



# Air Force Research Laboratory



**Integrity | Service | Excellence**

## **(U) Technology Options Enabling a 3rd Offset Strategy**

**Brief to PSTS, 29 October 2015**

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Acting Director / Site Commander, AFRL  
Munitions Directorate**



# The AFRL Munitions Directorate



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# AFRL Munitions Directorate VISION & MISSION



## Vision:

Global leader in advancing weapons science and technology

## Mission:

Lead the discovery, development, integration, and transition of *affordable* weapons technology, enabling the warfighter to win across all domains





# AFRL Effects-Based Strategy

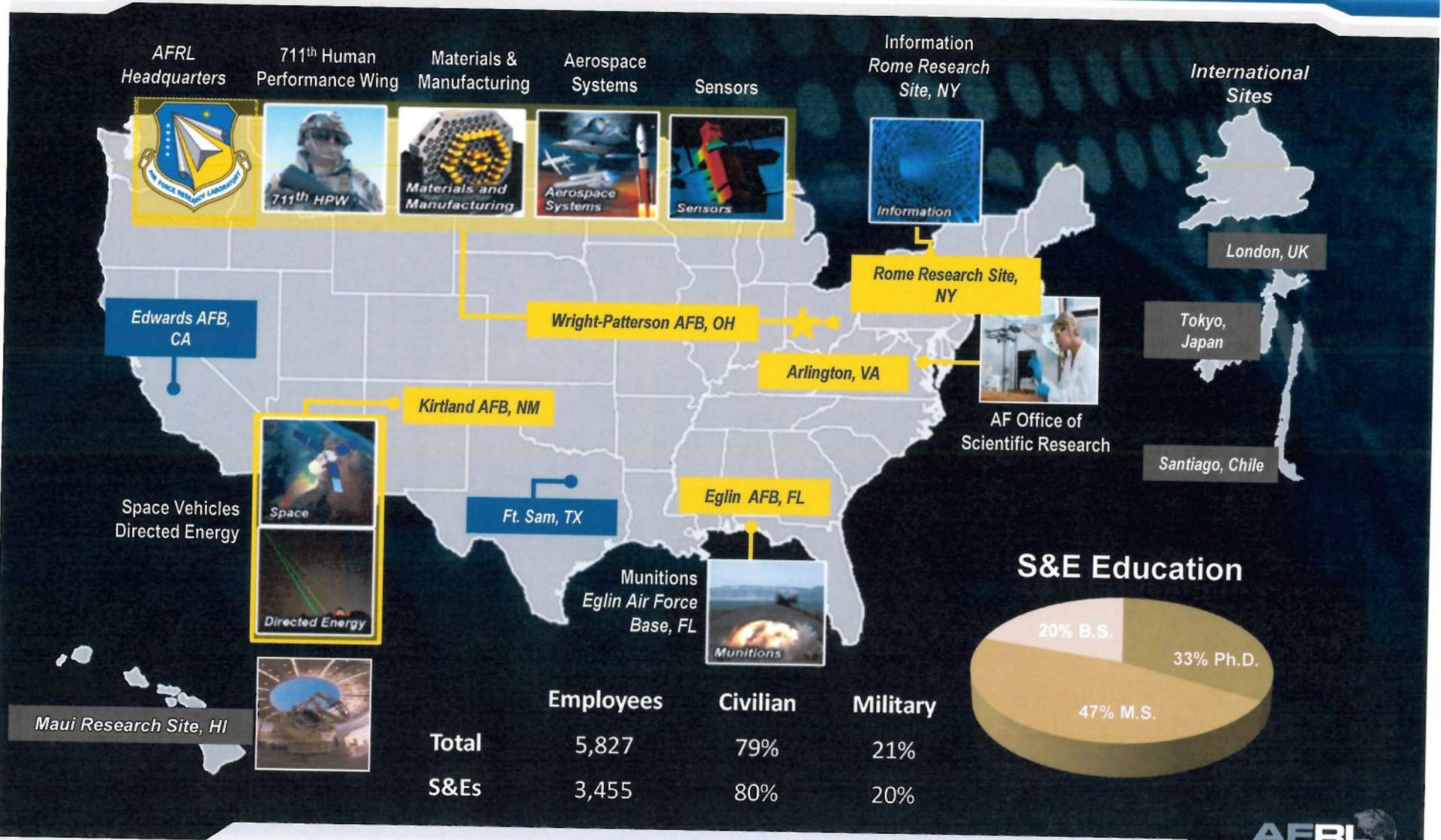


Fully *integrate weapons S&T portfolio* to exploit both the unique and complementary capabilities of *Kinetic and Directed Energy* systems in order to meet the *needs of the US Air Force and the Joint Warfighter*

**Must leverage the entire DoD Laboratory enterprise along with active industry partnerships!!**



# We Are Part of A World-Wide Enterprise of Researchers



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# Game Changers



## Hypersonics

- Survivable , fast-flying
- Defeat deep-layered A2/AD strategies



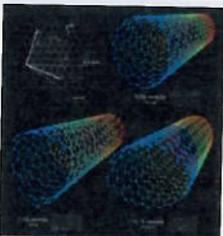
## Directed Energy

- High Power Microwave alternative to kinetic weapons
- Lasers with air & ground selectable effects & reduced collateral damage



