Integrity ★ Service ★ Excellence

Air Force Office of Scientific Research (AFOSR)

11 March 2015

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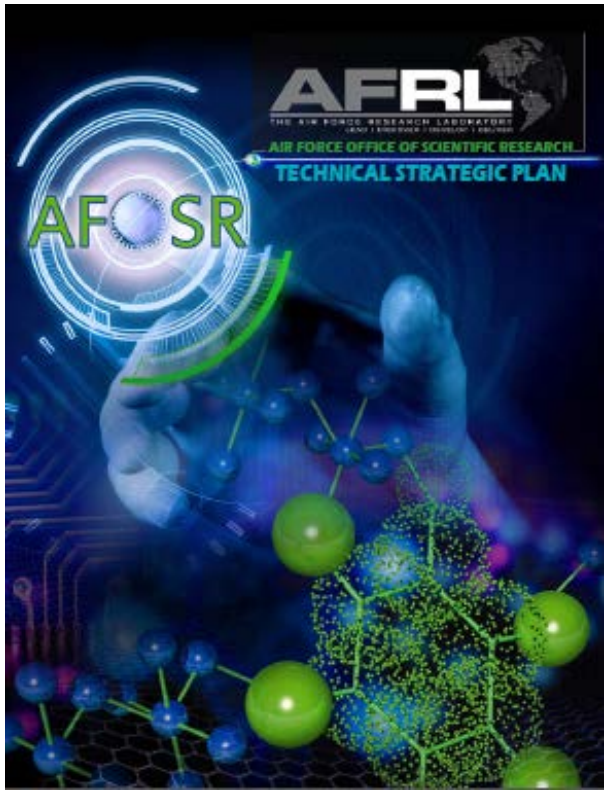
Air Force Office of Scientific Research
Air Force Research Laboratory

60+ Years of Basic Research

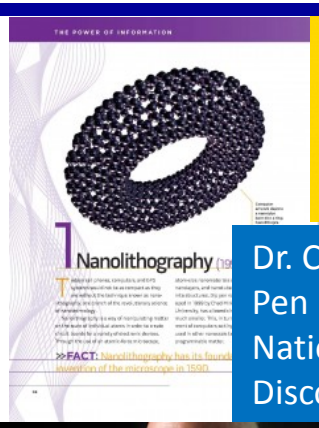
AFOSR Vision & Mission

- **Vision**
  - The U.S. Air Force dominates air, space, and cyberspace because of revolutionary basic research
- **Mission**
  - Discover, shape, and champion basic science that profoundly impacts the future Air Force
- **Scope**
  - AF basic research program: $390M
  - AF part of the OSD University Research Initiative program - $147M



Why does the Air Force Invest in Basic Research?

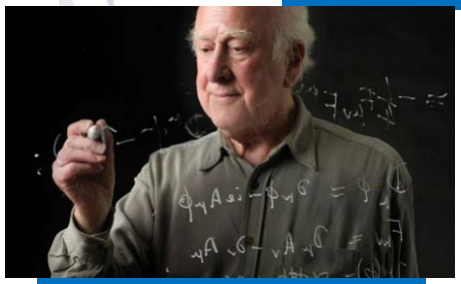
- **To probe today's technology limits and ultimately lead to future technologies with DoD relevance**



Dr. Chad Mirkin's research on Dip Pen Nanolithography was featured in National Geographic's '100 Scientific Discoveries That Changed the World'

