



DCN: 9774



# **The Army Research Office's Installation Familiarization Briefing**

**Dr. Jim Chang**  
**Director**



# ARL

# Providing innovative science, technology, and analyses to enable full-spectrum operations



## Survivability

- Signature Management
- KE Active Protection
- Lightweight Multi-Functional Armors
- Landmine Protection
- Soldier Protection

## Lethality

- Lightweight Materials for Ordnance
- Multi-Disciplinary Design for Smart Munitions
- Novel Energetics and Propulsion
- Penetrators and Multi-Functional Warheads
- Electromagnetic Gun

## Mobility

- Semi-Autonomous Robotics
- Vehicle Structures
- Vehicle Propulsion

## Power and Energy

- Soldier Power
- Vehicle/Weapons Power



## Revolutionary & Enabling

### Foundational Research

- Soldier Nanotechnology
- Collaborative Biotechnology
- Quantum Information Science
- University Research Network
- Opportunity-driven Innovation

## C4

- Mobile Networks and Communications
- Advanced Decision Architectures
- Information Fusion, Understanding & Assurance
- Microscale Weather

## Sensors & Electronics

- Distributed Sensor Networks
- EO Sensors
- RF Sensors
- MEMS
- Flex Displays

## Human Dimension

- Cognitive Engineering
- Collaborative Performance
- Auditory Research
- Soldier Performance

## Analysis

- Human Factors & MANPRINT Analysis
- Vulnerability and Lethality Analyses & System Evaluation Support



# The Army Research Office

**Seeding Army Research**  
at over 200 Academic  
Institutions

**Managing SBIR and STTR**  
to Transfer Technology to  
the Army User

**Assessing Scientific  
Opportunities** to Achieve  
Army Vision

**Manage European  
and Far East  
Research Offices**

**Strengthening the  
research infrastructure**  
at HBCU/MIs

**Educating a Superior  
Workforce in Army-Critical  
Technologies**

## ARO...

*Focuses **\$354M** on research  
in support of Army  
transformational technologies.*



