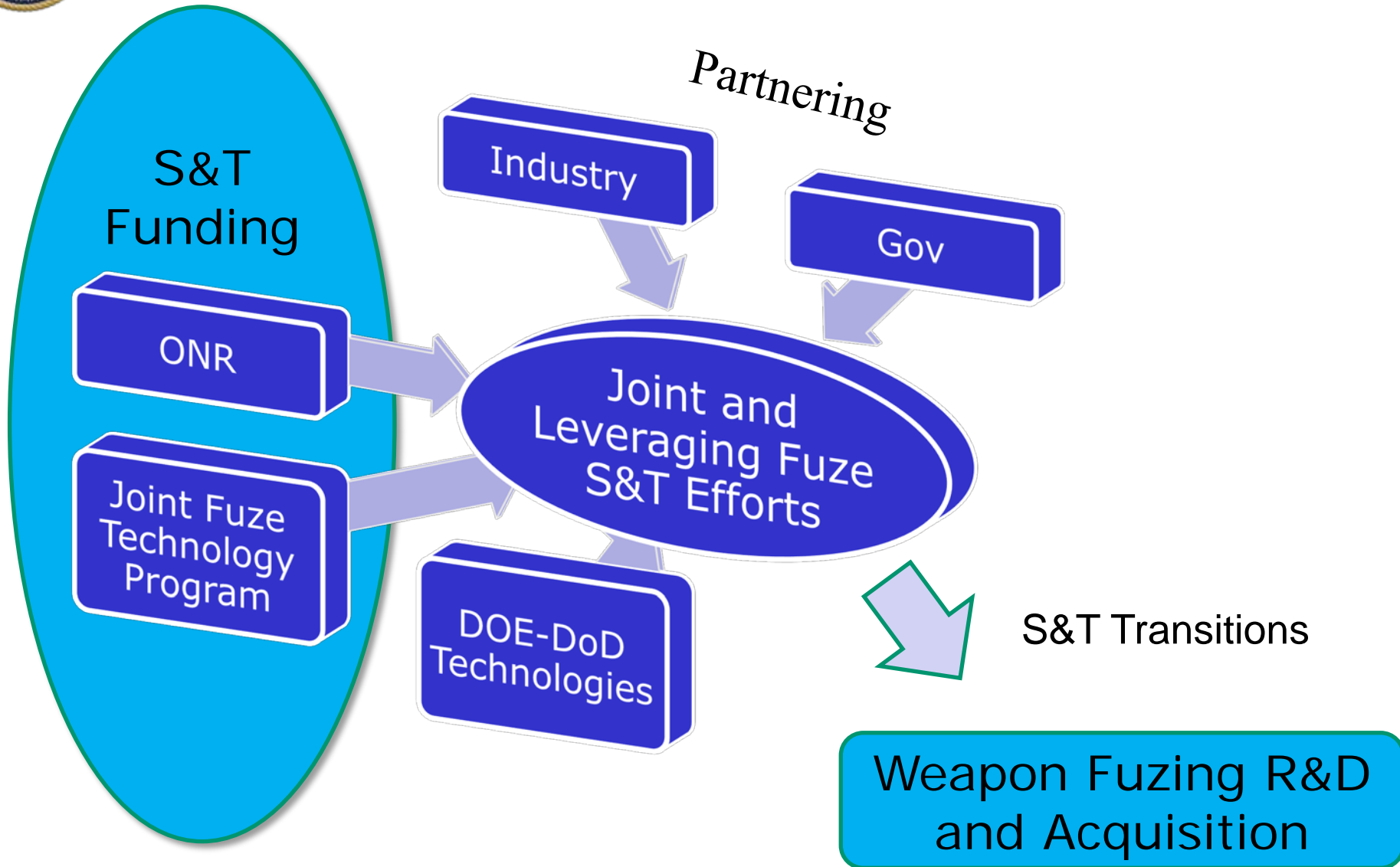
DEVELOPMENT
 PROCUREMENT



Navy Fuze S&T



Navy Fuze Technology





Selected Navy Fuze S&T Efforts



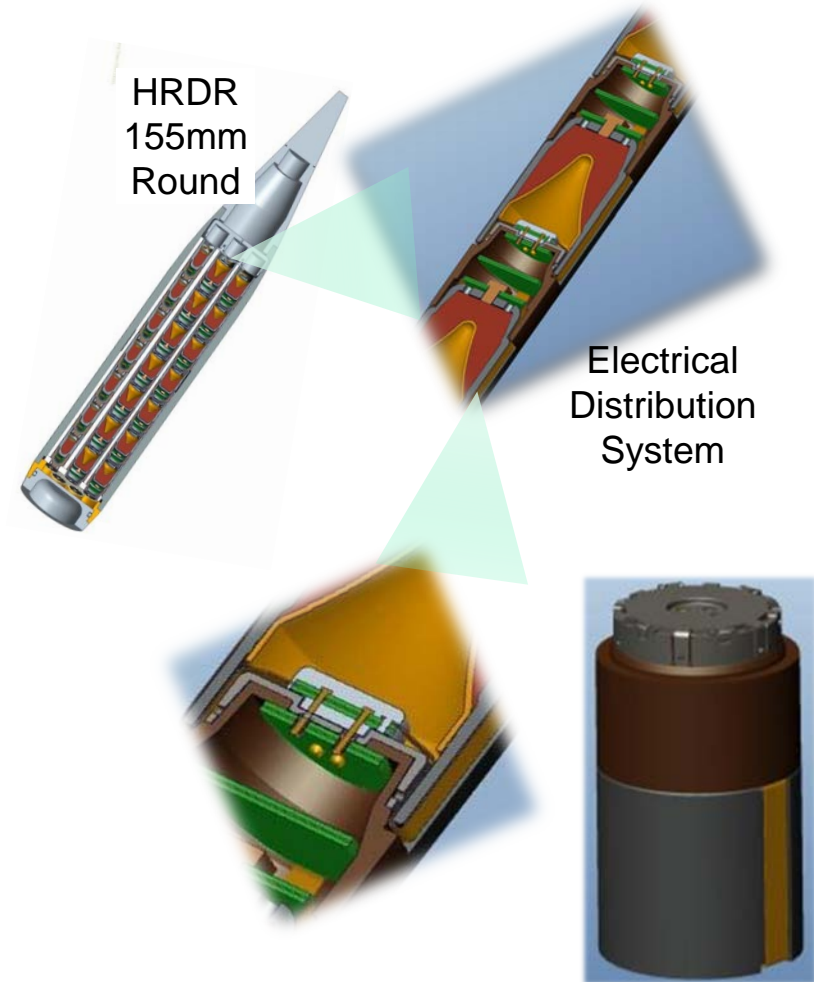
- Integrated Switch Slapper Progress (IIIB)
- JFTP Unpowered Cannon and Railgun Environment Validation (IVB)
- JFTP Stacked MOSFET and IGBT Pulse Discharge Switch (IVB)
- JFTP DoD MEMS Fuze Reliability Evaluation (VA)
- JFTP MEMS Retard & Impact Sensor (VB)
- ONR High Reliability DPICM Replacement (VB)
- JFTP Freefall Energy Harvesting and Sensor Design (VB)
- ONR Hyper Velocity Projectile Fuze
- JFTP Advance Proximity Sensing
- JFTP Hard Target Survivability – Modeling & Simulation, Testing, Encapsulation, Materials
- JFTP Metal Free Primary Explosives for MEMS



High Reliability DPICM Replacement (HRDR)



- Developing technologies to enable electrical signal distribution in a weapon system with large numbers of submunitions
 - Minimize disruption to the dispense event
 - Maintain robust mechanical and electrical interfaces



Closed Session VB briefing provided by Daniel Pines



HRDR - Synergistic Fuzing S&T Investments



Technical Challenges

1. Increase submunition fuze and explosive train reliability to >99%
2. Develop multi-layer potting compounds to protect electronic/MEMS fuzes
3. Construct safety compliant, distributed fuzing architecture and power system

Underlying Science

- Physics based explosive transfer models and experiments
- Predicting and measuring material failure under acceleration
- Arming signal/power surety under very high spin rates

