
Introduction to MIT Lincoln Laboratory

Bernadette Johnson, Chief Technology Venture Officer

MIT ILP R&D Conference

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Who Are We – A Little History

- MIT Radiation Laboratory: October 1940 – December 1945



Mission: *Development of radar systems and technology*

Main projects: Surveillance radar
Fire control radar
Navigation systems

4000 employees
Designed half of all US WWII radars



- MIT Lincoln Laboratory in the 1950s



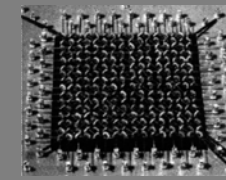
Established 1951: *Air defense and technology development*

Main projects: Semi-Automatic Ground Environment (SAGE)
- Spun-off Mitre in 1958 to operate SAGE

Major Innovations:



Real-Time
Computing



Magnetic-core
Memory



Light-pen CRT
Interface

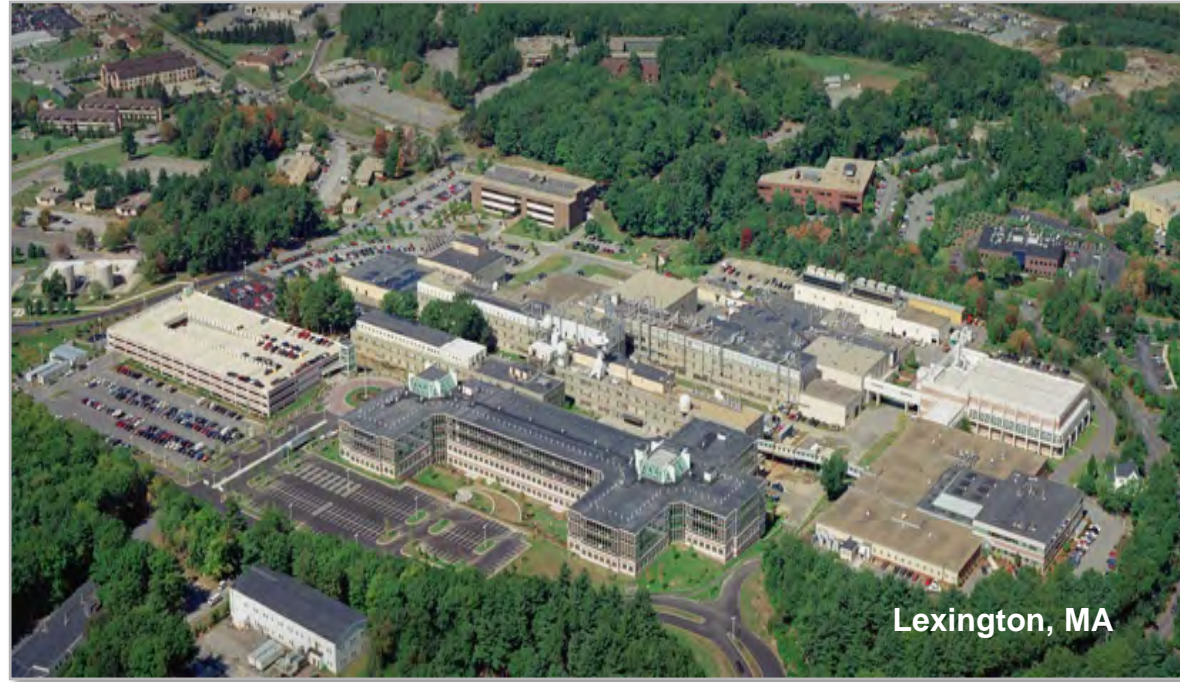


MIT Lincoln Laboratory Today



MIT: Cambridge, MA

Shared Values –
Technical excellence
Integrity
Meritocracy



Lexington, MA



Kwajalein, Marshall Islands



Albuquerque, NM

DoD Federally Funded Research and Development Center
Systems architecture engineering
Long-term technology development
Rapid system prototyping and transition

