Headquarters U.S. Air Force

Integrity - Service - Excellence

Overview of Air Force Science & Technology

14 Apr 10

Year of the Air Force Family

Dr. Steven Walker
Deputy Assistant Secretary
Science, Technology, and Engineering

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Outline

- Introduction
- AF Mission & Priorities
- AF S&T Vision
- AF S&T Organization
- AF S&T Program
- AF S&T: Turning Science into Capabilities
- AF Service Core Functions
- Summary

Air Force Mission

The mission of the United States Air Force is to *fly, fight* and *win*... in air, space, and cyberspace

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Air Force Priorities

- Continue to strengthen the Nuclear Enterprise
- Partner With the Joint and Coalition Team to Win Today's Fight
- Develop and Care For Airmen and Their Families
- Modernize Our Air and Space Inventories, Organizations and Training
- Recapture Acquisition Excellence

Air Force S&T Vision

Create knowledge to develop technology for demonstration of integrated warfighter capabilities in the air, space, and cyber domains

How?

- Do the best science and apply it to AF problems
- Team with others to demonstrate new capabilities
- Strengthen communication of AF-level S&T strategy and potential S&T solutions

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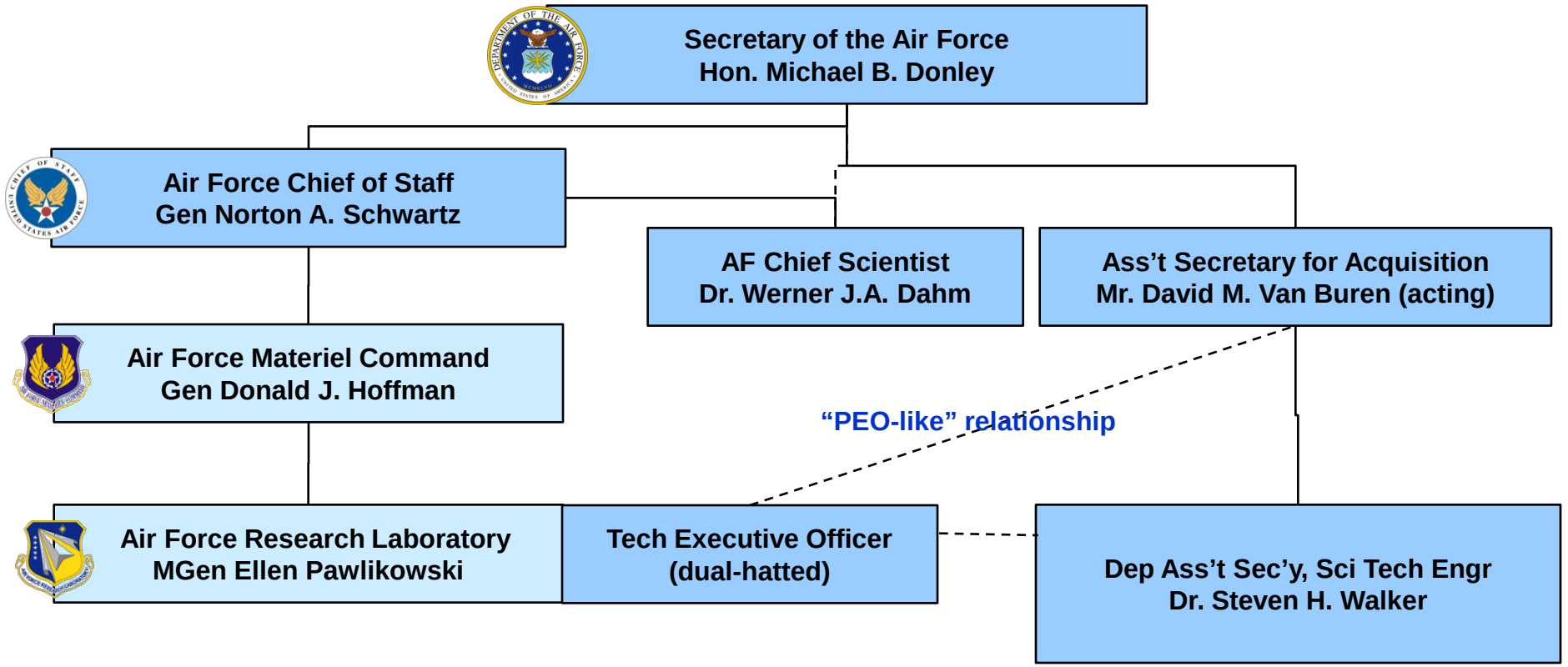
AF S&T Organization



AFMC – Air Force Material Command
AFRL – Air Force Research Laboratory
SAF/AQ – Ass't Secretary for Acquisition
SAF/AQR – Dep Ass't Sec'y for Science, Tech & Engr
AF/ST – Air Force Chief Scientist

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AF S&T Organization - Detailed

Air Force Research Laboratory
MGen Ellen Pawlikowski

Dep Ass't Sec'y, Sci Tech Engr
Dr. Steven H. Walker

Executive Director | Chief Technologist | Vice Commander

Technical Directorates

AF Office of Scientific Research (AFOSR)	Information (RI)	Sensors (RY)
Air Vehicles (RB)	Space Vehicles (RV)	Munitions (RW)
Directed Energy (RD)	Materials & Mfg (RX)	Propulsion (RZ)
711 Human Performance Wing		

AFRL is the only Air Force S&T executing organization
- >10,000 people on site
- Headquartered at Wright-Patterson AFB, OH
- Facilities located across the country

