



# Precision Strike Annual Review

## “Munitions Roadmap for the Future”

Col Kirk Kloeppe  
Director  
Munitions Directorate





# Weapons Video





# Outline

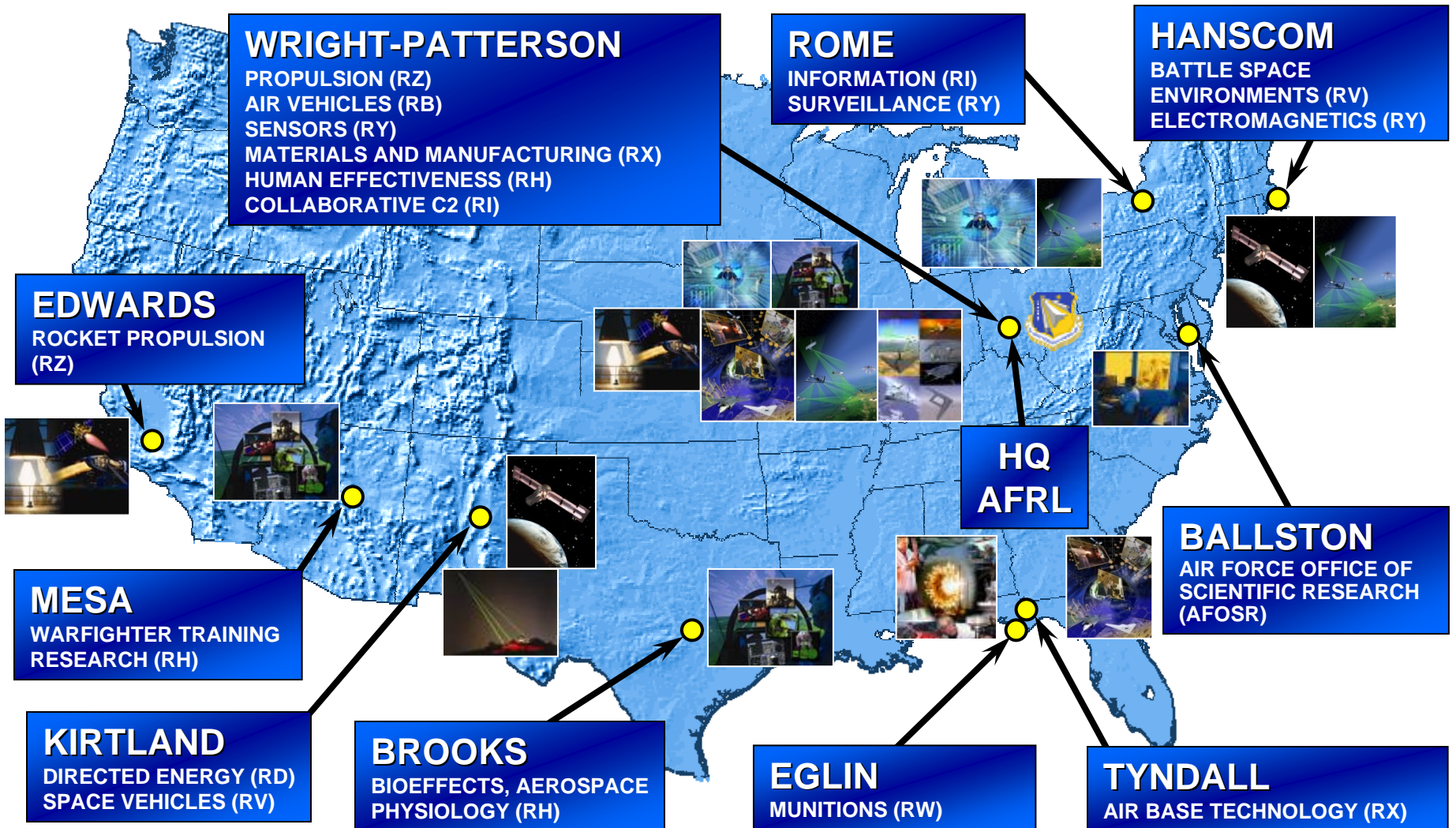


- **AFRL Introduction**
  - **Sites World-wide**
  - **AFRL Strategic Plan**
  - **AFRL Focused Long-Term Challenges (FLTCs)**
- **Munitions Directorate (RW)**
  - **Vision / Mission**
  - **Capability Based Planning**
- **Strong Record of Demonstrating Integrated Capabilities**
- **Conclusions**