~4000 employees
~\$1B in FY19



Socorro, NM

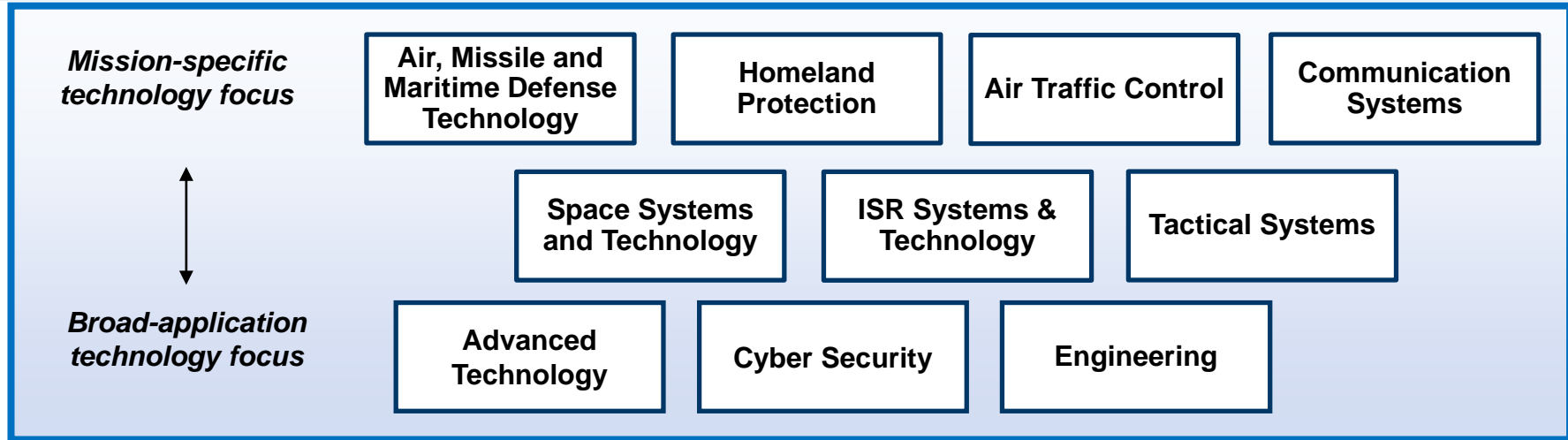


Westford, MA



Technology in Support of National Security

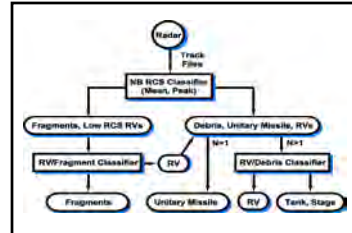
MIT Lincoln Laboratory Division Structure