- **Attract the most creative minds to fields of critical DoD interest**

AFOSR Sponsored 73 Nobel Laureates



2013 Nobel Prize in Physics – Dr. Peter Higgs, Univ of Edinburgh

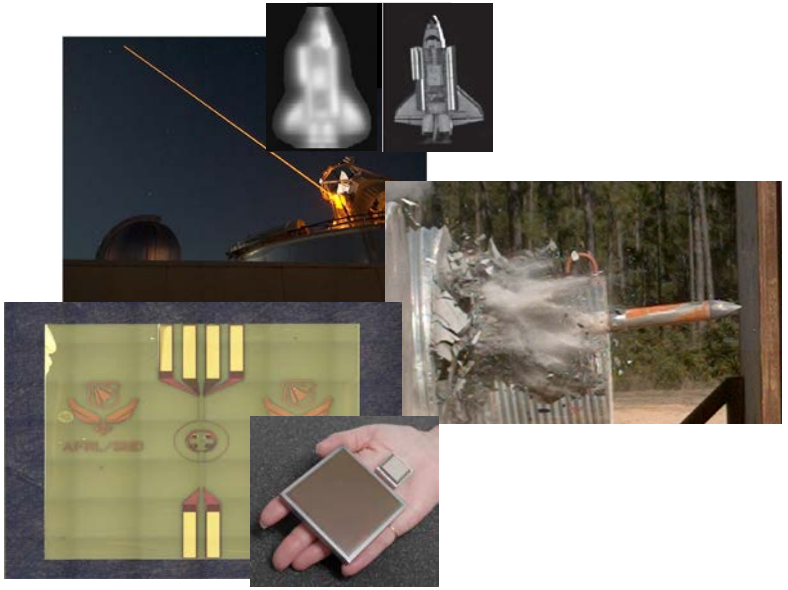
2012 Nobel Prize in Physics Dr. David Wineland, Univ of Colorado/NIST

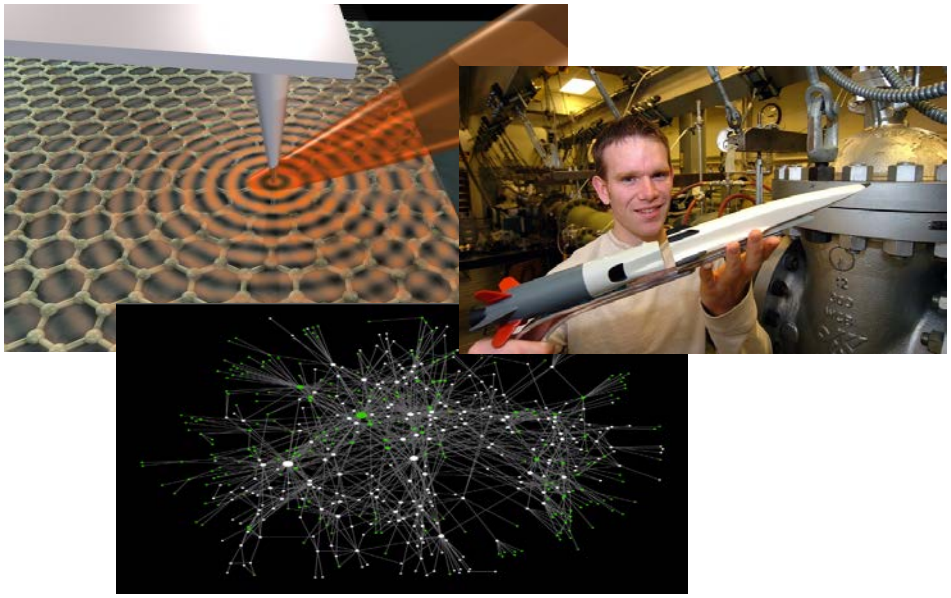
- **Create a knowledgeable workforce in fields of critical DoD interest**

Dr. Greg Pitz & Dr. Onome Scott-Emuakpor, AFRL scientists, received 2013 PECASE awards.

