Headquarters U.S. Air Force

Integrity - Service - Excellence

AF Science and Technology Overview

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Deputy International S&T
18 May 2015

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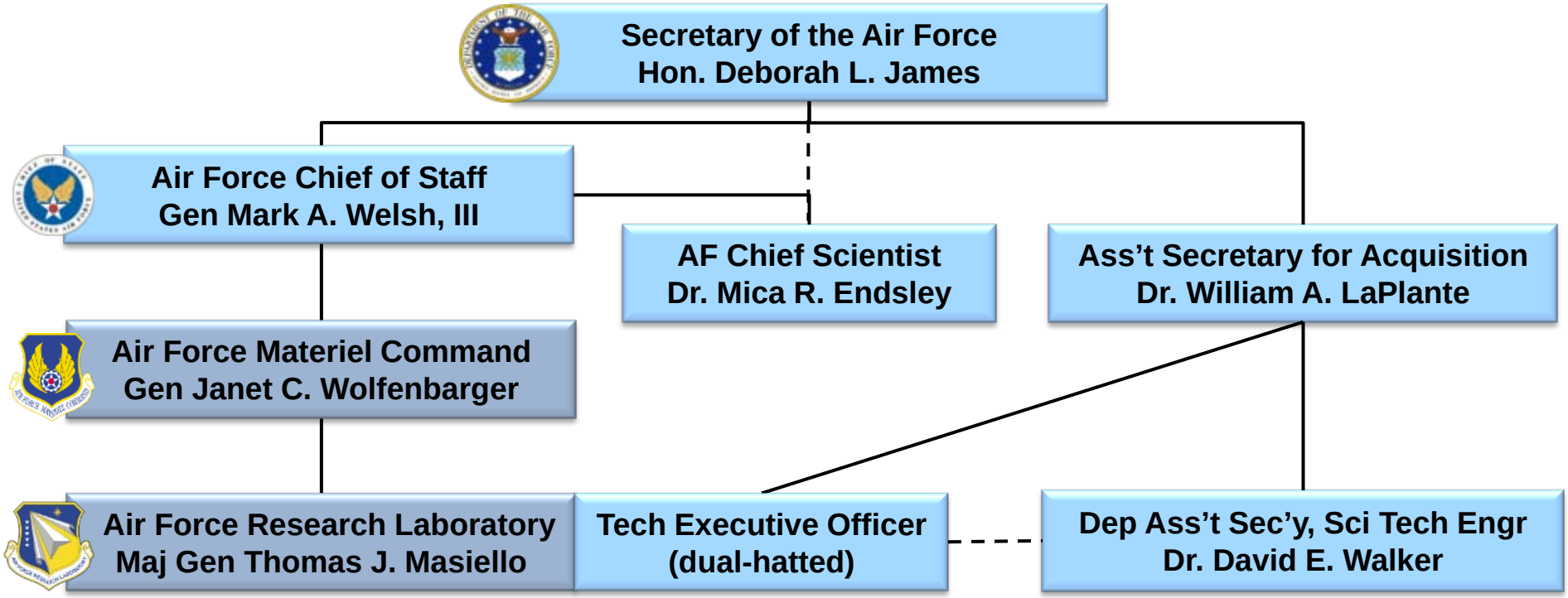
Air Force S&T Organization



- AFRL/CC under AFMC, dual-hatted as Technology Executive Officer to SAE
- SAF/AQR provides S&T guidance and oversight for SAE
- AF Chief Scientist under the CSAF advises SECAF and CSAF
- Scientific Advisory Board (SAB) reviews research quality and advises SECAF and CSAF on topics of interest

