Defense Basic Research

NDIA 7th Annual S&E Technology Conference/DoD Tech Expo

Presented by

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(Laboratories and Basic Sciences)

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O1 OUSD(AT&L), 10/20/2003

Defense Basic Research

- ***Why do Basic Research in DoD?***
- ***Basic Research in context of Defense RDT&E***
- ***STEM Workforce/Education***
- ***Summary***

Main Purposes for Defense Basic Research

- ***Generate new knowledge and understanding as foundation for future defense technologies***
- ***Train scientists and engineers in key disciplines for defense needs***
- ***Sustain research infrastructure needed for continued performance of cutting-edge defense research***

DoD's Basic Research Program

- **Competitive, multifaceted program to enable revolutionary ideas**
  - University based, single investigators, broad areas
  - In-house laboratories for "smart buyer" and "essential capabilities"
  - Industry and services to exploit results
- **Flexible, balanced portfolio**
  - Long-term, mission orientation
  - Stable commitment to key capabilities (e.g., sensors)
- **Infrastructure support**
  - University personnel and students
  - Laboratories (lean, modern, focused)
- **Planning and oversight**
  - Link to top-down elements (S&T Strategy, DTAP, JWSTP, DTOs)
  - Basic Research Review
  - Service reviews, peer and merit reviews

FY07 RDT&E Budget Request

- All FY07 Dollars -

FY07 RDT&E request = $72.97B
(Budget Activities 1-7)

Components (All RDT&E)	$B
Army	10.86
Navy/ Marine Corps	16.91
Air Force	24.40
Def Agency & SOCOM	20.81

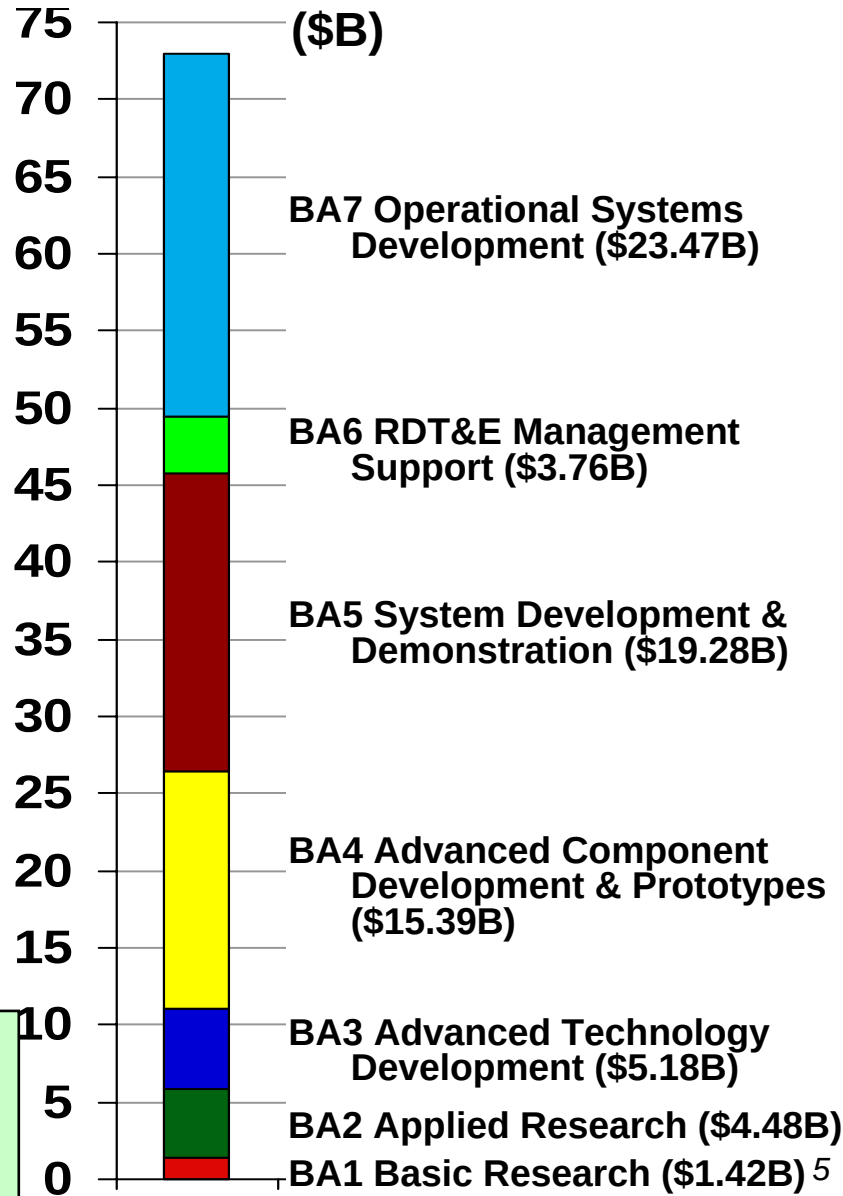
(BA6 + BA7 = $27.23B)