Executing Our Mission

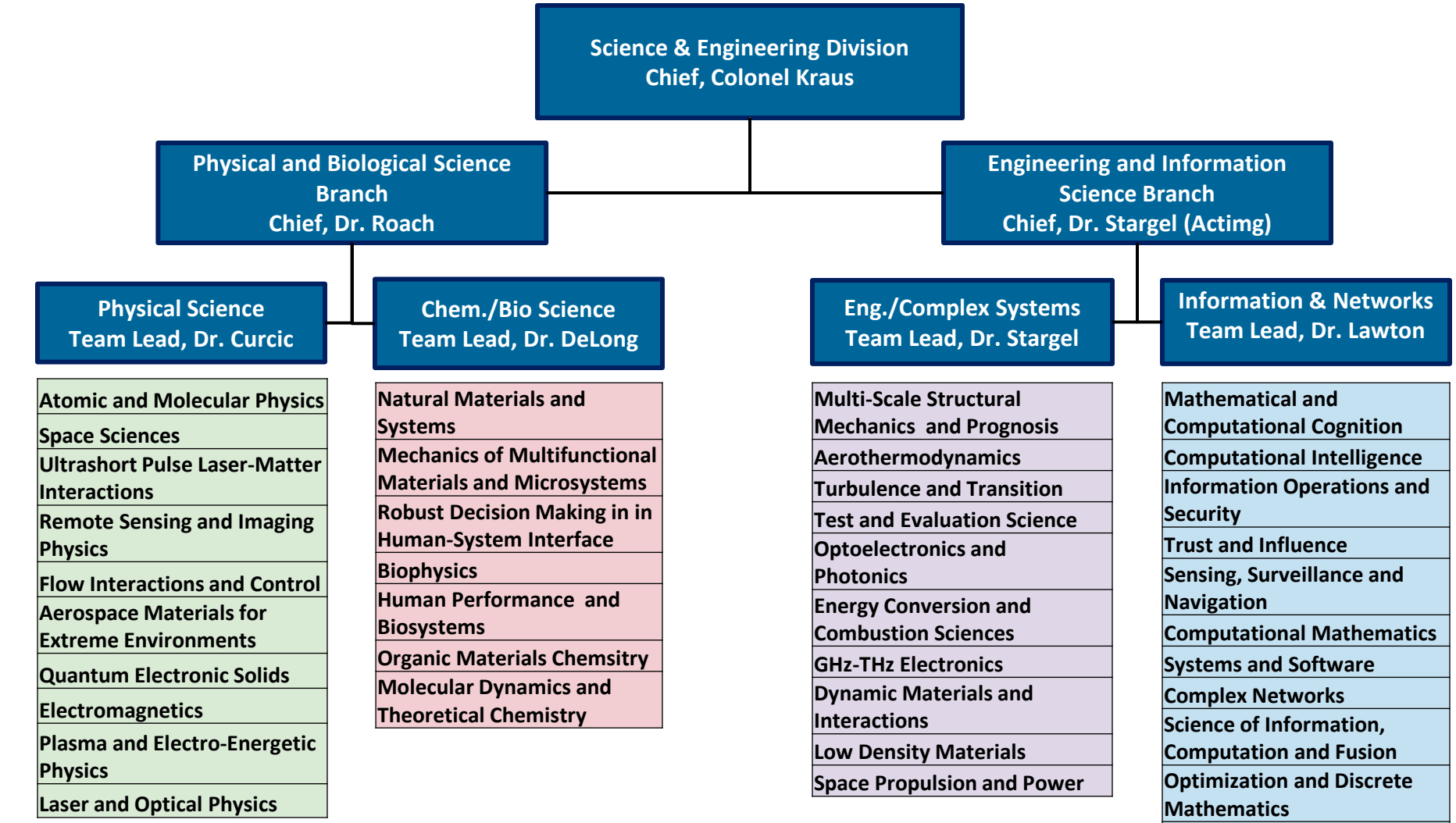
- **Intramural (AFRL) program**
  - **Lab tasks**
  - **Academic connections**
  - **International opportunities**



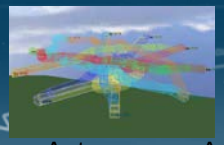


- **Extramural (university and industry) programs**
  - **Grants**
  - **Young Investigators**
  - **STTR contracts**

Basic Research Division



International Outreach



Autonomous Agents for Air Traffic Control: **Czech Technical University**

US-Korea Nano-Bio-Info Technology Program

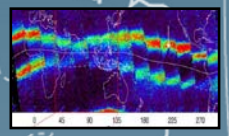
London

Arlington

Tokyo

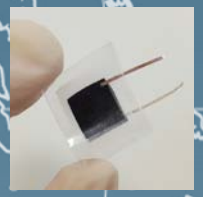
- Accelerating S&T transitions and achievements to the U.S.
- Avoiding technological surprise
- Strengthening partnerships
- Building international goodwill

