Overview of Air Force Science & Technology
14 Apr 10
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
The mission of the United States Air Force is to *fly, fight and win*... in air, space, and cyberspace
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
AF S&T Organization

Secretary of the Air Force
Hon. Michael B. Donley

Air Force Chief of Staff
Gen Norton A. Schwartz

Air Force Materiel Command
Gen Donald J. Hoffman

Air Force Research Laboratory
MGen Ellen Pawlikowski

AF Chief Scientist
Dr. Werner J.A. Dahm

Ass’t Secretary for Acquisition
Mr. David M. Van Buren (acting)

Tech Executive Officer (dual-hatted)

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

“PEO-like” relationship

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
AF S&T Organization - Detailed

**Air Force Research Laboratory**

MGen Ellen Pawlikowski

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<tr>
<th>Executive Director</th>
<th>Chief Technologist</th>
<th>Vice Commander</th>
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**Technical Directorates**

- AF Office of Scientific Research (AFOSR)
- Air Vehicles (RB)
- Directed Energy (RD)
- Information (RI)
- Space Vehicles (RV)
- Materials & Mfg (RX)
- Sensors (RY)
- Munitions (RW)
- 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

**Dep Ass’t Sec’y, Sci Tech Engr**

Dr. Steven H. Walker
BRAC 2005 AFRL Actions

- Center of Excellence for Human Performance at Wright-Patt AFB
- Center of Excellence for Sensors at Wright-Patt AFB
- Center of Excellence for Information at Rome NY
- RH efforts for DE bioeffects moving to Ft Sam Lab
- USAFSAM & HP
- Human Effectiveness
- Space Vehicles
- Directed Energy
- Sensors
- Information
- NAMRL
- Kirtland
- Mesa
- Brooks
- Rome
- Hanscom

I n t e g r i t y - S e r v i c e - E x c e l l e n c e
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)
AF S&T: Turning Science into Capabilities

AF S&T Strategy

Science & Knowledge
- Leads to Technologies
- Leads to Capability Concepts
- Leads to Service Core Function Capabilities

Science & Knowledge
- 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
- Informed by Long-Term Challenges

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

 Capability Concepts
- Directly impacted by AF/MAJCOM Needs
- Informed by Product/Log Centers
- Informed by Long-Term Challenges

 Service Core Function Capabilities

Integrity - Service - Excellence
AF S&T: Turning Science into Capabilities

AF S&T Strategy

Science & Knowledge

Leads to

Technologies

Leads to

Capability Concepts

Leads to

Service Core Function 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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<td>Global Integrated ISR</td>
<td>Agile Combat Support</td>
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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

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

- Transition path

  AFRL → SMC → AFSPC
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

  ![Transition Path Diagram](AFRL -> SMC -> AFSPC)
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 systems shaped by warfighter needs

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

• **Transition path**

  ![Transition path diagram](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)

- **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**

  ![Transition Path Diagram]
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
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 Fusion and Understanding
- Multi-sensor collaborative fusion
- Info-knowledge Base
- Advanced data fusion and visualization

Information Exploitation
- Comm
- Signals
- Imagery

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

Cyber Operations
- Defensive
- Offensive Assured
- Cyber Threat Avoidance

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

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

**Mfg Technology**
- Industrial Readiness
- Manufacturing Readiness

**Materials and Processes**
- Semiconductors
- Ceramics
- Hybrids
- Metals

**Materials Applications**
- Electromagnetic Spectrum Interactions
- Thermal Management
- Bio Applications
- Nanomaterials
- Nondestructive Evaluation
- Computational Materials S&E

**Support for Operations**
- Energy
- Robotics
- Systems Supt
- Operating Surfaces
- Protection
Advanced Guidance
- Integrated Sensing & Processing Sciences
- Weapon Dynamics & Controls Sciences
- Weapon Seeker Sciences
- Guidance Sub-System Integration

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

Modeling & Simulation
- Computational Physics
- Concept & Terminal
- Effects Research

Munition Systems
- System of Systems
- Integration & demo
- Multi Functional Airframe Sciences & Integration
Propulsion and Power

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

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

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

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

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