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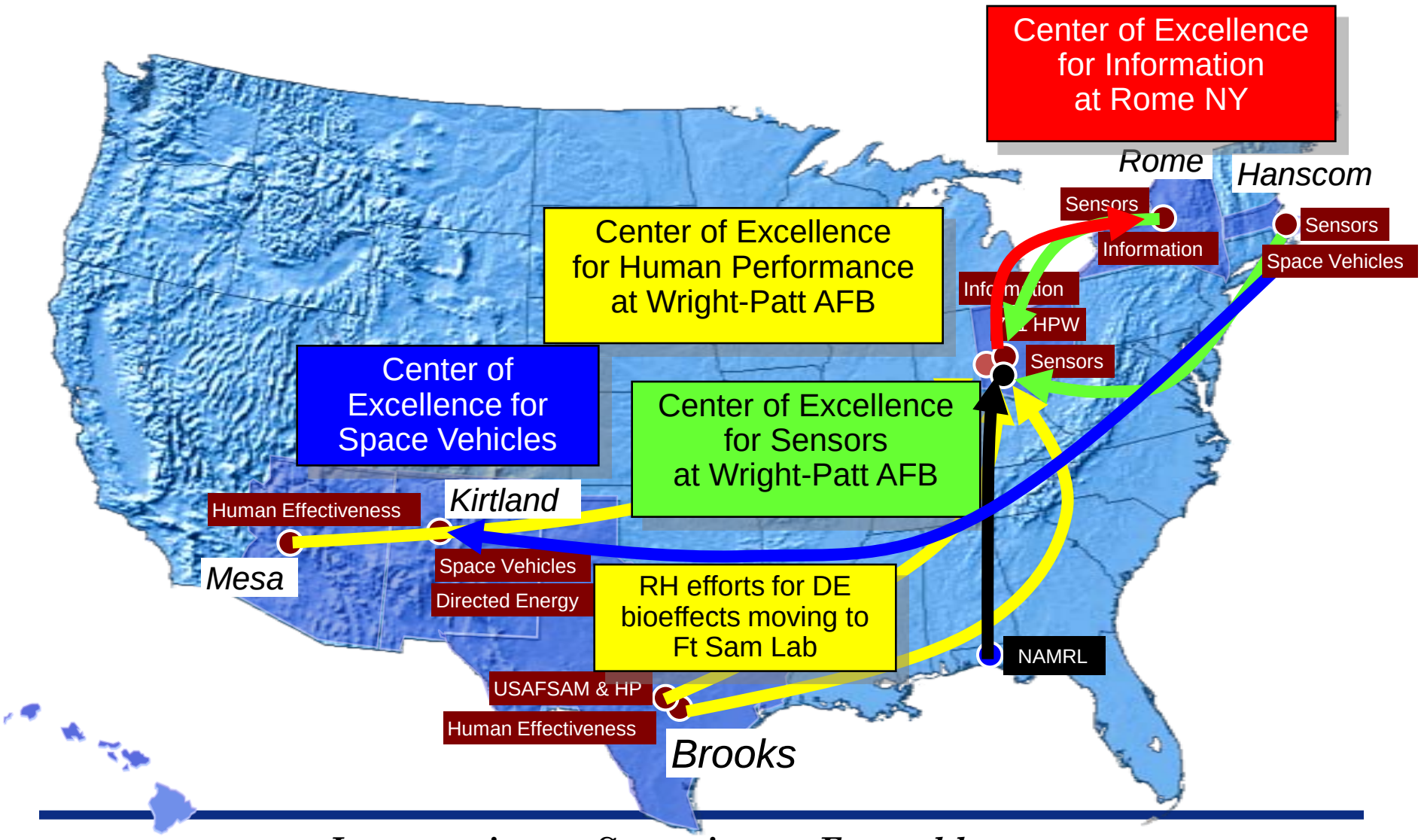
BRAC 2005 AFRL Actions



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Air Force S&T Program - At-A-Glance

- Program
  - $2B/year (core budget)
  - Basic Research (6.1)
  - Applied Research (6.2)
  - Advanced Technology Development (6.3)
- Investment Strategy
  - Focus 6.3 on more relevant technology transitions
    - High user pull
    - MAJCOM Capability Needs
  - Increase emphasis in addressing Small Business, Industrial Base, Supply Chain, Sustainment
  - Increase joint efforts (e.g., ISR, electric laser on B-1 demo)

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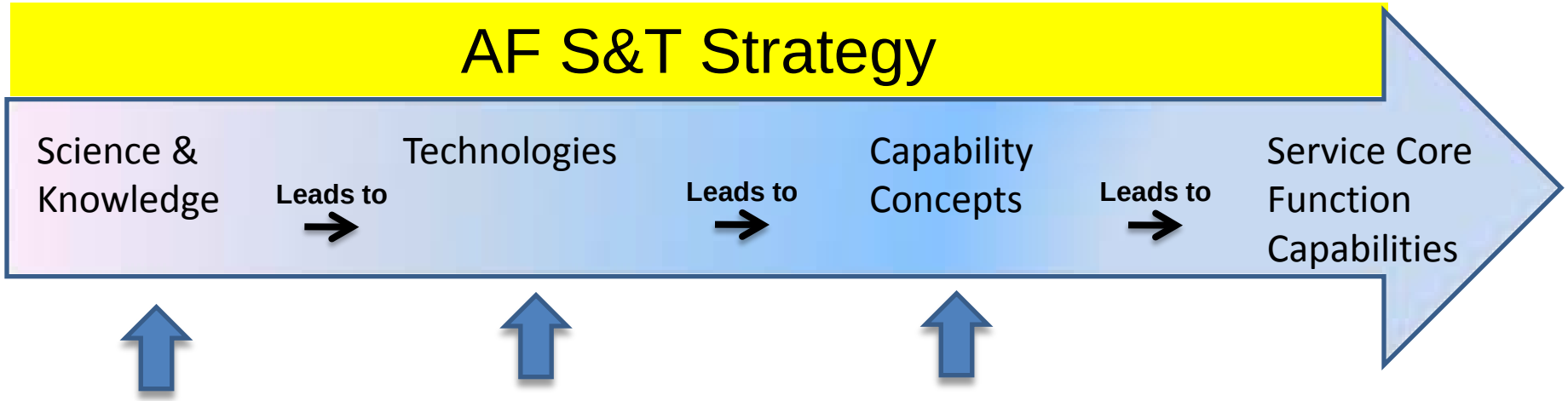
AF S&T: Turning Science into Capabilities



- Informed by AF Needs and Long-Term Challenges

- Directly impacted by Product/Log Center
- Informed by AF/MAJCOM Needs
- Informed by AF Long-Term Challenges