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What We Do – Core Missions

- Air and space superiority, cyber assurance
  - Air superiority foundational to joint operations & American way of war
  - Domains likely to be most contested in future
- Intelligence, surveillance, reconnaissance (ISR)
  - Maximizing battlespace awareness
  - ~60 RPA patrols, ~1,200 hrs full-motion video per day
- Rapid global mobility
  - 1M+ airlift & tanker sorties in support of Mideast ops
  - One airlift sortie every two minutes, 24/7/365
  - 97% aeromedical evacuation survival rate
- Global strike
  - Hold any target on planet at risk
  - Two-thirds of America's nuclear triad
- Command & control
  - Integrates them all

Global Vigilance, Global Reach, Global Power for the Joint Team

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DoD and AF S&T Priorities

SECDEF S&T Priorities	SECAF S&T Priorities
Autonomy Human Systems	Develop autonomous systems and human performance augmentation
EW/EP Counter A2/AD Capabilities	Enable long-range precision strike
Low-cost, Small Footprint Ops Engineered Resilient Systems	Improve sustainment, affordability, and availability of legacy systems Reduce energy dependency
Cyber S&T	Reduce cyber vulnerabilities while emphasizing mission assurance
Data-to-Decisions	Robust SA to enhance decision-makers' understanding -- ISR & PED
Tailored and Adaptive Capabilities Integrated Partnership Capabilities Counter WMD	Support needs of nuclear enterprise

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Technology Focus Areas

Next Gen Aerospace Systems

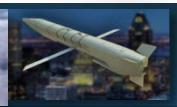

Air Vehicles


Turbine Engines

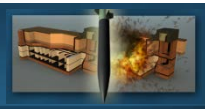

Hypersonics


Unmanned Systems

Weapons



Directed Energy


High Speed Strike

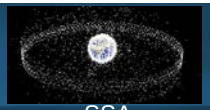

High Velocity Penetrating Munitions


Flexible Weapons

Space and Nuclear Deterrence

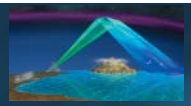

Space Access


Novel Payloads/ Platforms


SSA


Advanced Experiments

Intelligence, Surveillance, & Reconnaissance (ISR)

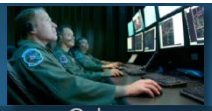

Advanced Sensors


Human-Centered ISR


Synchronized Operations

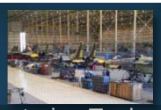
Command & Control, Cyber, Communications (C^4)

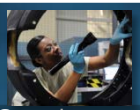

Processing, Exploitation, and Dissemination

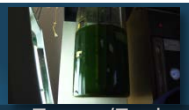

Cyber


Space Communications

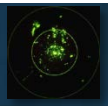
Affordability & Sustainment

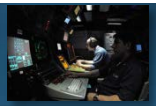

Manufacturing Technology

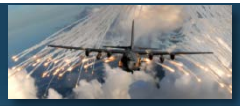

Sustainment


Energy/Fuels

Electronic Warfare / Electronic Protection (EW/EP)