Photorefractive Polymers - **Mexico**

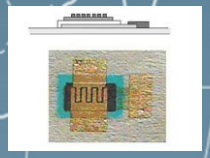


Ionospheric Prediction – **Brazil**

Santiago



Flexible Supercapacitor **Singapore**



Nanoparticle Solutions for Printed Electronics - **S. Africa**

HyShot scramjet – **Australia**

Awareness of, and access to, international basic research

Scientific Partnerships

- Hypersonics Research
- Non-equilibrium flow
- Digital Twin
- Nanocomposites
- Living With a Star Steering Committee

- Ultracold atoms, Quantum sensor-magnetometry
- Microplasma for counter HPM
- Plasma-based logic circuits for rad-hard applications
- Photonics, High-power energy,
- Many more…

- Quantum computing, transducers project
- Info ops and security

- Complex Networks OSTP/NITRD committee member

- Cognition

- Nanophotonics

- Partnership for Research in Optical Technology
- Multi-agency Materials Genome Initiative

- Combustion Working Group
- Multi-Agent Sys.

- Origami Structures, aero
- Solar and heliospheric physics
- Decision Making, Social and Behavioral Science, plasma chemistry, and others

- Alternative energy Interagency
- Pulse Power Energy
- High temperature superconductors

- Nanoenergetics: co-crystallization
- Combustion Chemistry

- Many joint reviews
- Metamaterials research
- Laser propagation
- Graphene research
- Alt Navigation
- Other areas

Space Weather

Working with many industry and international teams on various research topics

OSD University Research Initiatives

- **Multidisciplinary Univ Res Init (MURI) :**
  - 5-year grants, $500K 1st year, $1.5M each in years 2-5

FY15 Air Force MURI Topics

  - *Exploiting Biological Electromechanics: Using Electromagnetic Energy to Control Biological Systems*
  - *Large Scale Nano-Architecture Formation*
  - *Membrane-Based Electronics: Foldable & Adaptable Integrated Circuits*
  - *Semantics and Structures for Higher-level Quantum Programming Languages*
  - *Strong Field Laser Matter Interactions at Mid-Infrared Wavelength*

- **Defense Univ Res Instrumentation Program (DURIP):**
  - 1-year grants, up to $1.5M
  - Improve the capabilities of U.S. institutions of higher education to conduct research and to educate scientists and engineers in areas important to national defense by providing funds for acquisition of research equipment.

Develop Next Generation S&Es (AFOSR STEM Programs)

- **National Defense Science and Engineering Graduate Fellowship (NDSEG)**
  - Full tuition assistance + $31K/per year stipend
  - Fellows do not incur any service obligation
  - Supports over 550 PhD-track graduate students

- **Awards to Stimulate and Support Undergraduate Research Experience (ASSURE)**
  - Provide undergraduates with research opportunities in S&E fields of DoD interest
  - Supports over 500 undergraduate students during summer months – managed by National Science Foundation

ASSURE site at Fort Johnson, NY

- **Junior Science and Humanities Symposia (JSHS)**
  - Provide high school students opportunities to conduct an original research investigation in the STEM field

USA Science & Engineering Festival , DC

University Centers of Excellence

- Flexibility and continuous quality assurance
- Perform excellent research in high priority Air Force interest areas
- Strengthen AFRL in-house technical capabilities by providing frequent substantive professional interchanges between AFRL and university personnel
- Educate students in vital technology areas and offer opportunities for AFRL new employee recruitment
- Jointly managed and funded by AFOSR and AFRL TDs

Current Centers of Excellence (CoEs):

- Assured Cloud Computing (RI/Univ. of Illinois)
- High-rate Deformation Physics of Heterogeneous Materials (RW/Cal Tech)
- Integrated Computational Material Science and Engineering of Structural Materials (RX/Johns Hopkins)
- Guided Wave Infrared Sources (RY/Univ. of Wisconsin/Penn State)
- Nature-inspired Sciences (RW/Univ. of Washington)
- Advanced Bioprogrammable Nanomaterials (RX/Univ. TBD)
- Electromagnetic Interference for Extreme Electromagnetic Environments (RD/ Univ. TBD)

Resident Researcher Programs

National Research Council Resident Research Associate Program

- Provides Postdoctoral Scientist and Engineers to work at
  - AFRL Technical Directorates, AFIT, Air Force Academy
  - Renewable up to 3 years