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- Informed by Product/Log Centers
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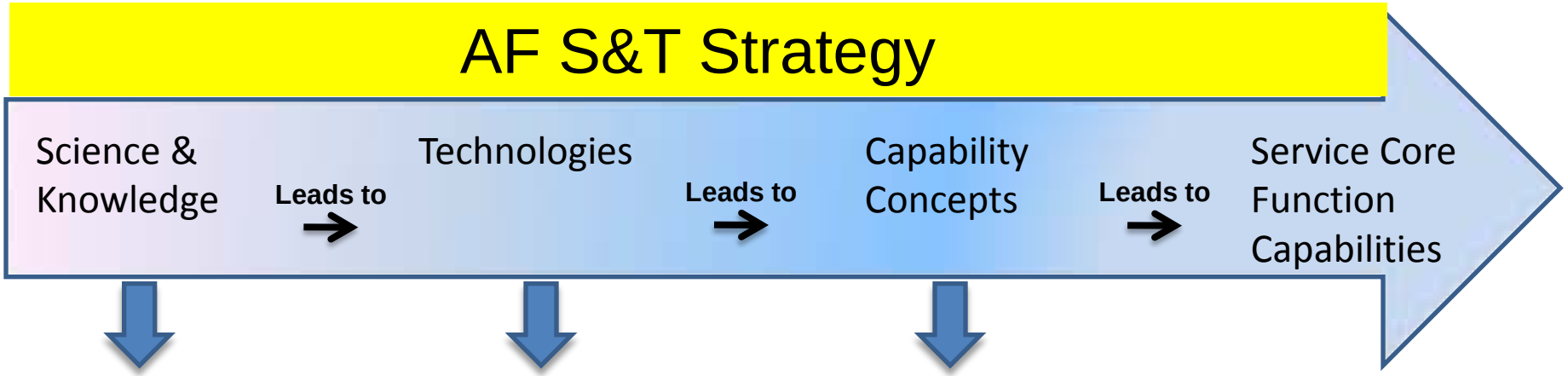
AF S&T: Turning Science into Capabilities



Transitions to:

- AFRL Tech Divisions
- Industry
- Academia

- Product Centers
- Industry

- Programs of Record
- Fielded Systems
- AF/Joint Ops

- AF/Joint Ops

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AF Core Functions

Nuclear Deterrence Operations

Air Superiority

Global Precision Attack

Rapid Global Mobility

Special Operations

Global Integrated ISR

Command and Control

Space Superiority

Cyberspace Superiority

Personnel Recovery

Building Partnerships

Agile Combat Support

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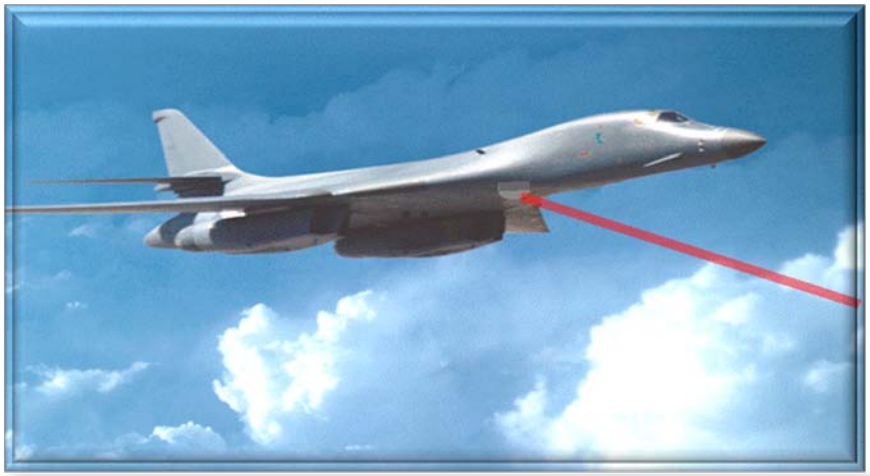
Electric Laser on a Large Aircraft (ELLA)

- Warfighter Capability

  Service Core Function: Air Superiority

  – Speed of light
  – Ultra Precision
  – Low collateral damage
  – Graduated effects

- Enabling S&T
  – Electric Laser
  – Power and Thermal
  – Tactical Beam Control
  – Advanced Acquisition, Tracking, and Pointing



- Transition Path

AFRL → AAC → AFSOC → ACC

Tactical Satellite-3 (TacSat-3)

- Warfighter capability

  Service Core Function:
  Global Integrated ISR

  - Operationally responsive hyperspectral imagery
  - Responsive theater comm using Common Data Link
  - Traceability to rapid deployment from alert status for launch to theater control

TacSAT-3 in Inspection and Test

- Enabling S&T
  - Integrating technology capabilities in responsiveness, mission ops, modularity of spacecraft design, and low-cost payload development

Launch May 09

- Transition path

AFRL → SMC → AFSPC

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Image Enhancement for Space Situational Awareness (SSA)

- Warfighter Capability

  Service Core Function:
  Space Superiority

  – Improved Space Object Identification

  – High fidelity SSA imagery from multiple lower fidelity images

- Enabling S&T

  – New computer algorithms combine images and remove atmospheric and system blurring to produce a single high-resolution image.

- Transition Path

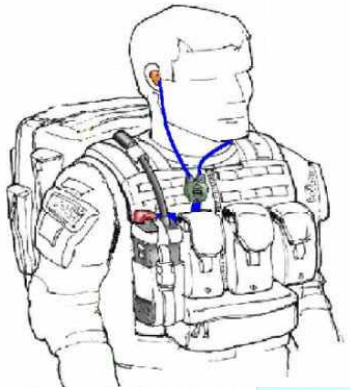
Battlefield Air Operations (BAO) Kit

- Warfighter Capability

  Service Core Function:

  Special Ops

  – Improve weapons effectiveness & precision
  – Enhance communications and night/day capability
  – Reduce operational risk due to lightweight, covert syste shaped by warfighter needs



- Enabling S&T
  – Alternative high energy storage and production
  – Multi-cast text/audio/video over wireless network

- Transition path

AFRL → ASC → AFSOC

Active Denial System (ADS)

- Warfighter Capability

Service Core Function:

Special Ops

– Force Protection, area delay/denial, crowd dispersion, escalation control

– Nonlethal counter-personnel directed energy weapon (Intolerable skin heating)

System 2
ACTD Field Residual

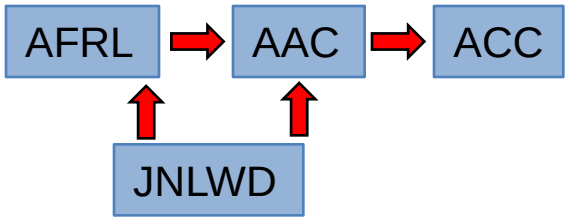
System 1
ACTD Field Residual

- Enabling S&T

– Continuous wave millimeter wavelength radiating system with hybrid-electric power plant on mobile platform

– Joint CONOPS development and assessment of military utility

- Transition path



Summary

- AF S&T focus is on supporting Air Force Core Functions
  - Developing technology solutions to meet MAJCOM/Product Center needs
  - Technology Push
  - Technology Pull