# AFRL

## 40 Sites World-Wide







# Capability-Based S&T Strategy – Strategic Planning Vectors



The *Air Force Capability-Based Science & Technology Strategy* presents a considered and incremental approach to **transforming the science and technology (S&T) investment focus of AFRL**. It offers a strategic look at aligning the priorities for nurturing and developing core competencies as well as aligning the pursuit of particular technologies toward the solution of high-priority problems. --- Executive Summary, pg 4

## S&T Strategy

Anticipate, find, fix, track, target, engage  
And assess – anything, anywhere, anytime

Universal  
Situational Awareness

Deliver Precision Effects  
(DPE)

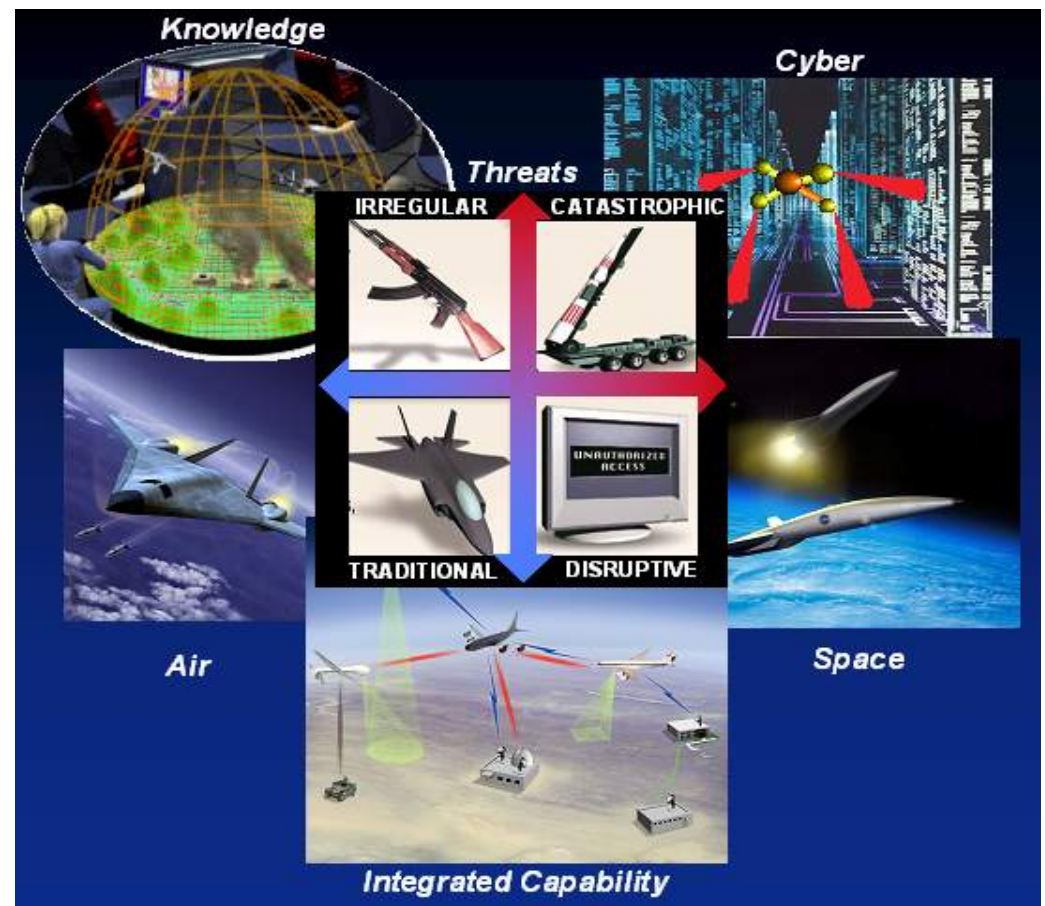
Access and Survive  
in the Battlespace



# Focused Long Term Challenges

*Delivering the Air Force S&T Vision Through Leadership, Discovery, Innovation, and Integration.*

1. Anticipatory Command, Control & Intelligence (C2I)
2. Unprecedented Proactive Surveillance & Reconnaissance (S&R)
3. Dominant Difficult Surface Target Engagement/Defeat
4. Persistent & Responsive Precision Engagement
5. Assured Operations in High Threat Environments
6. Dominant Offensive Cyber Engagement
7. On-demand Theater Force Projection, Anywhere
8. Affordable Mission Generation & Sustainment







Hunter-Killer  
(Kinetic Effects)

Hunter-Killer Canyon Warriors

(Ultra-Precise Effects)

Hunter-Killer  
(Non-Lethal Effects)