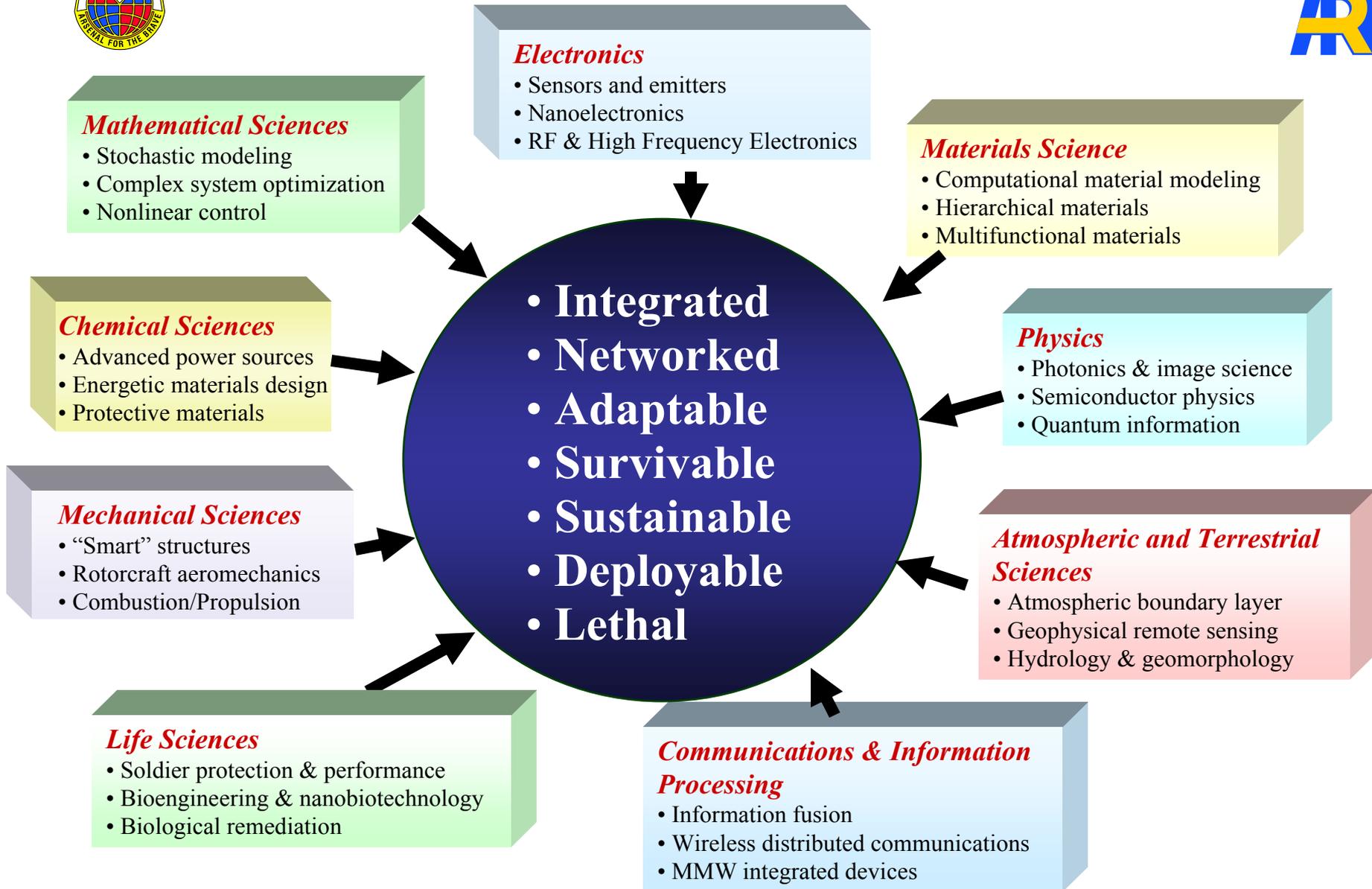
# ARO Strategic Goals and Objectives



- **Focus** research on **Force Operating Capabilities**
- **Accelerate the transition** of research to application
- **“Honest Broker”** for the Army for objective assessments
- **Exploit** scientific **opportunities** for revolutionary advances
- **Leverage** S&T of outside sources for Army benefit
- **Strengthen** university, in-house, industry **partnerships**
- Foster **S&E training** in disciplines critical to the Army
- Enhance **outreach** efforts for greater intellectual diversity