Communication is the foundation of technology discovery, development, and demonstration

BACKUP

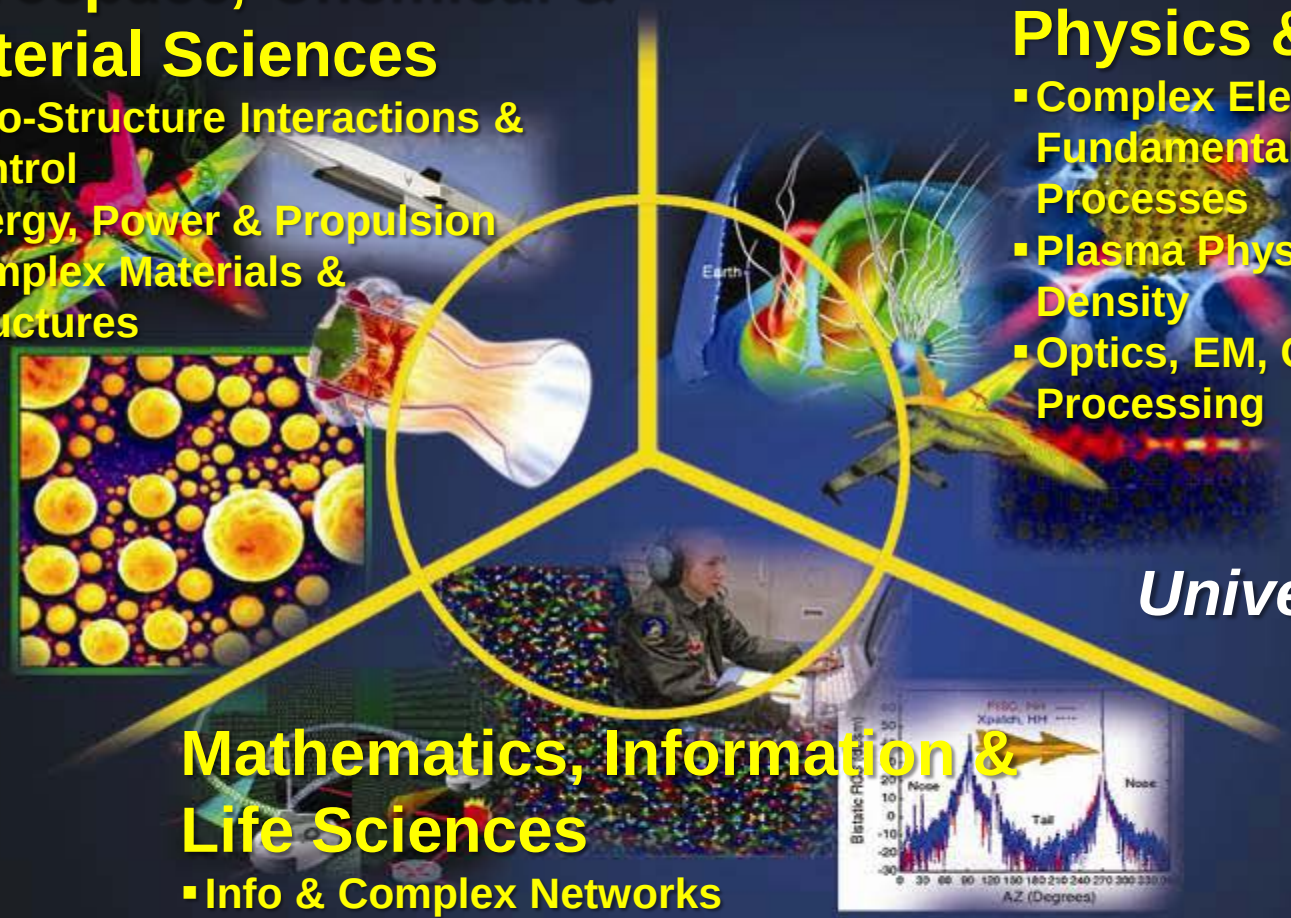
AFOSR - Basic Research (6.1)

Aerospace, Chemical & Material Sciences

- Aero-Structure Interactions & Control
- Energy, Power & Propulsion
- Complex Materials & Structures

Physics & Electronics

- Complex Electronics & Fundamental Quantum Processes
- Plasma Physics & High Energy Density
- Optics, EM, Comm, Signals Processing