Capability Realized

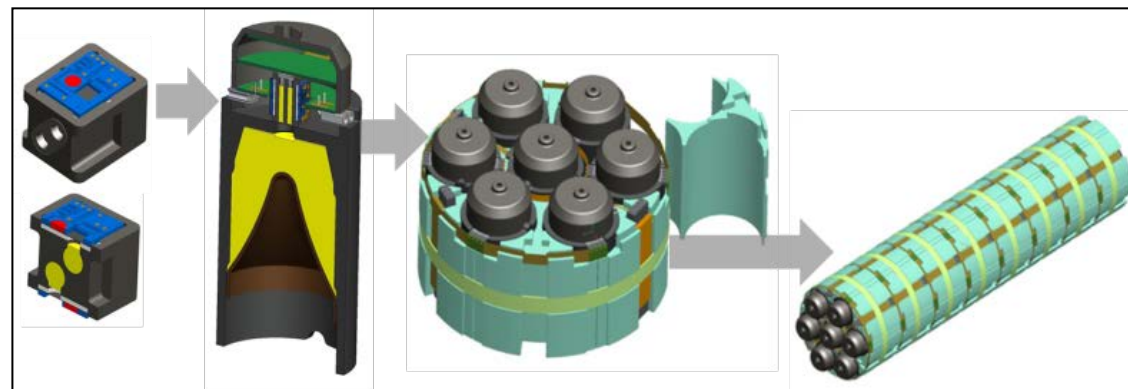
- Maintain area effectiveness of canon fired cluster munitions and meet OSD UXO Policy

Intellectual Property

- Navy Case number 102,421, "Distributed Fuze Architecture for Highly Reliable Submunitions"

Investment Sources

- Office of Naval Research
 - Code 30
 - Future Naval Capability
- Joint Fuze Technology Program
 - FATG II, III and IV
- Naval Innovative Science and Engineering (219)

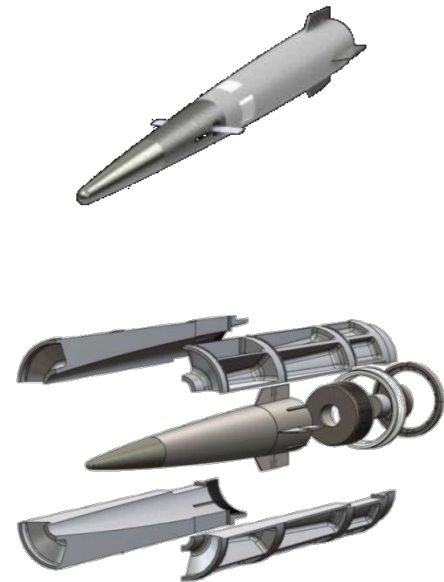
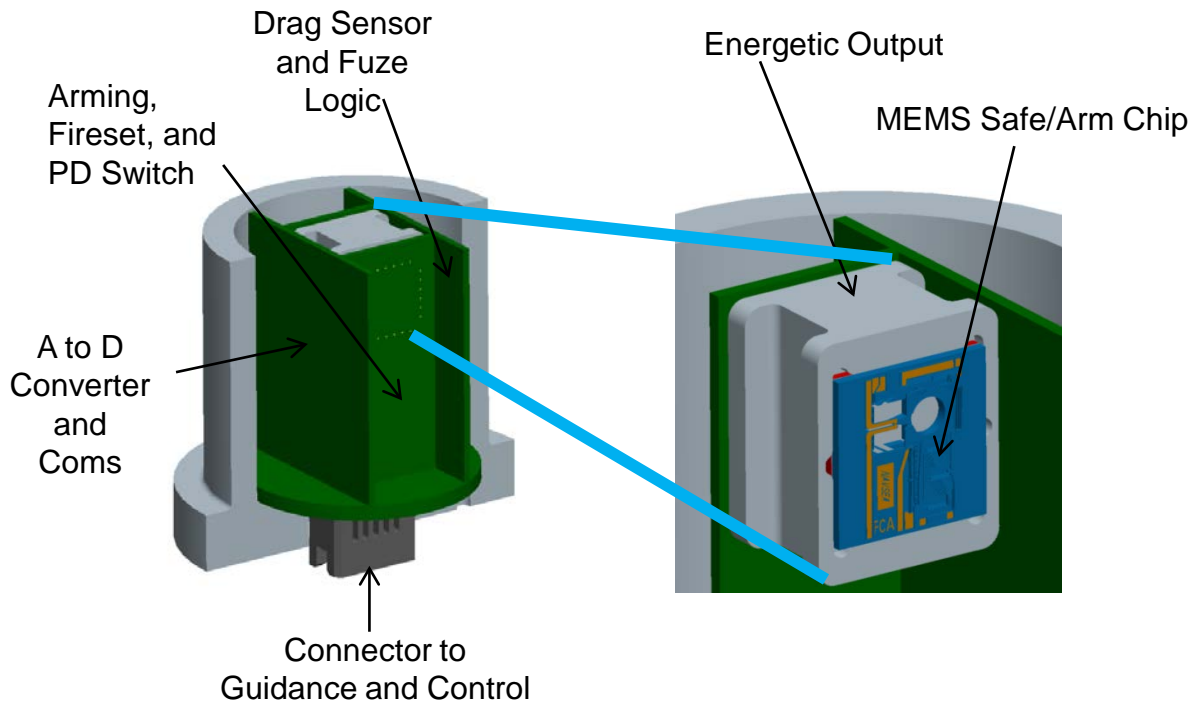