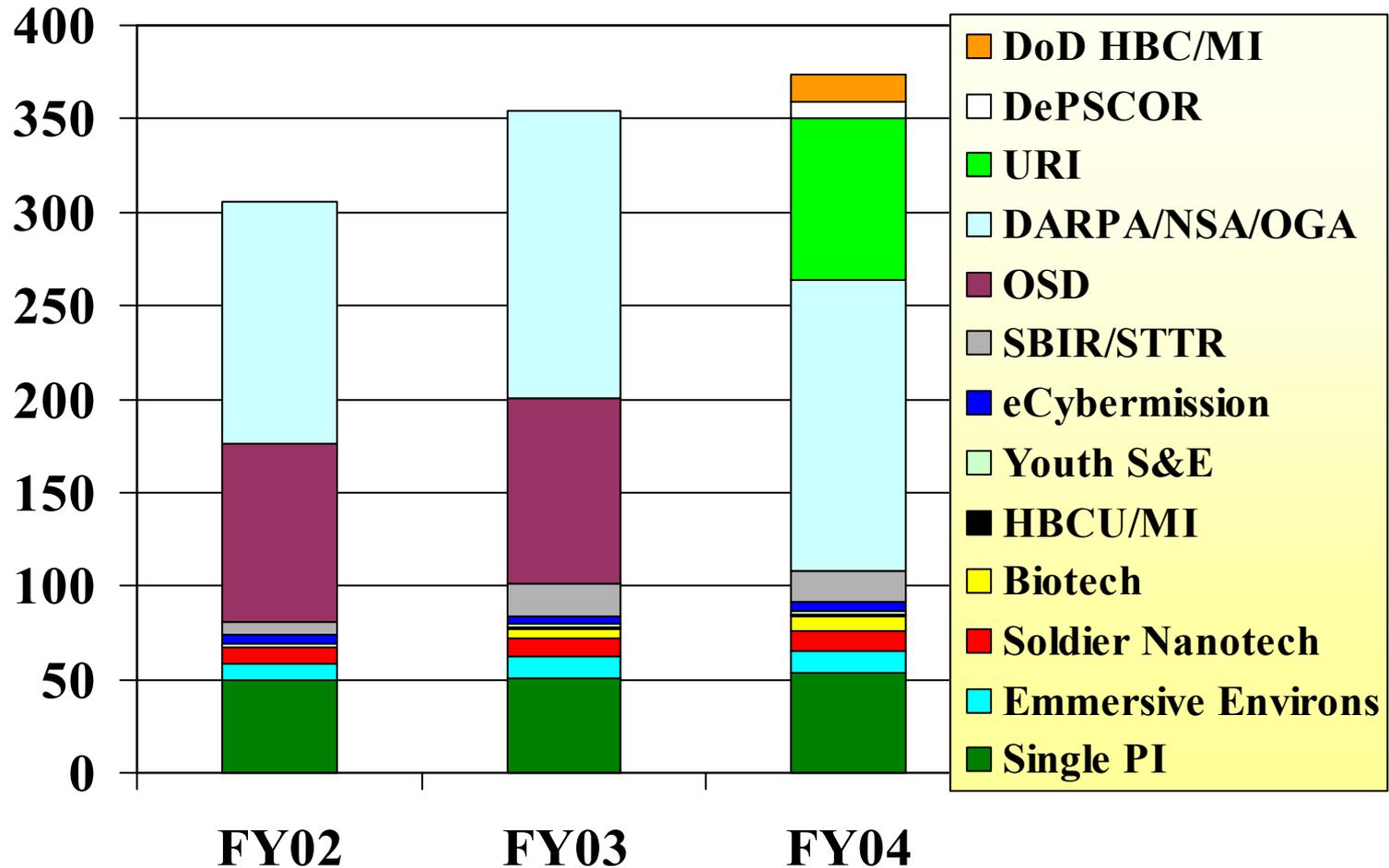
# ARO Basic Research Pursuits







# Total ARO Revenue (All Sources)





# ARO Program in Army S&T Enterprise

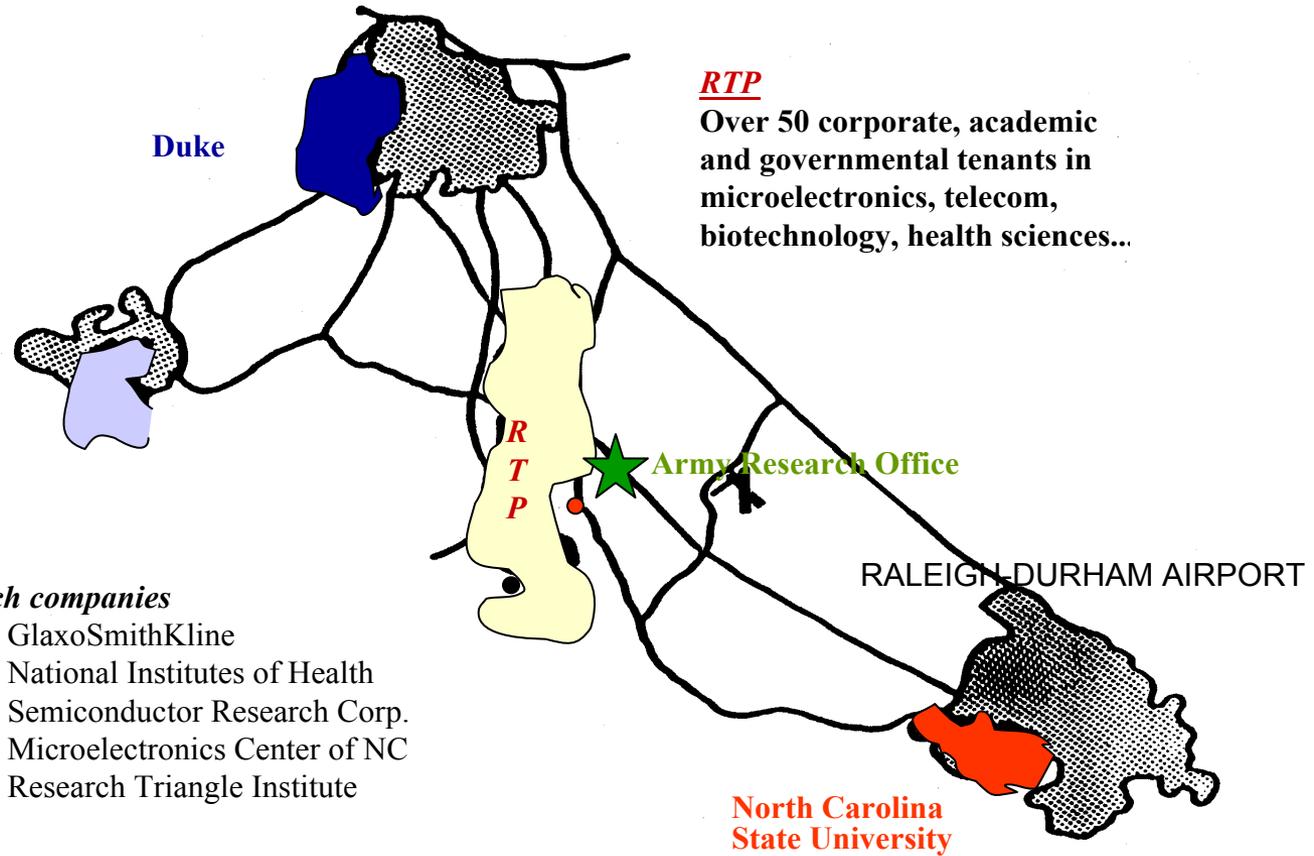


- **Vast Intellectual Capacity – 250 Institutions, 1,400 grants, 1000 faculty**
  - Focused and non-focused innovative research
  - Consultations, studies and review without bias and with a short response time
  - Timely capture of technology changes/response and refocus
  - Discovery seeds niche research areas and funding, i.e. DARPA
- **Fellowship of Interactions and Collaboration with Army Labs and Industry**
- **Broker, Matchmaker – ARO**
  - 47 accomplished PhDs to facilitate and harvest innovations
  - Initiate and develop technical options to support Army, i.e. compact power
  - Acquire non-Army resources (\$ and intellectual) to lab and industry
  - Leverage and represent Army in Service and national community
  - Manage Army focused innovations – ISN, ICB



# Research Triangle Park, North Carolina

*One of the highest concentrations of PhDs in the US*



**RTP**  
Over 50 corporate, academic and governmental tenants in microelectronics, telecom, biotechnology, health sciences...