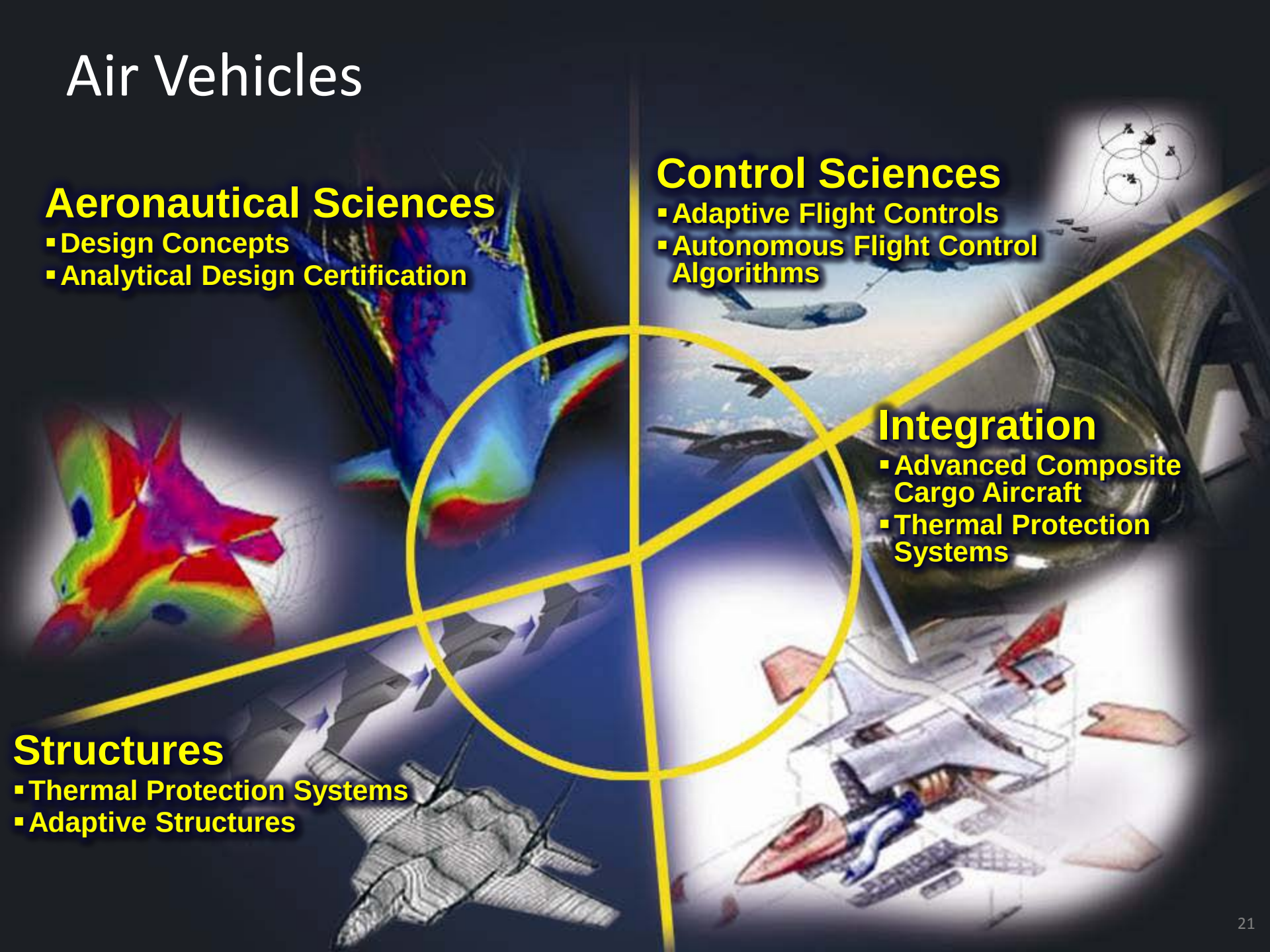


Mathematics, Information & Life Sciences

- Info & Complex Networks
- Decision Making
- Dynamical Sys, Optimization & Control
- Natural Materials & Systems

University Research Initiatives

Air Vehicles



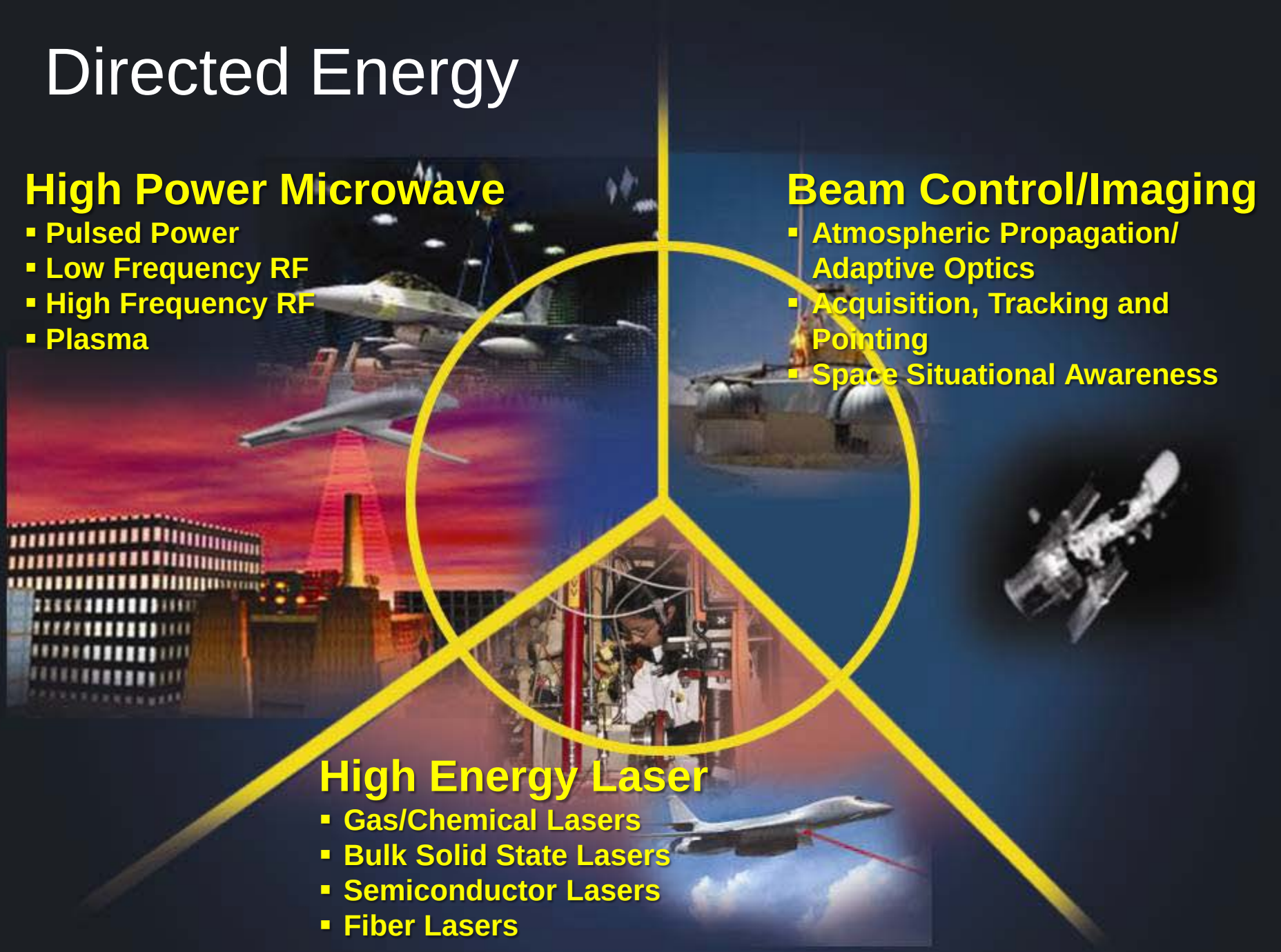
Aeronautical Sciences
- Design Concepts
- Analytical Design Certification

Control Sciences
- Adaptive Flight Controls
- Autonomous Flight Control Algorithms

Integration
- Advanced Composite Cargo Aircraft
- Thermal Protection Systems

Structures
- Thermal Protection Systems
- Adaptive Structures

Directed Energy



High Power Microwave

- Pulsed Power
- Low Frequency RF
- High Frequency RF
- Plasma

Beam Control/Imaging

- Atmospheric Propagation/ Adaptive Optics
- Acquisition, Tracking and Pointing
- Space Situational Awareness