Development
(BA4 + BA5 = $34.66B)

Science and Technology
(BA1 + BA2 + BA3 = $11.08B)

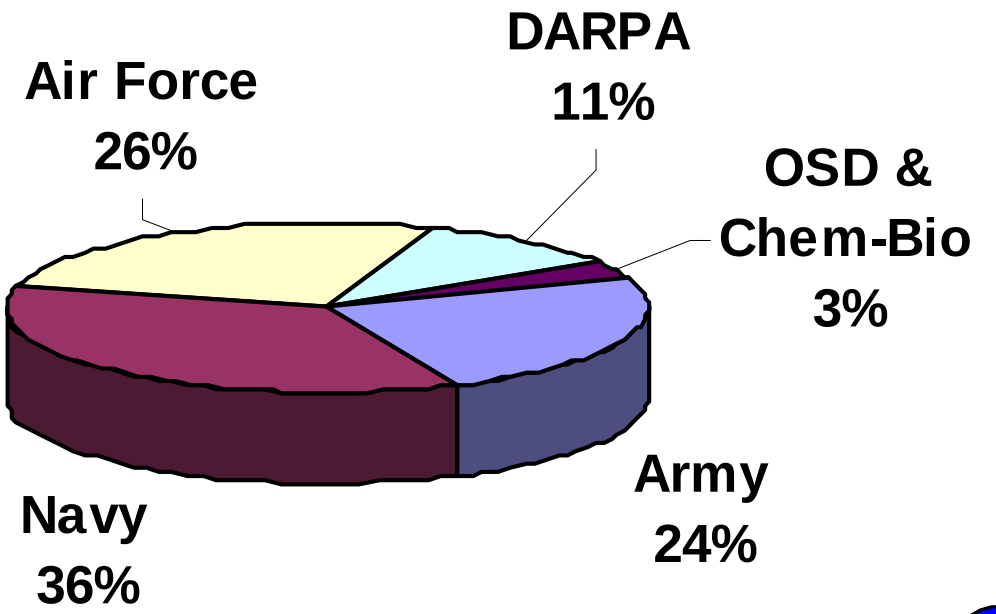
15.2% of RDT&E

Technology Base (BA1 + 2) = $5.90B)