University of North Carolina

**RTP**  
*40,000 employees in high tech companies*

- |                         |                               |
|-------------------------|-------------------------------|
| Lucent                  | GlaxoSmithKline               |
| Cisco Systems           | National Institutes of Health |
| IBM                     | Semiconductor Research Corp.  |
| Nortel                  | Microelectronics Center of NC |
| EPA                     | Research Triangle Institute   |
| NC Biotechnology Center |                               |

**North Carolina State University**

- **Staff Research**
- **Intellectual Stimulant in High-Tech Mecca/RTP**
- **Technology Innovation and Transition in RTP**

# Key to ARO Success

*ARO Program Managers are Smart Buyers!!!*

## *Peer Review is central to ARO*

- Most program managers are adjunct faculty researchers
  - Uniqueness: *No other DoD funding agency comes close*
- PMs oversee proposals in same discipline they perform research
  - Uniqueness: *Every proposal sent out for peer & Army review*
- Proposals funded are scrutinized at highest levels by experts
  - Uniqueness: *No other DoD funding agency does this.*



## *Proximity to Leading Universities*

- The three universities are of the highest caliber
  - Therefore, PMs affiliated with them work at the highest level
- All ARO Divisions are mirrored by a nation-leading department in one of the schools.

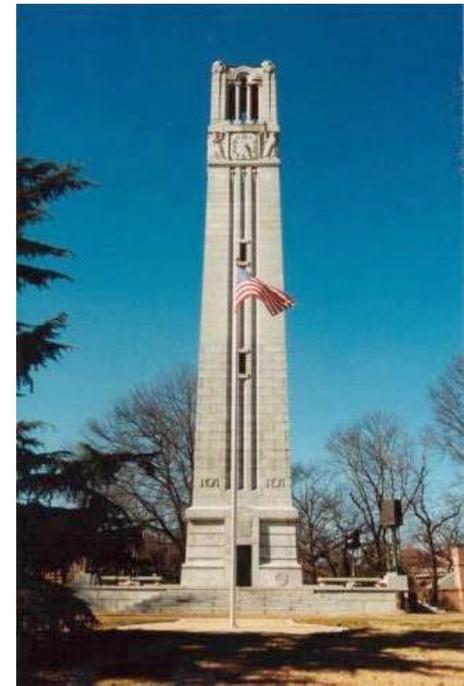
Duke	#9 National Doctoral
UNC	#29 (#5 Public)
NCSU	#87 (#10 Engineering)

Source: US News & World Report, 2004

Only U.S. location with greater concentration of top schools

- Cambridge/Boston MA
- Cost of living comparison
  - Durham, NC      \$100,000 income =
  - Cambridge, MA    \$179,703 income

Source: Nat'l Assoc. of Realtors, 2004





# Nobel Laureates Funded by ARO



## *“Impact on National Defense”*



- ↖ Superconductors
- ↖ Solid State Electronics
- ↖ Smart Munitions
- ↖ Laser Range Finder
- ↖ Target Designation
- ↖ Fiber Optics
- ↖ GPS



W. M. Lipscomb  
Borane Compounds  
1976



Hans Dehmelt  
Ion Trap - 1989



Daniel Tsui  
Quantum HeteroStructures  
1998

Room Temp  
Night Vision  
Hi-Performance  
Info Processing



Cornell, Wieman, Ketterle  
Bose-Einstein Condensation  
2001

2001

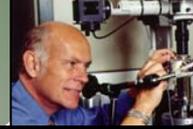
Atom Optics



Alan Heeger  
Conductive Polymers  
2000



Herbert Kroemer  
Semiconductor Heterostructures  
2000



Richard Smalley  
Robert F. Curl  
Buckminster Fullerene  
1996

Semiconductor  
Laser,  
Nanoelectronics,  
OEICs



John Bardeen  
Leon Cooper  
J. Robert Schrieffer  
Superconductivity - 1972



Herbert C. Brown  
Boron and Phosphorous  
Compounds - 1979

1980



N. Bloembergen  
Non-linear Optics  
1981

Energy Storage  
Displays  
Protective Materials  
Hi-Performance  
Electronics



Charles H. Townes  
Lasers - 1964

1960



Leo Esaki  
Superlattices - 1973

Brian D. Josephson  
Josephson Junction  
1973



Arthur Schalow  
Solid State Laser  
1981

Target  
Designation and  
Illumination  
Range Finders  
Eye Protection  
Remote Sensing

Semiconductors  
Optoelectronics  
Sensors  
Computers

Comms  
Fiber Optics  
Smart Munitions  
MRI, Surgery  
CDs..