Advanced Technologies



Cryogenic Yb:YAG Lasers



Decision Architectures

System Prototypes



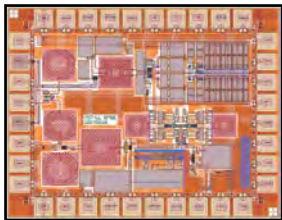
Rapid Agent Aerosol Detector



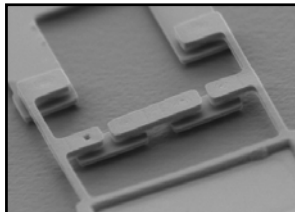
XTR-1 radar



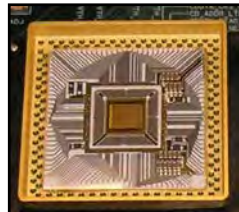
Haystack Ultra-wideband



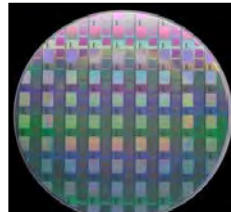
Miniature Low-Power Transceivers



Quantum Bits



APD Arrays



Advanced Focal Planes



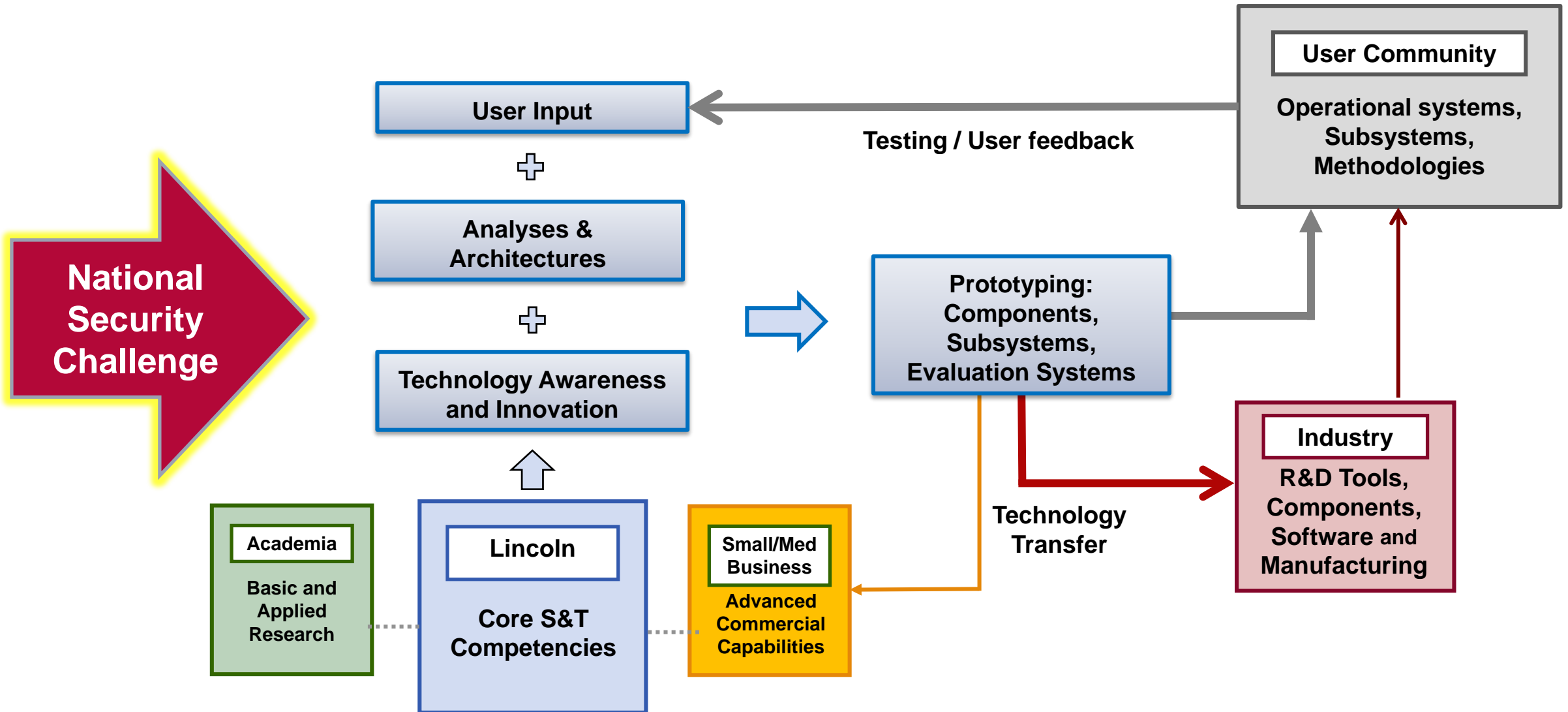
Lunar Laser Comm Demo



Space Surveillance Telescope


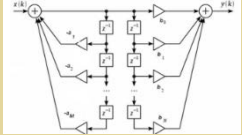





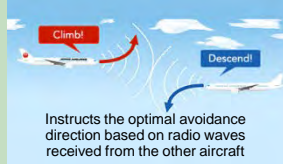


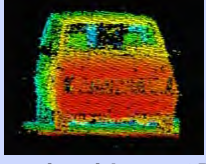
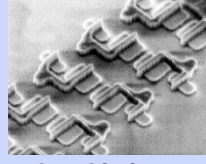