High Energy Laser

- Gas/Chemical Lasers
- Bulk Solid State Lasers
- Semiconductor Lasers
- Fiber Lasers

Human Effectiveness

Human Dynamics
- ISR Effectiveness
- Prediction and Anticipation

Decision Science / Warfighter Interfaces
- Human Sensory Integration
- Distributed Decision Making

Directed Energy Bioeffects
- Optical & RF Radiation Bioeffects

Human Performance
- Molecular Foundations
- Cognitive Performance Optimization

Learning / Mission Effective Performance
- Accelerated Learning
- Immersive Environments

Information

Advanced Computing Architectures
- Peta-Flop Processing Tech
- Predictable Software/High Assurance Systems
- Neuromorphic Computing
- Software Development Tools for Software Intensive Systems

Information Exploitation
- Comm
- Signals
- Imagery

Information Management
- Policy Based
- Survivable and Secure Info Sharing
- Dissemination

Cyber Operations
- Defensive
- Offensive
- Assured
- Cyber Threat Avoidance

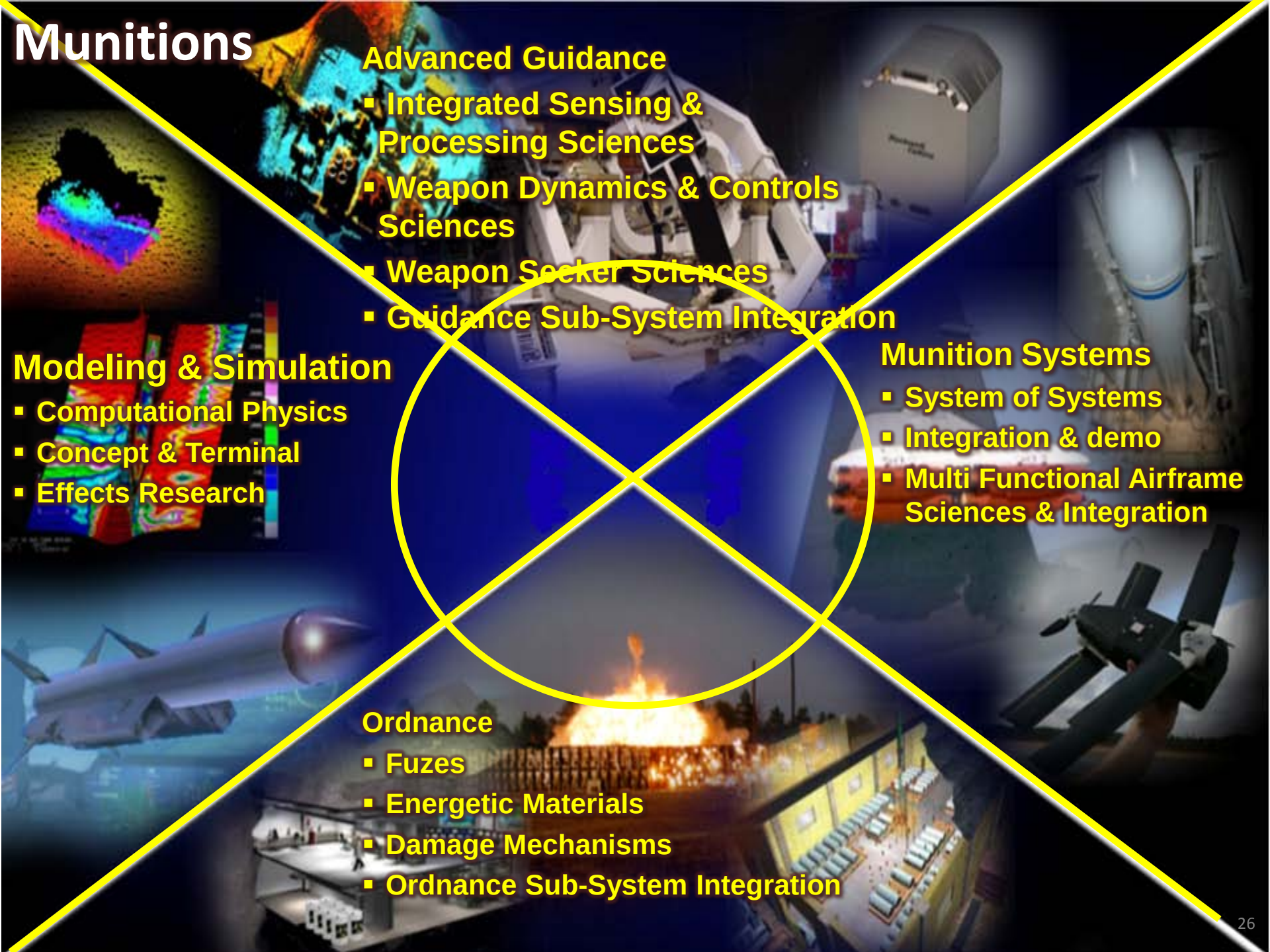
Information Fusion and Understanding
- Multi-sensor collaborative fusion
- Info-knowledge Base
- Advanced data fusion and visualization

Command & Control
- Effects-based Plan/Assess
- Adaptive Pre-planning
- Decision Support Tools

Connectivity
- Optical Networks for Space
- Assured Global Battlespace
- Assured, Survivable Networks
- Combined RF-Optical Laser Comms

Materials and Manufacturing

Munitions



Advanced Guidance

- Integrated Sensing & Processing Sciences
- Weapon Dynamics & Controls Sciences
- Weapon Seeker Sciences
- Guidance Sub-System Integration