Hunter-Killer

Perching ISR Vehicles

Loitering ISR Vehicle







LEAD | DISCOVER | DEVELOP | DELIVER

# AFRL Munitions Directorate Vision & Mission



**Vision:**  
**Precision Engagement ...  
Delivering Desired Effects**

**Mission:**  
**Lead the discovery, development,  
integration and transition of affordable  
precision engagement technologies for  
our air, space, and cyberspace force**





# Munitions Directorate Organization



**Executive Officer**  
Capt Josef Peterson



**Director**  
Col Kirk Kloeppel



**Deputy Director**  
Ms Gail Forest



**Associate Director**  
Dr John Wilcox



**Chief Scientist**  
Dr Bob Sierakowski



**Adv Guidance Division**  
Mr James Moore



**Ordnance Division**  
Mr Scott Teel



**Assess & Demo Division**  
Col John Williams

Munitions Directorate  
Product Divisions



**Financial**  
Mr Paul Higgins



**Contracting**  
Ms Stacey Darhower



**Corp Development**  
Ms Effie Krug



**Integration & Ops Division**  
Mr Rich Mook



**Senior IMA**  
Col Mark Koch

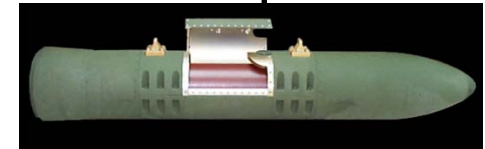


# Ordnance Division (RWM)



## ORDNANCE DIVISION

Core Competency  
Sub Core Competency



### ENERGETIC MATERIALS BRANCH

### FUZES BRANCH

### DAMAGE MECHANISMS BRANCH

### ORDNANCE INTEGRATION BRANCH

#### EXPLOSIVES

- Hard Target Explosives
- Focused Energy Warhead Explosive
- Advanced Energetics
- Dense Metal Explosive
- Explosive Characterization, Processing & Experimentation
- MK-series Insensitive Munitions Technology

#### FUZES

- Penetration Fuzing
- Point Burst Fuzing
- Advanced Initiation
- Battle Damage Sensing

#### WARHEADS

- Focused Energy Warheads
- Unitary Warheads

#### WARHEADS

- Surface & Air Target Defeat
- Agent Defeat
- Hard Target Defeat
- Alternative Payloads



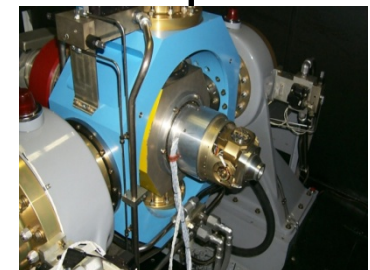
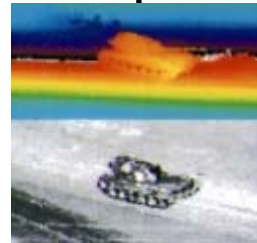
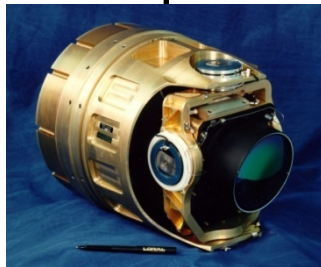


# Advanced Guidance Division (RWG)



## ADVANCED GUIDANCE DIVISION

Core Competency  
Sub Core Competency



### SEEKERS BRANCH

### SIGNAL & IMAGING PROC / ALGORITHMS BRANCH

### NAVIGATION & CONTROL BRANCH

### GUIDANCE SIMULATION BRANCH

#### SEEKERS

- LADAR
- Passive IR
- SAR
- Multispectral

#### PROCESSING / ALGORITHMS

- Algorithms
- Processors

#### NAVIGATION & CONTROL

- Tactical INS
- Anti-jam GPS
- Autonomous Control
- Cooperative Control

#### ASSESSMENTS

- Synthetic Scene Generation
- Weapon Digital Simulation & Analysis
- Hardware-in-the-Loop Simulation



# Assessment & Demonstrations Division (RWA)



## ASSESSMENT & DEMONSTRATIONS DIVISION

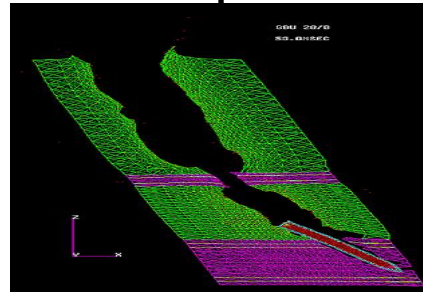
Core Competency  
Sub Core Competency



### LETHALITY & VULNERABILITY

ASSESSMENT

- Lethality / Vulnerability Methods
- Lethality / Vulnerability Analysis



### COMPUTATIONAL MECHANICS

ASSESSMENT

- Computational Weapon / Target Solid Mechanics
- Computational Weapon / Target Fluid Mechanics