Advanced Technology Development and Transition





68 Years of Impact for the Nation

<p>First Continental Air Defense System</p>  <p>Protected US from Soviet nuclear attack for 20 years</p>	<p>Digital Signal Processing & Error-Correcting Codes</p>  <p>Inventions of recursive digital filters and Reed-Solomon codes</p>	<p>First Fully-Transisterized Real-Time Computer</p>  <p>Spawned commercial mini-computer industry</p>	<p>Coincident Core Memory</p>  <p>Birth of nonvolatile memory</p>	<p>First Television Picture Transmission via Satellite</p>  <p>Used NASA'S Echo I Satellite</p>
<p>First RADAR-based Satellite Imaging</p>  <p>ALCOR radar located at Kwajalein</p>	<p>First Transmission of Packetized Speech</p>  <p>Forerunner of voice over internet protocol (VoIP)</p>	<p>Airborne Collision Avoidance System</p>  <p>Instructs the optimal avoidance direction based on radio waves received from the other aircraft</p> <p>Installed on <i>all</i> planes with >19 passenger seats</p>	<p>First Prototypes for All Military Comm. Satellites</p>  <p>DSCS, MILSTAR, WGS, AEHF, MUOS</p>	<ul style="list-style-type: none"> 1950–1960s 1970–1980s 1990–present
<p>Air Defense of the National Capital Region</p>  <p>Rapid deployment post 9/11</p>	<p>3-D Laser Imaging</p>  <p>Permits airborne 3D imaging through trees</p>	<p>193nm Optical Lithography</p>  <p>Leap ahead in integrated circuit technology</p>	<p>NASA Chandra X-Ray Observatory</p>  <p>Advanced CCD imaging spectrometer</p>	<p>First Laser Communications from Lunar Orbit</p>  <p>622 Mbps downlink for 30 days with zero bit errors</p>



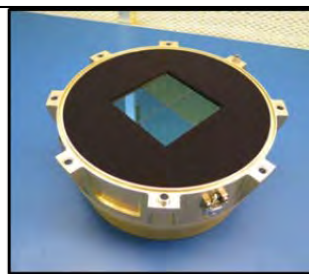
Transiting Exoplanet Survey Satellite (TESS)

All-sky, two-year photometric exoplanet discovery mission



First Light 26 April
2018
(1/4th of FOV Displayed)