## Supervised Autonomy

- Decisions at speed of computing
- Self-awareness & troubleshooting intelligence



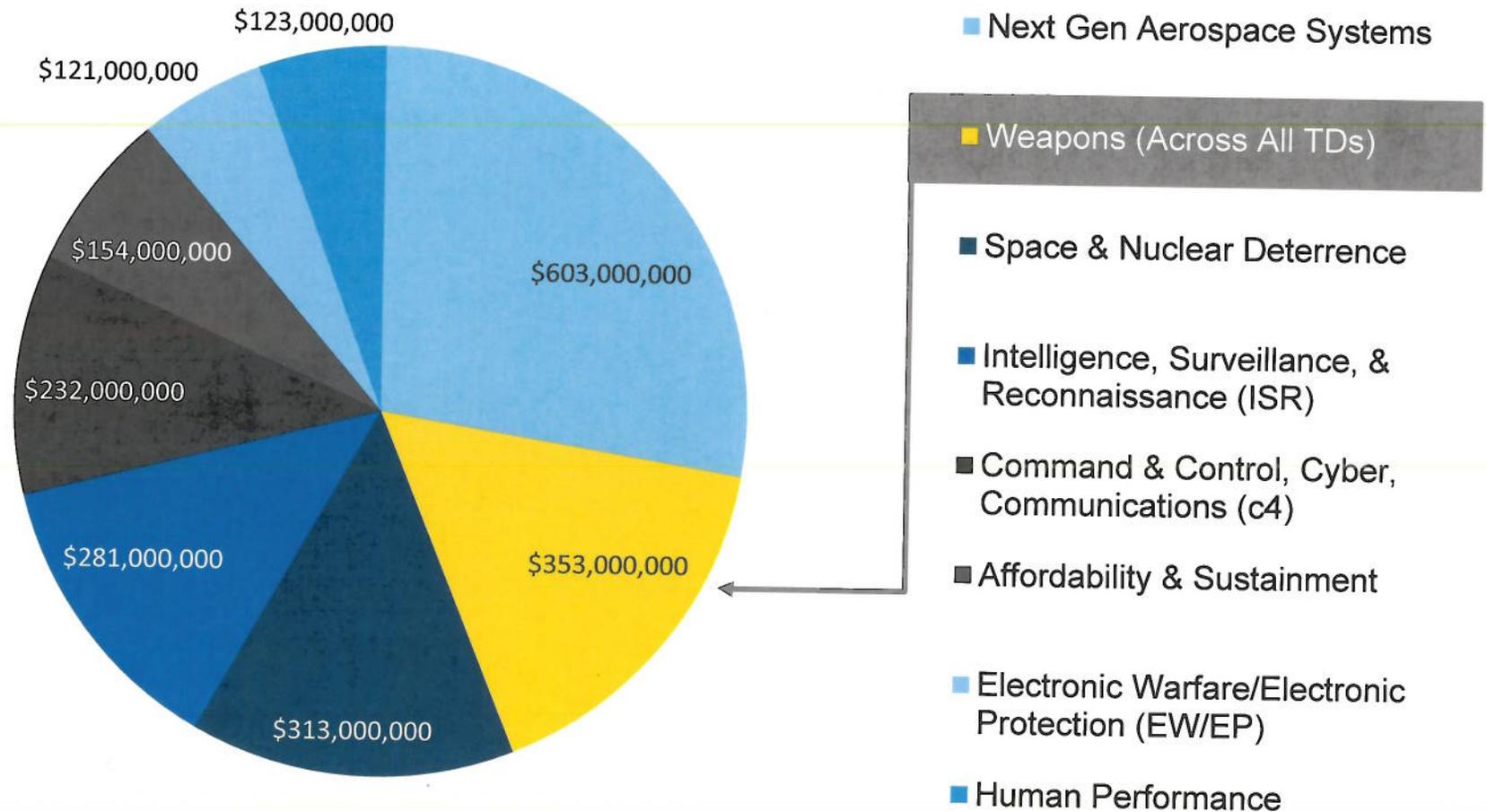
## Nano-Technologies

- Lighter, stronger, more reactive properties enhance speed, range, and energetics
- Lower life-cycle costs