### FLIGHT VEHICLES INTEGRATION

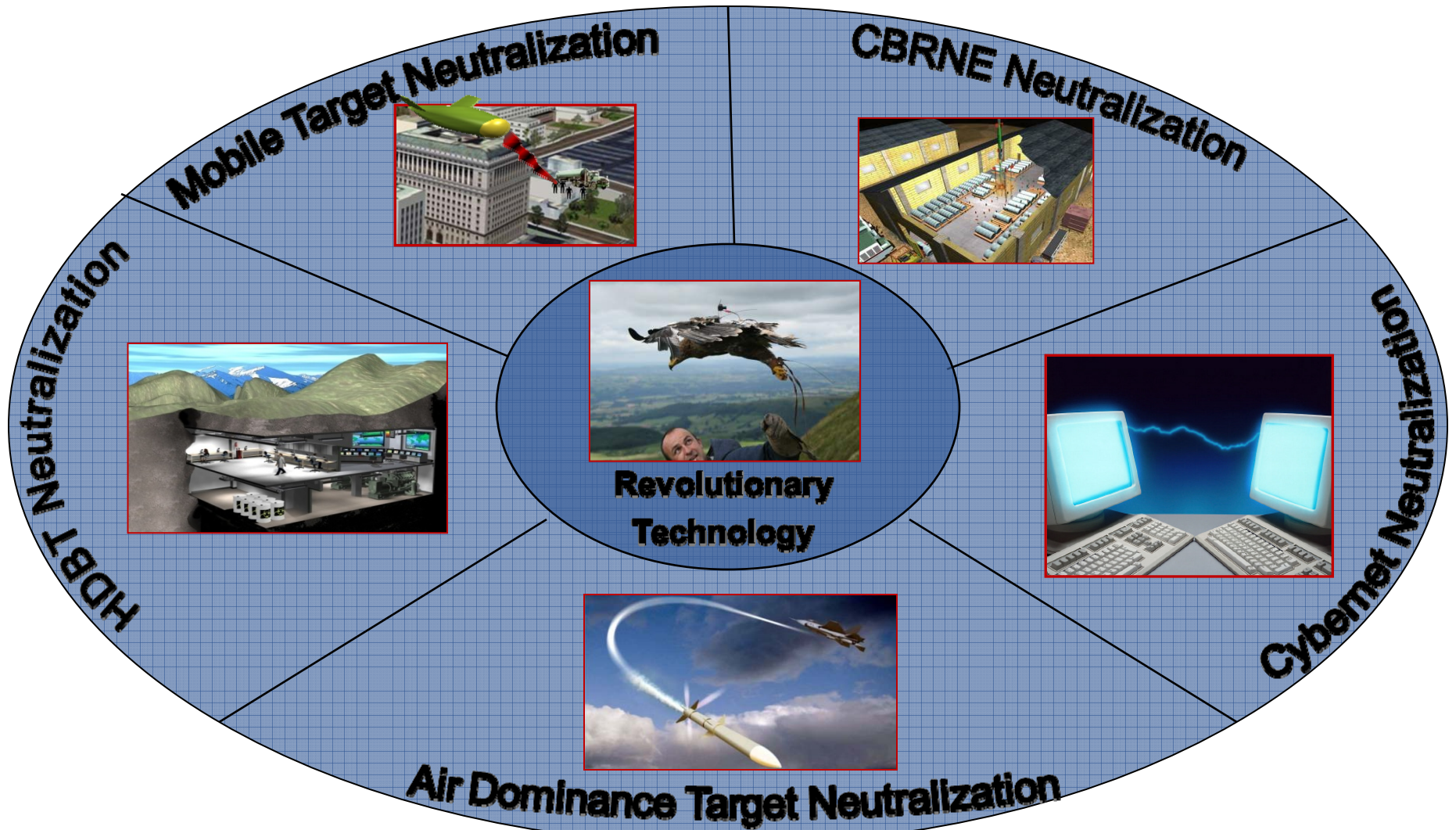
MUNITION INTEGRATION

- Subsystem Integration
- Integrated Technology Planning
- Micro Air Vehicles
- Weapon / Platform Integration