Launched 18 April 2018
Final Lunar Resonant Orbit: 30 May 2018





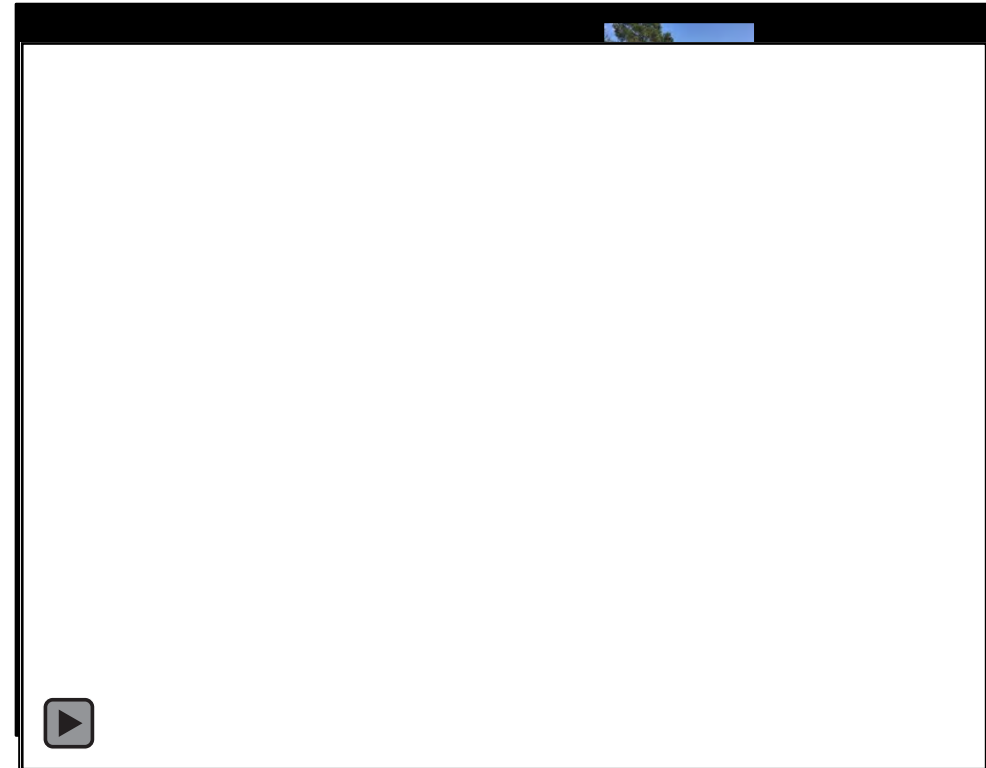
Airborne Ladar for Disaster Response

MIT LL Airborne Optical Systems Testbed



**3D GM-APD laser
radar on Twin
Otter aircraft**

Post-Harvey Debris Quantification



MIT Lincoln Laboratory rapidly deployed advanced ladar system and analytics to support FEMA and the National Guard with Texas Hurricane Harvey recovery



MIT Lincoln Laboratory Beaver Works

300 Technology Square + MIT Building 31, Cambridge, MA



300 Technology Square



MIT Building 31



Prototyping lab, classrooms, and research area (~9,000 sqft)

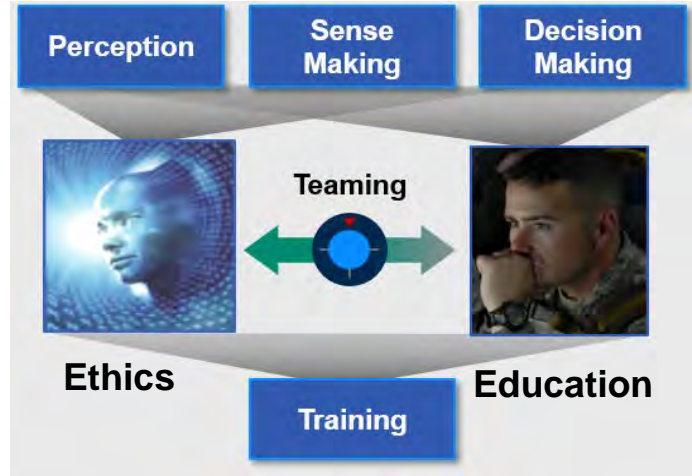
Lincoln Beaver Works Activities

- **Lincoln Beaver Works capstone projects (Lincoln funding and/or mentors)**
 - Persistent USV for ionosphere measurement (2.013/2.014)
 - Carbon neutral cooling (2.013/2.014)
 - SVTOL aircraft design (16.82)
- **Lincoln funded research projects / research assistants**
 - Two UAV-related research projects
 - Cyber research focusing on software analysis and vulnerability discovery
- **Beaver Works Summer Institute (BWSI)**
 - Elite summer program for rising high school senior ~ 200 participants summer 2018
 - Hands-on courses with a focus on robotics and AI
- **Other activities**
 - Cyber Capture the Flag (university teams)
 - Cyber Patriot Teams (high school teams)
 - Assistive Technology Hackathon
 - LL IAP courses
 - Lincoln seminar series