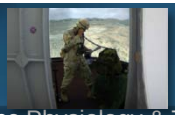

EW Plus

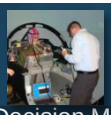

Distributed EW


Infrared countermeasures

Human Performance


Autonomy


Aerospace Physiology & Toxicology


Training & Decision Making Tech

Major International S&T Engagements

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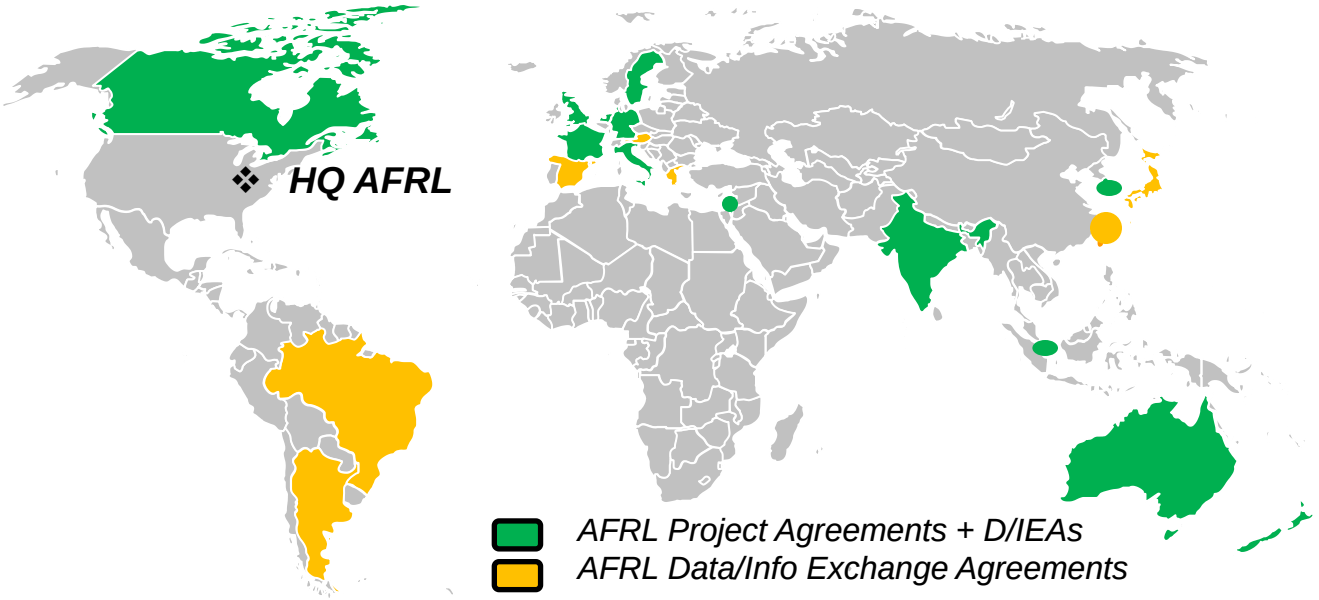
Top Multilateral S&T Forums

- NATO Science and Technology Organization
- The Technical Cooperation Program (TTCP)
- Five Powers Air SNR

Key Bilateral S&T Engagements

- Great Britain
- Australia
- Japan
- Canada
- Germany
- Singapore
- Korea
- Taiwan
- India
- Brazil

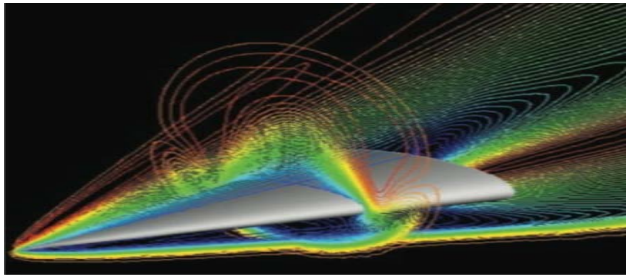


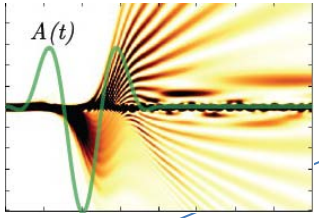
AFRL currently leveraging $300M+ in foreign partner resources

Projects with Spain

Top 5 Active Grants ($436K) in FY15 as of April 2015

Universidad Politécnica de Madrid, Prof V. Theofilis
Hydrodynamic and aeroacoustic instabilities on elliptic cone in high super-sonic and hypersonic flow

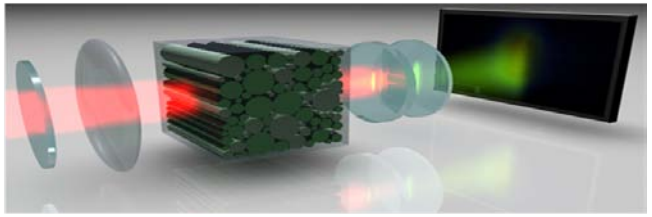




Universidad Del Pais Vasco - Euskal Herriko Unibertsittea
Prof. A. Rubio
Science & Emerging Technology of 2D Atomic Layered Materials and Devices

Real Academia de Ciencias y Artes De Barcelona
Prof S. Gladysz
Imaging through Turbulence

Universidad Politecnica de Cataluna, Prof. C. Masoller
Semiconductor laser complex dynamics: optical neurons to optical rogue



Semiconductor lasers (such as current modulation for optical communication purposes) rely on their dynamical response.