**- - 50 Years of Investments - -  
Today's Edge in National Defense**

# ARO-Supported Nobel Laureates for Physics in 2001



## *Bose-Einstein Condensation*

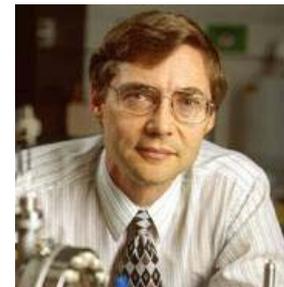
- New state of matter
- *All three Laureates under Army sponsorship*
  - Unprecedented sensitivity
  - Underground tunnels
  - Atom wave technology



**Eric A. Cornell**



**Wolfgang Ketterle**



**Carl E. Wieman**



# University Affiliated Research Center

*Critical mass of researchers for extended period*



## *Immersive Environments*

- Full Sensory Immersion
- 3-D Mobility
- Compelling Interactive Stories



## *Soldier Survivability*

- Protection
- Performance Enhancement
- Injury Intervention and Cure



## *Biotechnology*

**Biologically-derived:**

- Sensors
- Electronics
- Information Processing



# Institute for Creative Technologies

## *Immersive Environments*



*institute for creative technologies*  
University of Southern California

*Compelling environments for training and mission rehearsal to enhance warfighter performance*

- Full sensory, emotional and intellectual immersion
- Three dimensional mobility
- Platforms ranging in size, cost and portability
- Compelling interactive stories