Revolutionary technology to make and keep the fight unfair



# AFRL Funding by Tech Focus Areas



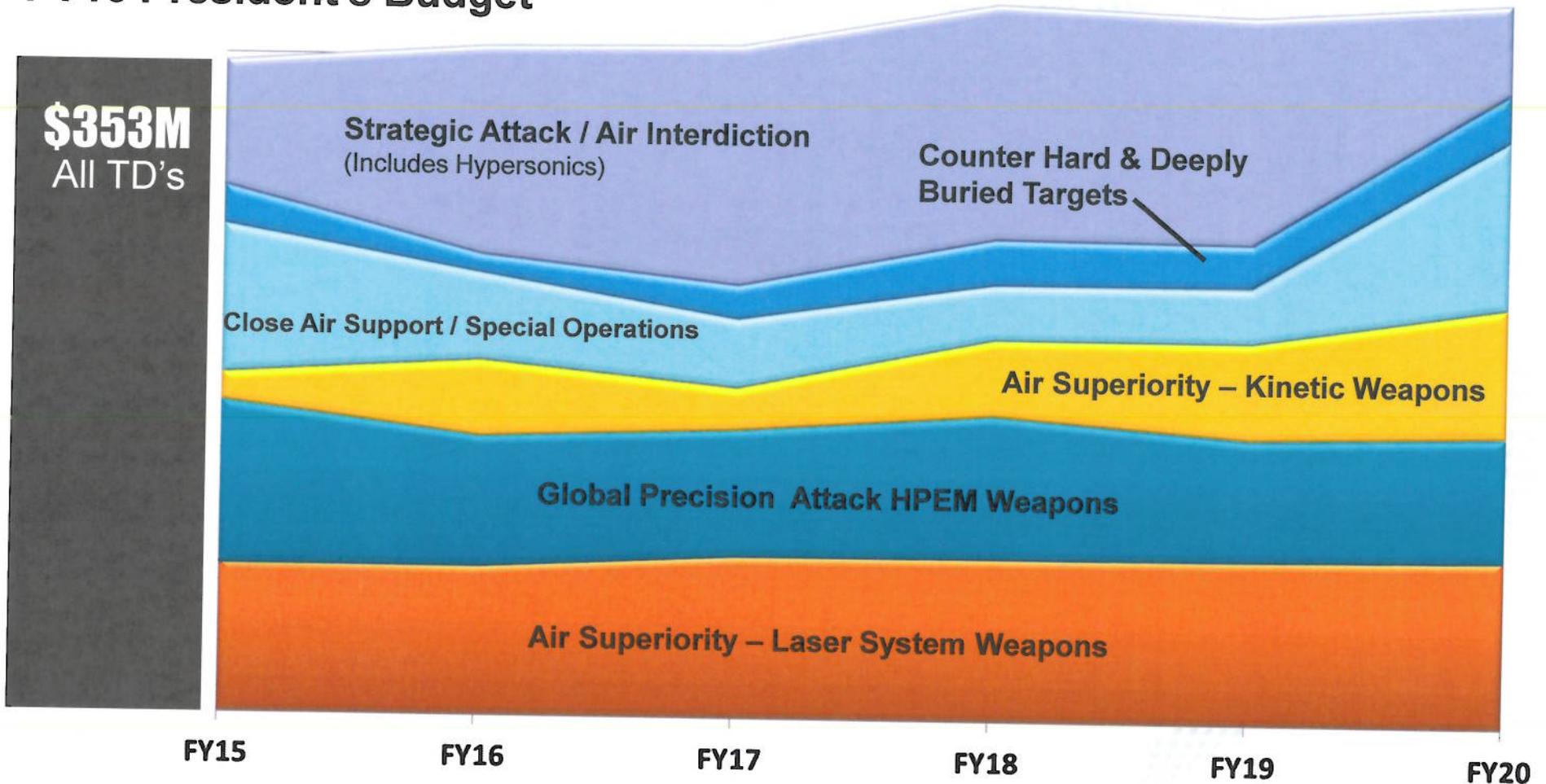
Total: ~\$2.1B, FY16 PB (No Devolved \$)



# What are our Current Weapons Investment Strategies for AFRL?



## FY16 President's Budget





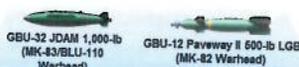
# Today's Weapons Against Tomorrow's Threats