# Capability Based Technologies





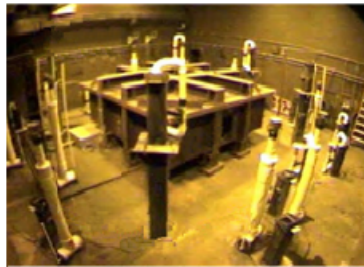
# CBRNE Neutralization Technologies



Outdoor Validation Test



Indoor Baseline Test



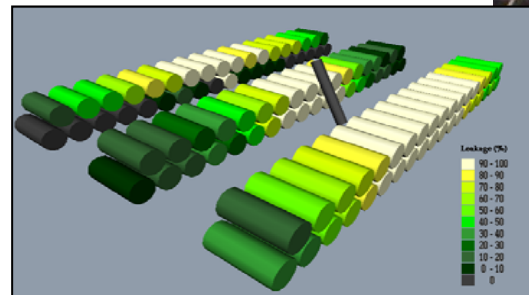
← Networked Munitions

Rigid Foams

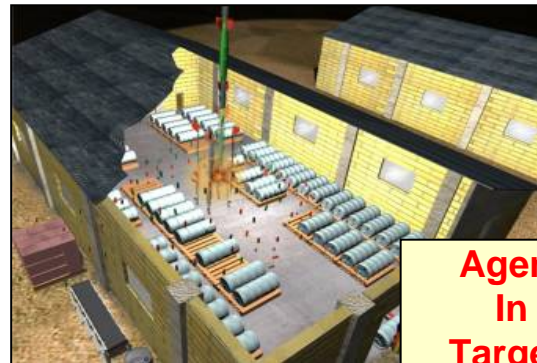
Cooperative Robotics



Improved Diagnostic and Analysis Methods

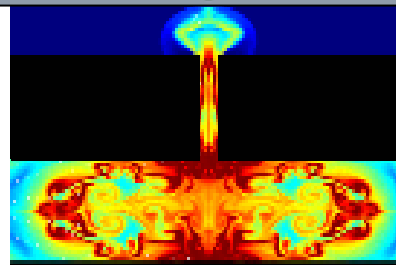


CBRNE Denial Concept Development



Agent In Target?

Weapon Borne Sensor Concept Evaluation



Development of Advanced Disruption Payloads



External Plume Neutralization



# HDBT Neutralization Technologies

## Boosted Penetrator Development

Demonstrate an ordnance package that can be internally carried on F-35, and survive high speed impacts and into reinforced concrete and function at the appropriate time.

Survive impact and intelligence to function at appropriate time



Penetrator & fuzewell design - Ensure fuze & explosive is provided a soft ride from impact to function



## High Speed Penetrator Development

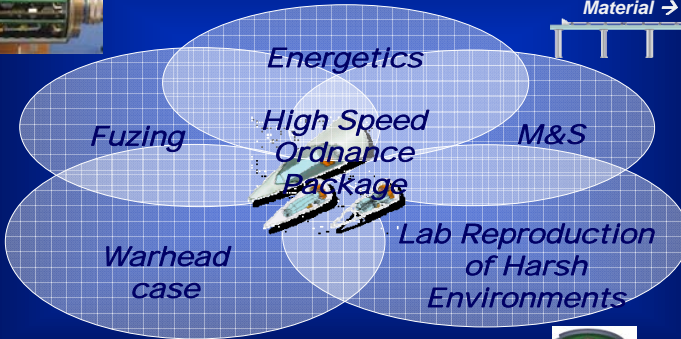
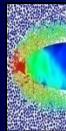
Provide intercontinental, quick response in an anti-access/area denied environment to deliver effects on hard & deeply buried targets.

Hard Target Explosive Formulation, Characterization & Phenomenology

Multiscale, "Bottom Up" Modeling/Experiments: Material → System



Target-Case Interactions



New Nose Shapes



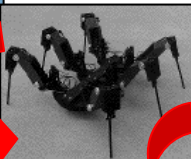
System Environment Characterization

## Functional Defeat

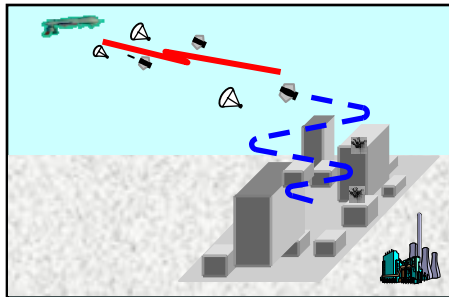
Delivery System



Micro-Platform



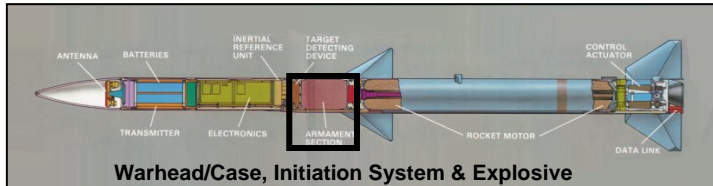
Underground Facility with Critical Nodes