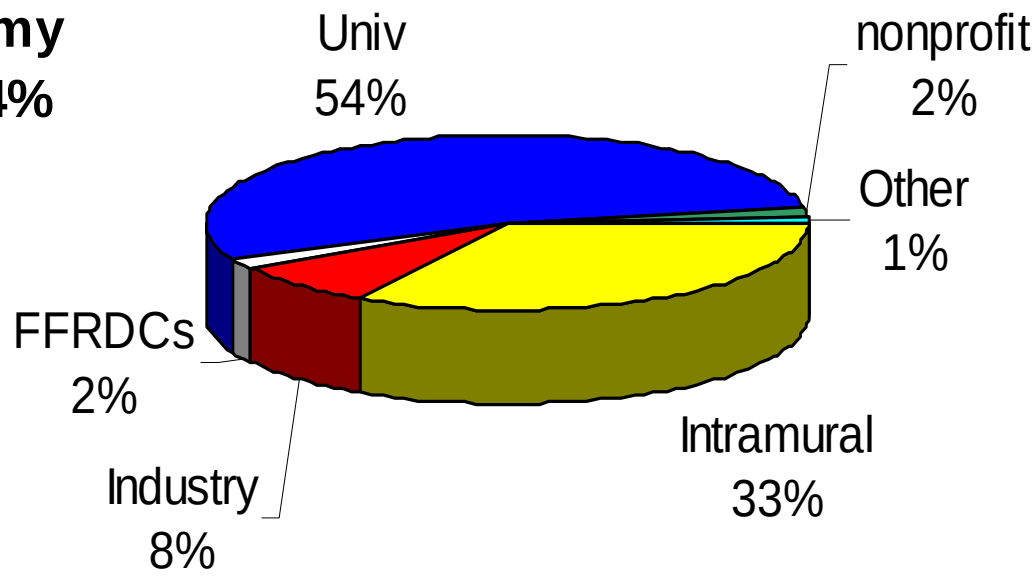


Source & Destination of Defense Basic Research Funding

←Source 86% of Defense Basic Research ($1.33B) is from Investments by Military Departments



Destination→ Performers of Defense Basic Research



Basic Research is Focused in Areas Important to Defense

- ***Invest in broad base of DoD-relevant areas across scientific and engineering disciplines***
- ***Broad base is complemented by six Strategic Research Areas, some of most exciting areas with high potential for DoD benefit:***

Bioengineering Sciences
Human Performance Sciences
Information Dominance
Multifunction Materials
Nanoscience
Propulsion and Energetic Sciences

- ***Complements other Federal agency investments. For example, while DoD provides only about 6% of total Federal investment in basic research, it provides:***

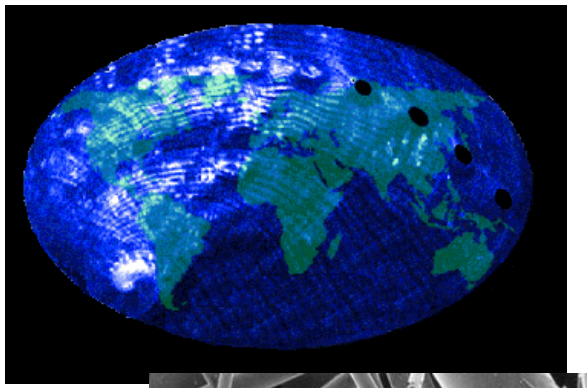
75% of Federal basic research funding in electrical engineering
66% of funding in mechanical engineering
40% of funding in mathematics and computer science

Basic Research Plan (BRP)

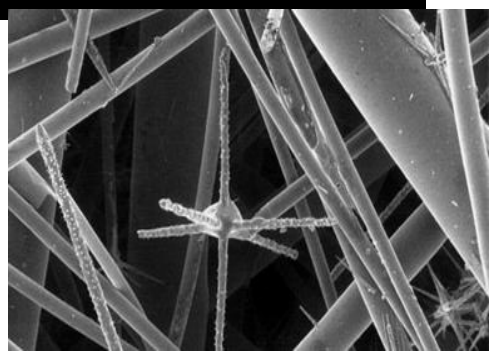
- ***Basic Research Areas***
  - **Physics**
  - **Chemistry**
  - **Mathematics and Computer Science**
  - **Electronics**
  - **Materials Science**
  - **Mechanics**
  - **Terrestrial and Ocean Sciences**
  - **Atmospheric and Space Sciences**
  - **Biological Sciences**
  - **Cognitive and Neural Science**

A Strategic plan guiding new technology development built around Basic Research Areas