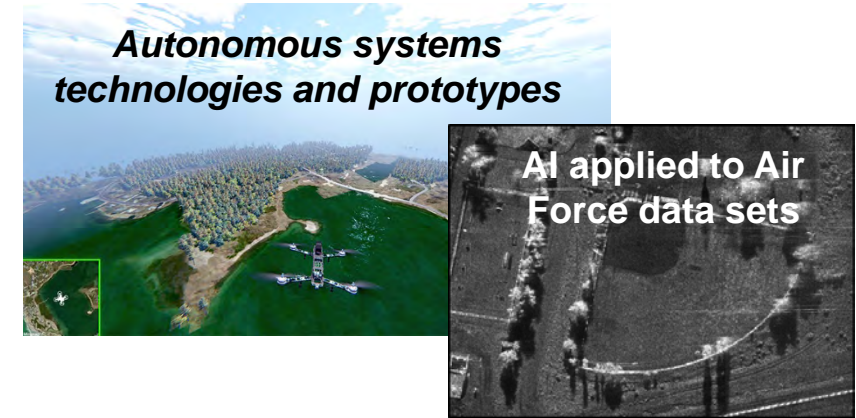


Air Force AI Accelerator (New 2019)

Groundbreaking R&D spanning foundational AI domains



Application of AI to Air Force prototypes and missions



- **Program Name:** AI Accelerator
 - 5 year MIT program sponsored by Air Force
- **Goal:** MIT to conduct open, fundamental research to advance AI including applications of new results to national security

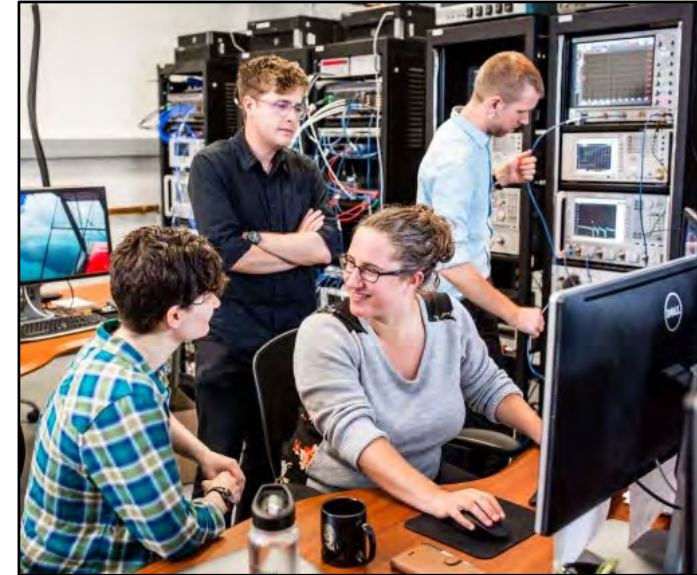


AI Accelerator Memorandum of Understanding (MoU) signing between the Air Force and MIT



Objectives

- Define the emerging discipline of quantum engineering
- Educate and train tomorrow's quantum engineers
- Partner with academia, government, and industry
- Advance the nation's leading role in QIS and Engineering
- Stepping stone to a future center with expanded participation



Meet the Instructors

			
Isaac Chuang Professor of Physics, Professor of Electrical Engineering, Senior Associate Dean of Digital Learning	William Oliver Professor of the Practice, Physics, Laboratory Fellow, Lincoln Laboratory, Associate Director, Research Laboratory of Electronics	Aram Harrow Associate Professor of Physics	Peter Shor Marss Professor of Applied Mathematics, Applied Mathematics Committee Chair, Quantum Computation, Quantum Information

quantumcurriculum.mit.edu

MIT Quantum Computing Curriculum

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Lincoln Laboratory Community Outreach

**Grades K-6
Science on Saturday**



**Grades 6-8
Girls Who Build Programs**



**Grades K-12
U.S. FIRST Robotics**



**Grade 12
Beaver Works Summer Institute**



**Grades 9-12
LLCipher Cryptography Class**



**Grade 12
LLRISE Radar Workshop**





Notable Lincoln Laboratory Spin-Offs