MEMS Fuze for Hypervelocity Projectile (HVP)



- Guided round for Navy Railgun
- MEMS-based fuze under development by NSWC Indian Head



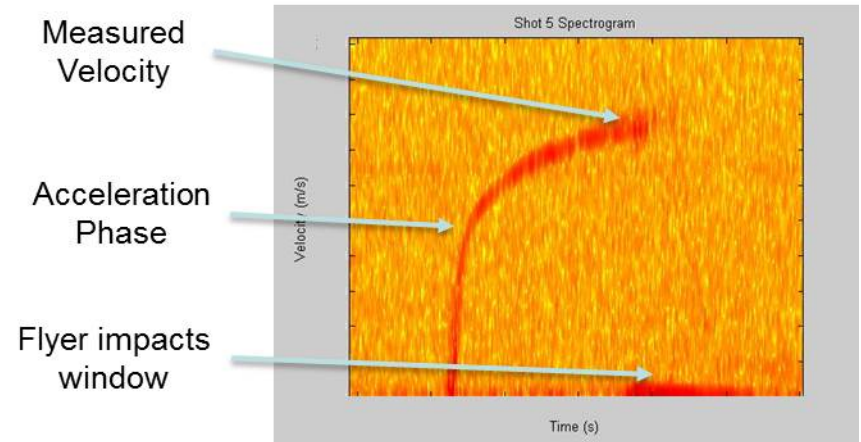


DoD MEMS Fuze Reliability Evaluation

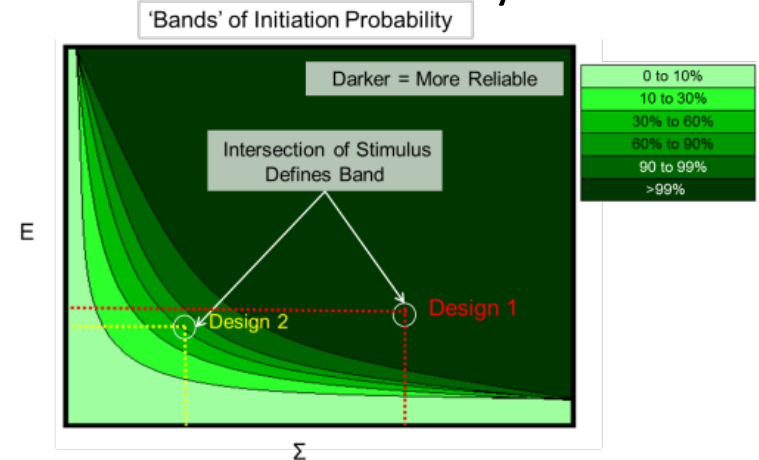


- Calculate estimated reliability for the explosive trains for both Army and Navy MEMS systems
- Measurements of MEMS flyer velocity and statistical variation (100 point data set)
- Characterize shock initiation EDF-11 used as explosive lead

PDV Measurement of Flyer Velocity



EDF-11 Sensitivity



Open Session VA briefing provided by Dan Lanterman



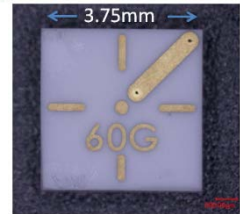
MEMS Retard and Impact Sensors



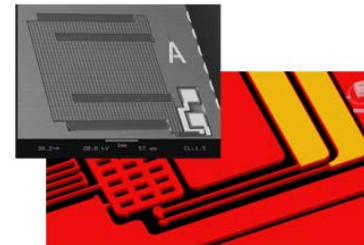
- Exploit existing MEMS micro-fabrication and packaging technologies to obtain higher-performance DoD retard and impact sensors.
- Improved G-sensor performance for existing and future fuzes.
- Metal (LIGA) and Silicon (DRIE)
- Small lot of both metal and silicon retard sensors will be manufactured, tested and submitted to fuze vendor for evaluation.
- DOTC contract established with ATK to evaluate and qualify MEMS G-sensors.