ICFO-the Institute of Photonic Sciences, Prof. M. Ebrahim-Zadeh
Compact, High-power, Agile Laser Source for Mid-Infrared Science

Generation of tunable coherent radiation in the mid-infrared and THz spectrum based on optical parametric oscillators in combination with difference frequency generation in new nonlinear materials.

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Current USAF-Spain Agreements

Air Force Office of Scientific Research (AFOSR) Activities

- 17 Active Grants with AFOSR and 10 Universities/Institutes in Spain

Foreign Comparative Testing (FCT) Projects

- Photonic Enhancements to the Science & Technology in EW Systems
  - Navy Research Lab, USAF Research Lab and DAS Photonics (Spain)
  - Increase Spectrum Agility to EW and SIGINT Systems
  - Enable countermeasures while threat systems are in still acquisition mode
  - Broader surface & airborne spatial/spectral mission options

Master Agreements

- Engineer and Scientist Exchange Program (ESEP)
  - Signed: February 2007, Expires February 2027
- Master Data Exchange Agreement for the Mutual Development of Weapons Systems
  - Signed: June 1980, no expiration
- Sonseca Seismic Monitoring MOU (Program MOU)
  - Signed: January 1996, no expiration

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Proposed Areas of Cooperation

- **AFRL Space Vehicles Directorate (AFRL/RV)**
  - GEO Observations with Latitudinal Diversity
  - Micro-Gravity, Two Phase Flow Research
- **AFRL Directed Energy Directorate (AFRL/RD)**
  - Non-linear Optics
- **AFRL Human Effectiveness Directorate (AFRL/RH)**
  - Cognitive Science
  - Cognitive Modeling and Human Behavior Representation
  - Autonomy
  - Pilot inflight Psychophysiological Assessment
  - Hex-chrome Lifetime Exposure Monitoring

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Proposed Areas of Cooperation Cont.

- **AFRL Human Effectiveness Directorate (AFRL/RH) cont.**
  - **Aircraft Oxygen System Containment Assessment**
  - **High Fidelity Biodynamic Spinal Injury Modeling for Aircraft Ejection**
  - **Speech and Language Technologies**
  - **Live Virtual and Constructive Training**
  - **Nanotechnology**
- **AFRL Information Directorate (AFRL/RI)**
  - **High Performance Computing**

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Engineer and Scientist Exchange Program (ESEP) Update

- **Capt Rachel Kolesnikov-Lindsey (2012-2014)**
  - Air Force Research Laboratory Materials and Manufacturing Directorate (AFRL/RX)
  - ESEP Participant at INTA (National Institute for Aerospace Technology) Research area focus: DIANA UAS Target Aircraft, MILANO Strategic ISR UAS, Fabrication Process
  - Interviewed by a Spanish Radio Station
  - HUGE success
- **Capt Kevin O'Neill (2015-2017)**
  - Air Mobility Analyst/Chief Scientist, AMC/A9 Analyses, Assessments & Lessons Learned
  - ESEP Participant to work at Área de planificación y control de la Subdirección, Tecnología e Innovación in Madrid
  - Currently at Defense Language Institute in Washington, DC
  - Departs for Spain summer 2015 for a two year tour

The USAF welcomes engineers and scientists from Spain to participate in the ESEP in the US!

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Summary

- **Air Force S&T is balanced between meeting warfighter current needs and discovering/developing new game-changing technologies**

- **International cooperation with our trusted partners accelerates S&T results, leverages resources, and facilitates interoperability.**

Maintaining our technological advantage is vital to ensuring freedom of access and action in air, space and cyberspace