*Embedded Training*



*"Flatworld"*

*Mission Rehearsal*

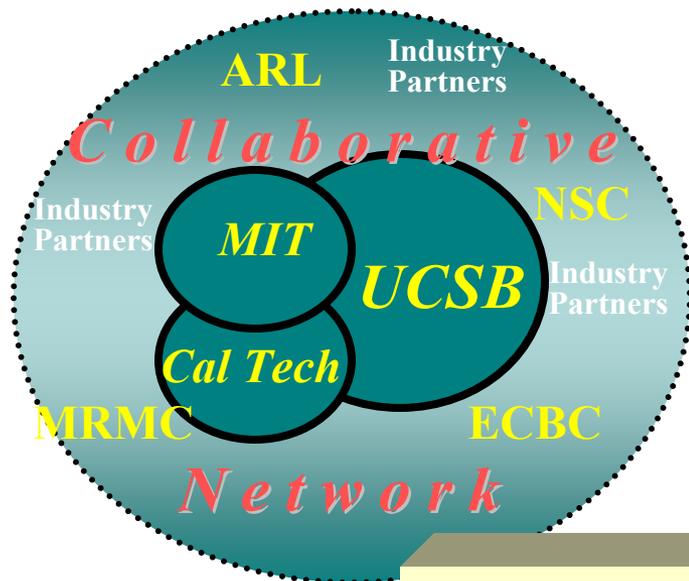


# Institute for Collaborative Biotechnologies



*University  
Affiliated  
Research  
Center*

CALTECH



**Anticipated \$37M  
over 5 years**

## Research Concentration

Sensors, Electronics, and Information Processing

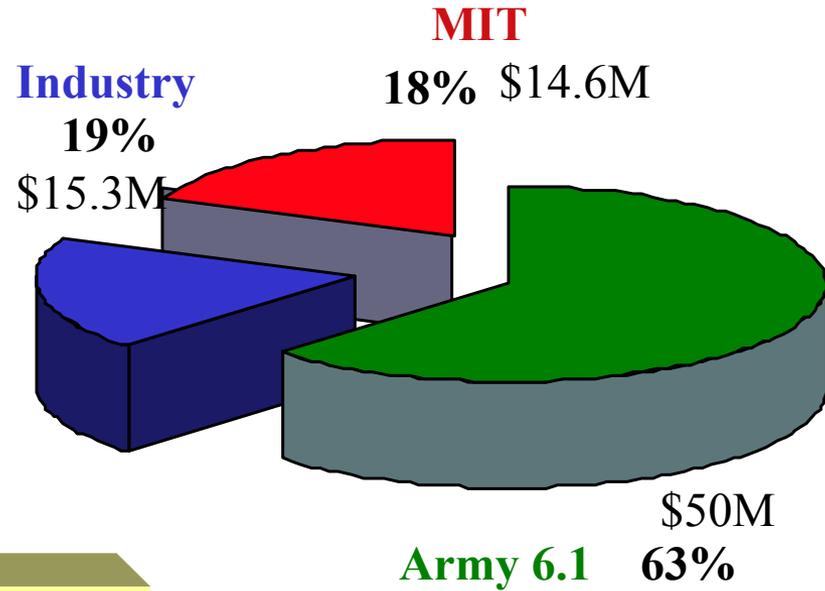
- Bio to non-Bio Interfaces
- Bio-derived EMO Materials
- Sense and Respond Capabilities

Technical Fundamentals and Enabling Tools for Dynamic and Predictive Models



# Institute for Soldier Nanotechnologies

## *Advanced Materials for Soldier Protection*



*An \$80M+ Center*  
**6.2 \$ and Dedicated Facility Not Included**

### *Research for....*

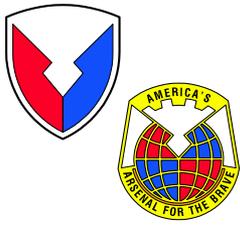
- Soldier Protection
- Performance Enhancement
- Injury Intervention and Cure



# Anticipated Transformational Payoffs (10 - 15 Years)

- Cheap Bio Agent (Anthrax) Detection Using Nanotechnology
- New Wireless Antennas Using Photonic Crystals
- Quantum Computing for Code Breaking
- Breathable Chemical Agent Protective Clothing for the Soldier
- Genomic-based Biosensors
- Large System Reliability (Failure) Analysis and Prediction
- Information Assurance and Control for Complex Networks
- Real-time, 3D Battlefield Visualization and Virtual Reality Display
- Hyper-energetic, Low-vulnerability Materials
- Super-maneuverable Air Vehicles, Projectiles and Missiles
- Molecular Nanoelectronics Engineering

*ARO is at the Forefront of this Research*



# ARO Customers



- **All RDECOM Organizations**
- **Training and Doctrine Command**
  - Battle Labs
  - Operations Research
  - Technical Expertise
- **Testing and Evaluation Command**
- **Corps of Engineers Laboratories**
  - Terrestrial Sciences
  - Engineering Sciences
- **Medical Research & Materiel Command**
  - Biological and Chemical Sciences
  - Mathematical Sciences
- **Assistant Secretary of the Army (ALT)**
  - Board on Army Science and Technology (BAST)
  - Special Programs (e.g. ISN, ICT, ICB)
- **Department of Defense**
  - Missile Defense Agency
  - DARPA
  - DDR&E
  - Special Programs (e.g. HBCU/MI, NNI, CIP)

*ARO research supports  
multiple commands*



# *ARO is Correctly Positioned for Army Transformation*



- Professional **staff highly recognized** by their peers
- Located in an innovation mecca - RTP
- Covers the **entire spectrum** of science for ARL and the Army
- Focused on **long-term, opportunity-driven research**, yet responsive to Directorate in-house shorter-term needs
- Attracts **four times** as much **research money** from non-Army sources **in support of Army Transformation**
- Located in a **“Hot-Bed”** of International R&D
- Research Centers in **3** of the Army’s Top **5** Areas
- PIs Make Pioneering **Breakthroughs** Every Year
- Positioned for Army Transformation and the **Future**