### INTERNAL WEAPONS



### EXTERNAL WEAPON



OR →

Limited number of very expensive weapons

Laser Guided or GPS only weapons greatly limits mission flexibility

Anti-Access requires stand-off

OR →

High a/c attrition on ingress

High weapon attrition

No weapon propulsion – insufficient range to reach targets

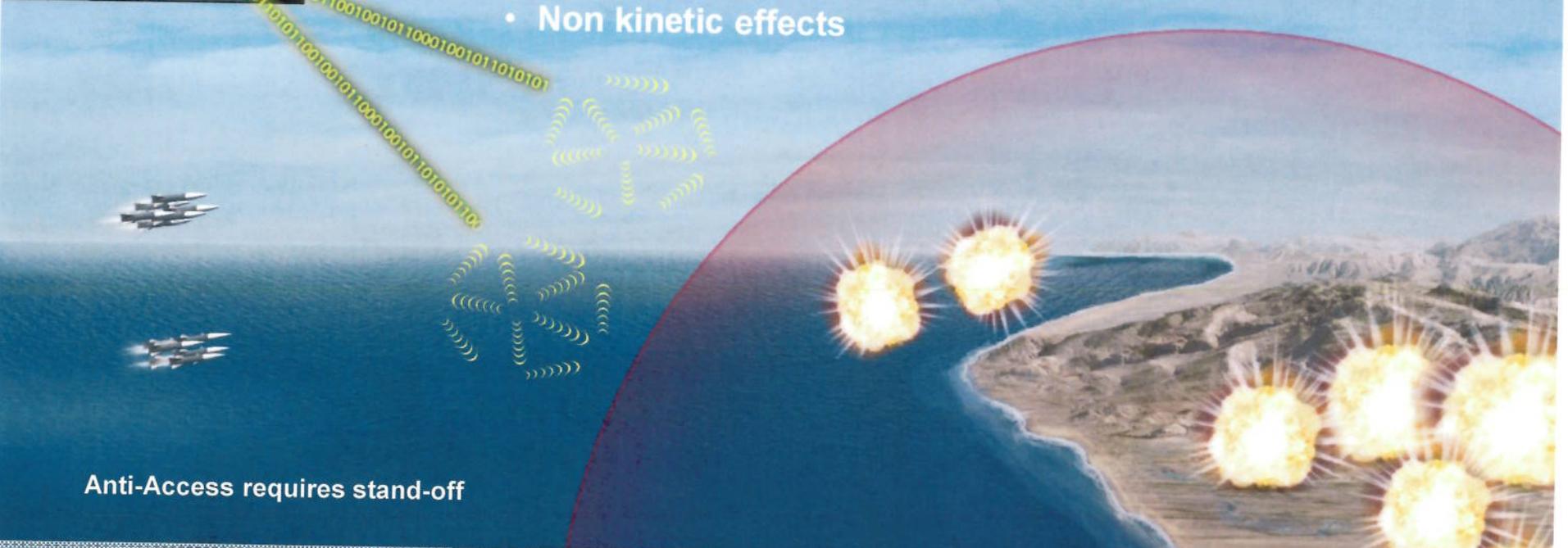
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# Changing the Game in 2020+



- Kinetic effects
  - Collaborative, scalable, dial-able, agile effects – saturate / swarm effects
  - Software defined weapon – modular in design
  - Common logistics reduce lifecycle costs
- Non kinetic effects



Anti-Access requires stand-off

## 1. Survive to Fight

- Cooperative saturation strategies
- Synchronize path planning & EA

## 2. Robust Re Acquisition of Targets

- Decentralized & distributing sensing, hand-offs
- Periodic C2 & “PED Cell” isolation is expected

## 3. Synchronized and Composable Effects

- Autonomy/flexibility to compose into effect no matter level of attrition
- Apply effect to target grouping

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# Changing the Game in 2030+



Advanced Stand-off Weapons on Legacy Aircraft

Advanced Platforms

- LRS-B
- F-X

Advanced KE/NKE Weapons

- Network Integrated Attack
- Automated Functions
- Precision Navigation
- Increased Lethality & Effects
- Survivable

## Weapons in 2030+ Must Match Advanced Platforms

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# Overarching Challenges



**Challenge:** Quantity of Threats and Cost Per Kill / Cost Exchange Ratio

**Challenge:** 5<sup>th</sup> / 6<sup>th</sup> Gen Fighters – Fewer Fighters – Maximize Payload (Loadout) & Integration (Targets per Sortie – A/A or A/G)

**Challenge:** Anti-Access / Area Denial (A2AD)

**Challenge:** Hard and Deeply Buried Targets Right of the Line



# What Are the Technologies That Offset These Challenges?



## Technologies that Enable...

### Networked Integrated Attack

Cooperative Engagement / Synchronized Wpns Attack  
Threat Saturation & Geolocation

### Automated Functions “Autonomy”

Target Classification / Identification, Countermeasures  
Dynamic Target Allocation, Reallocation & Geolocation  
Robust, Secure LPI / LPD Networking, ROE Responsive

### Precision Navigation

Alternatives for GPS Denied Environments, Adv Guidance

### Lethal & Non-Lethal Effects

Selectable, Structural Energetics, Functional Defeat - DE, NKE

### Weapons Affordability

Open Architectures, Adv Mfg, Modularity & High Tech Refresh

### Survivability

Responsive, Fast, Maneuverable, Collaborative Saturation  
Cognitive EW, Integrated Threat Warning

## Integrated Technologies Address Challenges



# 3<sup>rd</sup> Offset Strategy



*Offset Strategy: Lessening the potential for conflict by offsetting adversary advantages with superior technologies*

## 1<sup>st</sup> Offset Nuclear Advantage

1950s

- Robust nuclear arsenal and delivery systems
- Expensive
- Risky



## 2<sup>nd</sup> Offset Precision Weapons

1970s

- Smart weapons, sensors, and targeting and control networks
- Force multiplying effect
- Advantages eroding



## 3<sup>rd</sup> Offset Systems Approach

2020s

- Global Surveillance & Strike Network
- Networked Integrated, Supervised Autonomy, Precision Navigation, Multi-Effects, Affordability, and Survivability



AFRL



# Technologies Must be Integrated into Complex Weapons Systems



## Enabling Technologies



- Integrated Sensing & Control
- Coop Target Assignment
- Network Aided Nav
- M&S Coop Architecture

- Coop Navigation
- Flexible & Trusted Autonomy
- M&S Tools
- Integrated Sensing & Control