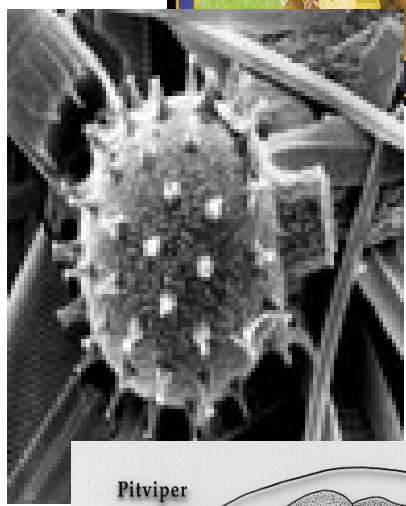
Bioengineering Sciences

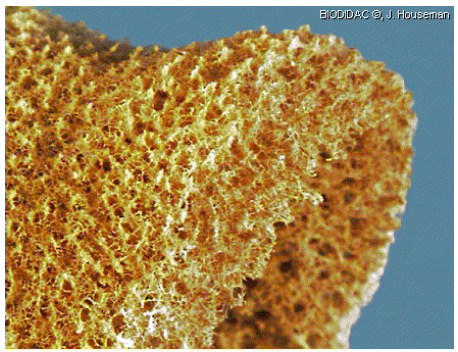


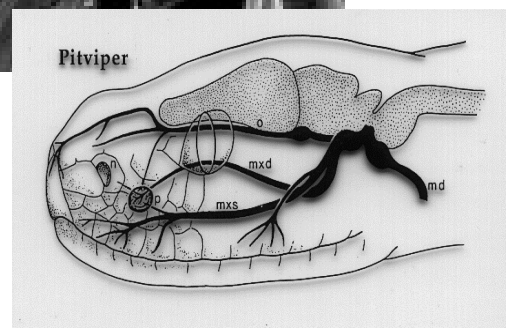
The science and technology of underlying design principles found in nature to enable the development of novel synthetic materials, processes, and sensors.



- Biomaterials
  - -Bioceramics
  - -Hybrid structures
- Bioprocesses
  - -Vision systems
  - -Auditory systems
  - -Networks
  - -Neural computation
- Biosensors
  - -Artificial nose
  - -Stochastic sensing
  - -electronic eyes



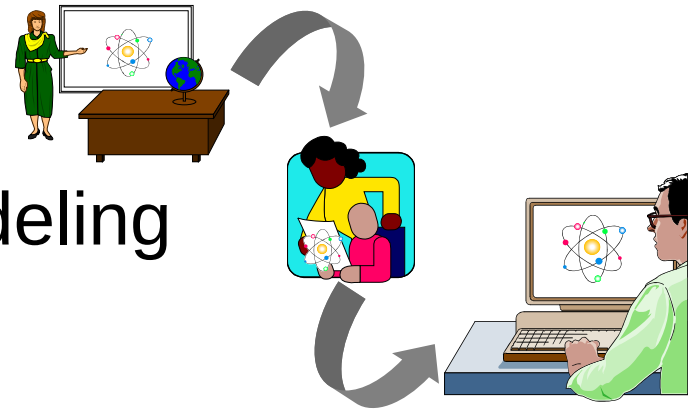




DoD Applications: Lightweight armors, Biochem sensors, smart sensors, bio-robotics

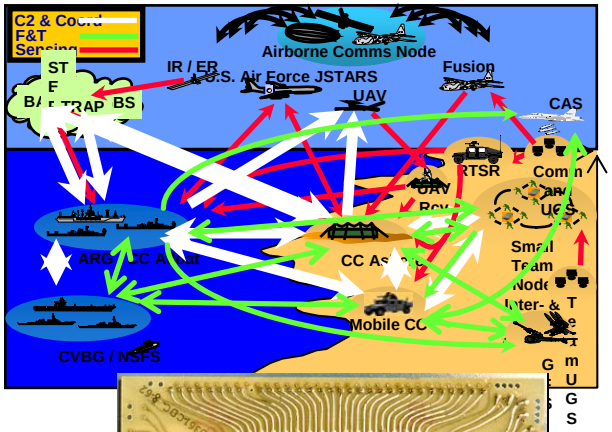
Human Performance Sciences

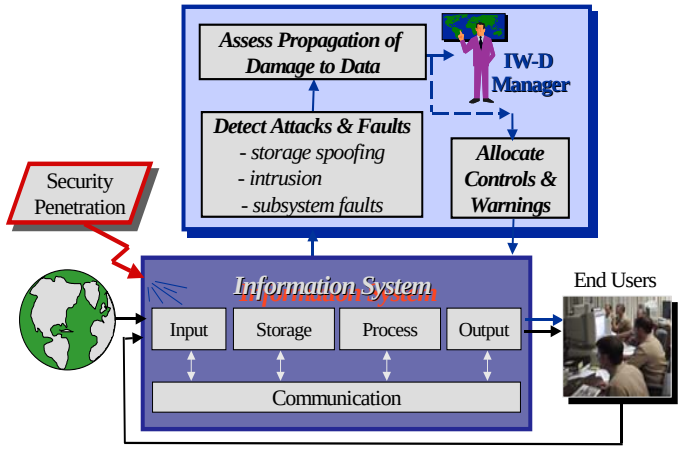
Objective: To investigate the following **Thrust Areas**:

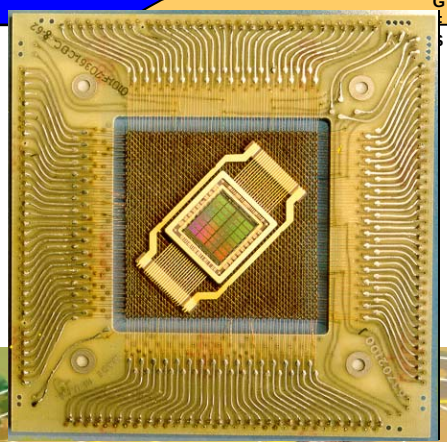


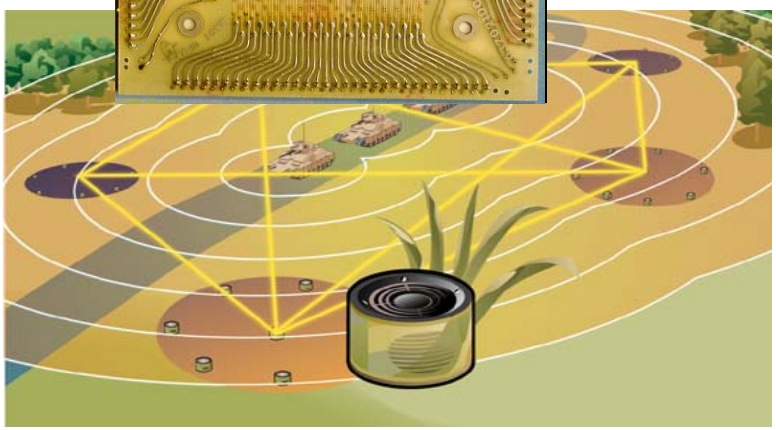
- Cognitive Performance Modeling
- Human-System Interfaces
- Physiology of Stress
- Intelligent Training
- Distributed/Collaborative Decision Making

Information Dominance







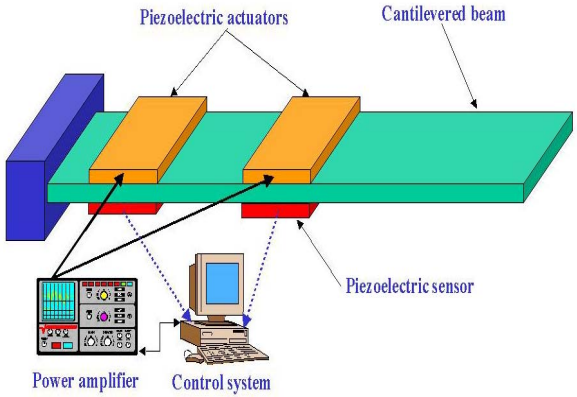


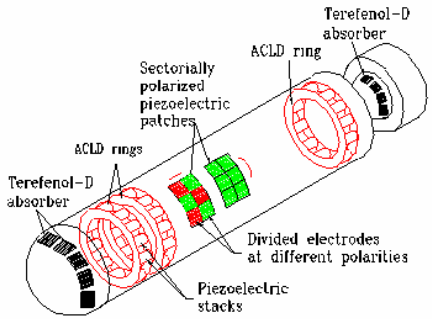
Basic science and engineering research on the fundamental principles and techniques of information acquisition, storage, processing, distribution, and display.

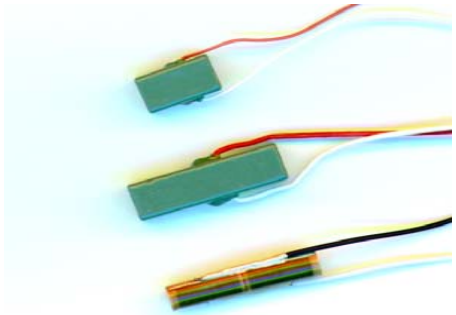
Computers, Communication, Networks, Information integration, displays, software.

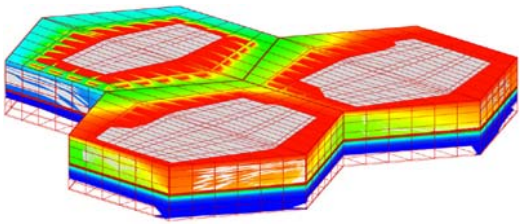
DoD Applications: C4ISR, Battle management, Surveillance, Sensors, Security, Information Assurance.