Modeling & Simulation

- Computational Physics
- Concept & Terminal
- Effects Research

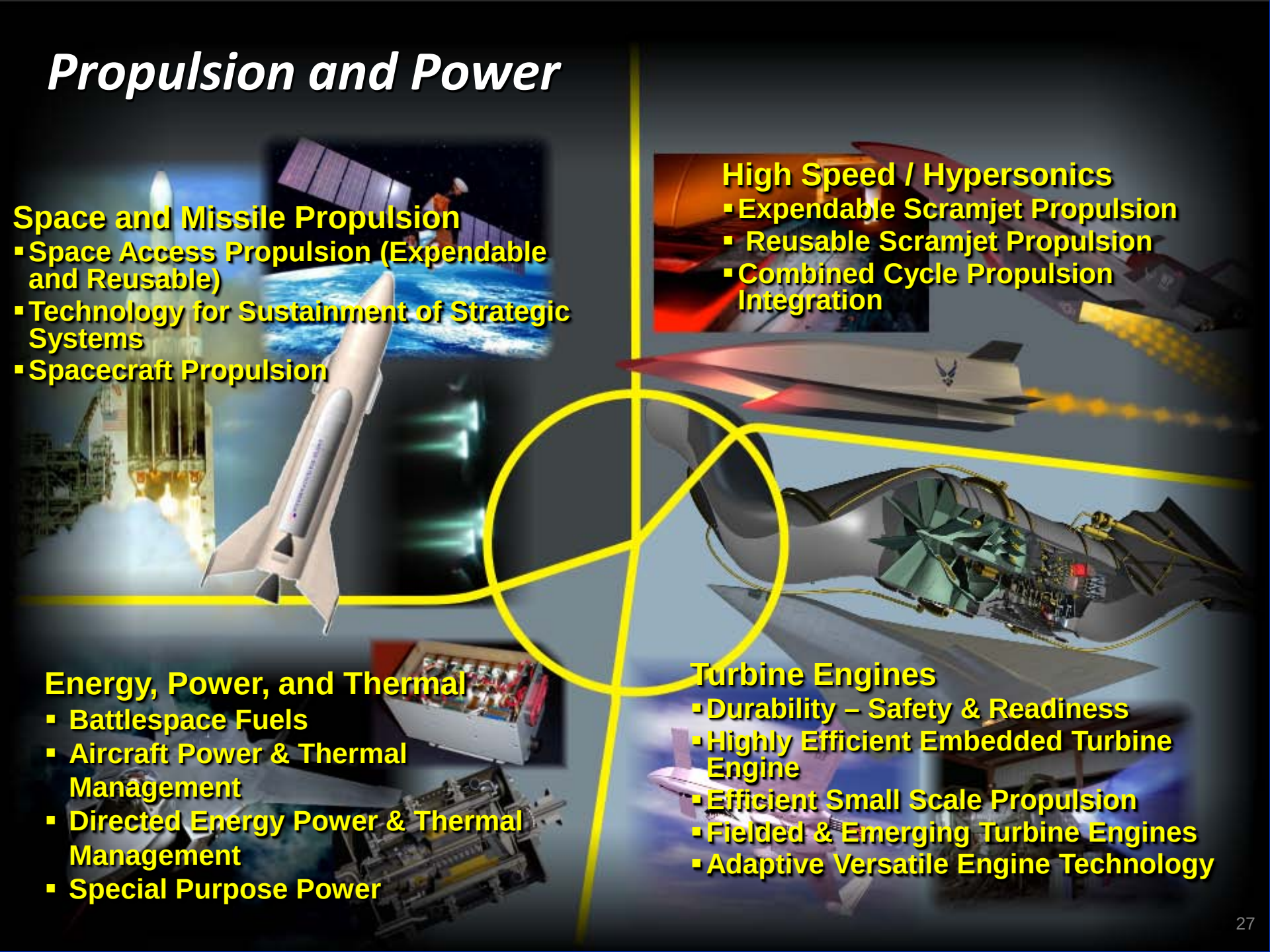
Munition Systems

- System of Systems
- Integration & demo
- Multi Functional Airframe Sciences & Integration

Ordnance

- Fuzes
- Energetic Materials
- Damage Mechanisms
- Ordnance Sub-System Integration

Propulsion and Power



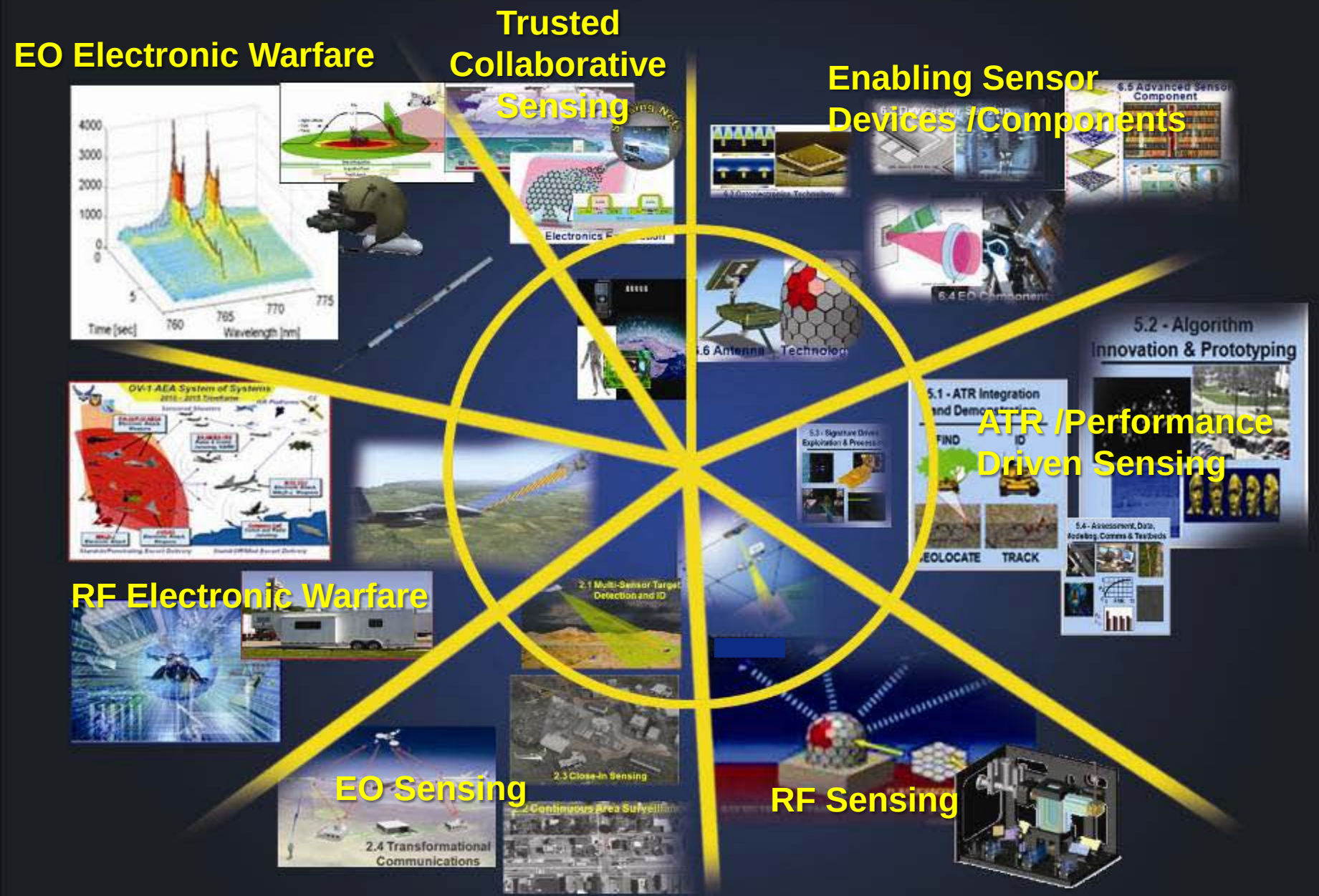
Space and Missile Propulsion
- Space Access Propulsion (Expendable and Reusable)
- Technology for Sustainment of Strategic Systems
- Spacecraft Propulsion