- Anti-Jam GPS
- Celestial Nav
- All Source Precision Nav
- Visual-Aided Nav
- Network Aided Nav
- M&S

- Selectable Effects
- Dialable Effects
- Nano-Energetics
- Reactive Materials
- Fuzing Solutions
- M&S

- Hypersonic Tech
- Weapon Case / Nano-materials
- Home-on-Jam / Anti-Jam
- Swarm Tech
- Range Enablers
- Survivable Explosives
- M&S

**Cooperative**

**Automated**

**Precision Nav**

**Lethal**

**Survivable**

**Affordability**



# Working with DARPA to Make 3<sup>rd</sup> Offset a Reality



HAWC & TBG



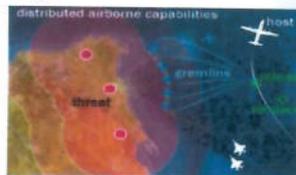
SoSite



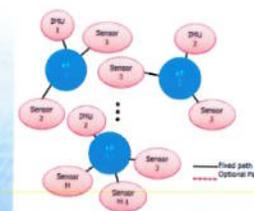
CODE



Navy CASE



Gremlins (DAC)



ASPEN & STOIC



Reactive Materials - Compact Warhead



SECTR



LWS ATD & HELLADS

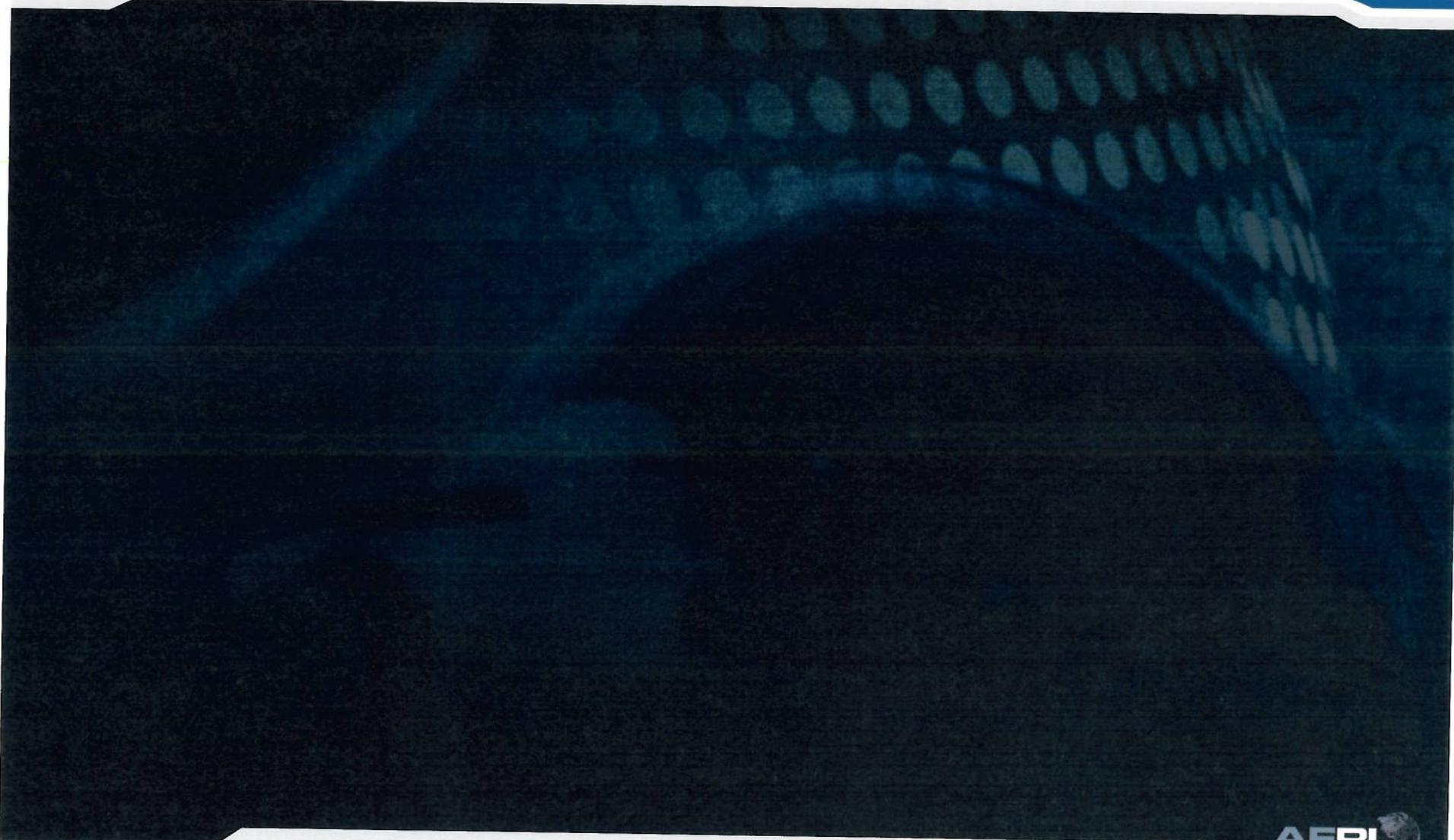
- Threat Saturation
- Enhanced Effects
- Collaborative Engagement
- Weapon Survivability
- Responsive Strike
- Selectable Lethality