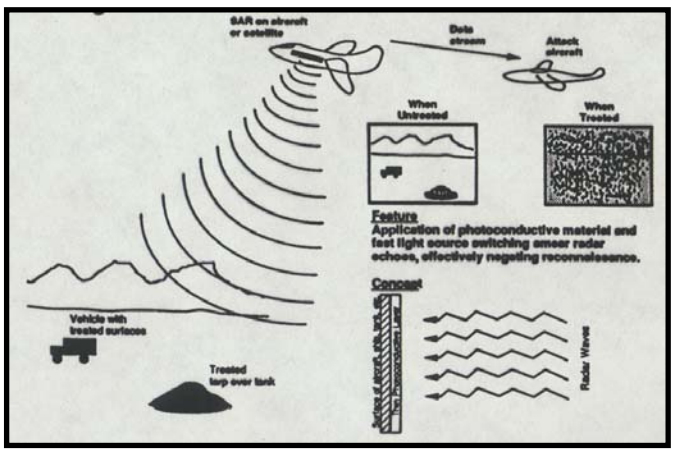
Multifunction Materials









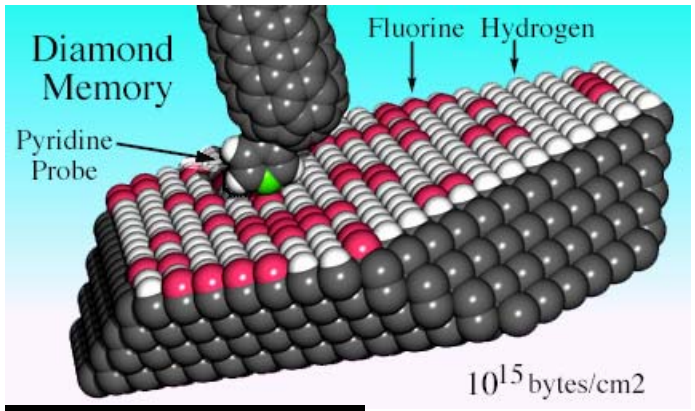


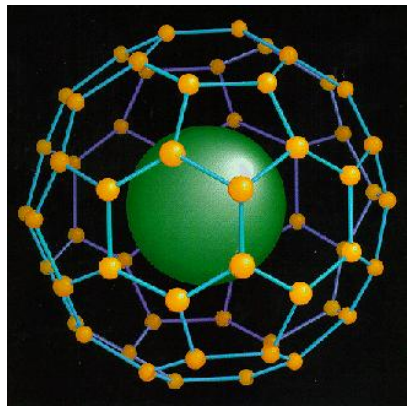
The Scientific investigation of materials and structures that can adapt to changes in the environment.

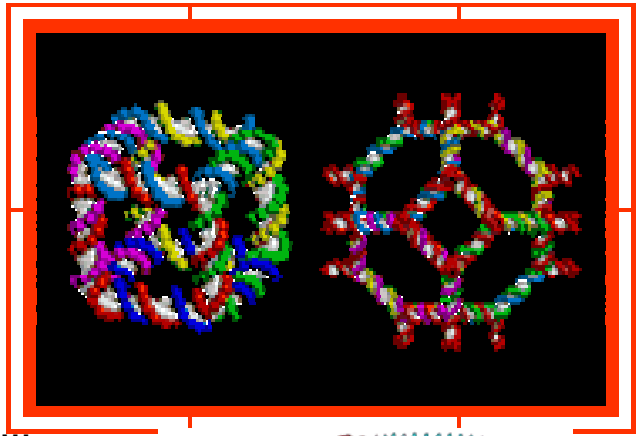
- Elastic active materials
- Smart skins and coatings
- Distributed sensors and actuators
- Armor materials by design
- Adaptive structures

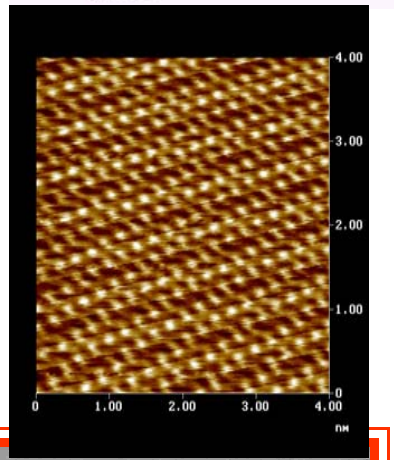
DoD Applications: Ultraquiet submarines, adaptive flight control, vibrational control, advanced stealth, armor materials.