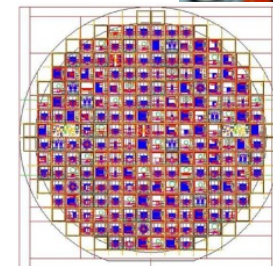
Conventional Impact Sensor



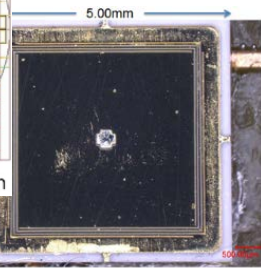
Metal (LIGA) Impact Switch



Silicon (DRIE) Retard Sensor



Silicon (DRIE) Impact Switch



Metal (LIGA) Retard Sensor

Closed Session VB Briefing provided by
Mr. Randy Drobny



Freefall Energy Harvesting and Sensor Design



- Developing drop event detection technologies for future Gravity Dropped Weapon ESAF
 - Lanyard pull energy harvesting and drop event detection
 - Smart kinematic sensor drop event detection
 - Targeting application in general purpose bomb and future miniature munitions.



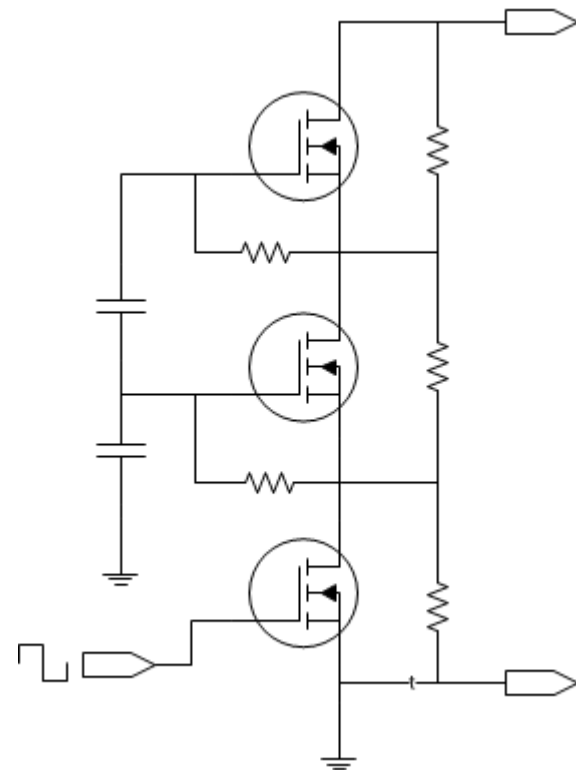
Closed Session VB briefing provided by Mr. Paul E. Anderson



Stacked MOSFET and IGBT Pulse Discharge Switch



- Demonstrating a novel pulse discharge switch topology based around a series stacked MOSFET or IGBT.
 - Built around COTS MOSFET/IGBT switches
 - Aiming for 40-60% cost reduction over NMCT
 - Live Fire testing planned
 - Targeting application in any ESAF