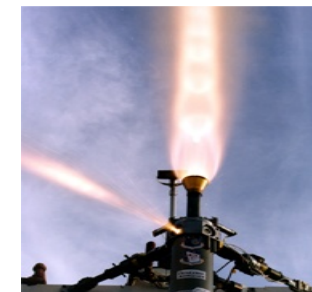
Concept Design and CONOPS



# Air Dominance Technologies



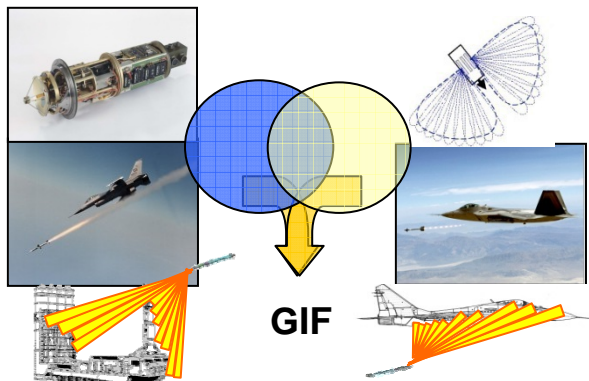
**Adaptable Multi-Point Initiated  
Mass-Focusing, Enhanced  
Lethality Warhead**



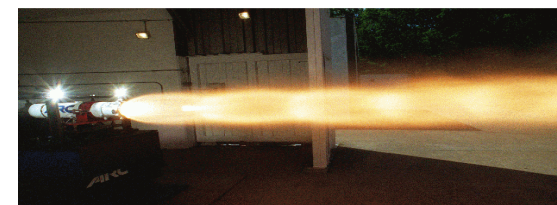
**High Maneuverability  
Hybrid Aerodynamic Fin /  
Reaction-Jet Control System**



**Potential Joint  
Demonstration**



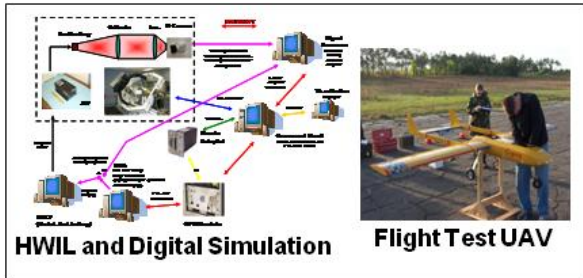
**Guidance Integrated Fuzing (GIF)  
Weapon Seeker/Fuzing Integration  
With Dual-Role Target Set Capability**



**Multi-Pulse Solid Rocket Motor &  
Other Advanced Propulsion Concepts**



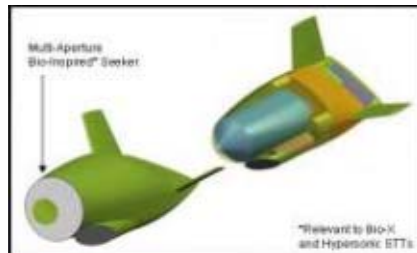
# Mobile Target Neutralization Technologies



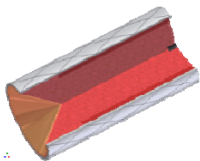
HWIL and Digital Simulation

Flight Test UAV

Micro- Mmunition Guidance and Control Test Bed



Precision Guided Submunition Airframe, Integration, & Demo



Precision Guided Submunition Warhead



Miniaturized Datalinks

Multi-Functional Materials & Structures	Integrated Systems	Low Speed, Unsteady Aerodynamics
Vision Based Guidance		Complex Aero-elastic Structural Interaction
Precision Navigation & Timing		Weapon Data Links
Fixed, Rotary & Flapping Wing Flight		Rapid Prototyping
Swarming, Cooperative Control, Collective Vision		Power Systems & Thermal Management
Miniaturized Payloads		





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# Cybernet Neutralization Technologies



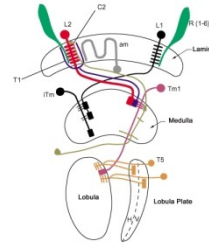
Approved for Public Release 96 ABW/PA No. 96ABW-2009-0116