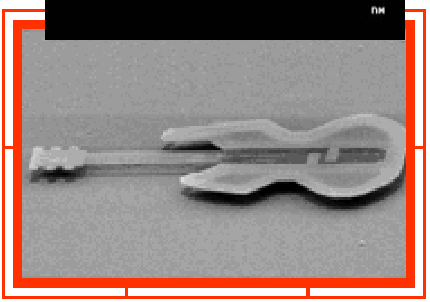
Nanoscience/Nanotechnology



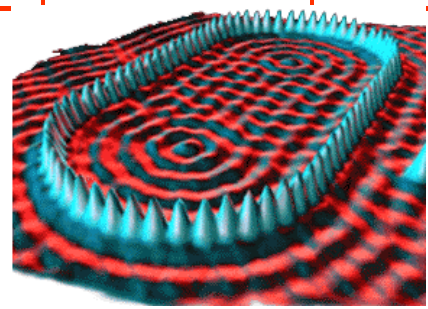






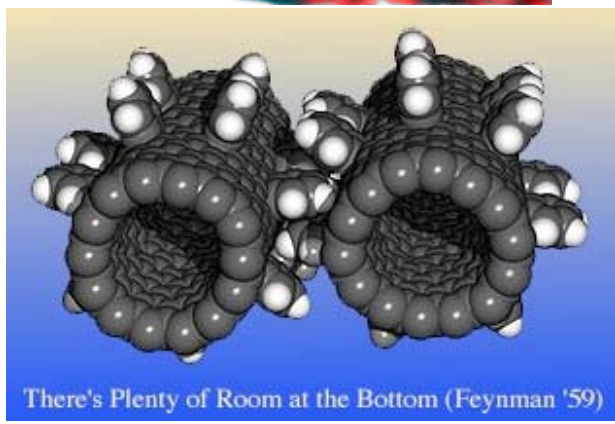


The science and technology of controlling and manipulating things at the atomic layer and nanometer (10^{-9} m) scale.



- Fabrication, synthesis, and processing of materials with predetermined properties
- Characterization, novel phenomenon, and properties for structural, electronic, and biological materials
- Nanoscale concepts and devices

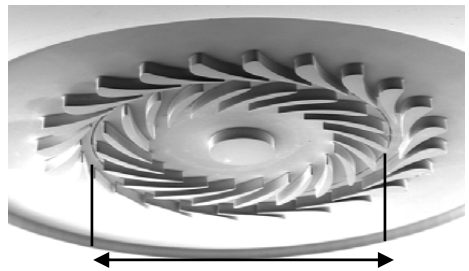
DoD Applications: Electronics, computers, Biochem sensors



Propulsion & Energetic Sciences

Exploit new concepts to achieve significant improvements in the performance of power and energy sources including compact power for portable field equipment.

- Compact Power Sources
- Energy Dense Materials and Systems
- Power Dense Materials and Systems
- Advanced Propulsion Systems