High Speed / Hypersonics
- Expendable Scramjet Propulsion
- Reusable Scramjet Propulsion
- Combined Cycle Propulsion Integration

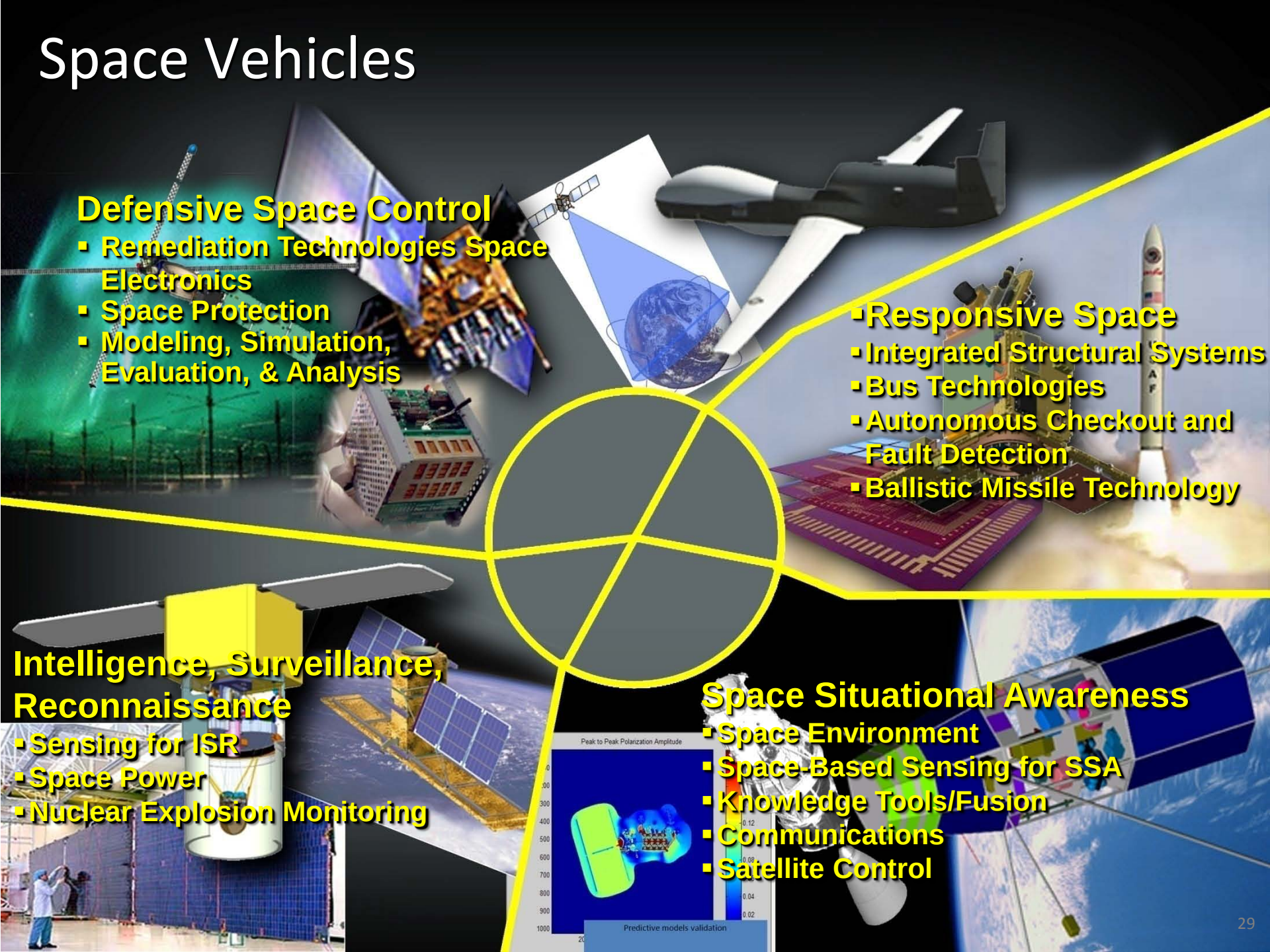
Energy, Power, and Thermal
- Battlespace Fuels
- Aircraft Power & Thermal Management
- Directed Energy Power & Thermal Management
- Special Purpose Power

Turbine Engines
- Durability – Safety & Readiness
- Highly Efficient Embedded Turbine Engine
- Efficient Small Scale Propulsion
- Fielded & Emerging Turbine Engines
- Adaptive Versatile Engine Technology

Sensors


EO Electronic Warfare
Trusted Collaborative Sensing
Enabling Sensor Devices /Components
ATR /Performance Driven Sensing
RF Electronic Warfare
EO Sensing
RF Sensing
Time [sec]
Wavelength [nm]
OV-1 AEA System of Systems
5.2 - Algorithm Innovation & Prototyping
5.1 - ATR Integration
2.1 Multi-Sensor Target Detection and ID
2.3 Close-In Sensing
2.4 Transformational Communications
6.5 Advanced Sensor Component
6.4 EO Components
TRACK

Space Vehicles



Defensive Space Control
- Remediation Technologies Space Electronics
- Space Protection
- Modeling, Simulation, Evaluation, & Analysis

Responsive Space
- Integrated Structural Systems
- Bus Technologies
- Autonomous Checkout and Fault Detection
- Ballistic Missile Technology

Intelligence, Surveillance, Reconnaissance
- Sensing for ISR
- Space Power
- Nuclear Explosion Monitoring

Space Situational Awareness
- Space Environment
- Space-Based Sensing for SSA
- Knowledge Tools/Fusion
- Communications
- Satellite Control