# Revolutionary Technologies



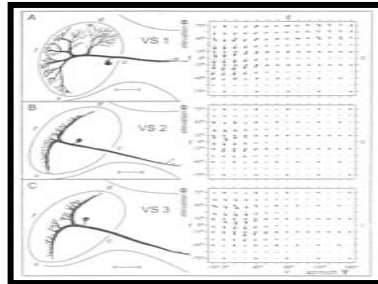
Compound Eye Modeling To Enable Designs Of Miniature Wide Field Of Regard Sensors



Translate Elementary Motion Detection Circuitry To Software Which Can Be Realized In Silicon



Understanding Raptor Flight Mechanics And Aerodynamics To Enhance The Agility Of Micro Mmunition Vehicles



Translate Optic Flow Algorithms To Software Which Can Be Realized In Silicon

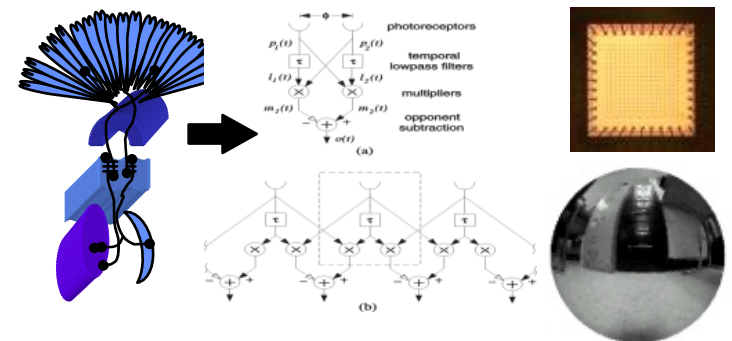
Retinal Image Motion (Optic Flow)

$$z_i = \langle Q, F_i \rangle w$$

Outputs useful for feedback control

Haag et al. (2002)

Merge Control Theory With Biological Vision Motion Processing To Establish Merits Of Biology-inspired Concept For Collision Avoidance



Increase Processing Efficiencies For ATR And Terminal Guidance By Going From Biological Understanding To Electronic Implementation



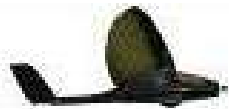
# Munitions Centric







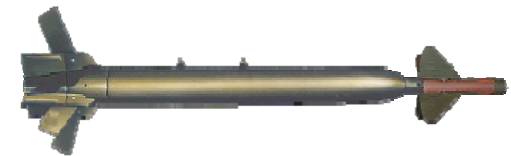
# Strong Record of Demonstrating Integrated Capabilities



BATCAM



SDB I



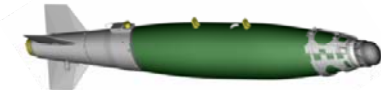
GBU-28 "Bunker Buster"



Shredder ATD



AMRAAM



JDAM



LGB



Crash-Pad



BLU-121



FLM



PAW



MOAB



HTSF



JASSM



# Conclusion



- **Munitions technology investment gives high ROI**
- **Mid term munitions outlook characterized by**
  - **Increased lethality (per munition and airframe)**
  - **Persistence**
  - **Smaller Weapons potential for UAVs**
  - **Network centric / Cooperative control**
  - **Low Collateral Damage**
- **AFRL/RW relies on industry partnering to achieve our mission**
  - **R & D contracts goal: 50% of budget**
  - **Growing Revolutionary Technology Initiatives**



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# AFRL Munitions Directorate