\* Weapon acronyms descriptions in notes



# AFRL is Addressing GPA



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# GPA Solutions



## (U) GBU-X / AGM-X / LCCM



- Increase Loadout on AF Platforms (Internal)
- Multi-mode Warhead & Precision Initiation
- Decreased Unit Costs through Modularity
- Modularity Overcomes Evolving Threat
- Cooperative Engagement
- GBU-X Standoff 100nm
- AGM-X Standoff 300-500nm

### Maturing Technologies



Selectable



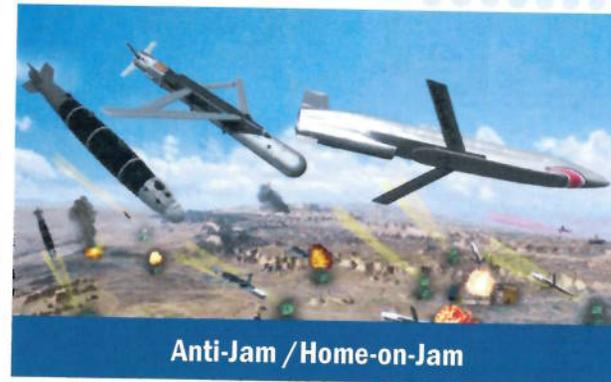
Cooperative



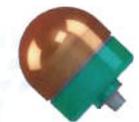
Alt Nav



Sensor Tech



Anti-Jam / Home-on-Jam



Fuzes





# GBU-X / AGM-X

Agile, Flexible Effects, Lethality-Dense Weapons



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# Selectable Effects Munition (SEM) Test Video



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## (U) Distributed Cooperative Collaborative (DC2) – Survivable Lethality in a Contested Environment

(U) A mix of key technologies that will enable weapons to survive in an A2 / AD environment

- (U) Seekers
- (U) Adaptive Control
- (U) Secure, Efficient Data Links
- (U) Flexible Autonomy
- (U) Includes GBU-X / AGM-X / LCCM Tech

### Tech Being Developed – Partnerships Key



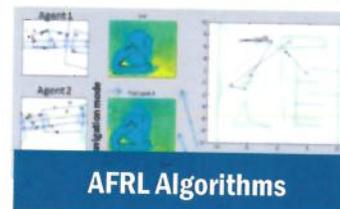
AFRL / DARPA Seekers



DARPA CODE



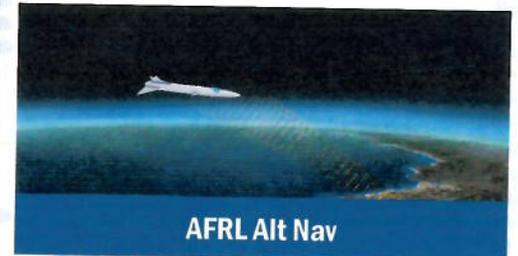
Navy CASE



AFRL Algorithms



AFRL Flexible Autonomy



AFRL Alt Nav



DARPA SoSite

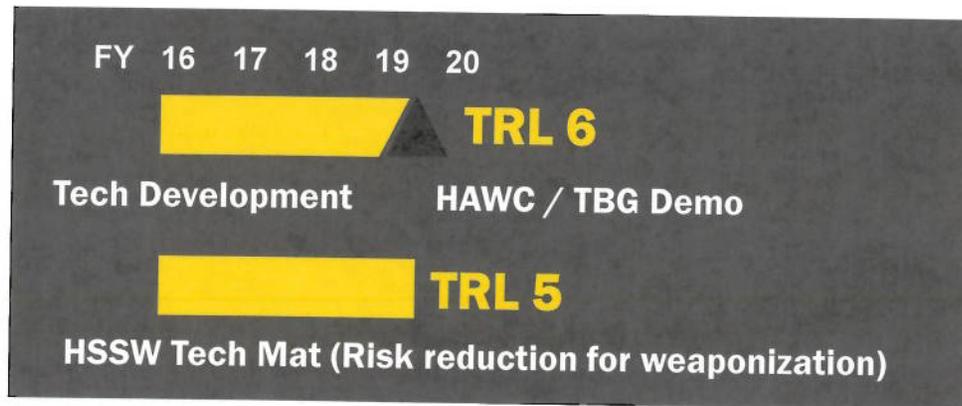




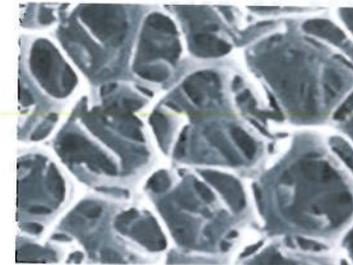
# (U) High Speed Strike Weapon (HSSW)

Develop & demo highly survivable tech to enable an air-launched, tactical range hypersonic weapon system. Demos planned for Hypersonic Airbreathing Weapon Concept and Tactical Boost Glide Weapon.