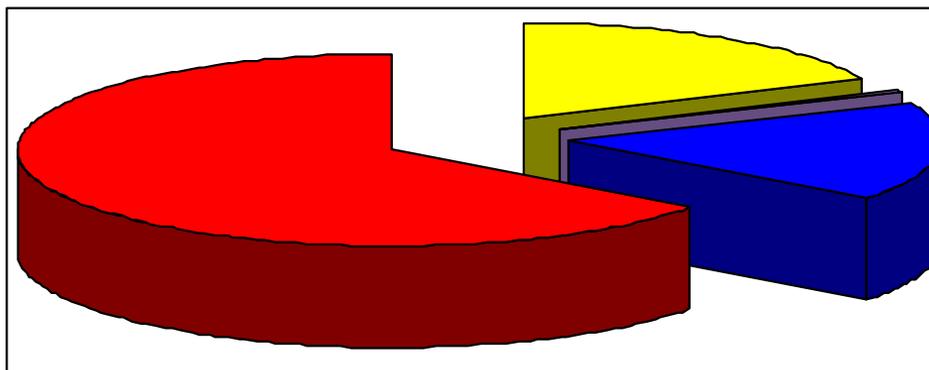
# ARO's Facility



**Administrative Office Space: 29,954 sq. ft.**

**Acreage: 2.37 acres**

**Cost Per Square Foot: \$17.07**



**Contractors: 25**

**Military: 1**

**Tenants: 23**

**Civilians: 90**



# COST COMPARISON

## US Army Research Office – RTP Location

- 29,954 sq ft
- \$17.07 per sq ft/\$511K (annual rent – includes utilities and maintenance)
- 139 total occupancy

## National Capital Region (NCR) – Maryland, Virginia, District of Columbia (to include a 100 mile radius from the Pentagon)

- \$25 - \$50 per sq ft/**\$749K - \$4.5M (annual rent)**
- One time cost to refurbish leased space = **\$1.4M**
- PCS Relocation Cost for DOD Civilian Employees = **\$6.8M**

**ARO remaining at RTP provides an extremely cost and mission effective course of action. Besides low rental costs and no exorbitant maintenance costs (as with many government-owned facilities), ARO professional staff have the unique opportunity to affiliate for staff research with one of several research universities in the area. This unique accessibility of multiple research university resources ensure a measure of technical competence of ARO scientific staff that is unmatched anywhere in the Army or DOD.**



# Prime Location for Research



- **LOCATION**

- RESEARCH TRIANGLE PARK (RTP) IS CONSIDERED TO BE THE 2ND LARGEST HIGH TECH MECCA IN THE UNITED STATES
- PROVIDES AN ENVIRONMENT FOR ARO PROGRAM MANAGERS TO ESTABLISH CREDITIBILITY AND INITIATE PROGRAMS FOR ARMY TRANSFORMATION

- **ACTIVITIES AND SYNERGISM**

- COLLEGIAL RESEARCH ACTIVITIES WITH INDUSTRY AND GOVERNMENT SUCH AS:
  - IBM
  - DU PONT ELECTRONICS DEVELOPMENT CENTER
  - GE SEMICONDUCTOR
  - NC MICROELECTRONICS CENTER
  - NC BIOTECHNOLOGY CENTER
  - ENVIRONMENTAL PROTECTION AGENCY
  - NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES
  - RESEARCH TRIANGLE INSTITUTE
  - SEMICONDUCTOR RESEARCH CORPORATION
- ADJUNCT PROFESSORSHIPS AND STAFF RESEARCH OPPORTUNITIES AT:
  - DUKE UNIVERSITY
  - NORTH CAROLINA STATE UNIVERSITY
  - UNIVERSITY OF NORTH CAROLINA

- **BENEFIT**

- INCREASES PROGRAM MANAGER'S ABILITY TO LEVERAGE ADDITIONAL FUNDING
- ATTRACT AND FUND INNOVATIVE RESEARCH TO ACCELERATE ARMY TRANSFORMATION