Summer Faculty Fellowship Program (SFFP)

- 8-12 weeks of research experience for up to 150 faculty members
- AFRL Technical Directorates, AFIT, Air Force Academy
- Faculty can bring graduate students (up to 80)

HBCU/MI Program

Historically Black Colleges and Universities / Minority Institutions

- Enhance defense-related research at covered educational institutions
- Provides grants for research and instrumentation
  - $200,000 per year for three years ($600,000 max)
  - $4.5M expected to be awarded in 2015

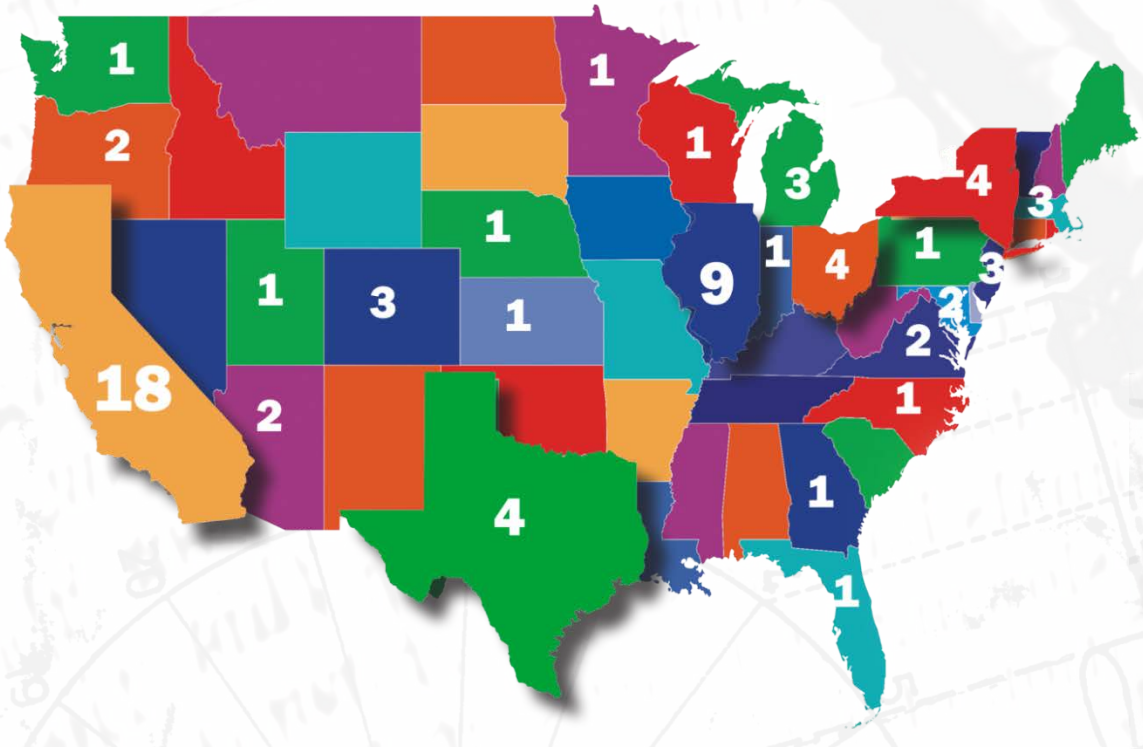
Young Investigator Research Program (YIP)

- Supports scientists and engineers who have received Ph.D. or equivalent degrees in the last five years and show exceptional ability and promise for conducting basic research.
  - *Foster creative basic research in science and engineering*
  - *Enhance early career development of outstanding young investigator*
  - *Increase opportunities for the young investigator to learn about AF research interests*
- **$120K/yr x 3 years (up to 5) each**
- **FY14: 39 New YIPs**
- **FY15: 57 New YIPs (Just Announced!)**

Small Business (University-Industry) Collaborations (STTR)

- **Small Business Technology Transfer (STTR) contracts provide up to $850,000 for early-stage R&D directly to small companies working cooperatively with U.S. research institutions**
  - Company must be U.S. for-profit small business
  - Research institution must be a U.S. college or university, FFRDC, or non-profit research institution
  - Principal investigator may be employed at small business or research institution
- **Support in FY14: 26 STTR awards**
  - $10.3M total funds
- **More information**
  - http://www.afsbirsttr.com/
  - http://www.acq.osd.mil/osbp/sbir/