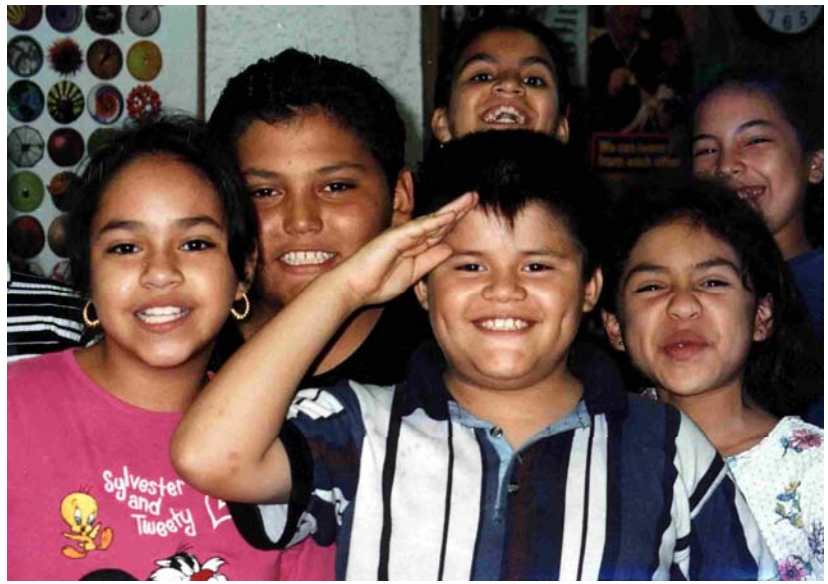
Miniaturized gas turbine

Basic Research Program Components

- University Single Investigators (3yr; < $200 K/ yr)
- Multidisciplinary University Research Initiatives (MURI)
  (3-5 yr; ~ $1-1.5 M/ yr)
- University Centers (3-5 yr; $1-2 M/ yr)
- University Affiliated Research Centers (UARCs)
  (5-8 yr; $5-10 M/ yr)
- Collaborative Technology Alliances (Industry-ARL-University)
  (5-8 yr; $5-8 M/ yr)
- Defense University Research Instrumentation Program (DURIP)
  ($50 K - $1 M)
- National Defense Science and Engineering Graduate Fellowship Program (~30 K Stipend + Tuition/Costs)
- DoD Laboratories Research (33% of Program)

DoD STEM Workforce

- **DDR&E Role: STEM**
  - **Science, Technology, Engineering and Mathematics Policy and Standards**
- ***Concern:***
  - ***Inadequate supply of clearable S&E's in areas critical to national defense.***
- ***Objective:***
  - ***Ensure the DoD Science an Engineering Workforce needs are met***
- ***Approach:***
  - ***Identify & advance effective, replicable programs***
  - ***Graduate, undergraduate, K-12***
  - ***Create pathways into mission critical S&E careers***
  - ***Build partnerships with Industry, Academia, other government***



DoD S&Es as % of Total Fed S&Es

Source: Pre-release - OPM data for NSF pub, Table B-14. Federal scientists and engineers, by agency and major occupational group: 1999-2002

	1997	1998	1999	2000	2001	2002
Total S&Es	46.6%	45.8%	44.2%	43.5%	43.1%	43.4%
All sci	28.0%	27.4%	26.1%	25.4%	25.6%	26.9%
Comp/Math sci	48.8%	47.6%	45.5%	43.9%	44.0%	45.3%
Life sci	12.2%	12.0%	11.4%	11.2%	11.0%	10.9%
Physical sci	28.2%	27.5%	26.7%	26.2%	26.1%	26.2%
Social sci	21.9%	21.4%	20.4%	20.4%	19.7%	19.6%
All eng	67.3%	67.0%	66.7%	66.4%	66.2%	66.7%
Aerospace	46.7%	45.2%	44.7%	43.6%	43.0%	42.8%
Chemical	61.3%	60.8%	62.3%	63.6%	65.7%	67.6%
Civil	62.1%	61.8%	61.8%	61.3%	60.6%	60.1%
EE&Comp	79.4%	79.4%	79.3%	79.1%	78.5%	79.1%
Industrial	83.8%	82.4%	81.1%	80.2%	79.4%	79.4%
Mechanical	88.2%	88.2%	88.2%	88.2%	88.4%	89.2%
Other eng	54.5%	54.7%	54.6%	55.1%	55.5%	55.9%

(Next NSF Publication expected February of 2007 (2003-2006 data))

National Defense Education Program

- **Enables comprehensive approach to education and training = <u>Shaped Workforce</u>**
  - Scholarship/Fellowship Pilot
  - US Citizens, Recruitment & Retention
  - Defense Critical Disciplines
  - Employment Payback requirement
  - Noncompetitive appointment authorized
  - $2.5M fully funded 30 awards in FY05 (up to 2 years of support)
- Provides both Academic and Non-Academic elements (within program $)
- Employee status while enrolled
- $10M for 2006 is expected to fully fund ~75 awards
- Planned effort expected to meet 10% of anticipated needs over 10 years
- Program Expected by Naval Postgraduate School for DoD

Defense Basic Research

- Fundamental, long-term
- Multifaceted
- Broad Based and Strategic
- “Effective” in
  - Generating new knowledge
  - Training new Scientists/Engineers
  - Sustaining research infrastructure
- Creates novel technical options/capabilities

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