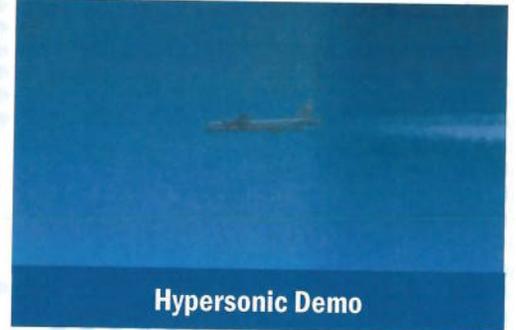
## S&T Objective:



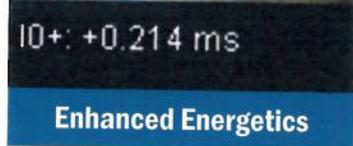
### Maturing Technologies



AFRL Ait Nav



Hypersonic Demo



Enhanced Energetics



Fluid-Thermal-Structural Interactions

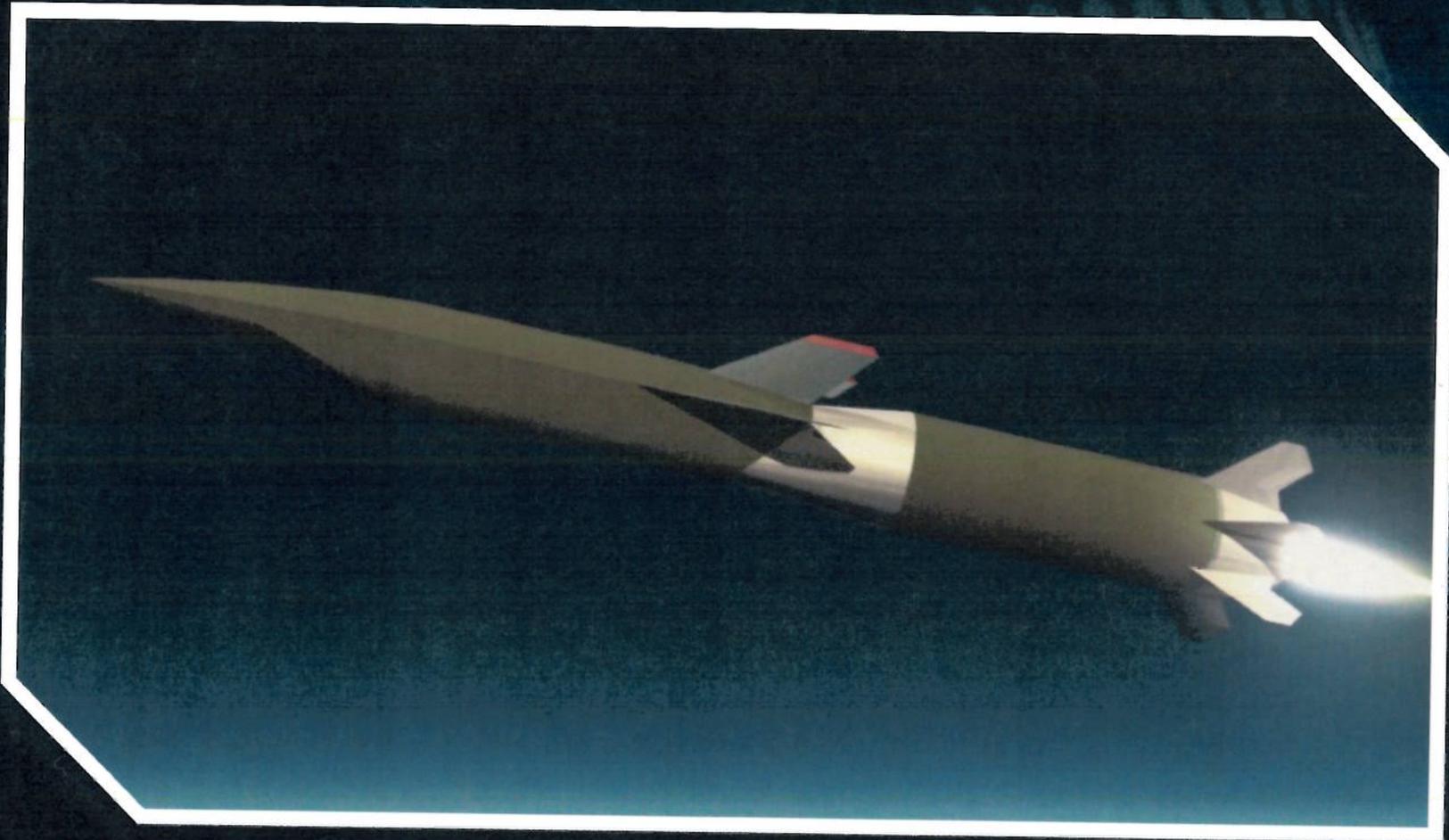


Hypervelocity Fuzing





# High Speed Strike Weapon Video (HSSW)



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## (U) High Power Electromagnetic (HPEM) Weapons