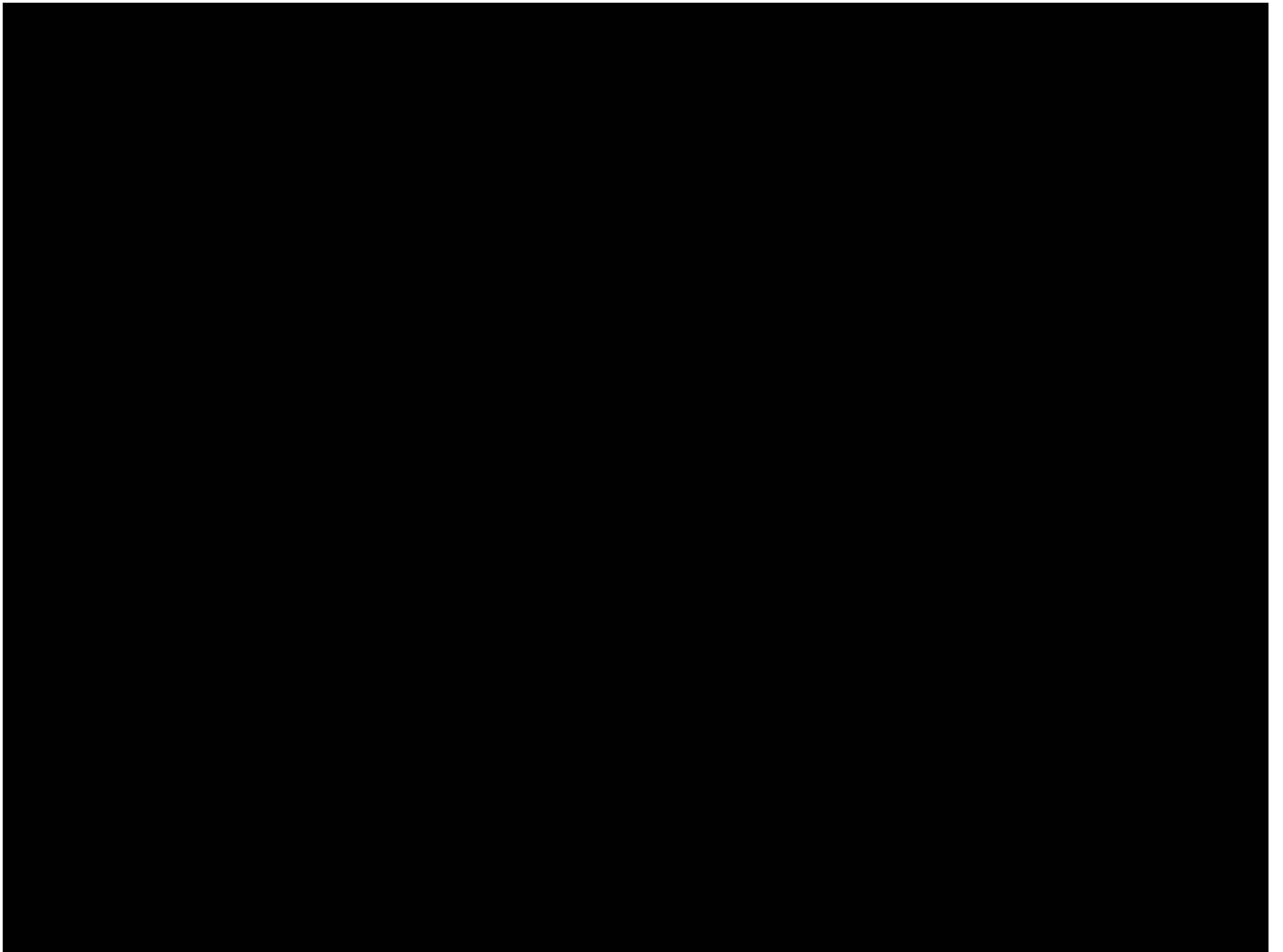
[http://www.eglin.af.mil/afrl\\_rw/](http://www.eglin.af.mil/afrl_rw/)



**We Deliver the Warfighter's Best Bang for the Buck !!**

Approved for Public Release 96 ABW/PA No. 96ABW-2009-0116







# Doing Business with AFRL/RW



- **Near Term Non-R&D Support Contract (Logistics Material Support Activity) Solicitation / Award 1Q09/ 2Q09**
- **Near Term R&D Contracts**
  - **External Plume Neutralization**
  - **Munitions Based Sensor / Seeker**
  - **CBRNE Denial Concept**
  - **Precision Guided Submunition Demo**
  - **Joint Dual Role Air Dominance Missile Demo**
  - **Armament Technologies BAA-RWK-08-001**
  - **Revolutionary Technologies BAA-RWK-08-002**
  - **Battlefield Airmen BAA-RWK-08-003**
- **SBIR Program – 13 Draft Topics**
- **Revolutionary Guidance & Ordnance Technology – White Papers & Proposals Anytime**



# Directed Energy High Power Microwave (HPM) Counter-Electronics

*Counter Electronics  
1 minute approx  
PA # AFRL/RD 08-0041  
Cleared for Release*

*Enables attack on high value electronic targets with minimal collateral damage; virtually eliminating high post-conflict reconstruction costs!!!!*

## Warfighter Benefits

Unique capabilities that disrupt through destroy:

- Command, Control, and Communications (C<sup>3</sup>) Centers
- Integrated Air Defense Systems (IADS)
- WMD Production Facilities
- Cyber War Targets
- Enemy Infrastructures