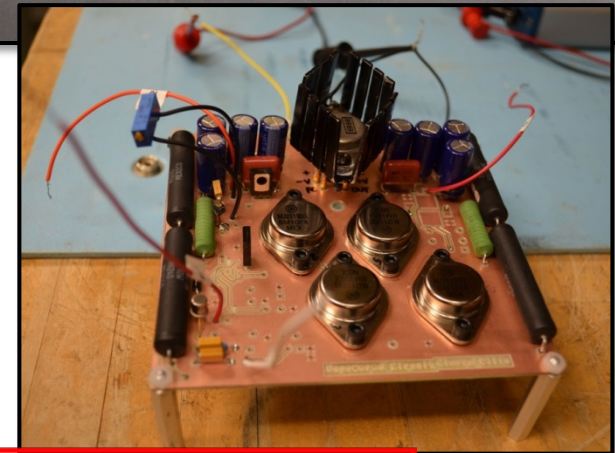
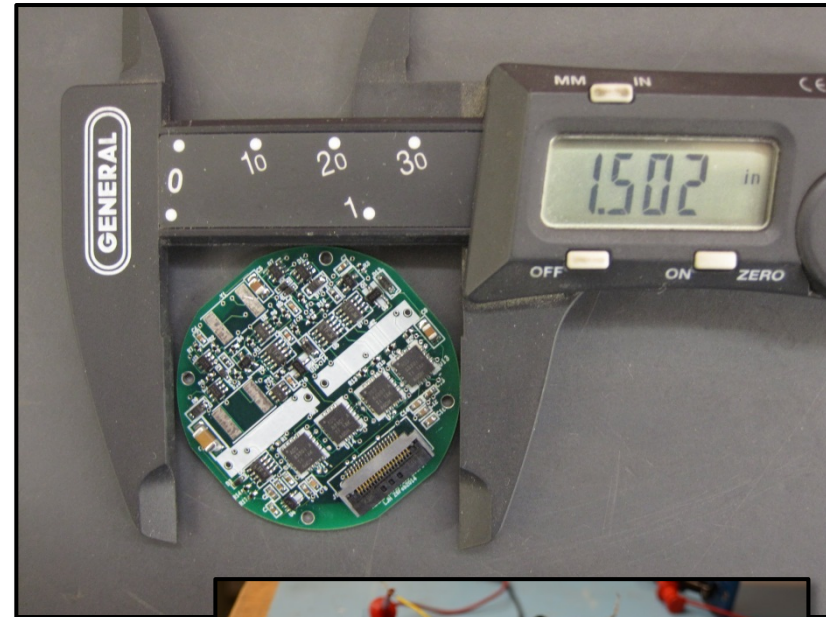
Closed Session IVB briefing provided by Mr. Paul E. Anderson



Unpowered Cannon and Railgun Environment Validation



- Addresses the challenge of using ESADs in guns
- Energy harvesting and analog signal processing
- Measures setback magnitude and duration
- Stores spin state change
- Measures magnetic field profile
- Gun tests in FY16 to validate circuits
 - 57mm/70 cannon
 - 16MJ railgun



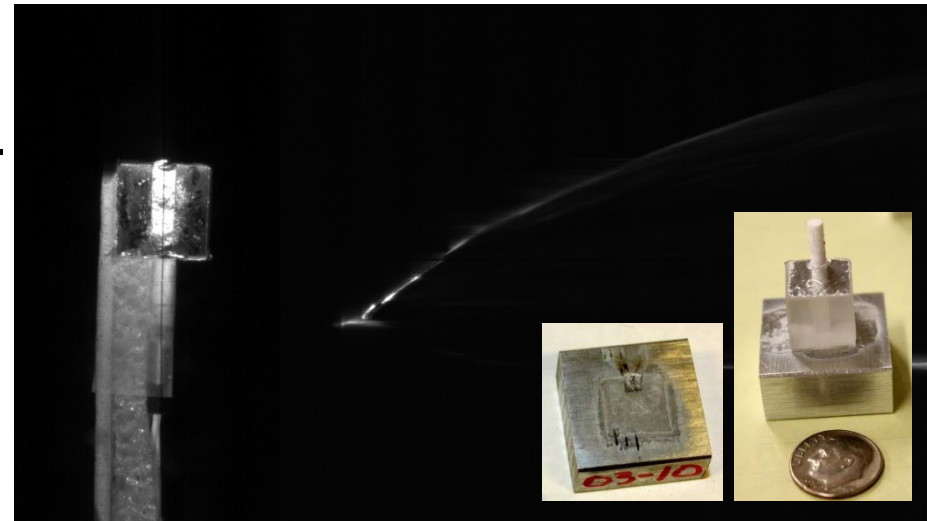
Closed Session IVB briefing provided by Mr. Michael Haddon



Metal-Free Primary Explosives for MEMS Detonators



- Develop metal-free, primary explosive with nitramine-like output and lead azide sensitivity for low-energy, out-of-line systems.
- Investigate and characterize CL-30, a novel high-output organic primary for MEMS devices.



JFTP funded as 13-G-003



Summary

- **Navy R&D fuze activity focused on ESADs and MEMS**
- **Detailed, Navy centric briefs to follow as part of the 58th fuze conference**