- Multiple target functional kills per missile
- Ability to attack kinetic-restricted targets
- Non-attribution / plausible deniability / non-lethal
- Low collateral damage / low reconstruction costs
- Long stand-off release of missile



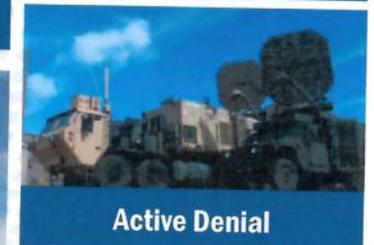
Leveraging & Maturing Technologies



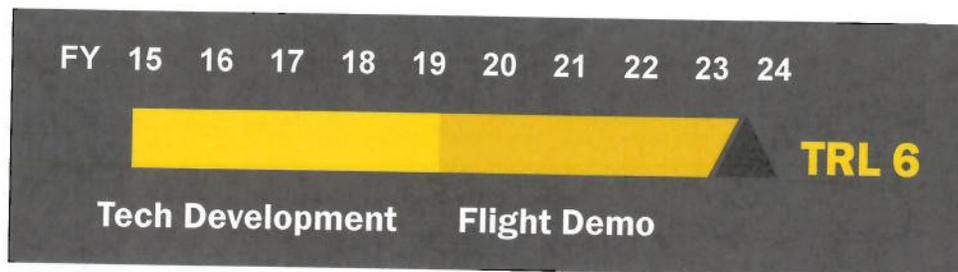
Max Power



AF CHAMP



Active Denial





# Alt Navigation



## Exploring and Demonstrating Alternatives to GPS

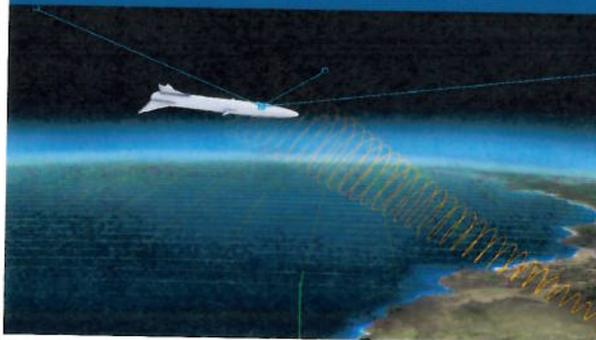
### Vision Aided Navigation

*C-LAND Tech Demo Ongoing*



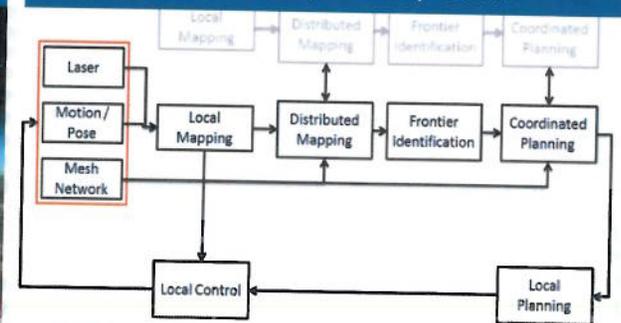
### Celestial Navigation

*CStAR Tech Demo FY 18*



### Network Navigation

*Part of GBU-X / AGM-X / LCCM*

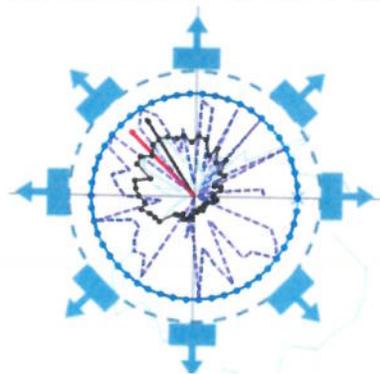


### Anti Jam / Home-on-Jam

*AJPGM Tech Demo Ongoing*



### Magnetic Navigation



### Signals of Opportunity







# CSAF – High Interest Area



## Close Air Support

- **Dialable Effects Munitions**
  - Multi-mode warhead
  - Precision burst point initiation
  - Selectable embedded fuzing (nose-mid-tail)
- **Forward Firing**
  - Fixed Wing - APKWS (2.75 Rocket)
  - Joint A-G Munition
- **Palletized Weapon System**
- **Pod Installed CAS Kit (PICK)**



CAS Tech Efforts



Dialable Effects Munition



500-lb Class Rotary Launcher  
6 stacks of 9 MM = 54 MM per Rotary Launcher

CAS Kit



Selectable



Palletized Weapon System



# Summary



- **AFRL/RW has significant technology investments to enable a Third Offset Strategy**
- **DARPA partnering provides synergistic advancements in technologies, prototypes, and demonstrations.**
- **Strategic focus on complex dynamic 2030 environment through hardware and M&S.**
- **5<sup>th</sup> and 6<sup>th</sup> Gen Aircraft Require Weapons Capable of Enabling our Missions in Challenging Environments**

# Questions?



## Legacy of War-Winning Technology Development



Early Flight

Space Age

Modern Flight

Cyber Domain

Future