AFOSR's Entrepreneurial Impact

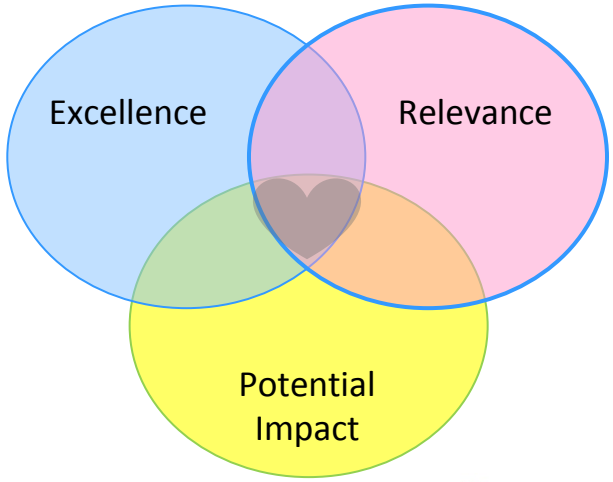


AFOSR funding has resulted in or significantly contributed to the establishment of 72 cutting-edge startup companies.

- Critical innovative technologies
- 24 states with new industries & new jobs
- Future scientists trained
- Sharing in foreign technology

How To Do Business With AFOSR

- **General GRANT Submission Process**
  - **Researchers submit white papers to AFOSR program officers (PO)**
  - **Promising white papers lead to request for full proposals**
  - **Individual grants awarded for up to 5-years in duration**
- **POs weighs several factors in selecting proposals for funding**
  - White paper process to identify overlap with program interests
  - Encourage proposals with high potential for breakthroughs
  - Peer review to gauge scientific merit
  - Programmatic issues
    - Strategic directions
    - Portfolio coverage
    - Budget realities



Broad Agency Announcement (BAA) open at all times to innovative ideas
http://www.wpafb.af.mil/afrl/afosr/

Social Media

60 years AFOSR

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH 1951 - 2011 AFRL

www.facebook.com/afosr

www.twitter.com/afosr

www.youtube.com/TheAFOSR

AFRL

AFOSR

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

AFOSR Supports AFRL "Game Changers"

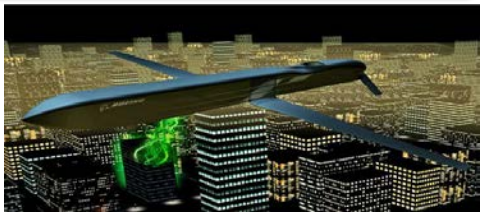
- **Autonomy**

Research includes decision and control theories, and how to co-ordinate the collective management of adaptive sensors

- **Hypersonics**

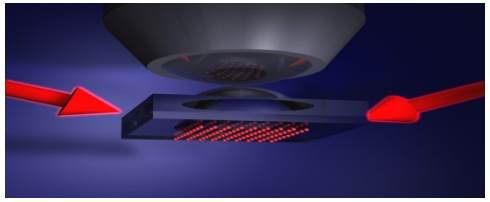
Research on characterization, modeling and interactions between unsteady aerodynamic flow field, thermal science, and structures.

- **Directed Energy**



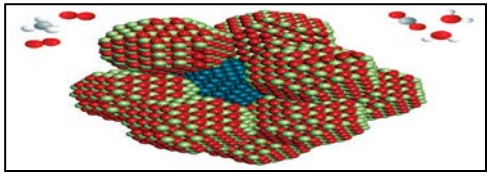
Develop relativistic plasma physics tools for high power/energy coherent electromagnetic signal generation.

- **Alternative Navigation**



Enhanced capabilities in precision navigation, cold chemistry, ultracold plasmas, metrology, and negative index materials.

- **Fuel Efficiency**



Create advanced fuel/propellants that can enable new mission capabilities or longer duration mission.

- **Big Data**

Understand relevant information from high-dimensional heterogeneous, or streaming data with quantifiable & provable performance.

AFOSR-Supported Nobel Prize Winners